Implementing inter-organisational service systems

An approach for emerging networks in volatile contexts

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Preface and acknowledgements

Public organizations in the developing world are undergoing a gradual but irreversible change, due to innovations in information and communications technologies. The emergence of business networks, among such organizations, indicates an increasing interdependence and a search for solutions to regain waning strategic relevance and competitive advantage. In this research we note that, the emerging public organizational networks in the developing world, work in unpredictable environments with resource scarcity. The environment is volatile and a potential obstacle to improving implementation practices for emerging networks. To find solutions that can improve the reliability and efficiency of the implementation practices, we focus on the implementation challenges that emerging inter-organizational networks currently face in implementing service systems for business collaboration. We define solutions that use repeatable processes for inter-organizational business IS implementation, avoiding the need to change the focus of the core business processes.

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Nora K. Mulira
TUDelft, April, 2007.

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Chapter 1: Inter-organisational networks in volatile contexts

1.0 Introduction

In this dissertation we investigated how inter-organisational service systems, can be implemented in volatile contexts, with a focus on emerging inter-organisational networks for higher education institutions in developing economies. The dissertation presents a way to support the implementation of inter-organisational service systems for business collaborations, aimed at reducing complexity from the implementation challenges caused by volatility. An empirical evaluation of this approach is discussed leading to a prescriptive empirical model of the approach as the final output of this research. This topic is related to Information system (IS) implementation, service system design, public organisation networks and the Internet.

In this chapter the research domain, the outline of the research, objectives and expected outputs are introduced.

The status of information systems projects in developing economies

The emergence of business networks, in developing economies indicates an increasing interdependence of organisations and a search for business solutions through information and communication technology (ICT), to regain waning strategic relevance and competitive advantage. Public organisations in developing economies which are the focus of this research, have been pressured by the threat of increasing isolation and lack of strategic relevance into forming bandwidth consortia and/or sharing information among organisations of similar business domain. There is a visible effort among universities and government organisations in this regard.

In this research we note that, the emerging public organizational networks in the developing world, work with unpredictable environments and resource scarcity that have led to a high failure rate of IS implementation projects. Investigating the reasons behind the high failure rate of IS development projects in developing economies, shows evidence and many practical reasons such as lack of technical and human infrastructure, to support the conclusion that failure rates are considerably higher, than the industrialised country threshold (Heeks, 2000). An overview of the literature for business information systems implementation projects in developing economies concludes that, "successful examples of computerisation can be found but frustrating stories of systems which failed to fulfil their initial promise are more frequent" (Avgerou and Walsham, 2000). The rate of implementation failure can be confirmed as high but, the actual evidence to devise solutions for failed projects in the developing economies, has not been clearly established. Heeks (2000) and Avgerou (1998) agree that provision of evidence to address the extent of failure, and move

beyond the threshold estimations offered in the literature, has been constrained by:

- *Lack of literature in general*: Until the start of the millennium, the entire literature on IS and developing countries was limited. The attention of writers, from researchers to consultants, to journalists, was focused elsewhere.
- *Lack of evaluation*: Practitioners in the field who would have evaluated the IS failure status, such as academics, lacked the resources and capacity. Aid donor agencies which have the resources often lacked the will to sustain evaluation.
- *Focus on case studies*: The literature on IS in developing economies has grown since, but it is dominated by case studies of individual IS projects. Case studies in isolation provide no basis for estimation of overall failure/success rates (Heeks, 2000).

Without precise evidence to establish the extent of implementation failure, we utilised the available estimations and descriptions offered in current research, to inform this research inductively. Current evidence shows that many organisations in the developing world, like their nations, have just begun to build the basic infrastructures needed to take advantage of the information age (UNDP report, 1998). The majority of these organisations have implemented IT system mainly over the past 15 years, combining legacy assets, third party software packages, limited outsourced applications and newly built functionality, with all these parts possibly running on different but meagre computing resources. Due to their complex and often monolithic structure, these systems are difficult to test and upgrade (Sperski, 1998; Sprott and Wilkes, 1999). The result is high maintenance, low reliability and uncontrolled development life cycles. These factors in turn, led to under/un-utilised information systems.

Literature sources suggest several elements that influence the implementation challenges mentioned above. These elements can be summarised under three categories; unstable infrastructure, funding, and unstable socio/economic organisational environment. For this research, these constraints are the causes of volatility. The resulting challenges like unreliable technology infrastructure, inadequate technical skill base and diverse incompatible applications are the volatility characteristics influenced by an unstable socio/economic organisational environment. The volatility element will be explained further in section 1.2.

Against that back ground, this research investigated how emerging public organisational networks can overcome an unpredictable environment to develop systems for business collaborations.

Research arguments

It is the assertion of this research that the emerging inter-organisational networks in volatile environments require support to manage the complexity of the implementation challenges, and additional complexity of the inter-organisational setting, to implement business systems. This support for the implementation of inter-organisational service systems was proposed as ideal for the volatile context, because of the following reasons:

- We argued that by adopting repeatable processes for the implementation of inter-organisational service systems, emerging networks in developing economies would reduce uncertainty in managing complex challenges caused by volatility. In addition, there is envisaged added value in the network business collaboration offered by increased business opportunities through generation of new innovative services and products, without having to change the focus of the core business processes.
- Theory and empirical evidence shows that inter-organizational systems are hard to design, implement and manage because they have multiple actors, each with their own value systems and interest (Bruijn, 2002; Brown, 2000; Sage and Armstrong, 2000).

On this basis it is concluded that introducing the relatively new service system implementation in a new and complex environment of the emerging networks with volatile characteristics, would be an even more difficult task that requires support.

- It is argued further that the required support for such an implementation project would not be met by the current approaches. Although the literature on IS implementation is vast and relatively mature, we did not find an integral view on the research specific problem domain of IS implementation and volatility. Available literature prescribing approaches for the design and implementation of service-oriented systems in inter-organisational business networks is predominantly focused on commercial (mainly private) organizations in industrialized countries. Useful elements can be selected from these approaches but, they are not adequately prescribed and validated to manage the complexity of volatile challenges and improve implementation practices.

Conclusion

Based on the above arguments, there is a need for innovative engineering approaches, including design theories, design heuristics, modelling techniques and environments in which this new organizational context for service delivery can be tested and evaluated from a strategic, operational and technological perspective. This is the research quest.

1.1 Volatile environments

For the purposes of this research, *volatility* describes the impact of external and internal factors in an organisation, on the key implementation elements that, adversely influences the realisation of the critical success factors for an implementation project. Several definitions of volatility are context based depending on subject of reference; like geography, geology and electricity. The definition of volatile contexts in IS implementation applied in this research, is drawn from risk management, change management, software engineering and organizational theory research. Barry and Slaughter (2000), relate software volatility as a characteristic of software behaviour that describes the changeable nature of software. Other related views are that software systems model some portion of the business and economic environment they serve. As these environments change, so must systems (Pfleeger, 1998). Organisational theorists Wholey and Brittain (1989), describe environmental variation with three dimensions; *amplitude, frequency and predictability*. A simple translation of these three terms would be; scope or impact of change, times of occurrence and how predictable the impact and frequency in combination. The first two terms do not offer useful application to the complex situational context, but *predictability* is a valuable element for managing uncertainty and the total lack of it disables any planned response to change. Change management practices are meant to mitigate potential risk effects of change, by providing alternative options to dealing with the problem situation.

Another relevant element to this volatility definition is complexity because implementation challenges derive complexity for the project. *Complexity* in ICT projects is distinguished from the mathematical meaning as a property of the real world issues related to IS. The Euromethod (1994) defines complexity as the difficulty encountered in managing the available knowledge or situation. Failure to manage the resulting implementation challenges caused by the unpredictable situational contexts indicates that these emerging network organizations have inadequate knowledge to manage the problem situation. Uncertainty is defined as lack of adequate knowledge to manage the problem situation or the gap between the amount of information required to perform the task and the amount of information possessed by the organization (Galbraith, 1977). Abstractions from these elements are combined to define volatility from the implementation perspective as:
Prevalence of unpredictable organizational management, behaviour and resource availability that cause implementation complexity, leading to increased probability of business IS project failure. Using this research definition of volatility, the causal relation between the volatility influences, and the key implementation challenges that increase the probability of IS implementation failure in volatile settings, is established in the next section.

Implementation challenges in Volatile environments

The IDRC guidelines for institutional maturity report (2000), explains that with very few exceptions, public organisations in developing economies are poorly funded and most rely on some measure of external assistance to remain functional. If new sustainable financing mechanisms are not found, external support for ICT could increase an institution's dependency. 'In general, the dearth of financial resources and the uncertainty of donor funding may be the most daunting obstacle to the aspirations for public organisations to become active players in the global knowledge revolution spurred and underpinned by ICT's.'

Key challenges affecting IS implementation in volatile environments are established from the literature and drawn from the researcher's experience. The Working Group of Experts identified a number of common obstacles to the utilization of ICTs in selected public organisations: (IDRC-Guidelines for institutional maturity report, 2000).

i). External obstacles—factors that define the environment in which institutions operate and that shape their ability to use ICT

- Poor national telecommunications infrastructure
- In some countries, the hostile social climate and political instability prevent opportunities of international collaboration and support.
- Internet traffic congestion or saturation due to limited bandwidth.
- Un-reliability of electricity supply.
- High Internet Service Providers (ISP) fees.
- Inadequate and irregular funding of ICT initiatives.

ii). Internal obstacles

- Poor and unreliable maintenance of ICT facilities.
- Low level priority accorded by institutional leadership to ICT development and applications.

iii). Human resources-related obstacles

- Inadequate human resources base for implementation of technical projects, due to inadequate training programs for critical skills to manage and support ICT functions, lack of recognition, inability to ensure the retention of skilled staff due to poor remuneration.

This section has established the characteristics of volatility that cause implementation challenges, which are the focus of this research. This is the environmental setting for which, emerging inter-organisational networks in the developing economies must devise implementation support for, in order to create and sustain business collaborations.

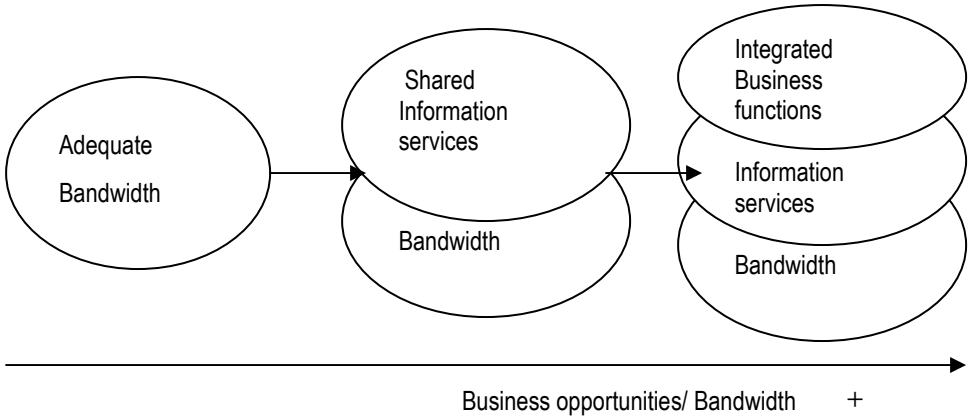
1.2 The research domain

Inter-organizational business networks in volatile contexts present a different context and business model from that of commercial enterprises in the industrialized world, where current research in inter-organizational networks is predominantly based. These differences in business orientation (non-commercial) and complexity (volatile), warrants a separate study. Information system research shifted to include the field of inter-organizational information systems (IIS), in the early nineties. The focus was commercial organizations in economically viable and stable organizations in the developed economies, and not the developing world where volatility issues are prevalent (Heeks, 1998; Avgerou, 1996). Wierda (1991) in his research for the development of inter-organizational IS (IIS), cited gaps in the theories discussed, which applied IIS only to commercial enterprises; "…. whereas IIS is gaining attention in public administration and non-profit organizations." These observations confirm the trend followed by the emerging business networks among public organisations in developing economies but, do not present a comprehensive response to the implementation requirements of the volatile context.

Emerging networks in the developing economies

In this research, the examples of the emerging networks are drawn mainly from higher–education institutions, as representative of large public organizations, where recent business collaborations are evident. The networks are at different stages of development. Some like Tertiary education network (TENET) of South Africa and Kenya educational network (KENET) enabled some member organizations to start business collaborations. The Research and education Network of Uganda (RENU) has started to evolve into a business network but, still considers the bandwidth consortia to resolve bandwidth deficiencies and support potential business opportunities. For the majority of these networks, the emphasis is still on access to cheaper (affordable) bandwidth, which is a mandatory pre-cursor to enabling inter-organizational collaboration. As the Association of African universities states:
"It must be accepted that for some years to come, bandwidth will be very expensive relative to the resources of the universities. Efficient utilisation which calls for good bandwidth management, is therefore a necessary part of the solution (AAU networking report, 2005). The transition from bandwidth consortia, to business systems is evidently made difficult by the unpredictable environment and requires support to move through the different collaboration layers. The transition layers that scale up from bandwidth consortia to sharing resources and finally integrate business functions can be summarised in figure 1.2.1 below:

Figure 1.2.1 Transition layers for emerging inter–organisational networks in volatile environments



From the inductive discussion of the implementation problems and issues for the new networks in volatile contexts, we turn to the justification for the proposed solution of service system implementation. In the next section the suitability of an inter-organisational service system implementation for this volatile setting is explained.

1.3 Inter-organizational information systems (IIS) and service systems

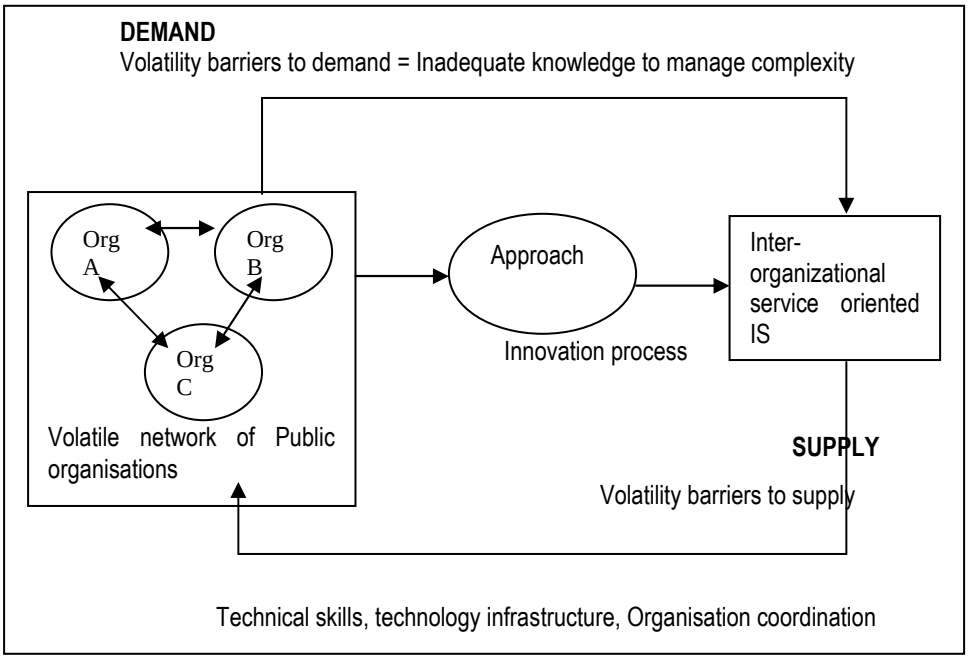
Service–oriented systems usually take place in inter-organisational settings. Wierda (1991), defines inter-organisational information systems (IIS) as information systems that are jointly developed, operated and /or used by two or more organisations that have no joint executive. Organisations today are collaborating with peers to remain competitive and strategically relevant in their business area. People and firms need outside sources and competence to complement their own because they lack certain resources in their companies (Powell, 1990; Sydow et al, 1998). The parallel view taken in this research is that organisations with volatility can be supported to collaborate and compliment mutual fundamental interdependencies to remain relevant else they will become strategically irrelevant and die.

Service-orientation

The service–orientation is introduced as ideal for the inter-organizational setting. There are several definitions of service which highlight its main characteristics: A market transaction, where the object is other than the transfer of ownership of a tangible commodity" (Judd, 1964) "…any activity that one party can offer to another that is essentially intangible and does not result in ownership of anything. It's production may or not be tied to a physical product" (Kotler, 1997) and a (series of) activities of more or less intangible nature that normally, but not necessarily, take place in interactions between the customer and service employees and /or physical resources or goods and /or systems of the service provider, which are provided as solutions to customer problems (Grönroos, 2001). The key words that characterize every service definition are transaction and intangible. Services can be considered as service systems which include the user needs translated into performance criteria, the technology and the actors in an (inter) organizational setting with operational processes. Service-orientation has been cast more in a commercial perspective but even for non profit organizations, the demand and supply roles are applicable. For the emerging networks, the volatile characteristics are barriers to the supply and demand of services. The network actors need to collaborate to implement and deliver information services to the user (customer). This is the supply side. The demand side consists of the customer who actually uses the services. There are transactions between the demand and supply side. In volatile contexts, *barriers to demand and supply of business IS services for the organizations in the network must be reduced by an innovative approach to lead to improved implementation practices.*

Figure 1.3.2 shows demand and supply relationship for services constrained by implementation challenges from situational factors.

Figure 1.3.2 Service demand and supply barriers in the volatile context



Suitability of service systems

The key desirable features of services include: on the organizational side the support for parallel and distributed systems, which are location independent. This is ideal for inter-organizational networks to access and implement business systems. Modularity of services offers flexibility in system development, which reduces complexity. In this research, we argued that organizations in volatile environments should offer more innovative products and services, avoiding the need to change the focus of their core business processes. The Internet can be used as a medium for access to pools of expertise to overcome inadequate expert skills and create shared information centers within homogeneous/ heterogeneous business environment. This also means that organizations share the 'best in the class' (Brown, 2000). The advantages of a service orientation will be explained in detail in chapter 3.

The implementation of service systems requires an overview on the implementation approaches and models as the core subject of this research. An overview of methodologies follows in the next section.

1.4 Information system development approaches and models

IS development methodologies

In broad terms system methodologies are a collection of procedures, techniques, tools and documentation aids (MacManus and Wood-Harper, 2003). However, other authors like Avison and Fitzgerald (1996), suggest that a methodology is more than merely a collection of the above items, it should be based on a philosophical view. Checkland (1990) states "… the methodology will lack the precision of a technique but will be a firmer guide to action than a philosophy." Research opinion agrees on a combination of a philosophy with methods .as more precise.

According to Fitzgerald (1996) the justifications for adopting a methodology to guide IS development include:

- Subdivision of complex process into manageable tasks
- Purposeful framework for applying techniques
- Economics
- Standardisation

However Fitzgerald also identifies problems with methodologies; weak conceptual and empirical foundations, rigidity and in some cases methodologies can become an end in their own right. Wastell (1996) also noted that a methodology becomes a fetish used in pathological rigidity for its own sake, not as a means to an end.' Used this way, it insulates the practitioner from the risks and uncertainties of real engagement with people and problems.

Approaches and models for IS development

The waterfall and the Spiral model are two basic IS development models (Cadle and Yeates, 2001; McManus and Wood-Harper, 2003).

The Waterfall model originates in the 70s. It has many variations but they all exhibit the same classical cycle stages in linear fashion. It is used by many organizations because complexities and problems of the development process are broken down in separate stages, making planning and control simpler. However, in situations where business processes are not well understood and the processes are unstructured, a different approach will be needed.

The spiral model introduced by Barry Boehm (1988) can be thought of as a meta-model since it can incorporate any other models within it. The key features of accommodative flexibility, focusing on problematic areas of the development process and the use of a non-linear iterative approach present ideal development options to deal with complexity in the problem domain. Other methods that can be combined with basic IS development models are:

Prototyping methods include the Rapid application development (RAD), joint application development (JAD) and dynamic systems development method (DSDM).

Prototyping are appropriate for data oriented applications, applications with emphasis on user interface and which are highly interactive.

Rational unified process is another approach that presents practice and theory useful for this research. RUP process builds on six commercial best practices:

- Develop software iteratively
- Manage requirements
- Use component based architectures
- Visually model software
- Verify software quality
- Control changes to software

to deliver a software development process focused on ensuring the production of quality systems in a repeatable and predictable way (Booch1999).

The overview on the methodologies leads into the critical success factors. What is the target criteria for successful IS implementation?

Information systems implementation critical success factors

The working definition of implementation for this research is from Swanson (1998), who used the phrase "system realization" and restricted the implementation process to the systems life cycle stages between design and use. Swanson defined implementation as "*a decision-making activity that converts a design concept into an operating reality so as to provide value to the client.*" Several researchers have used definitions with similar scope (Lucas, 1991; Cooper and Zmud, 1990). With this working definition, the *value to the user* embodies the success criteria for the project. Practitioners and research opinion on the critical success factors in terms of theories about factors that influence acceptance and adoption, is presented in table 1.4.3.

Table 1.4.3: The critical success theories and factors for information system implementation.

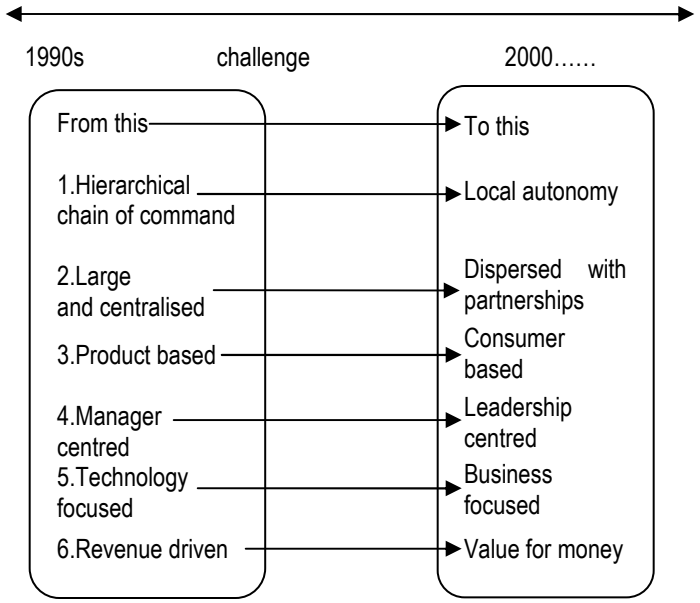
Factors (development)	**Author**
-Iterative development, Management of requirements, -Visual modelling of software, -Verify software quality , Control changes to software	Booch (1999) Rational unified process
Factor (System performance)	
-Correct functionality, Performance (especially under peak loads	McManus and Wood-Harper (2003)

-Compatibility/ (Interfaces with other systems, Robustness(capacity to handle big volumes and loads) -Availability, reliability and maintainability	
Theory	
Technology Acceptance Model (TAM)	Davis 1989)
Use, usability & usage.	Sol, 1992
Diffusion of innovations	Rogers 1983, 1995
Technology Transition model (TTM)	Briggs et al 2004

Conclusion

From the literature by IS implementation practitioners and researchers we can extract the common critical success factors for information systems implementation as being design oriented i.e. how user requirements are combined with technical infrastructure, and organizational environment to deliver a system the user wants. (MacManus and Wood-Harper (2003) summarize the implementation transition features, relevant to emerging networks. Adopting these features gives organizations a higher chance of succeeding in today's business environment of competition, rapid change and instability on a global scope (See figure 1.4.3). Implementation methodologies, approaches and models are investigated further to derive potential development mechanisms to improve implementation in volatile contexts, in chapter three.

Figure 1.4.3: The system implementation transition features



Adapted from MacManus and Wood-Harper, 2003.

1.5 An approach to support service oriented IIS implementation

In this section, the research proposition of the need to support inter-organizational service systems implementation in volatile contexts is explained. The research proposition is based on three reasons:

i) Difficulty of the task
Inter-organizational systems are extremely hard to design, implement and manage because they have multiple actors with different value systems and interests. The research domain adds another complexity element of the volatile environment that must be managed to improve implementation practices. Hence there is a need for innovative engineering approaches, including design theories, design heuristics modelling techniques for environments in which new organizational arrangements for service delivery can be tested and evaluated from a strategic, operational and technological perspective (Van de Kar, 2005).

ii) Absence of a satisfactory support kit for volatile settings
A brief review of the background, philosophy, assumptions, scope, and skills required, of the multitudes of IS methodologies, revealed that the methodologies reviewed in the literature, did not provide empirically validated prescriptive guidelines for the development and validation of inter-organisational service system implementation in volatile environments. The current guidelines and approaches do not cover the entire spectrum of complex requirements for volatile contexts. Research opinion to support this view includes the view that prescriptive methodologies are unlikely to cope well with strategic uncertainly, user communication and staff development (Middleton and McCollum, 2001; Rowley, 1998).

iii) Importance to technology transfer and diffusion
The development and empirical validation of this approach informs implementation in a pioneer context and has far reaching implications as a model for service system diffusion in developing economies, where business collaborations are just emerging. Service system implementation has the potential to strategically open up public organizations in developing economies and therefore requires a complete kit to accelerate the deployment process. In addition, the beneficiaries of this kit are nations with constraints to access the diverse available information sources to develop their own kit.

Defining the approach for inter-organizational implementation in volatile environments

The factors that should be influenced, to ensure increased chances of a successful implementation are based on the implementation critical success factors. Flexibility in this volatile research context calls for *a practical and*

extensible approach consisting of implementation processes and common functional elements that can be adopted without re-inventing them each time to reduce or eliminate the complexity associated with implementation challenges of volatility. In this section we discuss the goals for this research.

In volatile settings unreliable systems are a factor of unstable infrastructure, and incompatible variation of systems and monolithic structures, that are not resilient. The critical success factors proposed by this research should include:

i) Technical infrastructure goal

- *Reliability*

The technology infrastructure must be robust to support reliable service delivery.

- *Flexibility*

Flexibility is required to support development and use at the parallel and distributed levels. (Brown, 2000)

- *Maintainability*

Low maintenance is the target for any system implementation and especially for emerging networks that work with resource scarcity. High maintenance features prominently as a big challenge that threatens sustainability of the IS in volatile settings. It is important to remember that maintenance accounts for 50% of the software lifecycle costs.

- *Scalability*

The current variety of incompatible applications and platforms is not resilient and scalable. The ICT infrastructure must be able to support expansion of systems without relative loss of speed or of control.

In summary, technology goals aim at a robust technical architecture that can utilise existing resources, and provide flexible and reliable service system delivery.

ii) User goals

Users are the measure for successful Implementation (Nelson.1990). Methods and techniques to change user behaviour and support the coordination of the network activities are required to maximise effectiveness. The user satisfaction goals include:

- *Reliability*

System reliability is one of the core service quality dimensions (Parasuraman et al, 1985, 1988, 1991). Reliability consists of correct technical functioning of services, currency and accuracy of information and explanation of purpose (Liljander et al, 2002). The research definition of implementation denotes activities that deliver “value to the user” (Swanson 1998). This value is the embodiment of the service formula.

- *Usability*

Usability is defined in ISO 9241-11 (11) as follows:

"The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. To explain these two elements further, *effectiveness* is the accuracy and completeness with which users achieve specified goals and *efficiency* refers to the resources expended in relation to accuracy and completeness with which users achieve goals." Other usability elements include *satisfaction,* which is the freedom from discomfort and positive attitude to the use of the product and context of use i.e., characteristics of the users, tasks and the organizational physical environment. The user interface and response times feature prominently in the user friendliness of the system. *ISO/IEC 9241-14 Ergonomic requirements for office work with visual display terminals (VDTs), ISO/IEC 9241-14: 1991(E), 1998.*

iii) Organisational and Process goals

- *Distributed decision making and Effective Process management*

The effectiveness of the coordination methods and the results of the network activities should be measured by opinions from the partners. Networks and network organisation have emerged as an organizational form to overcome the problems with hierarchies and to create greater structural effectiveness and responsiveness with business partners (Powell, 1990). De Bruijn et al, (2002) confirms that the activities in the network are dynamic particularly the decision making because the various parties hold different views about the problem definition and solution. "As a result, the decision making will always be capricious and unstructured." The measurement of process management parameters in an inter-organisational context is a critical validation goal.

1.6 Research objective

It was proposed in section 1.3 that emerging inter-organizational networks in volatile context need support to implement business service systems to improve their implementation practices. It was argued however, that the required support for this innovative and difficult task deployed in overwhelming complexity, is not availed by current approaches. Hence there is a need for innovative engineering approaches, in which this new organizational context for service delivery can be tested and evaluated from a strategic, operational and technological perspective. The objective of this research is:

Develop an approach to support the improvement of the efficiency and reliability of the implementation process for inter-organizational service systems in volatile contexts.

Specific objectives are:
(i) Study and identify current process and practice challenges and issues in the IS implementation environment in volatile contexts.

(ii) Propose support requirements for effective implementation of inter-organizational service systems implementation to manage the complexity cause by volatile characteristics.
(iii) Develop, test and evaluate the support approach for inter-organizational service systems implementation aimed at improved implementation practices.

1.6.1 Research activities

The core activity of the research consists of:

(i) The specification of the requirements service system implementation provided the basis for formulating the support. This activity was informed by literature sources and empirical data from the exploratory case studies in chapter two, which analyzed the current and emerging issues for service system implementation volatile networks.

(ii) Developing the approach involved identifying potential mechanisms and extracting support for the identified requirements that reduce the complexity involved in the implementation of inter-organizational service systems in volatile contexts. This was done in chapter three and four.

(iii) Testing the requirements for the approach involved the assessment of goals achieved by the approach by both user and practitioners. This assessment measures predefined elements of the process, user satisfaction and robustness of the prescribed technology architecture, to support service system implementation. Testing was conducted using an expert survey and action research case study. The validation of the approach leads to the prescriptive empirical design of the approach to support service system implementation in volatility, as the final research output. Testing and evaluation was done in chapters five and six.

1.6.2 Research output

The approach can be described as a set of guidelines and technical design requirements for repeatable implementation processes suitable for inter-organizational service system implementation in volatile environments. The ready to use process and design approach consists of:
i) The Approach consisting of a *new implementation methodology (PADTR) supported by, collaborative business systems engineering, service system engineering and process management tools, techniques and reference guidelines,* to ensure replicable systematic achievement of the implementation design objective.

(ii) Prescribed technology and technical skill environment to support the identification of a robust technical architecture, service components and operational environment in an inter-organizational context, optimized through using existing technology resources.

Research contribution

The contribution of this research for academics will be a prescriptive framework for the development of an implementation approach to support inter-organizational service system implementations in organizations with characteristic volatility. Managing complexity of the implementation challenges requires adequate knowledge of a support framework to IS implementation. Available literature does not offer an adequate validated theoretical framework.
i) Implementation practitioners as the key beneficiaries of this approach will have a ready reference of methods, tools and guidelines with a methodology to implement inter-organizational service systems for projects in volatile contexts.

ii) The benefit for business is that a tested service system implementation approach provides organizations in volatile environments, particularly in the higher education sector, with insight into ways to make the implementation process more effective and efficient. Volatile organizations can build capacity for adoption of new, flexible, reusable and collaborative approach to suit volatile contexts, to optimize scarce resources, improve implementation practices, resulting services and become more competitive and strategically relevant.

iii) The research builds further on understanding useful concepts which are relatively new for public institutions of the developing economies, like:

- Service-oriented implementation in inter organizational networks of public organizations, is a relatively new concept in the developing economies, especially Africa.
- Collaborative business engineering approaches (Den Hengst and De Vreede, 2004) are another useful support for multi actor contexts that effectively manages negotiation and consensus building. This approach is new but ideal for the inter-organizational setting, to explore and adopt in an appropriate context.

1.7 Research Questions

An implementation approach is needed to support the coordination of network activities and the implementation process for inter-organisational service systems by emerging networks in volatile environments. This leads to the following research question:
How can the implementation of inter-organizational service systems, among independent actors with diverse technical infrastructures and scarce resources, be supported to improve implementation practices?

To help us find an answer to this question, we formulated several key research

questions. The first research question was intended to help us obtain a detailed understanding of the practice and process challenges, issues and problems of inter-organizational service systems implementation in a volatile context. The answer to this question provides deep insight into the problem domain.

Research question 1

1. What are the current and emerging issues in the implementation of inter-organizational service systems by business networks in volatile environments?
This research question was answered partially in chapter one and further elaborated in chapter two. It was intended to help us get a detailed understanding of the taxonomy of inter-organizational networks and service systems and the issues, problems and challenges involved in their implementation in volatile environments. It is necessary to consider information systems development and the service systems and how the two evolve. An exploratory case study in chapter two was used to investigate and derive implementation issues and problems from an intra and inter-organisational settings characterised by volatility.

Research question 2

2. What implementation mechanisms can be used to implement inter-organizational service systems in volatile contexts?
In chapter three, we discussed this research question to provide a possible way forward to find mechanisms for improving implementation practices in volatile contexts. The focus for relevant mechanisms used for service systems development by networks in volatile contexts, included IS development, collaborative business systems engineering, service system engineering and process management theories. After getting an understanding of the challenges and mechanism used for coordination of network activities and inter-organisational service system implementation, the third issue addressed by this research was to devise ways to improve the efficiency and reliability of implementation practices for emerging networks in volatile contexts. Therefore the third and main question that was considered by the research was:

Research question 3

3. How can we support the process of improving inter-organizational service system implementation in volatile environments?
This research question was directed at the researcher to develop a new implementation and coordination approach for emerging inter-organizational networks in volatile environments. The approach consisting of a *new implementation methodology (PADTR) supported by, collaborative business systems engineering, service system engineering and process management tools, techniques and reference guidelines* is described in chapters 4, was tested and evaluated in chapter 5 and 6.

1.8 Research Methodology

1.8.1 Research Philosophy

This is the underlying "way of thinking" (Wijers, 1991). In studying organizational phenomena, two major research philosophies are advanced: Positivism and Interpretivism (Galliers, 1992). Positivists claim that reality can be observed and described objectively without interfering with the phenomenon being studied. Positivist studies attempt to test a theory, in an attempt to increase the predictive understanding of phenomena. In line with this, (Orlikowski and Baroudi, 1991) classified information systems research as positivist, if there was evidence of formal propositions, quantifiable measures of variables, hypothesis testing, and drawing of inferences about a phenomenon from the sample to a stated population.

Interpretive studies generally attempt to understand phenomena through the meanings that people assign to them and interpretive methods of research in information systems are "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993). Interpretive research does not predefine dependent and independent variables, but focuses on the full complexity of human sense making as the situation emerges [Kaplan et al, 94]. Interpretivists, claim that reality can only be understood by subjectively interpreting observations of reality. Multiple interpretations of reality are possible. Reality therefore may vary due to differences in languages and cultures.

Design science is another perspective that can be used for research into information systems and organisational phenomena (Glass, 1999; March and Smith, 1995; Winograd, 1996). Design science is relevant to this research because it complements the positivists and interpretive perspectives. Similar to the positivists and interpretivists' research perspectives, the design science research perspective has been shown to produce scientific knowledge (March and Smith, 1995; Simon, 1996; Vaishnavi and Kuechler, 2004/5).

March and Smith (1995) recommend that the choice of research perspective should be based on the research objective rather than the research topic. In section 1.6 we stated that the research objective was to develop an implementation approach to support the improvement of the inter-organisational service system implementation process in volatile contexts. Following the design science perspective, we can obtain more knowledge about the implementation of service system s in volatile contexts and this knowledge is subject to revision as the research proceeds and more knowledge is obtained. From the issues we identify we will address our objective by developing an

approach (artefact). The Approach will be refined iteratively and more knowledge is obtained with each nitration. Thus knowledge is obtained through making artefacts in an iterative process. Moreover the goal of the research is to improve the efficiency and reliability if inter-organisational service implementation in volatile contexts. Improvement is value oriented. (March and Smith, 1995) Thus the choice was made to use the design science philosophical perspective for the research presented in this thesis.

1.8.2 Research Strategy

For the research strategy, we combined the design science and behavioural science paradigms to create and evaluate an implementation approach to improve efficiency and reliability of implementation practices for business networks in volatile contexts (artefact). We used the two paradigms to delineate the problem using behavioural science, and develop useful and usable solutions as prescribed by the design science paradigm. The ill structured nature of the problem and lack of sufficient theory made it difficult to fulfil our research objective from a deductive point of view. Secondly, the problem could not be tackled from a single perspective or using a single discipline. To get a detailed understanding of the issues and problems of inter-organization service system implementation in volatile contexts, we had to follow the behavioural science paradigm in the initial phase of the research (chapter 2), using the inductive – hypothetic research strategy (Sol, 1990). The exploratory case studies enabled us to obtain more knowledge about implementation process and practice challenges, to derive a descriptive model and to determine requirements of the problem situation. Based on the requirements, we were able to design the artefact i.e. the approach.

The inductive- hypothetical approach by Sol (1982) was chosen as the research strategy. This strategy based on the Singerian inquiring system of Churchman (1971), has been successfully applied in several research projects based on an unstructured problem like this research. See for example Babeliowsky (1997), Eijck (1996), Herik (1998), Sol (1982) and Uilenbroek (19997). According to Sol (1982), the main characteristics of an inductive- hypothetical research strategy are as follows:

- Emphasizes the specification and testing of premises in an inductive way
- Opens up possibilities for an interdisciplinary approach
- Enables the generation of various alternatives for the solution of the problem
- Permits feedback and learning.

The above characteristics fulfil the requirements of the research objective at hand. It is argued that the research problem is ill structured. As described in the previous paragraphs, the complexity of issues involved.

An inductive–hypothetical research strategy consists of five activities (see Figure 1.8.2). The characteristics of the inductive-hypothetical research strategy are described in general terms below. The application of the strategy for the research problem domain will be illustrated in the rest of the chapter.

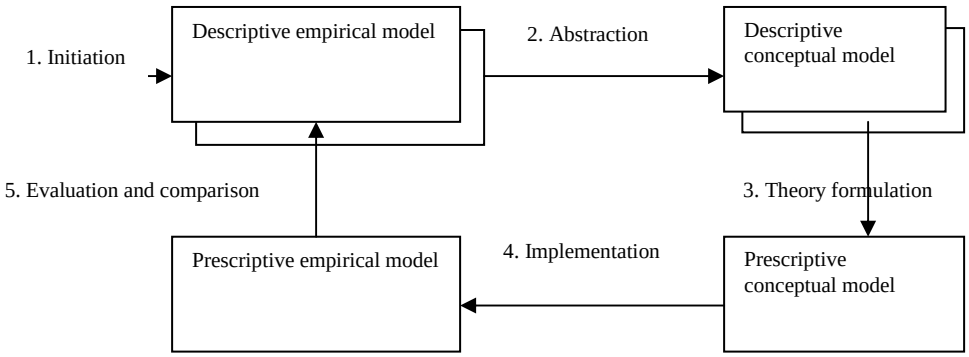


Figure 1.8.2: The inductive-hypothetic research strategy

1.8.3 Research instruments

Research instruments describe the way the data is collected and analyzed, i.e. the way the research steps are carried out. The selection of research instruments depends on the amount of existing theory available, research focus and objectives and resources available to the researcher (Orlikowksi and Baroudi, 1991; Benbasat et al, 1992).

Different research instruments are proposed to carry out the research: Action research was used for inductive case studies. Case studies were the main instrument of the research. They are useful for understanding the problem inductively and hence well suited to the proposed inductive-hypothetic research strategy (Sol, 1982). The case studies used both qualitative and quantitative data to provide a wider representation and to allow comparison of collected data (triangulation). When conducting a case study, the researcher is an observer in an exploratory, explanatory or descriptive manner (Vreede, 1995). Within the case study, prototyping was used in order to understand the problem incrementally as well as to realize and implement concepts. In observatory case study research, the researcher observes research object from a distance whereas in a participant observation case study, the researcher may participate in the events being studied by being a subject of the study, taking a functional role, serving as a staff member or key decision maker (Yin, 2003). A participant observatory case study can also be called ‘Action research’. Observatory and participant observatory case studies were applied in this research. In addition literature review was extensively used, and extended to focus groups and survey research.

Instruments used in the initiation phase

Literature was extensively reviewed to study the status of information systems implementation with particular emphasis on development methodologies. For further insight into implementation in volatile environments, the researcher studied current implementation reports for Makerere University administrative IS implementation in her capacity as Project manager. This included implementation plans, organizational, technical architecture and user environments. In addition *Case study research* was applied .The strength of a case study is that it can be used to describe complex relationships, personal interpretation, and historical narratives of the phenomenon under study. On the weak side, case studies are typically limited to single setting or set of individuals, often relying on the reconstruction of past events, and these are susceptible to multiple interpretations (Williams et al, 1988). Multiple case studies are often regarded as better than single case studies with respect to generalisability. However, when selected with care, a limited number of case studies or even a single case study may be appropriate under several circumstances (Yin, 20003).

Action research is a useful research instrument for testing the theory and concept, in a real situation and assessing the outcome. It is a type of investigation combining practice and theory that is designed to cooperate with and support enfranchised actors and groups in a system of study (Williams et al, 2003). In conducting action research, the researcher is an active participant in a prescriptive and intervening manner. A combination of case studies was used to investigate the field of IS implementation further. First exploratory case studies (Case1) were done in 3 African universities in 2004 with the objective of understanding implementation challenges with current practice. Next, an inter university implementation case study (Case2) was undertaken in 3 South African universities in 2004, to explore the problems for service system implementation in consortia. Key requirements, problems and possible solutions were investigated. Both these case studies were observatory, as the researcher did not directly participate in studying the research object. The case study employed mainly questionnaires and interviews for top managers of IS projects and unit heads of IT support departments. Abstractions from the two cases based on relevant theories, informed the proposal and subsequent specification of requirements for the approach to support service system implementation in volatile contexts.

Case study and action research is often criticized for reliance on subjective interpretations of collected data. Yin (2003), recommends that the following case study principals are observed to avoid bias:

Construct validity; establishing correct operational measures for the concepts being studied, *External validity*; establishing domain in which the findings of a study can be generalized, and *Reliability*; demonstrate replicability of study operations e.g. data collection procedures as repeatable with same results. The researcher used various data sources and research teams as in case 1 and 2 to counter balance the research bias.

Instruments used in the abstraction and theory formulation phases

This phase was conducted mainly on an individual initiative process based on the literature review, case studies, focus groups and surveys. All the knowledge obtained resulted into a prescriptive solution for an implementation approach.

Instruments used in the Development phase

Action research case study (Case 3) was designed and implemented in October 2006 with the researcher as an active participant in the project manager role. The objective combined university assessment of the on going administrative IS implementation adoption gaps and the research investigation for the type of information service required by students and lecturers. The researcher also conducted brain storming sessions with colleagues at manager level from the technical support unit about the requirements and investigate business models for of an inter- university IS implementation. From this case the key abstraction were the requirements for the development of the inter-university registration information service.

Instruments used in the Testing phase

The testing phase enables a better insight into the practical consequences of the implementation approach. An inter university registration information service (IRIS) was developed and implemented using the approach as a prototype for 3 universities in an emerging network. The object of observation is not the service but the effectiveness of implementation using the approach. In the action research case study, the researcher was the participant observer, practitioner/innovator who developed and launched the approach, used to implement IRIS. Observation, questionnaires, interviews and group discussions were used to get feedback from implementer on the approach and the results. Feedback from these multiple sources also counter balanced possible research bias.

Instruments used in the Evaluation phase

The evaluation phase used knowledge gained from expert surveys and the IRIS test bed project, as well as discussions of the results with participants in the project. The project results were also presented in various forums. The feedback from these meetings informs the reflections and conclusion of the prescriptive empirical model for further reflection.

1.9 Research Outline

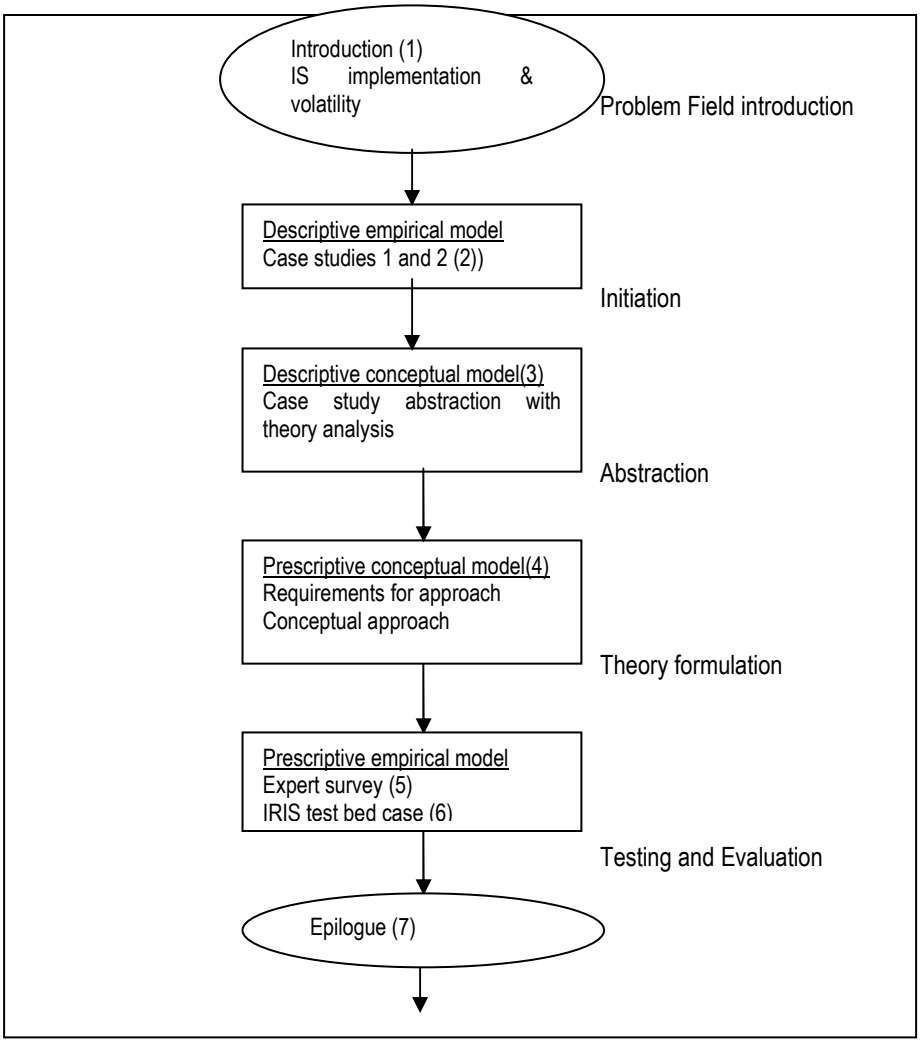
The thesis is outline is shown in figure 1.9. The outline is related to the research strategy; the hypothetical inductive research approach. A brief explanation per chapter includes linkage to the inductive hypothetic research strategy elements; the descriptive empirical model, descriptive conceptual model, prescriptive conceptual model and prescriptive empirical model.

In chapter 1, the problem field dealt with in chapters 2 and 3, is introduced. In chapter 2, issues and challenges experienced by emerging networks in volatile contexts are discussed using the exploratory case studies; case 1 (3 African universities with intra system implementation projects) and case 2 (Inter-university consortia in S. Africa). The result is the descriptive empirical model. In chapter 3, an abstraction of the case study observations is done based on relevant theories, to derive potential mechanisms that can be used for service system implementation to reduce the complexity. The descriptive conceptual model is derived. In chapter 4, the requirements of the approach are defined and a prescriptive conceptual model of the approach presented in 'the ways of' framework.

In chapter 5, the Usefulness test and evaluation of the implementation approach using the Expert judgement survey is conducted. In Chapter 6, the usability test and empirical validation of the approach is presented. The evaluation of the approach as per the requirements is concluded. The prescriptive empirical model of the approach is derived.

In chapter 7, conclusions and recommendations from the research are presented. A review of the research findings and recommendations for further research are provided.

Figure 1.9 Research Outline



Chapter 2: Current and emerging issues for service systems implementation

2.1 Introduction

In chapter we discuss the exploratory case studies to derive current and emerging issues, problems and challenges for service systems implementation in volatile contexts. The underlying motive for the investigation was to derive a starting point for the support approach. CASE 1 investigates implementation challenges for the student registration IS referred to as the Academic registrar information system (ARIS), for three universities with characteristic volatility in sub-Saharan Africa. Case 2 is an intermediary case study investigating how the challenges observed in CASE1 have been handled in the emerging inter-university consortia in South Africa, for 3 different types of applications. Case 2 presents useful elements for potential requirements and lessons to similar implementation challenges in a context of comparative volatility.

In chapter 1 the complexity posed by unpredictable socio- political factors, inadequate technical skills and technology resources for IS implementation, was presented drawing mainly from literature and the experience of the researcher. This chapter presents a case study, conducted with the aim of confirming the existence of the problem, and coming up with the empirical model of the current situation. This is based on the first step of initialising the inductive-hypothetic model cycle [Sol, 82]. It is expected that the findings of the inductive cases will help in consolidating the research issues and confirming the research assumptions that have been advanced in the earlier sections of this research, thereby providing propositions that will form a backdrop for the thesis work.

To formulate an appropriate case study to derive the research objectives mentioned above, it is important to revert back to the pertinent research question *What are the current and emerging issues in the implementation of inter-organizational service systems by business networks in volatile environments?*

The research question is of an exploratory type, for which we will require to provide a justifiable rationale for conducting exploratory research studies with the goal of developing pertinent propositions for further inquiry.
To begin the exploratory research, two questions should be addressed:

1. *"What criteria will determine the research relevant universities to explore the research question?"*
2. *"What (group of) universities will guide the research to best understand the requirements of inter-organisational service oriented IS implementation to improve implementation practices in volatile contexts?"*

To answer the above questions, the two cases are presented below:

In summary, both Case 1 and 2 are exploratory and complimentary. The abstractions drawn in Case 1, model the existence of the problem in the form of implementation challenges caused by characteristic volatility. Case 2 compliments CASE 1 by abstracting requirements and lessons for managing complexity of implementation projects in an inter-organisational volatile setting. The Cases are described along the lines of the questionnaire that was used (see appendix A). The case framework aimed to lead to a better understanding of the IS implementation challenges, comprises of the following criteria:

i) Organisational coordination characteristics
ii) The enabling technology used by the universities
ii) The implementation process focusing on performance requirements.

First, a description of how the case studies were set up is presented.

2.2 Set up of the Case Studies

A case study is an empirical inquiry that investigates a contemporary phenomenon within its real life context when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin 2003). Case studies also represent the need to study the phenomenon of interest in its natural setting. Typical situations in which the case research strategy is appropriate are characterized by:

- emphasis on interest in the *how* and *why* questions, i.e. in understanding the nature and complexity of the processes taking place.
- lack of previous studies, and elaborate theoretical understanding, with respect to the phenomenon of interest (Benbasat et al., 1987; Yin, 1984; Lee, 1989) .

All three points above are valid for the purpose of this research in which relatively little previous research has been done and where there is a need to gain deeper insight in order to formulate some explanatory theory and derive some research propositions.

As explained under research the methodology in chapter one case studies have advantages and disadvantages. To achieve quality in case study research, Yin (2003) has developed case study tactics designed to withstand the tests of construct validity, internal validity, external validity and reliability. Attention should be paid to the design of the case study and the site selection, sources of evidence and method of analysis (Yin, 2003; Van Meel, 1994; Van Laere, 2003).

The following steps must be observed to ensure quality case study Case study research.

Designing the Case study

Designing a case study involves decisions about the object and goal of study, the unit of analysis and use of single or multiple cases (Yin, 2003). In this case, multiple cases are studied. The *object of study* consists of:
Case 1 involves independent institutions with typical characteristic volatility challenges in the implementation of business information systems. In chapter one it was mentioned that such organisations lack the adequate knowledge to manage the resulting complexity to improve current implementation practices. Case 2 presents varied business IS university consortia impacted by comparative volatile characteristics. The partner universities need to agree to coordinate common business activities in an inter-organisational interaction as a competitive strategy for delivering user system value. The unit of analysis is the inter university grouping or network that implements and uses the common service. The *goal of the study* is to study and derive key elements that would guide the formulation of support requirements for inter-organisational service system implementation for organizations with characteristic volatility.

To ensure construct validity, internal validity, external validity and reliability the following case study tactics recommended by Yin (2003) were used. To achieve construct validity multiple sources of evidence were used and the interviewees reviewed, interview transcripts and draft reports of the case studies were endorsed by respondents. This is further explained below under collecting evidence. To achieve internal validity, pattern matching and explanation building was applied, further explained below under data analysis. To achieve external validity, multiple case studies were used to discover issues. It should be emphasized that the purpose of these multiple case studies is not to generalize but to achieve an understanding of the problems and challenges. To achieve reliability and minimize errors and biases in the case studies all steps were documented, procedures were discussed and results discussed with researchers in other forums.

Case (site) criteria for site selection

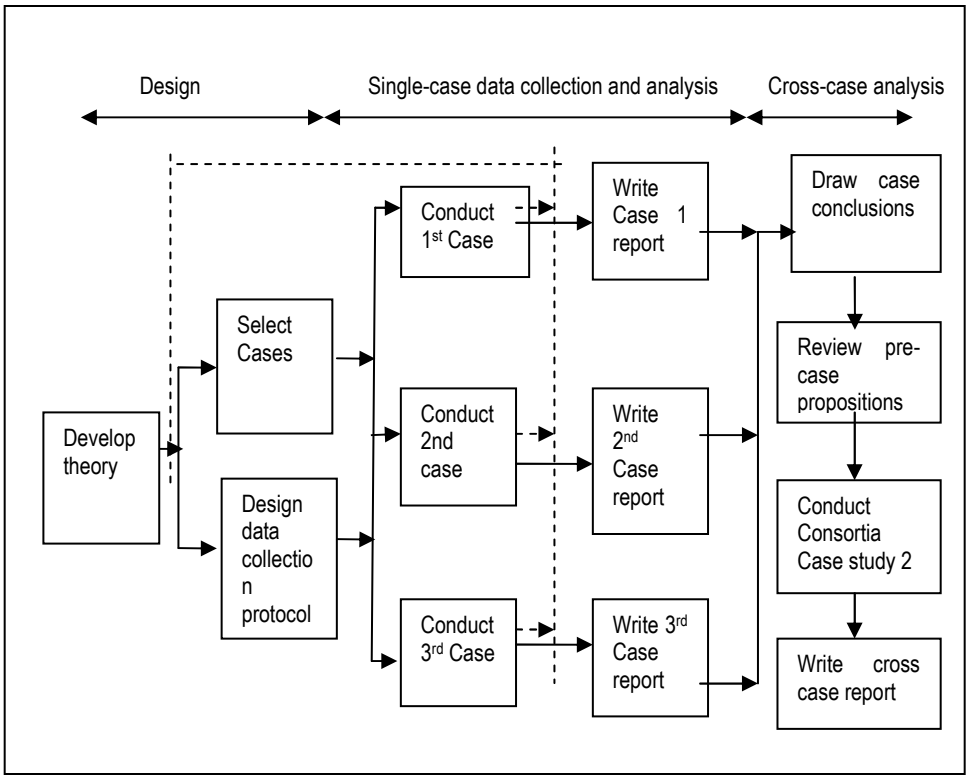
Suitability of the site selection is based on, the definition of the organizational setting which must be a large public organization with an IS implementation project impacted by the prevalence of volatile characteristics as described in Chapter one. Other criteria that can be found in the literature on case study methodology are:

- Availability of university IS implementation cases. Yin (2003) argues that choice of case study is often based on opportunism, rather than rational grounds.
- Readiness of organisations to participate by providing information required to conduct the study.
- Contemporary cases; the IS implementation projects must be fairly recent in

order to have first hand information from people active in the case situation (Yin, 1984, 2003; Benbasat et al, 1987; Mumford et al, 1985; Lee, 1989).

After the selection of suitable cases, the case studies were conducted. This involved collection of data, analysis and report write up for individual cases. A cross case analysis was done to abstract emerging issues for all 3 cases, derive conclusions and review pre-case propositions. The case study structure is summarized in figure 2.2.2.

Figure 2.2.2 Case Study structure



Sources of evidence

To determine sources of evidence, it is important to focus on the objective of the case study as stated in section 2.2 which determines the case study framework, for guidance.

The framework has the following key components.

i) Existence and impact of organisational volatility characteristics on implementation.

ii) The enabling technology used by the universities.

iii) The implementation process focusing on performance requirements.

Within the above framework, the research studies the effects of volatility on the implementation process focusing on compliance with the critical success factors mentioned in chapter one.

Different data collection sources were used to collect evidence. Multiple methods of data collection, allow for *triangulation* and *validation*. The multiple sources of information include published reports, ICT/IS project reports, financial reports, policy documents and semi structured questionnaires complimented by interviews. Observation was also used in the Makerere case. A questionnaire/interview protocol was used as follows:

- *First*, the published information on the selected cases was collected and processed into working documents. The names, designations and contact details of potential respondents who participated in the IS implementation project were extracted.

Furthermore, potentially relevant topics for the case study were listed from which the questionnaires were derived.

- *Second*, the questionnaire was administered internally for testing to one person per respondent category.
- Adjustments were done after the trial. The points raised in the questionnaires and semi structured interviews involved mainly IS and the participating organisation thus meeting the concept of an embedded case study design (see Yin 1984, 2003).
- As a validation technique interviews were tape recorded, subsequently transcribed and returned to each interviewee to check and resolve discrepancies.

Use of interviews, documentary sources, and observations requires that internal validity must be addressed. As recommended by Jick (1979), care should be taken to ensure that the data collected converges on similar facts.

- The interviewees mainly at the manager level received the interview transcript and a draft version of the case study report, to confirm correctness of the transcript and see whether confidential information had been divulged. Data from the interviews and questionnaires was supplemented with information from company websites and organizational reports.

Data analysis

The analysis of the data for the inductive case studies presented in this chapter is used for preliminary purposes. The case studies are described based on the case framework derived from implementation issues in chapter 1 and presented in section 2.2.2.

After the data collection phase, the cases were documented as follows: First a

mode of description aligned with the questionnaire structure was adopted to avoid theoretical bias. A summary of the key challenges was extracted to identify possible causal relations between the volatility characteristics and the challenges experienced in the different sub phases of the implementation process. The derived challenges from Case1 are observed in case 2 under the inter-university consortia implementation to derive requirements as per the case analysis framework (Yin, 1984). The final task was to draw cross-case conclusions indicating useful elements for potential requirements of the implementation approach. The two cases are described below.

2.3 CASE 1: Information systems implementation in Sub-Saharan African universities

As stated in the previous section, the case studies in this context are meant to provide deeper insight into the current implementation process to determine challenges and practices caused by volatility, that require support in the inter-organizational setting. This insight must result into one or more testable propositions. To gain insights and a validated confirmation of findings, multiple case design with relatively similar organizational environments, is adopted. The aim is to derive cross cutting implementation challenges and patterns in the implementation process in organizations (universities) with similar volatility characteristics impacting implementation.

2.3.1 Methodology

The case studies instruments applied in the three cases were outlined in section 2.2 above. Qualitative methods like structured and open interviews, observations of processes for on-going implementation, IS project documentation, report reviews and other relevant literature, were used in the study. This will be useful for: understanding organizational perspectives, revealing discrepancies between project objectives and practice.

Exploratory question 1 asked about the criteria that will determine the research relevant universities. This is answered by the following criteria based on literature and the researcher's experience and knowledge of African universities:

Volatility characteristics

The description below is still valid for the volatile influence on the case study setting:
"African universities are struggling to emerge from a decade of crisis. Rapid growth, the brain drain, frequent labour strife, campus closures, institutional deterioration, waning relevance and declining educational quality have produced a generation of graduates less capable and qualified than they were

10 years ago. -- Working Group on Higher Education, Association for the Development of Education in Africa report UNESCO (1998).
The three universities selected for this study, are representative of the majority of African universities. Situational characteristics of volatility that add to the complexity of the implementation project include an unpredictable socio/political environment that compounds inadequate technical skills, unreliable technology and unstructured implementation practices. There is inadequate knowledge to resolve the resulting implementation challenges. It is worth noting that there are a few exceptions to this perception where universities have constructed a coordinated ICT policy response. The criteria is summarized in table 2.3.1.

Table 2.3.1 Characteristics of the case study universities

Characteristics	Description
1. Organizational culture	-Highly centralized, bureaucratic and hierarchical organizational structure; headed by Vice chancellor or Rector with deputies -Slow decentralisation -Limited communication between users and IT support.
2. Technology infrastructure	-Unreliable network infrastructure -Inadequate internet bandwidth capacity to support diverse university programmes -Limited computer resources for users (ratio 1:10) due to scarcity -Varied and incompatible software applications and hardware
3. Technical skill base	-Low retention of ICT skills due to uncompetitive remuneration /incentives -Limited user training and a lack of an institutionalized training
4. Funding	-ICT projects on average 90% donor funded -Limited sustainability policies -Primary source of income is from government and students tuition fees
5. Profile	-Oldest and leading, Public universities -Pioneers of ICT usage in Higher education
6. Recent IS implementation	-Various stages of student records management IS implementation (known as the Academic records information systems (ARIS)
7.Size and complexity of organization	-Large, with more than one geographical area, more than one network (Internet connection), more than one help desk

	-Level of complexity in terms of size and different user profiles, number of applications and mission critical service, is high.

In relation to the specific countries (question 2), we deliberately selected countries with universities that answer the above criteria, with characteristic volatility, that are in the process of implementing, or intending to implement business IS.

The selected universities which represent Sub-Saharan African universities include:

(i) University of Eduardo Mondlane (Mozambique)
(ii) University of Dar es salaam (Tanzania)
(iii) Makerere University (Uganda)

Rationale for selecting ARIS

The academic records information system (ARIS), which was under implementation at all the three universities, was selected for the case study based on the following factors:

- ARIS supports a core business function used by a large cross section of the university community; students, lecturers and management. Such a system offers high research potential for defining and implementing services in demand by the university community.
- A system with multiple interfaces for all student services including library, E-learning and finance.
- The ARIS project was still under implementation and this offered a good opportunity for carrying out case study research.

The case studies were done in December 2004. The cases are presented following the questionnaire format in three categories:

i) Organizational description
ii) Technology infrastructure
iii) Implementation process.

(See table 2.3.1).

Table 2.3.1 Case study descriptions

Name of university	**Mondlane (UEM)**	**Dar es Salaam (UDSM)**	**Makerere (MAK)**
1.Description			
Organisational features	-Started in 1975 as the oldest university in	Started in 1961. University -Coordination by	-Established in 1922. -Bureaucratic system of

	Mozambique and the only one until the1980s. -Dispersed location and unreliable network causes delays in transactions and additional costs for university operations and activities.	bureaucratic system of committees. -No financial sustainability.	committees. -Technology cost recovery fee of 2% per unit's income, but costs were still unsustainable.
Population	Student 8,204, 800 academic staff, 960 technical and administrative staff	Student population of 7,089, 872 academic staff and 1,286 Non academic staff.	Over 30,000 students, 4000 staff members.
Location and size	Capital city Maputo with 15 academic sites, in a 7 km radius	Western side of capital city of Dar es Salaam, 13 km from the centre. -Occupies 1,625 acres.	Main Urban Campus in the capital city, Kampala and 2 small campuses; rural field stations. The total campus area is 1,146 hectares.
2. Technology infrastructure **-Connection** **-Network capacity**	Connected via fibre optic cable and radio link -Internet link is 128k./ 1Mb Via PanAmSat to MCI. **-**935 PCs, 4 operating systems and 18 software applications available.	-Extensive technology infrastructure. -Network runs a 8.2 km fibre optic backbone network running at 10/100 Mbps, linking 28 administration and academic buildings. -Bandwidth capacity is still inadequate and expensive.	Bandwidth (In) was 2.5 Mbps expected to double by Jan 2005. The campus backbone consists of 16 km of single mode optical fibre cable and WaveLAN. 40 extensive local area networks (LANs). Bandwidth capacity remains inadequate and expensive.
3.Implementation Process features **-Technical skills**	Computer centre with 10people, Two (2) Part time engineers for network support, no system specialist.	-Provision for technical and managerial training. -Registrar was a user, with 2 technical staff in charge of the system operations in registrar's office.	-Registrar in charge of content supported by Technology support unit of 25 people. -Requirements elicitation was done successfully but

-Methodology **-Performance**	-No requirements analysis. -Performance could not be measured since system not yet in use by students. -Documentation was not availed to researcher	-UCC in charge of hardware support. UCC is also limited liability company.	lacked adequate decision making and reporting. - Slow system adaptation -No interface with students and staff. -60% sampled not aware it existed -Performance limited to registrar's office.

Case abstraction

Case1 was an exploratory case using qualitative methods to confirm a causal relation between volatility and the overwhelming complexity that inhibit successful IS implementation projects. Secondly, this case identifies challenges and knowledge gaps in the three pillars for service system implementation; technology infrastructure, implementation process with a focus on the user value and organisational coordination that contribute to the complexity of current IS implementation projects in volatile settings. In response to these challenges, key elements that should guide the formulation of requirements to support implementation of an inter-organisational begin to emerge.

2.3.2 Conclusion –Case 1

The three universities exhibit similar implementation challenges in varying degrees. They confirm the pre-case assumptions about the causal relationship between an unpredictable environment and the implementation challenges of an unreliable technology infrastructure, inadequate skills for implementation and support as well as unstable organisational coordination. The three institutions are large in size and present multiple areas for complexity in the different user profiles, the number of applications and varied hardware on the dispersed campuses. The ICT capital budgets are on average 90% donor funded, bandwidth is inadequate but user population is very high. The findings also highlight support priority areas which indicate most deficiencies in implementation. These elements are the focus of consortia case study. The priority support areas identified from the case study are explained below:

Implementation Process management

The implementation process in the three universities is characterized by the following:

- Rigid methodologies, which can transfer risk

- Low or no user involvement in un structured/no requirements management
- Poor documentation practices and log of development activities.

These are the underlying factors for the incomplete and underutilized projects shown by the case study. Lack of a formal implementation method and especially the omission of requirements elicitation is highlighted in the literature as the reason behind low user system acceptance. It was noted that although Makerere University had an elaborate elicitation and requirement process, there were gaps in the reporting and an all inclusive stakeholder consultation. UDSM and Mondlane both lacked the stakeholder consultation.

Skills

Evidence from the case study presents an acute shortage of IT/IS technical staff to develop and support IT implementation in all three institutions. In addition, user training has been omitted since ARIS implementation remains largely the preserve of IT/ Academic registrar's unit.

Technology Infrastructure

The unreliable technology infrastructure was presented in three ways. It was evidenced by the

- Unstable campus networks. This was largely influenced by the power outages and funding shortages. Cases where utility services were terminated due to unpaid bills were also mentioned as responsible for the instability in the supporting infrastructure.
- Standalone applications and platforms compounded the lack of application and hardware standards. The result is a variation of systems and applications, which were incompatible. The list includes free and open software applications, proprietary software and in house software for small user groups. This indicates undesirable systems attributes like high maintenance and low scalability.
- The prohibitive cost of bandwidth was considered as a transient but still critical obstacle to system reliability, maintenance and scalability.

These issues are the focus of the second empirical search aimed specifically at inter-organizational service system implementation in a context of comparative volatility. CASE 2, investigates the formation of university consortia and implementation of service systems in South African universities. The study investigates how similar implementation challenges derived from case 1 are handled, with a view to draw practical lessons and elements that inform the definition of support requirements for volatile contexts.

2.4 CASE 2: The Inter-university IS implementation in South Africa.

2.4.1 Introduction

This case study is an illustration of typical emerging business networks among public organisations in developing economies that, can add value to the execution of common business activities. The volatility in the South African context is comparative to enable parallel study with useful lessons for implementation in extreme volatility. This case investigates how the complexity that emerges from the implementation challenges identified in the intra implementation of CASE1, can be managed to coordinate network activities and manage the implementation process in an inter-organisational context in practice.

Objectives

The objectives of Case 2 were:

- Study formation, operations and challenges of implementation networks for different types of business service applications in a similar (university) setting.
- Assess the solutions to similar implementation challenges as identified in Case1.

The study involved three types of consortia, in the university; an administrative information system, library system and bandwidth. Bandwidth consortia, was relevant to this study because it supported the initiation of business systems collaborations among the 52 member universities. In addition, it presented useful elements for a governance model. The study was conducted on site in March 2005.

2.4.2 Methodology

The research instruments were questionnaires and interviews and observations conducted on site. The profile of the three university consortia studied are summarised in the table 2.4.2.

Table 2.4.2: CASE 2 Organisations Profile

Consortia name	Type	Objective	No. of participating organizations and contact.
1 Tertiary Education Network **(TENET)**	Bandwidth consortium	Sustaining institutional collaboration through procurement of adequate internetworking services at affordable cost.	52 (All S. African Tertiary and research institutions. Duncan Greaves" dbg@tenet.ac.za *Executive Officer: Capacity Development programs.*

2. Gauteng and the Environs Library Information Consortium, (**GAELIC**)	Library consortium. (Shared application)	Successful lobbying for funding and implementation of library systems. *'provision of access to information in all formats through the development of collections, providing access to global information resources.'.*	3 core member universities Witwatersrand in Johannesburg- *Di Man* man.d@library.wits.ac.za -University of S.Africa (UNISA) in Pretoria- *"A J Erasmus"* ERASMAJ@unisa.ac.za -University of Pretoria- *"Soekie Swanepoel"* soekie.swanepoel@up.ac.za
3. University Trust (**UNITRUST)**	Administrative software development consortium	Shared development and sale of administration software aimed at; -Cost reduction and income generation -Provide Competitive advantage -shared best practice	3 universities - University of Stellenbosch, Pretoria and Potchefstrom -Helmi Driejer – IT Director mwd@maties.sun.ac.za -Johann Kistner- Director Information systems, Information technology

TENET origins and governance model

TENET was selected for this study specifically because of it's governance model that has lessons for organizational networking of public non-profit organizations. The Tertiary Education Network (TENET) was registered by the technical working group (TWG) formed by committee of Technikon Principals (CTP) and South African Vice Chancellors Association (SAUVCA), as a non-profit private company to provide an organizational home for collaboration, research and higher education internetworking. It was incorporated on 22nd August 2000. TENET is the agent for sustaining institutional collaboration in the procurement of adequate internetworking services at affordable cost. It lobbies Telkom (S. African National operator) for bandwidth, a critical support medium for information system services consortiums.

Role of TENET

TENET is not an ISP. It does not negotiate with TELKOM. It is an agent for the consortium bound by two legal contracts:

- Agency agreement between TENET and its clients, gives TENET the power to place orders for bandwidth other behalf.
- Agreement between TENET and TELKOM obliges TELKOM to provide internet bandwidth according to TENET requests.

TENET handles the billing and monitors the service provider (TELKOM)

performance. It is a point of escalation for network problems in the consortium.

Governance Model

A guiding philosophy with regard to structuring the new organisational home for collaborative internetworking was:

- Avoid placing employees of the institutions, and especially institutional IT Managers, in positions of responsibility that could or would conflict with their primary responsibilities and interests within their institutions. In particular, it was felt that nothing should conflict with the primary duty of the IT Managers of the institutions to be demanding customers of TENET.

Operational management of TENET is coordinated by empowered and accountable managers; not left to collaborative processes within committees comprised of institutional representatives. TENET has a lean staff of 2 employees; the CEO and the executive officer in charge of capacity development programmes. Office space and secretarial services are hired from the customer, Cape Higher education. The separate roles are important to avoid conflict of interest. This is a key lesson behind the success of TENET management.

- TENET is currently preparing amendments to its Articles of Association that will enable public research institutions to participate as co-owners of TENET.

Roles of members

The primary collective role of the 52 Member institutions (half are universities and the rest are research institutions and libraries) is to sustain the will and intention of the institutions to collaborate in the procurement of internetworking services.

Lesson

TENET presents an interesting agency model of technology network coordination for public organisations. The model presents useful elements for formulating and sustaining a successful working relationship between a provider, agent and consumer network without conflict of interests.

Shared Business software implementation – UNITRUST

UNITRUST stands for University trust. The trust was founded as the collaboration effort to develop and operate a joint university administrative system. This case was selected because it represents many attributes of the typical business entity of a system implementation project that the research focused on. The implementation of the business administrative system was a result of collaboration agreements between the universities of Stellenbosch (SUN), university of Pretoria (UP) and Potchefstrom university of Cape Higher

Education Authority. Agreements between the three partners, led to the sharing of the newly developed computerised business system of the University of Stellenbosch and the synchronisation of the business processes of the three institutions. The development of a 'generic parameter- driven, modern business system' was initiated (Unitrust project report, 2001). The co-operative development fulfilled the business needs of the three universities for student administration, financial management and human resource management.

Collaboration goals

The purpose of *Unitrust* was development, sale and distribution of the shared systems of the U-BASH system (Unitrust Business and administrative system for Higher education) with the following objectives:

- Cost reduction and income generation
- Provide competitive advantage
- Shared best practice in the development of unique function soft ware.

The project implementation could be regarded as both automation of already existing processes, and opportunities for new processes and functions.

Technology Infrastructure and technical skills

A dedicated new data network was created to test systems, download files and facilitate video conferencing. The joint project had the relevant technical expertise as shown by the table below:

Technical skills	No. of expert staff from the 3 universities. .
Systems analysis and design	10
Systems programming, testing	15 (9 were from Stellenbosch)
Roll out	5
Total	30

Implementation stages:
The project was conducted using the following stages:

i) Specification

Active end user participation at some levels of the development process through joint application design (JAD) sessions identified specific comprehensive functionality and flexibility for each University. The total functionality of all systems was further significantly enhanced, by synchronizing the individual system requirements of each of the three member universities.

ii) Design of the system, stages and tools

The system design was undertaken by the project champion university; Stellenbosch.

All Unitrust systems were developed using the James Martin 'Information

engineering' methodology. Using this methodology, a strategic long term plan for administrative computer systems (LTPACS), consisting of more than 50 high level functions was produced as basis for the design of systems with a high level of integration. Modern case tools were used through out a top-down development process, enabling the design of a fully integrated real time system, which spans all the business areas of an educational institution. System documentation is an integral part of the Case tools.

iii) Development

A management Information system (MIS) covering the total spectrum of the business areas in an integrated manner, enabled management information from a single separate relational subject database (Data warehouse). It was seamlessly populated and updated at predetermined intervals from the productions database, thus ensuring data integrity between the data models of the production and MIS databases at all times.

iv) Testing and roll out

Test strategies involved different test groups comprised mainly by IT support staff at the parallel level and for synchronising the service. Each university was responsible for it's own roll out.

v) Evaluation

In terms of realising the core objective of shared implementation, UNITRUST implementation was considered a success by all. It achieved the key objectives:

- Sharing best practices and cost reduction in business system implementation.
- Benchmarking costs with other institutions showed that UNITRUST costs were very low (half to a third of the cost).
- Automation of business processes was done in a relatively short time.
- Achieved a shorter time lag between examinations and graduation, compared to other institutions.

In response to the research focus on the emerging trend of public organisation networks, the project director for IT services confirmed that differences that would constrain IT collaborations in institutions of higher learning are becoming smaller and this should spur the growth of business collaborations. This is further confirmation of the growing interdependency among public organisations.

Challenges

The UNITRUST project had major challenges, which culminated into the end of the business partnership. The challenges are summarised in three categories as shown in the tables below:

Network coordination

Challenge	Result
The project champion (SUN) had two major roles as lead developer and system manager and consumer.	SUN internal service quality declined. End-users were not receiving adequate support.
A loose management structure with few controls	Too much freedom resulted into uncontrolled system modification.
Differences in organisational structures and work culture. SUN had a small administrative staff, UP had twice as many as the academic staff.	Synchronising the core system activities to meet the big discrepancies in requirements was difficult.
Communications and perceptions were not managed properly.	Administrators in the partner universities attributed system inefficiencies o the champion.

Technology

Challenge	Result
Different legacy architectures on the campuses were managed by open architecture standards	The software was transferable across different architectures

Process management

Problem	Result
Poor Project Management: UP and SUN differed a lot in management procedures eg. Pretoria had a centralized financial system whereas Stellenbosch had a decentralized (self –service) management.	Different management structures and definition of project roles were used in the member institutions, without consensus the best practice.
There was little end user involvement in functional specification and performance surveys.	Institutional IT directors were perceived as the users
Objective monitoring measurements like Number of open change requests and error logs	Uncontrolled changes to the system.
Use of loose benchmarks with no direct user involvement to monitor and evaluate service.	Service surveys always indicated additional needs. Performance basis was not based on user value.

Conclusion

The UNITRUST business case was evaluated as a short term success but, it was not sustainable. The consortia challenges presented by this case study are useful

for network coordination aspects and project and process management elements. The following lessons were derived by the architects:

Organisational coordination

- Operating / coordination body must be external to the universities**.**
- Taking ownership of the system by consortium members is critical even when the project is initiated (championed) outside the institution. The perception that this was, a Stellenbosch project was maintained by other consortium members.
- Conflict management necessitates an exit contract clause. Effort was spent on how to make the project a success and not enough on remedies, if it did not work.

Process management issues

- Competent project management is a prerequisite. The appointment of local capable business managers was essential. The project focused more on the technical managers.
- The focus should not be on the technology. Conservative perception of the project based on massive growth but sharing best practice was replaced by technology.
- Process controls should be clear and enforceable. Institutional ability to make and enforce rules and policies on internet usage and billing is a key component of the business model.

Gauteng and the environs library information consortium (GAELIC)

This case presents another type of business system consortia that is proprietary but jointly used and managed. *Gaelic* is a library consortium and the only IS project under FOTIM. *"It has become a big unit because libraries network very well and there are many areas of cooperation and collaboration."* (Gwenda Thomas, Gaelic, 2004).

FOTIM Vision is "*to create opportunities for the benefit of higher education in the region through collaborative projects and initiatives.*" This means meeting the plans for higher education through academic collaboration, administrative cooperation, the sharing of resources and best practice.

Formation of Gaelic

Gaelic was initiated funded by the Mellon Foundation. The Mellon foundation enabled the institutions to form consortia for successful lobbying of funding and implementation of library systems. The consortium decided to implement a commercially available integrated library system (ILS) and not to develop a system. Roll out and testing was addressed in a complete implementation plan

for each of the libraries. The implementation elements noted in case 1 which are pertinent to this case, were:

- Bandwidth capacity

Unlike the universities in case 1, the consortium members had successfully lobbied for adequate bandwidth to access services across member institutions. This was enabled by TENET as the tertiary education agent that lobbies for cheaper bandwidth from the national ISP.

- Technical Skills

Network and infrastructure support skills within the university and / or the library skills levels of the ICT staff, was the required minimum.

Evaluation

The implementation of ILS in the Gaelic consortium was considered a success. The initial project was completed on time and all expectations were met. The most important benefit was that all member institutions had access to each other's library catalogue. The key benefit for members of Gaelic was that the consortium has leveraged lobbying power to:

- Negotiate annually for discounts on new purchases, without incurring losses due to the impact of the exchange rate.
- Share knowledge and best practices in library management between various institutions.
- Gaelic strategic planning shows that it had the potential to take a lead in the library sector in the country and the southern Africa region. Neighbouring countries like Namibia were interested in becoming members of the consortium.

Performance

Monitoring performance was done by the Gaelic governing board which, meets 3 times a year. This was the steering committee during the implementation stage. The chairperson had to report to the Mellon Foundation (sponsor) on progress. Performance indicators varied at the parallel and distributed levels. There are no formal benchmarks and Service Level Agreements (SLA's) used by the consortium to monitor and evaluate the service. Statement of service intent was used because *Gaeli*c is not a legal entity.

Challenges

The challenges experienced by the Gaelic collaboration, which are relevant to the research objective, are presented below:

Challenge	Result
Technical skills	Lack of the required skills level for network infrastructure staff
Technology	Technology resource disparities delayed implementation
Network coordination ▪ Relationships	No cooperation between the Library and the ICT unit with the previous software vendor. This delayed phasing out of the old system.
Resource disparities ▪ Some institutions lacked adequate IT support skills and funding. ▪ Geographical distance	-Mergers of institutions with a big discrepancy in resources, required additional deployment of technical staff and training to bring disadvantaged institutions on board. -Implementation in the disadvantaged institutions took very long due to inadequate local network infrastructure and ICT skills levels available at the institutions.

Lessons

Gaelic demonstrates a successful collaboration using a proprietary system. Some lessons for the implementation network include:

- Maintaining good relationships with the ICT unit and previous software vendor is important, as well as high level of collaboration between participating institutions and parties.
- Conflict management is successful through policies that maintain institutional independence outside the core sharing attributes.

2.4.3 Case 2 Summary

Case 2 presents the study of an inter-university implementation setting to investigate how issues arising from problems of case 1 were handled in an empirical situation. The study involved three functionally varied cases of inter-university service system implementation. From this case, knowledge about requirements for supporting the implementation of different service applications was gained in the framework of organizational issues, the enabling technology and process management and technical skills. The summary of lessons drawn from CASE 2 shows some recurrent lessons from each case study and some new elements that can provide useful guidelines for implementation requirements. Recurrent themes from the service system implementation case are: user involvement in the design, competent project management and clearly defined roles and obligations regulated by formal contracts and agreements between clients and service providers in the network.

The objective of this case study was to investigate how challenges of volatility derived from Case1 can be handled in an inter-organizational network. The case framework focused on organizational coordination, technology and user requirements management in the implementation process by the networks. From this case, the following useful elements were derived:

- **Organizational issues**
  Owing to the business success of all the three consortia, inter-organizational collaborations for business system implementation was confirmed as a strategic and resource optimization practice for public institutions. There are tradeoffs in implementing shared resources especially between institutional autonomy and realization of business goals. It is important to adopt a design that best serves network and parallel operations. Communication and management of perceptions was also emphasized as important to the sustainability of the business network.

- **Enabling technology**
  Adequate bandwidth capacity is a critical prerequisite, which may require a separate consortium arrangement like TENET, to ensure network viability. The integration of legacy architectures from partner institutions is necessary to leverage existing system resources but it is a challenge even, with a reliable technology infrastructure. In this case open architecture was used to deploy the services across institutions.

- **Process and User performance management**
  The two implementation cases, underscore the importance of user involvement from the project inception stage to the implementation performance evaluation. Requirements management must be supported through out the implementation especially where there are big variations in institutional operational requirements.

2.5 Cross case analysis and conclusion

In this chapter we discussed two exploratory case studies to derive current and emerging issues, problems and implementation challenges that inform the requirements formulation process for inter-organizational networks in volatile setting. The case studies have highlighted potential areas, which must be supported to improve implementation practices in volatile contexts. The empirical research takes the research closer to defining these key requirements and suitable tools, techniques and methodologies to reduce complexity in implementation projects for volatile environments. A summary analysis extracts key issues for further investigation in the requirements definition stage. The case study insights for potential requirements and support elements of the approach include the following observations:

Network formation

- Ownership and commitment by members. Taking ownership by consortium members is critical, even when the project is initiated (championed) outside the institution. For each member institution, conception and analysis of the collaboration should never be confined to IT support staff.
- Minimum imposition of standards on organizational operations to accommodate all differences. Synchronizing the core system activities to meet the big discrepancies in capacity or requirements has proved difficult and led to failed consortia.
- A cultural fit where political agenda is of less importance should give a more successful network formula.
- An agency or independent operating/coordination body must be external to the universities. This should be lean to minimize overhead costs.
- Strategy should not be technology driven. Adding value through unique services by sharing implementation resources and products should be the goal.
- Clear and enforceable contractual relationships should not be ignored. Contracts will spell out pre-conditions of membership; rights and obligations; benefits and responsibilities.

Process management

- Requirements management is pivotal to reliability of the implemented service. Elicitation should include stakeholders outside the technical IT support.
- End users of the system and other stakeholders must be involved especially at the requirements elicitation stage and performance evaluation.
- Support for the process management must adopt methods and tools that incrementally provide a good understanding of user appreciation at all stages. The South African case study (Case2) shows the use of visual models, and prototypes to test the system.
- Project management techniques must include a business model that combats high maintenance. It is important to decide resource allocation; especially for skills, hardware, applications. Decisions on who will meet what costs and what skills will be required must be made at the start of the project. Contracts, agreements and service level agreements are necessary for performance evaluation.

Technology

- There is a need to leverage old investments of legacy systems by integration into the new service.
- Adequate bandwidth for current and projected client demands should be estimated for network scalability. Procurement strategies for affordable

bandwidth to access and deliver service in the network as well as sustaining growth of business requirements must be defined.

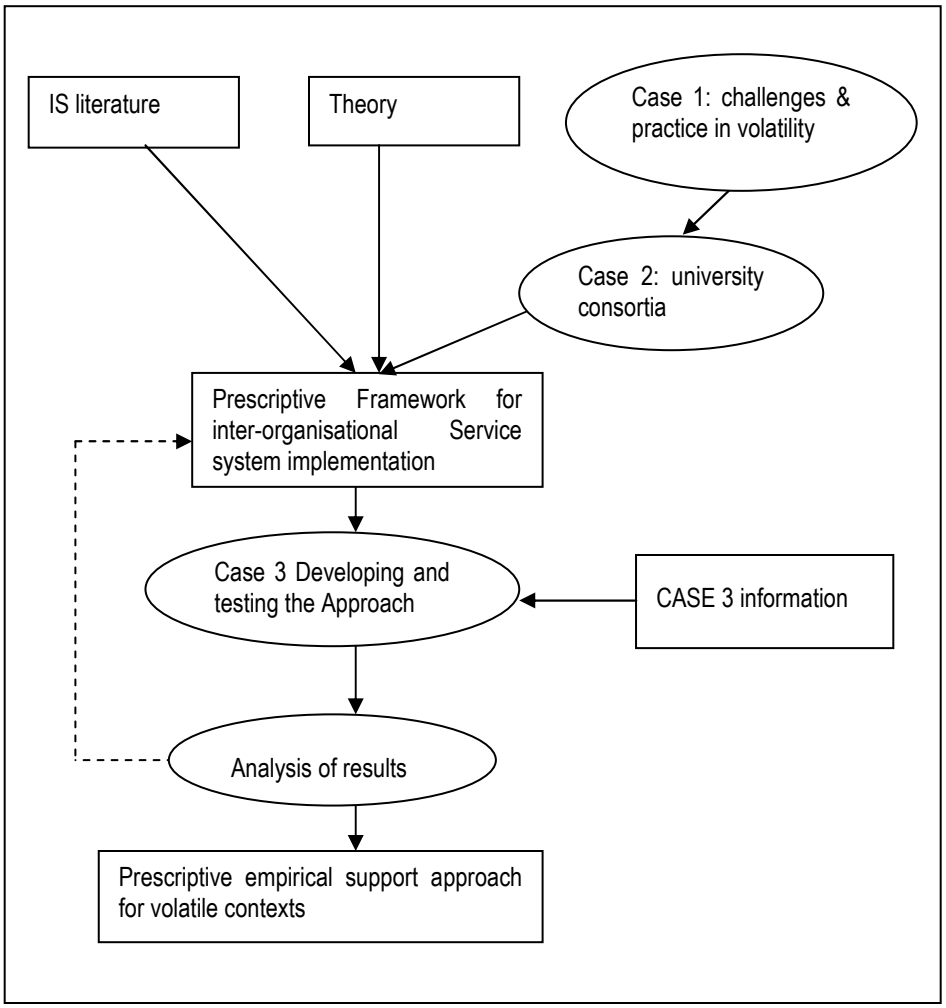
- Transparency in an inter-organizational network requires an open architecture that supports, parallel and inter- organizational operations.

The definition and development of an implementation approach to handle the above specific design issues in a volatile inter-organizational context, were investigated further from literature and modified with abstractions from empirical evidence in the next chapter. Further literature study aims at understanding how the organizational factors, enabling technology and process management factors above, can be supported in an inter-organizational implementation, to reduce complexity. Questions to guide further investigation from the literature review in chapter 3 are formulated, based on the three issue categories. From this empirical investigation the following questions are derived for further investigation, to inform possible mechanisms that can be used for service system implementation by emerging networks in volatile contexts.

- How can an inter-organisational network be created from independent organizations, with varied technical skills and technological infrastructure?
- How can a user –centred implementation process for a service system, be managed to elicit and monitor user requirements at all stages?
- How can we derive an inter-organizational technological infrastructure, to integrate varied systems resources and support a reliable service delivery?
- How technical skills for the implementation and support of technical projects, be developed and sustained?

  In the next chapter (3) an in depth literature investigation is conducted to answer the above questions.

Figure 2.5.2: Case study context in the research strategy

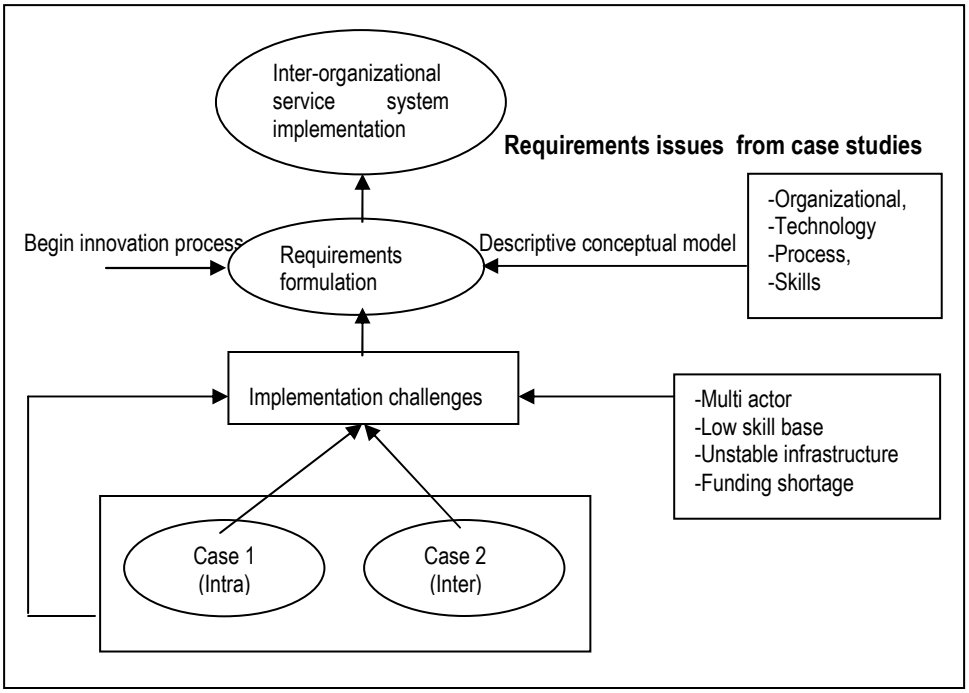


Chapter 3: Principles of inter-organizational service systems implementation

3.1 Introduction

In chapter 3 relevant concepts drawn from the literature and from the exploratory case studies are discussed, to derive new theories and inform the emerging support issues to improved inter-organizational service systems implementation in volatile contexts. To answer the questions raised at the end of the previous chapter, theoretical notions on implementation approaches relevant to IS development, implementation approaches, service systems and process management are applied to the case study observations, to investigate potential mechanisms that help us to understand what could improve the efficiency and reliability of service systems implementation for the emerging networks in volatile contexts. This abstraction from the analysis of the case observations, using theoretical notions was aimed at deriving the descriptive conceptual model. See figure 3.1.

Figure 3.1 Abstraction of context issues to derive requirements for inter-organisational service system implementation



Investigation of the theory relevant to the implementation approaches in the problem domain is aimed to derive potential mechanisms that can inform the formulation of requirements for the approach. Using the questions based on the framework for the exploratory case study at the end of chapter 2, four components to guide the theoretical investigation were derived.

(i) The network formation and coordination. The formation of inter-organisational networks for business collaborations is a necessary starting point. In this regard we study the motivating factors, support environment, activities and actors that can lead to the formation of a business IS service implementation network.

(ii) Next, system related development/implementation theories are analyzed in comparison to the case study observations to derive relevant support theories for systems implementation that can resolve deficiencies observed in the cases study and indicators for requirements of the volatile contexts. Such theories should focus on management of the user requirements, which was observed as a critical gap. The theories include systems engineering and information system development

(iii) Another question derived from the case study and posed at the end of chapter two asked how an inter-organizational technological infrastructure, to integrate varied systems resources and support a reliable service delivery can be derived. It is therefore important to analyse theories about service-oriented architectures to derive issues relevant to the enabling technology, design and implementation of services to understand how the challenges in the case study organisations could have been supported further to implement reliable services. This investigation is aimed at providing indicators for requirements of the volatile network to implement service systems.

(iv) Lastly, the question about inadequate technical skills should be handled to understand options for the development and sustainability of technical skills for the implementation and support of technical projects. This was observed as a recurrent deficiency in the case studies.

The relevant theory and objectives of this investigation is summarized in table 3.1.

Table 3.1 Relevant theory and objective of investigation

Theory	Objective- Derive theoretical concepts and develop new theories to formulate requirements for:
1.Organisational- -Network organizations	-Creation of the networks from independent organizations, with varied technical skills and technological infrastructure -Coordination of network activities
2. System development approaches -Systems engineering -IS development	-Appropriate systems engineering and IS development approaches.
3. Service systems -Service oriented architectures	-Service design and implementation -Enabling technology.
4. Technical skills development and sustainability	Theories and best practice for developing technical skills to implement and support projects.

3.2 Organizational forms

At the end of chapter 2, four pertinent questions to guide the theoretical investigation were suggested. The first one probed how an inter-organizational network of organizations with varied resource deficiencies and technology can be formed. This requires a literature review of network organizations. The network forms the foundation of the collaboration effort before the actual implementation begins. Accordingly, the theoretical analysis of network organizations formation, coordination and sustainability is conducted.

The Network Organization (Inter-organizational framework)

In this section the basic organizational forms, market, hierarchy and network are investigated, to find useful elements for identifying requirements for the approach to support the formation of the inter-organizational network.

Analysis of the three forms shows why the network is the preferred option for the research context.

- In market transactions, the benefits to be exchanged are clearly specified, no trust is required, and agreements are backed by the power of legal sanction. Communication means are prices. The degree of flexibility is high, commitment is low, climate is precision and /or suspicion and the actors are independent.

- In hierarchies, communication occurs in the form of an employment contract. Means of communication are routines. The degree of flexibility is low, commitment is medium to high, the climate is formal, bureaucratic and actors are dependant.
- Network forms of exchange entail indefinite, sequential transactions within the context of a general pattern of interaction. Sanctions are typically normative rather than legal. The means of communication are relational. The degree of flexibility medium, commitment is medium to high, climate is open-ended, mutual benefits and the actors are interdependent.

Networks have no high or low coordination and production costs, and are somewhere in the middle of hierarchies and markets. Coordination in a situation of interdependence can be achieved by standardization, by plan and by mutual adjustment (Thompson, 1967). Thompson argues that there are very real costs involved in coordination. Networks can be described by the characteristics of members. If a network is for instance limited to the core business of its members, then the scope is narrow. A network must also have defined membership limits. One such limit is the goal of the network, with network membership being established by each individual firm's contribution to the attainment of this goal (Jones et al, 1998).

A distinction of two networks relevant to this research is presented by Nooteboom and Gilsing (2004); networks of exploration and for exploitation. Exploitation aims at improvements with respect to established practice, while exploration entails development of new practices.

Table 3.2 Networks for exploration and exploitation (Nooteboom and Gilsing, 2004)

Network features	Exploration	Exploitation
Network structure:		
Density	High	Low
Stability	Limited	High
centrality	Low	Often high
Strength of ties:		
Scope	Wide	Narrow
Duration	Limited	Often long
Frequency of interaction	High	Low
Control	High	High
Trust/openness	High	Generally low

In conclusion, the suitability of the network organization for the inter-organizational collaboration as observed from the consortia case study in volatile contexts is supported by theory as the best option for business collaboration. Powell (1990) states that, networks and network organisations have emerged as an organisational form to overcome the problems with hierarchies and to create greater structural effectiveness and responsiveness with business partners. The following factors about networks, which are useful for the formulation of requirements for a volatile context were extracted.

- **The non commercial context** - As observed from the empirical study, inter-organisational networks can be non-commercial like the non profit public organizations in this research, but they are motivated by learning and gaining strategic relevance (Sydow and Windeler, 1988; Wierda,1991; Van de Kar, 2005).
- **Embedded relational ties** - The effects of embedded relationships and social ties are well known for influencing choice of partners (Granovetter, 1985; Uzzi, 1996). It is concluded that the way to reduce uncertainty when creating a business network, is to collaborate with organizations where there are existing good relationships. This observation again follows the case study findings where the consortia was formed based on prior relational ties in culture and business domain.
- **Networks interdependencies** - In a network, organizations are interdependent not dependent. Network formation, is driven by internal and external factors. Maitland et al, 2003a; reference to Hite and Hesterly, 2001 and Gulati, Nohria et al, 2000) argue that this is related to trends in organizational forms and economic change. In particular, high environmental uncertainty, changes in transaction atmosphere like technological progress, lack of capital and knowledge, which may lead firms to seek partners (Wigand et al 1997). These forces lead to interdependencies, a key driver of network formation (Gulati and Garguilo, 1999). This is a parallel with emerging networks in the case study which are initiated due to interdependencies from technology and technical skills.
- **Specific roles and actors -** A variety of business models, role divisions, revenue models and different benefits of being part of the network for each actor have been expounded in the literature Maitland et al (2003). The formal specification of roles is an essential element that was non existent in the Unitrust consortia and led to the eventual break up.
- **Flexibility** -The network organization offers the flexibility of interaction at the parallel and distributed level. This is important for institutional entities to continue with their autonomy and shared business opportunity in parallel. Retaining institutional autonomy while participating in the network collaboration was pointed out as a concern for the Gaelic case study. This indicates a need for requirements that balance parallel and distributed benefits and contribution.

- **Membership limitation related to goals** - This theory enforces what was observed in the case study that network membership should be limited by similarity of goals. Using this approach, a service network will be limited to those firms actively involved in the implementation of the inter-organizational business information system and eventual provision of services.
- **Exploration and exploitation phases -** The two phases prescribed for networks are very applicable to an implementation project, but they were not observed in the case study. There was no distinct period of learning and feedback and as a result the correct formal commitment to distinguish the phases or incentives to nurture trust. This distinction is useful categorization for defining boundary requirements and features of networks in volatile contexts. Secondly, the distinction also provides a basis for the initial definition of relevant support for the management of the implementation challenges confirmed in chapter 2. Exploration is ideal for iterative learning and feedback in a relatively new experience of inter-organizational implementation. Based on the features of exploitation presented under trust and openness, it is imperative to support incentives for growing levels of trust and openness. This is a prerequisite for sustained growth of business collaborations.

Inter-organizational characteristics

The inter-organisational characteristics in the consortia case study were analysed based on three relevant theories for the formation of inter-organizational business forms.

The competitive advantage approach

It was observed from the consortia case study that competitive advantage and strategic relevance were the motivation for network formation. This is supported by competitive advantage theories, which noted that, competitive implications, both commercial and political, that are associated with the implementation of inter-organizational information systems have stimulated a renewed interest in inter-organizational networks. The competitive advantage approach has been investigated and practiced by IS practitioners and managers and articulated by many authors (Porter, 1985; Parsons, 1983; McFarlan, 1984). All theorists agree that while the competitive advantage is intangible it continues to motivate inter-organizational business collaborations.

Development theory

Related to the competitive advantage theory is the development theory which investigates the validity of competitive advantage as the basis for forming inter-organizational networks. IS researchers in the early nineties were asking the same question about the lack of a validated theoretical framework or structure for applying competitive advantage tools. As Benjamin et al (1990) noted, the

reality of developing and maintaining electronic linkages between companies is 'not as easy or as profitable as the inter-organisational information systems (IIS) advocates, would lead us to believe.' A parallel from the case study observations would agree with this view because the benefits from the IS consortia to the member institutions were intangible but apparent.

The sociological approach

Literature in the field of sociology of organizations cooperation has for a long time informed investigations in organizational theory. Warren, (1967) characterizes inter-organizational networks as a form of an inclusive decision making structure with four types of structures:

(i) The unitary context: Member organizations are deliberately organized for the achievement of inclusive goals. Decision, making takes place at the top of the integrated structure

(ii) Federative context: Organizations have their individual goals, but there is a formal organization for the accomplishment of inclusive goals. Decision making is by a specific part of the inclusive structure but subject to ratification by the units.

(iii) Coalition context: organizations cooperate more or less closely to attain desired objective. Each organization has its own goals but collaborates informally. There is no formal organization for inclusive decision making. The coalition has no authority.

(iv) Social–choice context: Organizations retain an autonomous behaviour, but they relate and come together on particular issues that concern all of them. They do not necessarily share inclusive goals.

From the above contexts, we observe that case study 2 of the South African university consortia presented a variation of the decision structures for the implementation of inter-organizational business networks. The case study of three different types of consortia was characterised by the federative and coalition contexts. However, the loose collaboration arrangement without formal structures in the coalition context was not sustainable for the network goals, as seen from the break up of the *Unitrust* network. The context types above, presented the research with different types of decision structures and strategies which can be investigated for suitability to accomplish particular network business goals. Drawing lessons from the empirical parallels, we can conclude that network organisations need to adopt a formal coordination structure.

In conclusion, requirement formulation for network creation and sustainability in volatile contexts should reinforce these positive qualities and cater for critical elements that are considered as essential from the theory but, missing from the empirical study. These include the distinction of network phases, formalisation of roles, appropriate governance models and structure as well as a flexibility that balances parallel and distributed goals and values.

The network and inter-organisational theories have reinforced the growing trend of inter-organizational networks observed in the consortia case study. The competitive advantage for IT collaborations may still be intangible but, it is motivated by strategic relevance as evidenced by the emerging networks in developing economies. Practitioners provided empirical evidence in case 2, which confirmed the growing IT interdependence of public organizations. The study presented empirical evidence of university consortia that reduced institutional development/support and maintenance costs through joint system development of administrative business systems. Based on this analytical abstraction, it is concluded that while a prescribed validated framework maybe inadequate for all contexts, business networks add value and public organisational networks in volatile contexts have taken the correct option for learning and regaining competitive advantage. This further reinforces the research objective for developing and validating a support framework for implementing inter-organizational business in this new context.

Process management theories

Analysing Process Management theories is relevant to the understanding of network coordination challenges and issues observed from the consortia case study. In the Unitrust case, perceptions were never managed and there were no formal agreements or contracts to initiate the business collaboration. Loose benchmarks were used to evaluate performance and users did not participate in the evaluation. All these factors contributed to the break up of the network and should be analyse using the relevant theory to be able to specify requirements.

Project management is one of the most basic forms of management used to control projects. In project management it is assumed that problems and solutions are reasonably stable within certain limits and the management techniques like clear goals and targets, time schedule, a clear framework and prefixed end product can be used. Project management techniques for a stable environment would therefore not be appropriate to manage the implementation a complex dynamic project of a relatively new service by a multi actor network. De Bruijn (2002) et al argues that this only works in a static world and that this approach is impossible for dynamic activities; “there will be dynamic activities particularly when decisions have to be taken in a network. The various parties hold different views about how a problem and a solution should be defined. As a result, the decision making will always be capricious and unstructured.”

Process management techniques are important to coordinate and guide the implementation process. The design requirements advocated by the literature include openness, integrity, protection of core interests and core values of parties, incentives for sustaining collaboration, and process type arrangements to facilitate sufficient content. The empirical case studies in chapter 2 illustrated the need to manage perceptions, relationships among partners and providers and formal means of commitment like agreements, meetings and negotiations. The

process architect has to design the process that results from negotiations and with the involved stakeholders. The core elements of process design for the proposed network are i) openness ii) protection of institutional core values iii) sustainability iv) substance.

3.3 System development approaches (IS methodologies)

At the end of chapter two, another question was raised about how a user–centred implementation can be achieved because this was observed as critical gap in the implementation approaches used in the empirical study. The investigation of systems development approaches is critical to the abstraction of comparisons of approaches used in the empirical case studies and, what options from the literature could have derived better results. By understanding the gaps in the implementation process in the case study environment and analysing the available options presented from the literature, we can get indications of the relevant requirements for a new methodology to improve implementation of service systems in volatile networks. For this abstraction we use Systems' thinking to define the perspective of various system development approaches of which implementation is a core sub set. In this section, concepts of systems engineering and information systems development, which are essential for systems implementation in the network organisation are discussed.

System Engineering

Sol (1982) defines a system as a whole of objects one would like to recognise in a certain problem area under study, during a certain period of time. Another definition of system is a group of components that work together for a specific purpose (Sage and Armstrong, 2000). This research is intended to develop guidelines for combining organisations with varied resource deficiencies, technology infrastructure and system components to effectively deliver services to users in an inter-organisational setting. Engineering can be defined as designing solutions for actual and practical problems. All the definitions of system engineering consist of a formulation, analysis and interpretation effort. Therefore systems engineering can be seen as a management technology that includes knowledge perspectives, knowledge principals and knowledge practices (Sage Armstrong, 2000; Checkland, 1999; Nadler, 1995; Jackson, 1991). Knowledge perspective represents the present reality and future knowledge principals represent the problem solving approach; and knowledge practices represent the standard operating policies based on accumulated wisdom and experiences.

As a starting point, Sage and Armstrong (2000) present ten critical issues that must be considered in order to manage the implementation of large systems like the implementation projects of inter-organisational networks, proposed by this research. From the list in the table below, we evaluate how the two cases

performed in the consideration of the 10 critical points and extract the relevant but missed components to enable identification of gaps for which requirements should be formulated.

Table 3.3 Points to consider for large scale implementation projects (Sage and Armstrong, 2000)

Issue	Case1	Case 2
1.Many Considerations and interrelations.	Intra- multi –actor values and relations	Distributed and parallel values and relations. Relations not formalised
2. Many different and controversial value judgements	Not considered	Considered but not managed
3. Knowledge from several disciplines	Inadequate experience & knowledge	Knowledge was technology focused
4. Knowledge at the levels of principals, practice and perspectives	Knowledge on principals Inadequate practical implementation skills	No project management experience, Perspectives not managed IS development expertise not level
5. Considerations involving product definition, development and deployment	Low experience	Joint Application Development (JAD)
6.Consideration that cut across the three different life cycles associated with systems planning and marketing, RDT&E and system acquisition or production	Poor planning. Little knowledge about acquisition and disposal. No bench marks, no User contracts SLA's	Knowledge about cycles not integrated in project. User M&E based on loose bench marks
7. Risks and uncertainties involving future events that are difficult to predict	Skills and technology but not evaluated.	Risks were perceived as finance, project complexity, and skills. No risk analysis done
8.Fragmented decision making structures	Not relevant	Inter-organisational
9. Human and organisational needs perspectives and value perspectives as well as technology perspectives	No user requirements elicitation. Project is technology focused Project goal technology oriented	It directors perceived as end users. Project focused on technology. Clear goals but different practice
10.Resolution of issues at the level of institutions and values as well as the level of symptoms	No change management procedures	No formal ways for conflict management Perceptions were not managed

From the table above it is concluded that implementation requirements should be formulated to manage network partner relationships and activities in the project. This includes issues 1, 2 and 7. Secondly there is a need for knowledge and experience 3, 4, 5, and 6. The third aspect to consider for requirement formulation is the balance between human and organisational needs visa avis technology, issues 9 and 10.

Information system development

The question raised at the end of chapter two about how a user–centred implementation can be achieved, is focused on development approaches. The abstraction for development approaches is focused on the lack of/ low user involvement in the implementation process, observed in the case study environment. This critical implementation gap is analysed based on the available options presented from the literature. The derived descriptive conceptual model is aimed at providing indications of the relevant requirements for a new methodology to improve implementation of service systems in volatile networks.

Information systems development was discussed briefly in chapter 1 with an overview of methods, approaches and the methodologies. It was proposed that implementation should be studied in conjunction with preceding stages of the system development cycle, which define the requirements and design of the system that is finally transformed into an operating reality. Using this perspective, the activities recommended for the implementation approach must be determined from this development process view, combined with elements of the network preparation. The question about implementation that uses development approaches which can support user–centred approaches indicates that the theory review should focus on the two basic development attributes that include iteration and structure, to address the gap observed in the volatile context.

The waterfall model

The waterfall life cycle was briefly described in chapter one as a series of incremental steps where output of the previous stage forms input for the next. The deliverables cascade downwards like a waterfall with a completed software at the bottom. The waterfall model originates in the seventies and it is fundamental to decomposing implementation projects into manageable stages (Cadle and Yeates, 2001). It was observed especially in case1, that a rigid waterfall version was applied in the implementation project of ARIS, and in other cases there was no structure at all. The orderly and stepwise refinement of a complex problem into smaller problems is a desirable attribute to reducing complexity. However, it has been criticized as being suitable for designed artefacts like computer chips but, less appropriate for human activity systems

where the human and organizational factors are less easy to define (Vidgen et al, 2002). Since this research quest includes formulating a user-centred implementation process, it is essential to modify this stepwise approach with development theories that support user participation, learning and feedback in all implementation activities (Booch, 1999).

The User centred approach

The lack of a user–centered approach in IS implementation has already been noted as responsible for unreliable services leading to underutilized or unutilized systems in the exploratory case study. Reliability is a core attribute of service quality and it stems from a constant monitoring and revision of an evolving system to deliver user value. It is therefore critical to correct functioning of services and a successful implementation Parasuraman et al, 1985, 1988, 1991; Liljander et al, 2002). As Tetard (2005) noted, a key enabler for successful services in the future is the move from a technology–centric world, where technology develops almost independently, to a user centric world, where the development and use of technology originate from user needs. Literature on creativity and improvisation indicates that user- centered implementation can be supported by a variety of other contextual elements and techniques. One such element that is relevant to this research is participative approaches to implementation using techniques involving group working and end-user involvement (Cooper, 2000). These techniques seek to bridge the contextual gap between design and use. Caution to balance participation must be observed because Participative approaches have been criticized as being to laborious and leading to delays due to extensive and constant consultation with user groups. This observation necessitates an investigation of evolutionary approaches.

Evolutionary approaches

From the empirical abstractions based on the theoretical analysis above, we note that, for the investigation of suitable IS development theories for the research problem, no single methodology can suffice. In situations where the requirements are not well formed or understood by users, where it is difficult to specify requirements, or where it is difficult to determine how a proposed solution will perform in practice, like the problem domain, an evolutionary approach is useful (Vidgen et al, 2002; MacManus and Wood-Harper, 2003). “An evolutionary design approach consists of expanding increments of an operational product with the direction of evolution being determined by operational experience...the disadvantage of this approach is to distinguish it from the old code- and –fix model, whose spaghetti code and lack of planning were the initial motivation for the waterfall model” (Boehm, 1988). The addition of iteration to the stepwise structure of the waterfall can use the spiral model.

The waterfall and the spiral model (Cadle and Yeates, 2001), are two basic development models for information systems which can provide potential requirements for structure and iteration for user feed back and learning. The iteration in the evolutionary approach can be adopted in combination with a stepwise implementation of the waterfall model. The combination is aimed at giving a structured and incremental approach to the implementation process. The question of adopting a user- centred implementation process also indicates a learning and feedback process to understand and incorporate evolving user needs (Booch, 1999). User learning and feedback requires learning aids in the form of models to be included in the implementation process. In addition effective use of service systems are highly dependent on the user system interface. Methods like prototyping, that enable user appreciation and support incorporation of accurate evolving needs, present useful elements for the research objective.

Prototyping methods

Prototyping is appropriate for data oriented applications, applications with emphasis on user interface and which are highly interactive (Wood-Harper 2003). Methods include the Rapid application development (RAD), joint application development (JAD) and dynamic systems development method (DSDM). Cadle and Yeates (2001) observe that prototyping approaches are becoming increasingly popular. This is driven by commercial pressure to achieve competitive advantage by developing systems fast .The methods take into account management issues and design issues related to the user. Management issues are conditions on the environment, staff empowerment and fit for business purpose. Desirable elements for implementing a user centred system are:

- Testing is seen as being an integral part of the iterative cycle
- Products are delivered frequently rather than as a perfect end product
- Iterative and incremental development is an integral part of the approach
- Users must be actively involved

These attributes make prototyping an appropriate option for implementing a service-oriented system in a multi user environment.

Rational unified process (RUP) - RUP is another approach that underscores the relevance of iterative and incremental development and user involvement, elements which are useful for this research. The process builds on six commercial best practices:

- develop software iteratively,
- manage requirements,
- use component based architectures,
- visually model software,
- verify software quality,
- control changes to software

to deliver a software development process focused on ensuring the production of quality systems in a repeatable and predictable way (Booch,1999).
The high maintenance due to lack of resilience of current monolithic architectures in the research domain, is another contributing factor to complexity in the implementation process. In addition this is an environment with resource scarcity that needs to leverage existing investments in technology by opening them up to user, clients and third parties (Arsanjani, 2005). Low maintenance strategies for easy adaptation of systems to changing user requirements, is another critical requirement. In this regard component based development (CBD) presents some useful elements to consider for the requirements of approach.
From the analysis of empirical observations based on the development theories investigation, we concluded that this relatively new implementation strategy needs development requirements that are aimed at correct user requirements elicitation and management, with user involvement at all stages. In situations like the new networks in volatile contexts, where business requirements are not well understood, and where business processes are unstructured, a different approach that supports user learning, iteration and incremental but orderly development will be needed (MacManus and Wood-Harper, 2003).

Conclusion
An overview of the useful elements for the development aspects of the approach is extracted from the development theories in the table below:

Development Theory	elements	objective
Waterfall model	Orderly and stepwise refinement of complex problem into smaller problems	Determine appropriate stages of development for reducing complexity.
Evolutionary approach	Suitable in situations where the requirements are not well formed or understood, difficult to specify, or where it is difficult to determine performance of proposed solution in practice.	Iterative development involving user feed back.
Prototyping	▪ Testing is seen as being an integral part of the iterative cycle ▪ Products are delivered frequently rather than as a perfect end product ▪ Iterative and incremental development is an integral part of the approach ▪ Users must be actively involved.	-Enable user appreciation and feedback for incorporation of accurate evolving needs. -Suitable for data oriented applications, applications with emphasis on user interface.
Rational unified	six commercial best practices:	-Software development process focused

process (RUP)	▪ Develop software iteratively ▪ Manage requirements ▪ Use component based architectures ▪ Visually model software ▪ Verify software quality ▪ Control changes to software ▪	on ensuring the production of quality systems in a repeatable and predictable way (Booch, 1999).
Component based development (CBD)	-Selection, reconfiguration, adaptation, assembling and deployment of, replaceable, interoperable system elements enables: -Parallel and distributed development -Legacy integration -Technology independence..	-Reduce development and Maintenance costs -Increase productivity -Increased scalability

3.4 Services and service systems

In this section service systems are analyzed to understand their characteristics, implementation requirements, and limitations for inter-organizational business networks in volatile contexts. In the consortia case study, service delivery was synchronised using the remotely strategy (Arsanjani, 2005). This flexibility enabled access to member catalogues *Gaelic* and for the *Unitrust* case, it provided for both distributed development and use of new software. It was observed that this strategy was convenient for the participating organisations but it was a bandwidth intensive option. To provide enough bandwidth the network organisations were all members of the bandwidth procurement consortia; TENET.

Service systems framework

The service framework presented in chapter1 section 1.3.1 is explained in detail to derive emerging issues for the service implementation in the volatile context. The service system represents an amalgamation of 4 interdependent aspects:

- Service concept (business model) itself, which is the proposed strategy within which a service would create value for its customers.
- An appropriate organizational architecture should be in place to support the distributed service production from an inter-organizational perspective. The organizational architecture provides coordination between resources, such as people and other resources.
- Technical architecture structures the software, hardware and net ware that enable service delivery.
- Operational processes are the activities and their interdependencies that directly contribute to the design and implementation of a service. The operational process design includes the user interface of the service. User acceptance of the service is mainly dependant on how and with which

quality the service is delivered to the user through the user interface. Operational processes are supported by the organizational and technical architecture and deliver the service according to the service concept that has been chosen (Van de Kar et al 2005).

It is important to understand the four aspects of the service framework and the dynamics between them, in order to devise requirements for the volatile network with the same parallels. The four aspects have interdependent roles in the service development and implementation and therefore have varied dominance in affecting service delivery. This determines the trade offs between the four aspects that network organizations will have to consider and manage in order to successfully implement service in line with the user-value. The technical and inter-organizational architecture will both determine the service concept that can or cannot be realized in respect of the implementing organizations and the limitations of the technical architecture that is available for the service delivery. The organizational and technical architecture dominate the actual service delivery using the operational processes. Figure 3.4 shows the distinguished aspects of a service system and their interdependencies.

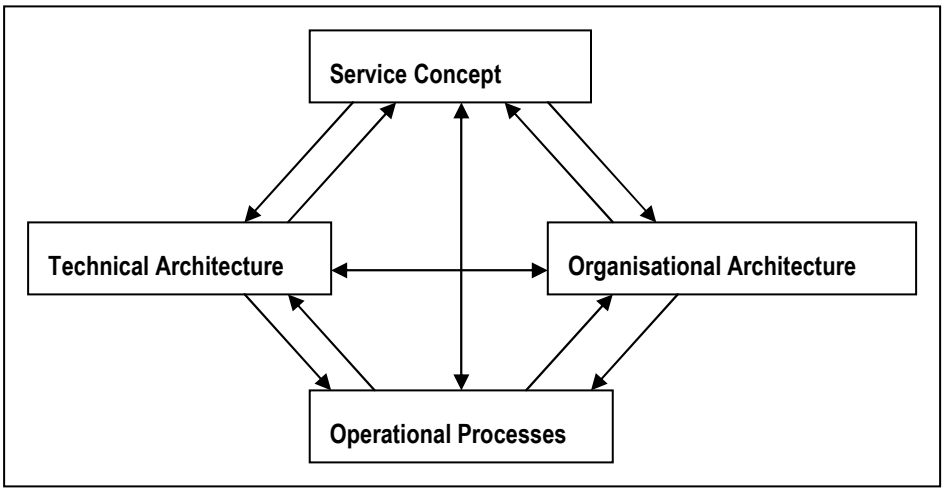
Service oriented architecture (SOA)

A desirable attribute of the service oriented architecture, is the utilization of an organization's existing assets and applications as services to integrate business processes and supporting business needs. The service operates using a three tier architecture:

- Presentation layer or client tier ('netware'): client is mainly used for display with some limited logic for checking the consistency of data entered.
- Application layer or middle tier (software) typically includes application logic and the business rules.
- Data layer or persistency tier: included the databases and processes large volumes of data.

The suitability of service –oriented systems to overcome the high maintenance associated with existing monolithic implementations has been justified by the SOA flexibility of using building blocks from the web "An a la carte collection of business utilities in the e-service format can obviate the need for monolithic enterprise systems and the subsequent extensive internal infrastructure development they require. The modularity of service of a SOA, complimentary use of existing assets of an organization, possibility of outsourcing service components from the web are key benefits for the implementation in volatility. The low bandwidth capacity as observed from the case study institutions means that the adoption of SOA maybe an ideal candidate but it has barriers to realisation in terms of low bandwidth latencies and low technical skill base. This is a key requirement consideration for service development and delivery for networks in volatile contexts.

Figure 3.4: Aspects of a service system. (Verbraeck and Van de Kar, 2005)



The technical architecture of a service system is composed of the software, hardware and net ware that enable a service to be delivered. The need for flexibility in creating the value network puts a huge demand on the technical systems. Applications and processes for service provisioning should be created using a pool of existing and new components and web-services. Openness of standards used for this, is key to the ability to link various services. However before the design process begins, complexity must be reduced and specifications made explicit. Technical resource interdependencies are defined by the service requirements because existing technology does not answer customers' demands, for a useful and easy to use service.

3.5 Technical skills for implementation and support of IT projects

Another pertinent question at the end of chapter 2 that emerged from the case study findings was how to optimise the critical technical skills resource shortage, for the implementation and support of ICT development projects. A precedent for the development that is useful for organizations with resource scarcity was drawn from the *Unitrust* case study from South Africa. The study showed that development of expert skill pool and resource centre started with the project champions who were better equipped in both technical human resource and IT equipment. This resource nucleus incorporated technical people from other institutions and shared best practice expertise.

Resource centres

Resource centres should evolve to incorporate the following:

- Online and Offline help facility
- Research resources like publications and information source sheets to guide users to relevant publications on a series of relevant topics
- Training for systems analysts, developers and designers, network administration, database management and other first line and end support skills.
- ICT technical computer based training packages with workbooks and manuals that are self paced and easy to use.
- Tools and shareware that enable people to perform various tasks online.(ICT resource, 2005)

In addition to resource facilities and equipment a technical expert skill pool to support IS development should include multi skilled developers, programmers, network experts, content providers, designers, policy and IT support. A cross cutting research component must be incorporated for sustainability. Nurturing of an institutional software incubator is a useful element for research and education institutions to build in house capacity and partner with industry for the development of innovative software solutions (Makerere IDRC software incubator project, 2005).

Development of local capacities

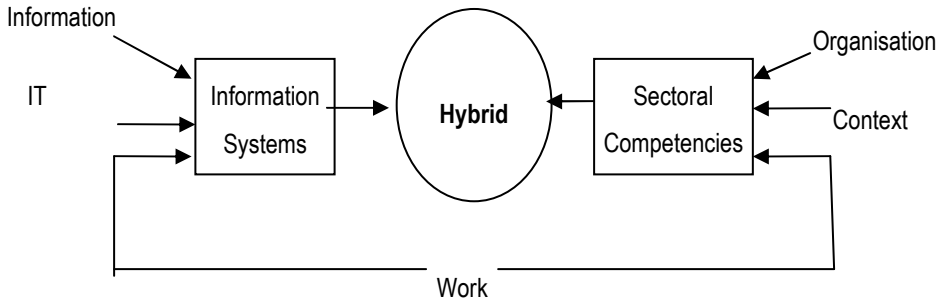
An important factor for developing economies who normally import their technology is to develop local capacities for local IT improvisations. Free and open source soft ware (FOSS), has been proposed as the option for organizations with resource scarcity to foster local capacity building. There is a growing wave of enthusiasm based on successes in other developing countries. There is an opportunity to capitalize on this enthusiasm, but first, serious hurdles must be overcome to translate the hype surrounding FOSS into tangible benefits. Above all they need to support communities of software developers who have the means and interest to develop and maintain locally relevant applications (Bridges.org, 2005).

Hybrid skills for improvisation

Technology and design factors may allow for local improvisation, but the ability of implementers in developing economies to enact such improvisations depends partly on local capacities. A wide range of such local capacities is required, but there is a central requirement for *hybrids* (Earl 1989). Hybrids understand both organisational context and work processes of their sector *and* the role of information systems. As such, they can bridge the contexts and assumptions of both technical designer and business-oriented user. They can therefore play a key role in the improvisation of both design and actuality, and help to improve

success rates. (See figure 3.6). To date, schemes to develop hybrids in developing countries and, hence, DC hybrids themselves have been virtually non-existent, thus hampering improvisation (Mundy et al 2001).

Figure 3. 6: The Competencies of Hybrids



Conclusion

In conclusion the theory reviewed in this chapter has provided answers to the questions raised at the end of chapter 2. We have analyzed the case study observations for the exploratory case studies through a theoretical investigation on how the deficiencies observed could be resolved. This analytical abstraction provided the descriptive conceptual model that gives indications on what the requirements formulation issues should be. We investigated IS development theories and approaches to understand how a user centered implementation can be realized to support that critical gap in reliable implementation processes and systems in volatile contexts. Network formation and coordination was also investigated to derive requirement issues for, and answer the question of how an inter-organizational network can be created from independent organizations, with varied technical skills and technological infrastructure. The analysis of case study observations regarding service development and delivery theories was important to derive new theories that can be used to develop requirements to support the implementation of inter-organizational service systems in volatile contexts. In addition best practice and theory about development and sustainability of technical skills to overcome the shortage observed in the empirical study were also investigated. From this analytical abstraction, a descriptive conceptual model has emerged with useful elements from which specific requirements can be specified to develop a support framework for inter-organizational service systems implementation in volatile contexts. The specification of requirements for the approach follows in the next chapter (4).

Chapter 4: Supporting inter-organizational implementation in volatile environments

4.0 Introduction

In this chapter the conceptual model of the implementation approach for inter-organizational service systems in volatile contexts is prescribed. The approach consists of a development methodology, supported by software engineering, business systems collaboration approaches, process management guidelines, tools and techniques. This chapter begins the innovation mode by reflecting on the previous chapters where the problem was initiated and analyzed, to specify requirements for the approach. In chapter 3 we derived a descriptive conceptual model by abstracting issues from the observations in the exploratory case study based on the relevant theory. This was aimed at extracting issues that can guide the specification of requirements for the problem domain. The emerging implementation issues for networks in volatile contexts, showed a need for support requirements in the following areas:

- Information systems development approaches that would focus on user requirements
- Network formation and coordination
- Robust technology infrastructure that integrates diverse technology resources to deliver reliable services
- Technical skills to implement and support projects

First, the requirements for the approach are formulated using the abstractions from the issues in the exploratory case study. Next, the details of the approach are outlined and discussed using the 'ways of' framework, discussed in section 4.2.1. Lastly, the reflections on the requirements formulation and the prescription of the approach are presented.

4.1 Requirements of the implementation approach

Now that the main issues and concepts of inter-organizational services system implementation have been identified, the third research question presented in chapter 1 is addressed: *How can we support the process of improving inter-organizational service system implementation in volatile environments?*
In this section, requirements are formulated for key issues generated by the combined complexity of implementation challenges from the inductive case study and abstractions derived from the theoretical analysis of case observations in chapter 3.

The emerging theories guided by the observations from chapter 2, provided useful elements to form the basis for specifying requirements and developing new theories for the implementation approaches of service systems in volatile contexts. From the literature we conclude that implementing service-systems can be seen as transforming a system design that consists of technology, actors (providers and users) and a service formula, into an operational system that provides value to the user. T*he waterfall model* combined with *the Spiral model* (as introduced by Boehm, 1988) presented an ideal basis for IS development with structure and iteration, prototyping approaches provided the essential elements of a user-centred approach by supporting interface and data oriented projects. This is ideal to elicit iterative user feedback and manage evolving requirements. In addition process management theories were useful to inform the elements that coordinate network creation and sustainability, the development of process support and criteria for validation of out puts.

The verb, require comes from the Latin word *requirere* which means 'to seek for'. A requirement embodies the idea of a search by someone for a specific purpose answering the questions; who needs what, why do they need it. For implementation in the volatile context, answers to these questions are established in this chapter.

The theoretical basis of the five requirements is derived from the work of Keen and Sol (2006) which states that effective support is based on the 3 U's; *Usefulness, Usability and Usage*. The usefulness of a support framework addresses the value it adds to the decision making process. Davis (1989), in his technology acceptance model (TAM) describes usefulness as a fundamental determinant for the acceptance of an information technology. *Usability* deals with the mesh between people, processes and technologies, while the usage dimension deals with how the support environment is embedded in the decision process.
For each requirement, the implementation issues derived from the exploratory case study is stated, followed by an explanation for the basis of the requirement, then the derived requirement for the approach is presented as follows:

Issue 1: The complexity of the multi actor inter-organisational

Network coordination
The implementation of inter-organisational service systems involves diverse stakeholders brought together by mutual interdependencies. The actors must coordinate their complex activities effectively to sustain the collaboration. Networks and network organisations have emerged as an organizational form to overcome the problems with hierarchies and to create greater structural effectiveness and responsiveness with business partners (Powell, 1990). The emerging business networks in the case study showed characteristic interdependencies of technology, technical skills and complexity of the network

coordination. It was evident from the findings, that the bureaucratic decision making and communication structures, observed for the volatile context would not be amenable to network collaboration. De Bruijn confirms that the activities in the network are dynamic. "As a result, the decision making will always be capricious and unstructured." In these networks, actors and their values, language and argumentation are important in a process management approach. (De Bruijn et al, 2002). This is the basis for requirement 1.

Req # 1: *The Approach should provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.*

Issue 2: The unreliable technology infrastructure in the emerging networks

Case 1 (implementation practice and challenges in Sub-Saharan universities), showed that in volatile environments, system reliability is critically compromised by the unreliable technology infrastructure. External factors causing the unreliable infrastructure include the erratic electricity supply and poor telecom infrastructure. Internal factors like varied incompatible, legacy, proprietary, outsourced applications and platforms, monolithic structures, as well as inadequate, bandwidth and latencies contribute to this complexity. Reliability is one of the core service quality dimensions (Parasuraman et al, 1985, 1988, 1991). Therefore, a reliable technology infrastructure is critical to support the correct technical functioning of services (Liljander et al, 2002). In addition the case also showed that technology was a core interdependency for the network, because it is a high cost investment. This indicates that, trade-offs between the service formula and technology, technology and financial interdependencies must be considered in a multi–actor network. This is translated into requirement 2.

Req # 2: *The Approach should assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.*

Issue 3: Technical skills shortage

From the exploratory case study, it was revealed that organisations in volatile environments lacked the relevant technical skills to implement and support technical projects. The shortage of expert skill was a critical recurrent challenge to implementation, in all the three universities studied. Evidence showed that the technical skills inadequacy, contributed highly to the implementation project failures. This was supported by the Working Group of Experts who identified a number of common obstacles to the utilization of ICTs in the selected public organisations, (IDRC-Guidelines for institutional maturity report, 2000) and

literature sources (Walsham, 20000; Roche and Blaine, 1996; Heeks, 2001; Mundy, 2001; Odedra and Kluzer, 1988). This was the basis for requirement 3.

Req # 3: *The approach should enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources, to optimize the low technical skill base for implementation and support of ICT development projects.*

Issue 4: Deficient requirements analysis process

User centric development

The consortia case study findings showed unreliable systems where user involvement in specification and performance evaluation was negligible or nonexistent. In addition, the institutions in case1 had no structured implementation process, leading to underutilised or unutilised systems. Booch (1999), in his rational unified process (RUP) emphasises requirements management, to monitor user appreciation from system inception to realisation, as the key to implementation success. Other researchers in the IS field concur with this observation (Vidgen et al, 2002; MacManus and Wood-Harper, 2003). Accordingly this issue is translated into the following requirement.

Req # 4: *The approach should provide systems developers with means for conducting a user–centred implementation within a controlled process that tracks changing user appreciation and provides feedback.*

Issue 5: Complexity of integrating varied legacy components and available system resources

The integration of relevant elements for system development, presents considerable complexity due to the diversity of the existing systems components. The exploratory case study revealed that organisations in emerging networks have independently evolved IT system mainly over the past 15 years, combining legacy assets, third party software packages, limited outsourced applications and newly built functionality, with all these parts possibly running on different but meagre computing resources. Due to their complex and often monolithic structure, these IS are difficult to test and upgrade. This has led to high maintenance and low scalability of systems. For organizations that work with resource scarcity, there is a need to integrate useful elements from existing system resources into the new service. In this situation, the development of a service application, dictates techniques that reduces complexity and strategies that integrate existing legacy systems and open up systems for business partners, and third parties. Accordingly requirement 5 is formulated as follows:

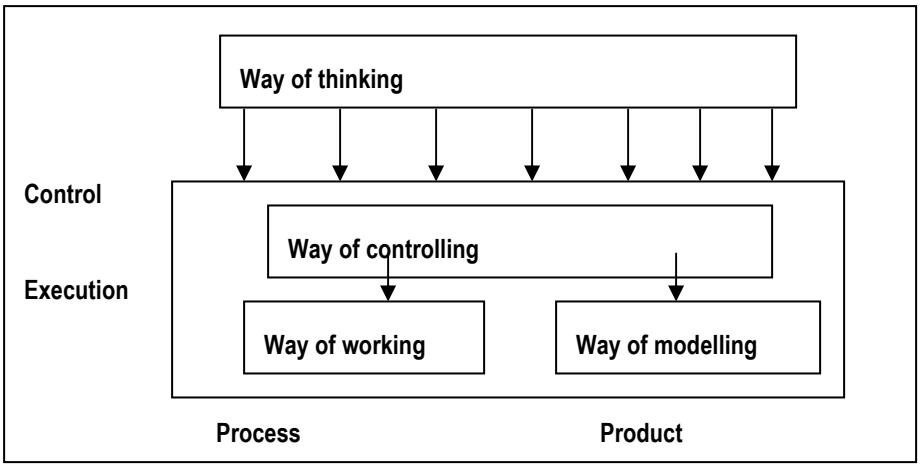
Req # 5: *The approach should assist the system developers to select and integrate available system and technology components into the new system, with minimal complexity.*

4.2 The conceptual model of the approach

4.2.1 Framework for the approach

An approach is commonly understood to be a coherent set of activities, guidelines and techniques that can structure, guide and improve a process. Approaches can be expressed as a way of thinking, a way of working, away of modeling and a way of controlling. See figure 4.2.1. On the basis of the 5 requirements defined above, the approach is presented in the '*Ways of*' framework (Sol, 1990). The pragmatic framework has been used to construct design approaches and methodologies for new problems areas in numerous studies, for example, for information system design (Shrijver, 1993; Berbraeck, 1991; Wierda, 1991), for business reengineering and the design of organizational coordination (Eijck, 1996; Lare, 2003; Vreede, 1995) and for research decision support (Meinsma, 1997). Using this framework, it is possible to characterize design methodologies by their mode of thought, modeling constructs, working method and management.

Figure 4.2.1 Framework to analyze approaches (adapted from Seligman et al, 1989)



4.3 Way of Thinking

The way of thinking expresses the underlying philosophy of the approach. The perspective taken of the problem domain is stated and the underlying assumptions are made explicit. As stated in the previous section, it determines the appropriateness of the support framework (approach) for the problem considered. It delineates the view on the problem domain and provides an overview of the methodological principles the support framework is based on.

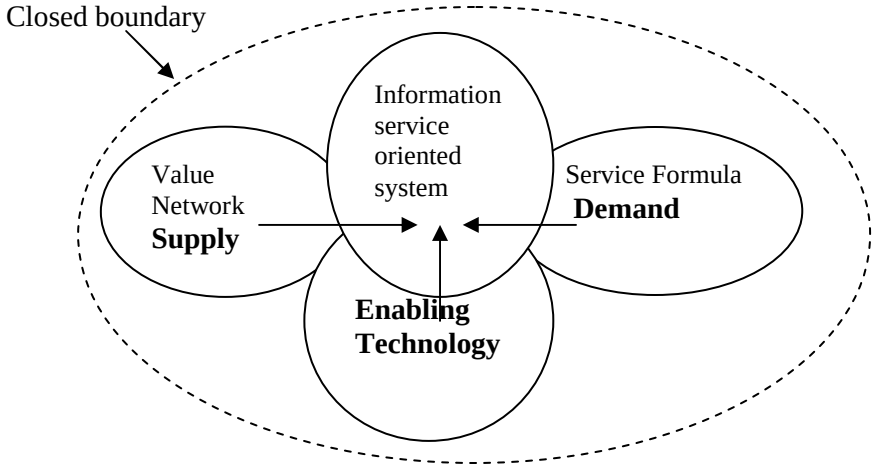
4.3.1 View on the problem domain

In chapter 1 the problems and issues faced by practitioners in the implementation of inter-organizational business information systems in volatile contexts, were discussed. The research view of the problem domain and prescribed methodological principals and recommended guidelines are presented in this section. The inter-organizational service system implementation combines three basic elements namely, the enabling technology, a service formula demanded by users and this service supplied by a network of organizations. The implementation of a service system occurs among interdependent actors in an inter-organizational network aimed at adding value to business goals. The research context is the emerging public organizations networks with complex implementation challenges, resulting from resource scarcity and unpredictable socio/ political environments. The networks needs support to reduce complexity in order improve implementation practices for service system implementation.

The emerging networks in volatile contexts (*Define boundaries and set priorities)*

A network must also have defined membership limits. One such limit is the goal of the network, with network membership being established by each individual firm's contribution to the attainment of this goal (Jones et al, 1998). Using this approach, the emerging service network in volatile contexts, will be limited to those organisations that are actively involved in the implementation and eventual provision of the service under the roles specified. For organisations that work with resource scarcity, defining boundaries of operations and setting priorities is even more critical. Figure 4.2.3 illustrates the service network view of the problem domain.

Figure 4.3.1: The way of thinking: Inter-organizational service systems implementation in volatile contexts



- **Service Formula:** The differentiating value proposition demanded by the end user
- **Value Network:** The configuration of activities between organizations and the correlated relationships, revenue models and cost structures
- **Enabling Technology:** the service architecture providing the necessary technical functions to realize the service.

Actor in the inter-organizational network must consider trade offs between the three elements by addressing the following questions:

i) *How can network actors get a technology to support a service that fulfils the user demands?*
ii) *How can a value network to provide the technology be formed?*
iii) *How can the activities of network actors be coordinated and managed to implement a service system that delivers value to the user?*

Factors influencing network Formation

- **Business Interdependencies**

The emergence of public networks in developing economies is driven by mutual resource interdependencies of technology and skill deficiencies and, to gain competitive advantage and strategic relevance. These motivation elements are supported by empirical studies and literature, which shows that network formation, is driven by internal and external factors. Maitland et al (2003a; reference to Hite and Hesterly, 2001 and Gulati, Nohria et al, 2000) argue that

this is related to trends in organizational forms and economic change. In particular, high environmental uncertainty, changes in transaction atmosphere like technological progress, lack of capital and knowledge, which may lead firms to seek partners (Wigand et al 1997). These forces lead to interdependencies, a key driver of network formation (Gulati and Garguilo, 1999). These observations show the common underlying elements for network formation as attainment of prestige and business edge. These observations are concluded with the following guidelines:

Guideline 1
Take into consideration when creating a business network that the value of network membership is determined by the optimisation of technology and technical skills to realise the business goals.

Guideline 2
Take into consideration when creating a business network that the value of network membership and working with partners with an established reputation in an innovative project, is to learn and achieve a competitive advantage.

- **Relational ties**

A factor that influences choice of partners and network sustainability is the relational ties. The effects of embedded relationships and social ties are well known for influencing choice of partners (Granovetter, 1985; Uzzi, 1996). The exploratory case studies in chapter 2 presented evidence that the choice of collaboration partners was based on prior relations with business domain similarity, language, culture and administration. It is concluded that the way to reduce uncertainty when creating a business network, is to collaborate with organizations where there are existing good relationships. This translates into guideline 3 for network formation.

Guideline 3
Reduce uncertainty by using embedded relational and social ties when creating the network.

- **Membership definition**

The emerging networks of volatility are non-profit public organizations, whose membership limitations must be influenced by resources scarcity. The concept of a value network for public organizations is not one based ‘on reacting to competitors and striving for profit’ (Christensen 1997). The network aims at delivery of quality services in a similar business domain and learning by shared best practice. Hence, membership in terms of numbers and tasks should be restricted by that objective. Based on the above requirements for membership definition, the following guideline is recommended for membership limits.

Guideline 4
A service system network will be limited to those organisations that are actively involved in the implementation and provision of the service under the specified roles.

4.3.2 Methodological principles

Trade–off between the service formula and the technology

The trade-off between the service formula and the technology, is complicated by the multiple stakeholders and the prevailing unstable technology infrastructure prevalent in volatile contexts. The trade off between the service formula and technology manifest in the non-functional requirements. For the research context, the technology goals specified in section 1.7 include reliability, usefulness, maintainability and scalability as presented in chapter1. Reliability consists of correct technical functioning of services, currency and accuracy of information and explanation of purpose (Liljander et al, 2002). It is one of the core service quality dimensions (Parasuraman et al, 1985, 1988, 1991). To determine the trade off between the service formula and technology, technology and financial interdependencies must be considered in a multi–actor network.

Technology interdependencies and the volatile network

Technical resource interdependencies are defined by the service requirements and they require organisations to cooperate to make the service work technically. The service architecture is recommended for this environment. The standard a three tier architecture that includes:

- Presentation layer or client tier (Net ware): displays some limited logic for checking the completeness of data entered.
- Application layer or middle tier (software). This layer typically includes application logic and the business rules.
- Data layer or persistency tier: includes the databases and processes large volumes of data.

The need for the flexible creation of a network puts a high demand on supporting technical systems. New services and processes for provision should be created *using a pool of existing and new robust components and web services.* A desirable attribute of the service oriented architecture, is the utilization of an organization's existing assets and applications. The high demand for service delivery requires adequate bandwidth to support multiple business transactions at the parallel and distributed levels of the network. It is important to underscore that adequate bandwidth capacity is a transient but critical enabler in the network service delivery. Due to the prevailing shortage, prescribed bandwidth management approaches must be a component of the approach in the short to medium term.

Bandwidth Management

The formation of *bandwidth consortia for* large volume procurements *in the medium to long term*, and adoption of *bandwidth management procedures* that include good procurement practice, efficient management and utilisation (human resource capacity) in the short term should be considered. In addition, policy and regulatory environments (lobbying); physical access constraints (technology) and sustainable cost recovery policies should be improved (Association of African universities, report 2004). (See Appendix 4B for guidelines). Best practices derived from the case study and suitable for the research context, include: local public /private partnerships where the technology risk for telecomm infrastructure is largely transferred to the private sector and the provider/agency governance model for affordable bandwidth provision.

Financial sources interdependency

A consequence of high financial resource interdependency for the implementation approach is that a risk analysis has to be done before the implementation process. The risk is spread among different partners who become dependent one each other (Sage and Armstrong, 2000). The following aspects are identified as those with the greatest potential risk towards the success of the project:

- *Complexity of the project:* Inter-organisational projects are difficult to conduct due to their parallel and distributed levels. The involve multi tiered project teams to be coordinated to deliver the system within the completion schedules.
- *Inadequate institutional budgets:* There are no *s*pecific budgets for implementation availed at institutional level.
- *Low skill base:* Inadequate expert skills and experience to implement and support technical projects, compromise the development and sustainability of the network project. The financial requirements to sustain the service implementation and system operation for the member organisations must be projected to give the go /no go decision. Sustainability of the network project is therefore a key motivating factor for financial interdependency.

Guideline 5
The sustainability of reliable network information services should be the primary guide for resource interdependency. Revenue models are desirable but secondary.

4.3.3 Trade off between the network and the service formula

- **Determining the service formula**

The partners in the network have to agree on the service formula. The design

factors that directly influence this trade-off are: the compliance with user requirements and the necessary technical skills to deliver such a system. The achievement of the user service value entails management of requirements practices to track user appreciation and elicit feed back. Booch (1999) defines a *requirement* as a condition or capability a system must meet. He adds that active management of requirements encompasses three activities: 'eliciting, organizing and documenting the system's required functionality and constraints; evaluating changes to these requirements and assessing their impact; and tracking and documenting trade-offs and decisions'.

- **User-centred implementation**

A user-centered implementation approach must be adopted to ensure service reliability. Ensuring reliable system starts with management of requirements at all stages to monitor user appreciation as system evolves. This includes elicitation, logging, reporting and verifying, monitoring of changes in the user requirements and incorporation of changes (Booch, 1999). Literature on creativity and improvisation indicates that user-centered implementation can be supported by a variety of other contextual elements and techniques. One such element that is relevant to this research is participative approaches, using techniques for group working and end-user involvement (Cooper, 2000). It is recommended that to guide the trade off between the network and the service formula, the implementation process must start with understanding user requirements and monitoring changes in user appreciation to elicit feed back. The user contribution compliments the creativity of the developers who must have innovative ideas and designs. This is the prescribed solution to the recurrent constraint observed from the case studies in chapter 2 where requirements elicitation and management is lacking. These recommendations translate into two related guidelines.

Guideline 6

6.1 The implementation approach must start with investigation of the targeted user's profile context and needs.

6.2 The targeted user should participate in all phases of the implementation process.

Inter-expert pools and resource centre

The availability of technical skills is fundamental to the trade off between the user value and the network. The shortage of expert skills and technology to execute the project must consider:

- The development of an inter-skill pool and resource centre, mandatory (see section 3.6 for details).
- In the long term, planning for technical skills begins with a survey of available skills, noting critical deficiencies and planning for training or

acquisition.

- The required skills must be identified by type and numbers and planned for periodically.

Institutions must prioritize and make the commitment to develop internal expertise from their meagre budgets because expertise is a critical resource to the success of the project and network sustainability.

Best practice observed in this research indicates that, sustainable skills development can be achieved through:

- the use of institutional software incubator centres that nurture development skills among students and collaborate with industry.
- the development of hybrid skills (Heeks, 2001; Earl, 1989) with improvisations tailored to the skill requirements developing economies.

In the short term, best practice showed that optimizing skills starts with sharing best practice from the champion of the network, who is technically more endowed with skills and facilities. This translates into the following guidelines for technical skills development:

Guideline 7

7.1 Organizations must project and periodically plan for required technical skills training and facilities, in the long term.

7.2 The network champion should initiate the gradual development of a skill pool through shared technical best practice and facilities, in the short term.

4.3.4 Roles of network members

A variety of business models, role divisions, revenue models and different benefits of being part of the network for each actor have been explained in the literature. Maitland et al (2003), made a standard list of roles for actors involved in a mobile information services, which provide useful elements for the volatile network. People and firms need outside sources of cognition and competence to complement their own. This is the fundamental reason why inter organizational linkages are important, especially for innovation (Nooteboom, 1999). The relevant roles are extracted for the service implementation for emerging networks (See Table 4.3.4 below). The roles shown below take into account the multiple roles of service developer, provider, and consumer, which were recommended for organizations with resources scarcity.

Table 4.3.4 Service implementation network roles. (Adapted from Maitland, Van de Kar and When de Montalvo, 2003)

Roles	Description
Functionality related roles	
Service provider	Provides service to the end user
Network operator	Operates the network over which the service is disseminated
Platform provider	Provides the software that defines the general platform on which a variety of services run
Content supplier	
Raw content supplier	Supplies raw content format to transform into usable service format.
Content developer	Transforms raw content into appropriate for the service
Content aggregator	Serves as an intermediary between service provider and content provider
Hardware roles	
Equipment provider	Provides hardware and physical components of the network
Customer relations	
User support provider	Point of contact for user queries regarding service; responds to user queries
Content quality manager	Monitors and improves quality

Guideline 8

8.1 The multiple roles of developer, provider and consumer by each network organization must be clearly articulated. The network participants have to commit to this role.

8.2 At the start of the project, a role list must be checked and actors to fulfil each role must be decided.

Conclusion

In this section the problem domain and methodological principals in *the way of thinking* for inter-organizational implementation in volatile contexts have been presented. We noted that service systems implementation requires an assembly of the three elements:

- the service formula
- enabling technology
- actors in the network

Actors must consider trade-offs between the three elements. For the emerging networks, the unreliable technological infrastructure and skill deficiencies

indicates that Technology /service formula, service formula/network tradeoffs are high. Consideration should be given to network formation and coordination factors that influence sustainable business collaboration. Based on this discussion, working guidelines for network formation and coordination, service system development, technology and skills development were derived. It is the view taken in this research that combining these process management, development and service implementation guidelines for an inter-organizational setting, is an appropriate conceptual approach for inter-organizational service system implementation.

4.4 Ways of working, controlling, and modelling

In this section the ways of working, controlling and modelling are combined as they are deployed in an implementation project. The activities and tasks to be undertaken in the implementation process, the means of coordination of tasks and resources, as well as the tools to assist stakeholder learning and feedback are prescribed in the way of working, controlling and modelling. First we present the merging issues for this section.

4.4.1 Emerging issues

Emerging issues that present useful elements to the way of working, controlling and modeling are presented. Collaborative Business systems Engineering (CBSE) based on CBE, 'system' is added to show that this is a combination of insights from system engineering (complex hard and soft thinking) for the multi coordination of multi actor activities, especially negotiations and decision making.

Collaborative Business Engineering

The multi actor environment of the inter-organizational collaboration requires support to execute activities at the parallel and distributed level. Collaborative Business Engineering is derived from the Business engineering (BE) approach. BE is based on the dynamic modeling (DM) approach that has been proved suitable for dealing with the design of complex human activity systems in different types of problem situations (Sol and Crosslin, 1992; Bockstael-Blok, 2001). This approach has been applied and developed further from numerous studies including inter-organization systems from a chain perspective (Bockstael-Blok, 2001). BE has also been applied in business process redesign (BPR) projects using collaboration and simulation support within organizations. The case experiences and lessons derived are referred to as collaborative business engineering (CBE). A group support session is recommended as a suitable support environment. A repeatable process for information user elicitation is executed with the different actor groups. The relevant elements

from collaborative business engineering are:

- Incremental improvements are necessary: The network is in exploration mode, organizations have to go through a learning process to test, learn and guide gradual improvements until the system is ready for exploitation.
- Solving ill structured problems: The inter-organizational project is an innovation with varied risks and unknown entities. Implementation support should aim at the most optimal organizational structure that would enable realization of business goals.
- Modelling is a prominent feature for CBE design. Modelling facilitates accurate requirements analysis from visual aids. Instant feed back is critical to managing requirements of an evolving system. A distinction can be made between conceptual models, that define the structure of a problem situation, and empirical models, that represent a further specification of the problem situation and facilitate analysis and diagnosis of the problem or possible solutions (Den Hengst and De Vreede, 2004).
- Negotiation techniques such as the Win-win approach: This approach is defined as a "set of principles, practices and tools, which enable a set of interdependent stakeholders to work out mutually satisfactory (win-win) set of shared commitments" (Boehm et al 2001). Combining the WinWin spiral model, collaborative knowledge techniques and automation of the Group Support system gives the EasyWinWin approach. This approach has been applied in about 50 projects (Briggs and Gruenbacher, 2002). In the volatile context, a pen and paper version of the Group support system can be adopted.

Component–Based Development (CBD)

Component based development is introduced to provide solutions for building complex and adaptive enterprise IT systems in the internet era (Welke, 1994; Brown and Wallnau, 1998; Syzperski ,1998; Crnkovic and Larsson, 2002). One of the primary aims of CBD is to deal with increasing complexity and size of business applications (Allen and Frost, 1998; Allen, 2000). To meet the challenges in rapidly changing domains and provide the basis of new techniques supporting the next generation of software intensive solutions, CBD presents the most promising attempt (Brown, 2000). CBD literature presents several reasons that are relevant for service systems implementation in dealing with complexity and possibility of shortening the development life cycle:

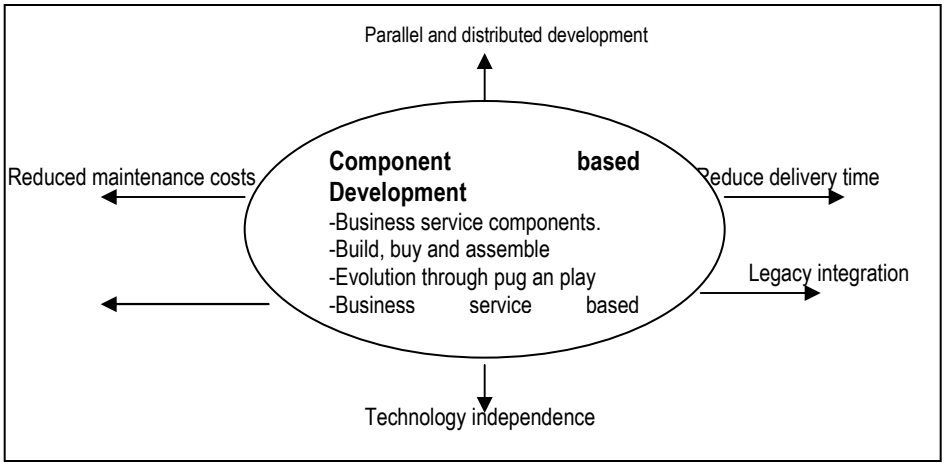
- The CBD paradigm system development uses selection, reconfiguration, adaptation, assembling and deployment of encapsulated, replaceable, interoperable system elements with clear functionality and hidden implementation rather than building the entire system from the start (Brown, 2000; Clements, 2000). Using CBD helps developers to manage changes better as it can be used effectively to localize changes inside single components and prevent uncontrolled propagation of changes throughout

the system (Cheesman and Daniels, 2000; Veryard, 2001).

- Reduce development and Maintenance costs and increase productivity: Using components to develop systems reduces development costs as it supports reuse of existing, developed and pre-tested components. In addition, reuse of existing components can increase productivity since development does not always start from scratch.

CBD is amenable to environments with stable and abundant technology resources but, useful elements for reducing complexity in systems development that can be adopted for unreliable infrastructures and incompatible applications are still applicable. The useful concepts are summarized in figure 3.4.2.

Figure 4.4.1 Concepts and benefits of CBD (adopted from Sprott and Wilkes, 1999)



4.4.2 Implementation phases

Emphasis was put on the user–centered approach for the implementation process. This is because of the relative newness of the service-oriented paradigm and the need to ensure delivery of a system that complies with user value proposition. The active management of requirements is central to the user-centric development. It involves 3 activities: eliciting, organizing and documenting the system's required functionality and constraints; evaluating changes to these requirements and assessing their impact; and tracking and documenting tradeoffs and decisions (Booch, 1999).

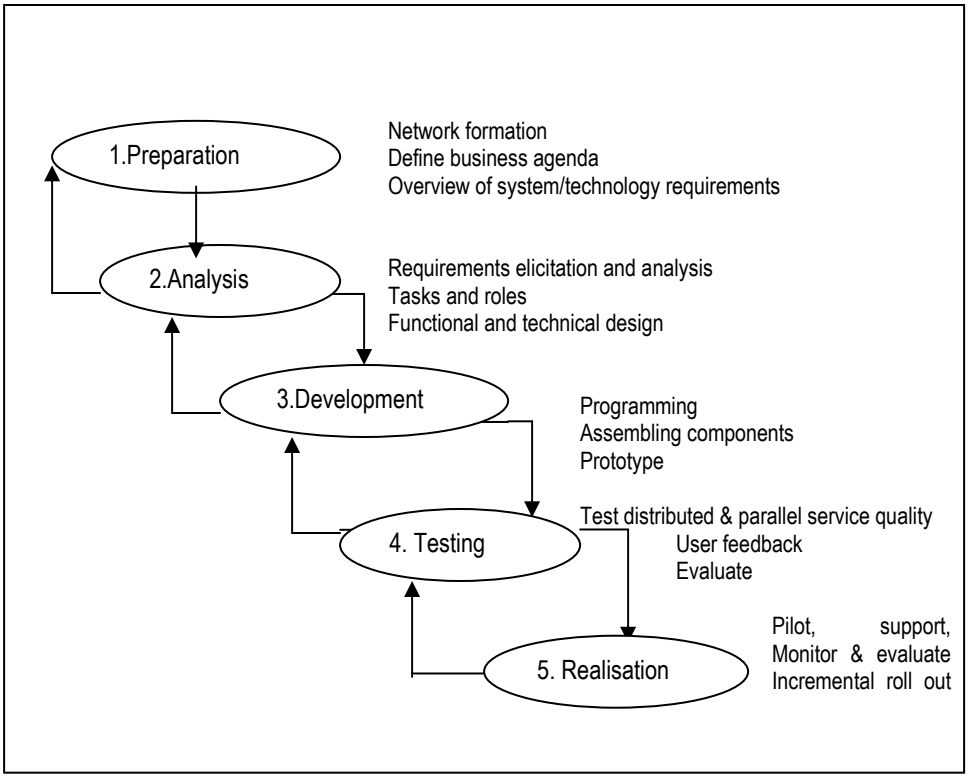
Determining the implementation activities was influenced by:

- The research definition of implementation that denotes that implementation is dependant on the preceding activities of design and analysis.
- The need for a user-centred structured and incremental system development as indicated by the exploratory case study abstraction.

- Inadequate knowledge about service system implementation in volatile contexts
- The need to support network creation with a common business agenda prior to the implementation (Sydow and Windeler, 1998).

On the above basis, theories of network formation combined with IS development approaches, evolutionary approaches and process management were used to propose the implementation phases to improve reliability and efficiency of the implementation process. The proposed phases are: Preparation, Analysis, development, Testing and Realization (Roll out) (PADTR). The perspective taken is that implementation is dependant on the preceding stages in the development cycle especially design. For the way of working, the project management perspective is added to derive the following description of the project as to *undertake a series of controlled activities that transform business design concepts into working service systems, of user value.* Implementation stages and activities prescribed for the problem domain are conducted iteratively. Using this PADTR approach, implementers need to deal with trade-offs mentioned above at each phase.

Figure 4.4.2 The PADTR Methodology for inter-organizational service system implementation in volatile environments.



4.4.3 The PADTR method

The PADTR method is prescribed for service–system implementation as a methodology that can be applied to improve the efficiency and reliability of implementation process, to reduce complexity from context challenges. It can be used as the starting framework of the approach. The methodology combines the stepwise order of the waterfall model and the iteration of the Spiral model (Boehm 1988) for evolutionary approaches. Activities can be added in each of the phases depending on specific circumstances. The form of deliverables will also be determined by project circumstances. It is important to decide at the onset of the project what the form of and content of the deliverables will be.

Preparation

P1. Process design

The process of the network formation has to be thoroughly described. It is important to incorporate dynamics in this process and to do it carefully (*guideline 1 and 6)***.** The creation of the network can be done by executing the following activities, based on De Bruin et al 2002, Unitrust consortia Project, Tenet report, 2001.

- Explore problem: Starting of the process will be initiated by one actor or by a limited number of actors. Agree on the broad system functionality required and prescribe minimum requirements for all partners.
- Actor scans: Investigate each actor's profile in terms of infrastructure, skills competencies to play the dual provider and consumer roles of each network member. Invite committed innovators who want to learn and gain competitive advantage. *(Guidelines 1 and 2).*
- Define a governance model, or working rules and regulations of open corporation and. seek commitment with incentives for organizations.

Some networks require agreements to be made for entry and exit rules, decision making rules and project management issues such as organization of the project i.e. chairperson, steering committee, work groups, secretariat and planning and budget. In such cases, it is recommended that sufficient time be given to establish the network as this prevents problems later.

P2. Agreement on intention to cooperate

It is important to agree and commit in writing the intention to participate in the general capacities decided for each partner. Letters of intention can fulfil this requirement. At the preparation stage the partners should present individual status profile of technology status especially current bandwidth capacity and requirements, technical support staff and application managers. The profiles show technology and skill gaps and requirements to reach the minimum requirements for the network to execute the service implementation. These include bandwidth management procedures as stated in section 4.3.2. At the end

of the preparation stage the following deliverables are expected in line with the three elements that constitute service systems:

i) Network: Letters of intention outlining motivation for collaboration, agreed system for implementation and formation of the network.
ii) Enabling technology: Minimum infrastructure requirements. Overview of institutional technology status and gaps for the implementation project.
iii) Service Formula: Summary of core systems collaboration requirements.

4.4.4 Analysis

A1. Scan required roles and tasks

The role table in 4.3 can be used as the checklist to check that all roles are covered. It is important to communicate clearly to all project members, which actor is expected to fulfil which role (*guidelines 8.1 and 8.2).* At the same time co development of the service between content providers, application developers and providers must be coordinated. It is advised not to control this process too strongly during the exploration phase. This is a situation that has limited stability and frequency of interaction (Nooteboom and Gisling, 2004).

- Use Role tables *(table 4.3.6*) as a checklist to determine completeness in fulfilling roles. As far as possible, define similar roles across partners. Do not over load the lead organization. Draw up a project work plan, and assign roles, tasks and responsibilities.
- Define conflict resolution procedures. Conflicts should be formulated as dilemmas because this has a positive effect on the process (De bruin, 2002). From the consortia case studies in chapter 2, conflict resolution was based on the following most causes and possible solutions.

Table 4.4.4 Conflict resolution

Conflict cause	Solution
Unclear lines of communication	Communicate reporting structure at the start.
Undefined areas of responsibility	Role checklist for all project teams
Unresolved policy issues within the network	List policy conflicts areas and resolve or anticipate response
Institutional politics and culture Lack of trust	Relational ties

A2. Elicit and analyze user requirements

Implementation starts with getting knowledge of what the different users of the service want *(guideline 6.1 & 6.2*). The required service evolves from the broad functionality of the systems as initially agreed by the top policy, operations and technical representatives at the preparation stage. The target group specifically addresses what problems they want to be solved and in what context. These sessions are modeled with 'thinklets' and the supporting tool is the group support system. A pen and paper version of the GSS can be structured with selected thinklets, in case of technology constraints albeit with some limitations. An over-view is presented in appendix B and the method is adopted from Den Hengst, Van de Kar and Appelman (2004).

A3. Analyse existing services and available and usable technologies

Initiating a service should start with investigating the existing functionality in the legacy systems and reviewing potential FOSS applications that are relevant to developing the new service. Selection and analysis requires an exhaustive search from internal existing resources and systems as well as the Internet. The use of web search tools is recommended.

A4. Draw up an overview of functional and technical design decisions

In addition to starting with the targeted user's needs and context, it is necessary to investigate the availability of technologies that are reliable and robust enough to develop and enable the service. Outsourcing should be also be guided by selection of robust components. Component Based Development (CBD) is presented from theory as useful for assembling components that lead to high system quality and reduce complexity.

4.4.5 Development

D1. Define roles, tasks and responsibilities

The roles, responsibilities and tasks for the actual service development, usage and testing activities, have to be decided in this phase. The procedure for the test of the service that will be executed in the next phase must be clearly understood by all participants. This includes the test scenario, who does what when and how, what guarantees test validity. Workflow models can support this process. To run a usage test, it is necessary to organize willing participants, a prototype available to participants, mechanisms for collecting data and a process for interpreting feedback (Isaacs and Walendowski, 2002). Practical details like user manual, questionnaires and contracts have to be planned. Arrangements have to be made for conducting the test. Developing a test log, potential points of failure and support and escalation procedures for parallel and distributed Help desk have to be planned. The development team must identify points of

user involvement in the development especially for the design of the interface. Models and tools for elicitation of feedback should be articulated and quality assurance instruments that to collect user suggestions for revision and incorporation into the new system, should be determined at this stage. Quality assurance tests for users should request user evaluation based on satisfaction, effectiveness and efficiency criteria

D2. Define technical architecture

We present two architectures that can be considered for the volatile context; the service oriented architecture (SOA) and the MVC model architecture. Implementers should adopt a choice that meets bandwidth capacity and technical skill base. The over view of the whole technical architecture has to be designed from a top down perceptive and then filled in. The architecture can be structured into at least three logical layers: the presentation layer, business logic layer and data access layer (Vidgen, Avison, Wood and Wood-Harper, 2002). Remember the three phases of the component based development (CBD) approach are: understand the context, architect of the solution and provision of the solution (Brown, 2002).

Service oriented architecture

In chapter 3 we looked at the service oriented architecture (SOA) as a suitable candidate for service system implementation in volatile contexts. In our analysis we also noted critical consideration and barriers to the adoption of SOA, especially low bandwidth latencies which cannot support the remote service strategy (Arsanjani, 2005).
A desirable attribute of the service oriented architecture, is the utilization of an organization's existing assets and applications as services to integrate business processes and supporting business needs. The service operates using a three tier architecture:

- Presentation layer or client tier (Net ware): client is mainly used for display with some limited logic for checking the consistency of data entered.
- Application layer or middle tier (software) typically includes application logic and the business rules.
- Data layer or persistency tier: included the databases and processes large volumes of data.

The suitability of service–oriented systems to overcome the high maintenance associated with existing monolithic implementations has been justified by the SOA flexibility of using building blocks from the web. The modularity of service of a SOA, complimentary use of existing assets of an organization, possibility of outsourcing service components from the web would be key benefits for the implementation in volatility

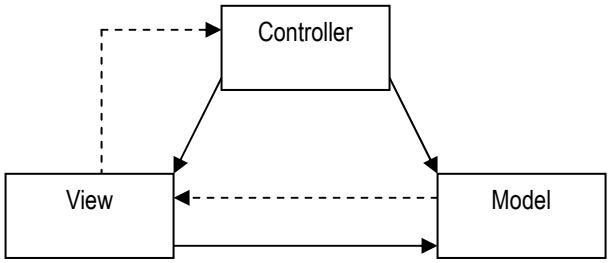
SOA adoption at level 1 is an ideal starting level of adoption by volatile networks as it presents useful elements that are suitable for volatility, like the

integration of existing legacy assets and resources by opening up task databases, accessed through the creation of services to enable business collaborations with multiple business partners and facilitation by third parties (Arsanjani, 2005). However, to start the process organisations should begin by changing the corporate culture and adopting practices that can support the implementation of service systems. In addition volatile contexts should consider barriers to SOA adoption, which include the limitations of bandwidth and a skill intensive orientation. As observed from the South African consortia case study, bandwidth procurement consortia should precede any system collaboration project to sustain business collaboration in emerging networks. Other architectures for consideration include the MVC model.

The MVC model

The MVC model has been used for distributed and parallel development/use, to create common platforms that support interactive online work, within bandwidth limited environments and unstable architectures, and it has proved to be robust (KEWL NextGen, 2006). MVC supports CBD by presenting a flexible layer that separates the data and the interface. Currently it is used as the architecture for the distributed development and use of the Knowledge Environment for Web-based Learning (KEWL), a free and open source Learning Management System (LMS) that runs on Apache, MySQL and PHP, by 12 African universities.

A simple diagram depicting the MVC architecture pattern



Model-view-controller (MVC)[*] is an architectural pattern used in software engineering for complex computer applications that present a lot of data to the user, to separate data (model) and user interface (view), so that changes to the user interface do not affect the data handling, and the data is reorganized

[*] http://en.wikipedia.org/wiki/Model-view-controller.

without changing the user interface. The model-view-controller solves this problem by decoupling data access and business logic from data presentation and user interaction, by introducing an intermediate component: the controller.

Model- The model is the domain-specific representation of the information on which the application operates. MVC does not specifically mention the data access layer because it is understood to be underneath or encapsulated by the Model.

View - The view renders the model into a form suitable for interaction, typically a user interface element.

Controller – The controller processes and responds to events, typically user actions and may invoke changes on the model.

MVC is often seen in web applications, where the view is the actual HTML page and the code, which gathers dynamic data and generates the content within the HTML is the controller. Finally the model is represented by the actual content, usually stored in a database or XML-files.

Modelling

Within the PADTR framework, modelling techniques are required to improve user appreciation and provide feed back. Models assist us to grasp the problem: study the behaviour of unavailable or accessible material through an experiment. They can be used to describe and visualize situations thus enabling the discussion of scenarios (Roozenburg and Eekels, 1995; Weirda, 1991).

Defining the architecture is aimed at identifying all the components that will be used to build the application and to identify dependencies between these components. The ways to model this are:

- Component architecture modelling – In this case, Unified modelling Language (UML) and case and class diagrams (Booch, Rumbaugh and Jacobson, 1994) are appropriate at the conceptual system level to support analysis. The components architecture modelling for information systems can be structured in layers: the telecommunication network, the middle ware, the applications and presentation layer.
- Context modelling which describes the proposed system to enable understand of the performance in the defined business area. Interface modelling is useful but time consuming.

UML techniques such as use cases, sequence diagrams and component diagram can be used for CBD. UML use cases will be more beneficial for the design process and are useful for iterative consultation for verifying consistency with original requirements. They can be used in context modelling to understand the scope of the system developed and interface modelling in which interfaces are described in detail. To support the actual implementation in the context of the stages of PADTR, iconic models like prototypes are needed. Iconic models are material models that can be used to conduct experiments (Roozenburg an Eekels, 1995). Actor and role models are useful for modelling the network.

Paper prototypes can be adapted and improvised using a graphic artist. They are cheap and fast to use (Nielsen, 2000)

D3. Select technical components

After making the technical architecture, the different components have to be chosen. Decisions have to be made about the components to use and their source. What components are in-house and what should be outsourced? Suitable criteria should be developed that considers technology and user goals stated in chapter 1, section 1.5. Selection should also consider a platform that enables the parallel/distributed, user/development forge. Robust, tried and tested home grown solutions which can meet both parallel, distributed and third party requirements, should guide the selection of an ideal and sustainable platform for implementation. For volatile contexts, the selection criteria was informed from best practice as well as researchers in IS development including (MacManus and Wood-Harper, 2003; Booch, 1999, 2003; Vidgen et al, 2001; Angell and Smithson, 1991). The selection of the development framework should be guided by the following general system attributes:

i) **Open-source**- Free and open source platform because:

- Open source encourages contributions from a wealth of other developers as it scales to accommodate more functionality.
- It is free (zero financial cost) to enable even the smallest organisation to acquire a copy and benefit from updates to the same system.
- Unification of the system processes across the member organisations to ensure individual organisations are able to embark on bigger and more extensive projects that may involve sharing of data.

  ii) **Ease of management**: the system should be reasonably simple to manage and use.

  iii) **Multi-platform**: multi platform executable. This means that the system is not only executable on Windows but also Linux/Unix platforms. Open source operating systems like Linux and Unix are becoming frequently used. There is need therefore, for the MIS system to be executable on these platforms.

Additional factors considered in the evaluation of these systems are:

- **Ease of installation** refers to the amount of time to install the system, the need for additional modules than those provided with the standard package, the number of operating systems or standard systems on which the installation can be achieved.
- **Ease of use and navigation of the system** by both developers and end users' ability to find content, the effectiveness and robustness of the search functionality.
- **Ease of building the system or ease of incorporating more modules** into the system. The ease with which to tailor the system to the required

organizational needs.

- **History of the system** in question includes but is not limited to the user base (which increases support) and adequate documentation. In documentation we refer to availability of developers/ users forums, availability of supporting documentation, ease of acquisition of help online and offline.
- **Level of security** refers to the ease with which a hacker may attack the given system, the proper organization of users into groups with proper privileges and access rights (Daskapan, 2005).

Based on the above criteria, a general Software quality evaluation that rates general and specific software qualities should be conducted to derive the best options. The desirable attributes are summarised as the use of existing, free and open software components that would reduce cost, use the best available applications, with low demand on the scarce development resources and support low maintenance and scalability (Brown, 200).

D4. Application design

After deciding on the platform, the development team may design the application. Two standards that provide application level support for wireless networking are mobile IP and wireless application protocol (Stallings, 2002). An application server provides a server–side platform for building and deploying business logic and can provide many technical benefits (Jagoe, 2003). The application design depends on the choices made for the technical architecture design, the selection of the technical components and hardware and web service platforms. Regarding platforms the technology should be standardized so that it can support a wide range of services.

D5. Define Content design

This activity is closely related to the application and navigation design. The content depends on what users will trigger. The term content should be understood as referring to text, graphics, web pages, emails, audio and video. In this activity the required content is described. A content group should be composed for specifying and redesigning content with the developers. This group constitutes of selected representatives of end users and the content provider who is usually the department in charge of the business system. The content group can redesign content like forms for data entry to suit user needs by eliminating redundant fields and adding relevant functions. The requirements specified through modelling are put into a draft design to show what the service will look like. This can be databases and forms for different functions contained in the requirements. The draft can be a paper demonstration quickly done by a graphical artist with suggestions for revisions from the content provider group. The design has to be user friendly.

D6. Navigation and user inter face design

A simplified view of the user-centred design process is to conduct the user research, set usability goals, design, model and test the user interface, and specify the user interface (Wiklund, 1994). The design, model and test of the user interface should be repeated until the user is satisfied. The user interface determines the look and feel of the service. The designers develop the font, colour, icons and text. The underlying process of getting a user interface that is usable is user–centred design process; this means that targeted user has to be participate in the entire implementation process (*guideline 6.2*). Usefulness and ease of use should be part of the quality assurance criteria evaluated by the users (see appendix 6C). These attributes should be tested by potential users to determine whether the designers are still complying with user–requirements. This is an iterative activity. The rationale is that users and developers explore the possibilities and constraints of the technology using hands–on experience and providing feedback for modifications. This session is a participative evaluation process that enables users to evaluate the service and define usability problems. The aspects can be technical like a slow device, or functional like functionality that is perceived as not useful or with minimal usefulness. Different methodologies for usability evaluation can be practiced including surveys, expert evaluation and usability focus groups. Ways of modelling is prototyping to get hands-on experience.

D7. Programming, scripting, assembling and testing

Several books have been written on developing applications, like Ince, (2004). These are applicable for networks of various actors that will be located in different place. It is recommended to have a work method that suits the distributed and parallel environment. The lack of adequate technical skills especially in development has been noted as key cause of complexity. It is unlikely that individual organizations in these networks will have the relevant development skills in a distributed environment hence, the need to consolidate the scarce skills into a resource centre for the programming and support skills. Open source components can be useful in the selection of components for service delivery. Next the various completed parts have to be tested. The tested parts have to be assembled and the whole system technically tested. The deliverable of this activity is a prototype. The prototype will advance and evolve with feedback from the users in the parallel and distributed usage. The test criteria for the development team should be initiated at this point.

4.4.6 Testing

T1. Preparation and installation of equipment

Depending on the number of users in the test group this might be a labour

intensive activity. A Test group representative of the target end user, technical support and application mangers has to be predetermined. Equipment pre-installed, and instruction manual written. The test–log is used as a checklist.

T2. Support developers during test

Application developers should note all and solve some problems that crop up during the test. This is also an opportunity to have informal discussions with users and get a better understanding of usage. In cases of big test groups, test each group separately to be able to capture specific system queries and issues for a user group.

T3. Monitor usage and evaluation

The usage of the network, platform and applications has to be logged. The operators can test the load and peak load of the network. The service providers can use the log files to scale the necessary capacity on the servers. At the same time, the usage designers can log files to evaluate usage. Observation is also an important evaluation method. Pertinent key questions for technology performance are stated in the technology goals in section 1.5 as reliability, flexibility, scalability, easy maintenance. Incorporate user feedback in the next versions of the service. This is like the final draft.

4.4.7 Realization

R1. Review the business case

The business partners analyze and evaluate their benefits from participating in the implementation project to decide if the system serves internal business agendas and if they are willing to continue with the pilot. This activity requires reports by the steering committee especially the financial report and the project management committee report on implementation activities, system projections and challenges. This should be compared with the original network objectives to decide the network continuity into the exploitation phase.

R2. Determine roll out plan

Review technical equipment needs and technical support gaps. Draw up a pre-implementation checklist. This should include all technical and support requirements needed to roll out the system.

R3. Distribute service (Launch the pilot)

The relationship with the user fraternity starts with the distribution of the service. The service is now distributed to test parallel and distributed usage, synchronized at the different participating sites. It is ideal for the business network in this research, where system operations should be

accessible to all participating organisations and provision of mutual redundancy by/for all partners is critical. The rotation of the service provision in case of failure from a participating site can also be tested. The high cost of bandwidth remains a problem but it is acknowledged as a transient issue given that trends show declining costs. The distributed user support must also be tested at this point. A Common reporting interface for failures and queries by users from all sites instituted under an existing joint collaboration office is recommended to optimize scarce technical skills. This works on an escalation basis that starts with local network support.

R4. Gather user experience

Data collection begins when the distributed pilot sites start to use the service. It is recommended to use a combination of multiple sources to get a good feedback on the usefulness and usability of the service. Questionnaires for users should ask whether the service is easy to use and useful for the tasks to be executed. The implementation approach can b reiterated. After each round of modification resulting from user feedback, the refined service should be distributed to a larger pilot test group.

The next two activities should be conducted after the agreed period for piloting has elapsed.

R5. Analyze the business case

Network partners meet to re-evaluate the business agenda that they agreed on at the preparation stage, and whether or not it can be realized by the current pilot project. They report individually on the benefits and gaps from the implementation project. This meeting enables partners to define the progress plan and outstanding issues to be addressed before the pilot scale up.

R6. Scale up service

This ends the pilot and launches the service fully for all network partners. This phase is heavily dependant on the monitoring and logging all technical and operational queries events at the pilot phase and resolving them. At this point partners can start full exploitation with mutual contractual engagement, as providers and consumers of the service.

4.5 Controlling

In the way of controlling, implementation should be managed as a project, although process management elements are also required to commit participants and create inspiration. Relevant governance mechanisms should be considered

at the start to support the business model of the value network at exploitation phase.

Project management

Since this is a multi actor environment, it is important to consider the process management. Project management techniques combined with some elements of process management, is helpful in the design and implementation of information services. This includes: exploring opportunities with partners, understanding mutual agendas, share dilemmas, establish common agenda and establish rules of engagement (Bruijn et al, 2002). As advocated by De Bruijn et al, 2002, the service system implementation principals among network members are openness, protection of core values, incentives for continuation and substance.

Process management guidelines

The following elements adopted from De Bruijn (2002) are applicable to facilitating the exploration and exploitation phases of the implementation network**:**

- The process should create prospects of gain and incentives for cooperative behaviour. This is critical to sustainability of the collaboration throughout the exploitation phase.
- Participants should have commitment power
- Conflicts should be transferred to the periphery of the process.

Command and control should be used as an incentive relates well with project management techniques of clear goals and time schedules.
Risk assessment becomes necessary process management issue regarding financial interdependencies.
The project and process management activities i.e. way of controlling are related to the value network; and implementation activities i.e. way of working are related to the service formula and enabling technology. The deliverables of each design element in each phase are presented in table 4.5.

Table 4.5 Deliverables per phase

Element	Value network	Technology	Service formula
Phase			
Preparation	Letters of intention	Overview of technological gaps and requirements	Overview of system collaboration requirements
Analysis	-Project work plan -Tasks roles and responsibilities	Overview of technical options -Functional and technical design	-Draft service description -Detailed service description (thru analysis iterations)

Development	Work procedures	Application design	Communication formula
Testing	Project/Business evaluation report	technical support evaluation	Usage evaluation
Realization	Roll out plan	Network technical report	-Pilot system – (Incremental roll out)

4.6 Conclusion

This chapter started with a discussion of the five essential requirements for the approach that is aimed improving inter-organizational service systems implementation in volatile contexts. The five requirements were formulated based on the exploratory case studies discussed in chapter 2, and the literature review. Three of the requirements (1, 2, 3) focused on the usefulness of the approach and the remaining two (4 & 5), on the usability of the approach.

At this point, we reflect on the approach and evaluate if it facilitates the requirements posed in this chapter: The approach should:

Req # 1: *provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.*

Req # 2: *assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.*

Req # 3: *enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.*

Req # 4: *provide systems developers with means for conducting a user–centred implementation within a controlled process that tracks changing user appreciation and provides feedback.*

Req # 5: *assist the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity.*

Requirements 1, 2 and 3: These requirements emphasize that the approach should help practitioners to analyse, assess and prescribe the mandatory elements for site and process preparation for inter-organizational service system implementation projects. Requirements 4 and 5 stress the need for the approach

to provide a means to adopt system development practices that would accurately specify and manage user requirements and optimally utilise available technology resources to improve system performance and accessibility. To answer the question of responsiveness of the approach to the above requirements, a summary table to show location of the response to each requirement is presented in table 4.6.

Table 4.6: Requirements summary

Requirement	Page location
1. Provide decision makers with mechanisms for coordination of dynamics in a distributed network.	Process management techniques(pg 102-104), Role checklist (106), Trade off guidelines (106-8)
2. Assist implementers to analyse the appropriate technology environment for a robust technical infrastructure, with trade-offs.	Three tier architecture, bandwidth management practices,(pg 104), Service approach (101)
3. Enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources.	Inter skill pool, resource centres, strategies, hybrids (pg106)
4. Provide means to conduct a user-centred implementation within a controlled process	User-centred approach (105), PADTR approach (108-119). Project management (119), Modelling (114)
5. Assist the system developers to select and integrate available systems with minimal complexity.	Component based development (113), Analysis

We conclude that in theory, the support approach developed in this chapter is suitable and fulfils the requirements extracted from the exploratory case. In the following chapters, (5 and 6), the testing and evaluation of the usefulness and usability of the support approach using an expert evaluation survey and action research case study, will be discussed.

Table 4.7: An overview of the prescriptive conceptual implementation approach in the '*Ways of*' framework

	Thinking	Controlling	Working	Modelling
Collaborative Business Systems Engineering -CBSE	Consider: -Project execution of complex system Resources interdependencies of skills and technology. -Volatility constraints at the network formation stage. -Service system implementation as an innovation with inadequate knowledge and experience to manage complexity .	Consider: - Project Management -Process management elements required to commit participants and create inspiration -Relevant governance mechanisms at the start - Use Trade off guidelines	-Use a waterfall model combined with a spiral model for decomposition of sub-stages and iteration. -Prototype for testing and requirements management as part of the iteration. -Use best practice quality standards and framework for IT management -Define and install minimum technical requirements for a robust systems architecture in all organizations. -Adopt bandwidth management practices	-Conceptual modelling of networks to understand overview of network actors and roles. -Use object oriented dynamic modelling for applications. -Elements of thinklets are useful for modelling group decision sessions. Adopt pen and paper version

Process management	-Adopt a network perspective at exploration and exploitation stages -Create prospects for gain and incentives for network collaboration & sustainability	- Distinguish network phases of exploration and exploitation -Use meetings, agreements and negotiations to create win-win situations. -Trust is very important at the exploration stage. Formalise with letters of intention -Contracts at the exploitation phase. -Use established relational ties to create network. -Publicize early positive gains to gain momentum.	-Monitor the changing user requirements. Provide incentives and create prospects for gain during the exploration and prestige during the exploitation phase.	Enable understanding of how the system works within the defined business context. -Context modelling; - to describe proposed system -Interface modelling- Test candidate interfaces with users. -Interactions diagrams for interaction between structural (sequence and collaboration)
Objective	-Reduce complexity of implementation project -Focus on value delivery to the target user group	-Project management approach with change management. -Create multi disciplinary skill pool and resource centre. -project teams with all relevant skills like developers, content providers, application managers and system operators.	Execute the implementation project stages: -Preparation, -Analysis, -Development -Testing -Roll out (PADTR).	Help users to visualise system context, performance Useful ways of modelling are prototypes, scenarios and storyboards

Chapter 5: Testing the implementation approach for inter-organizational systems

5.1 Introduction

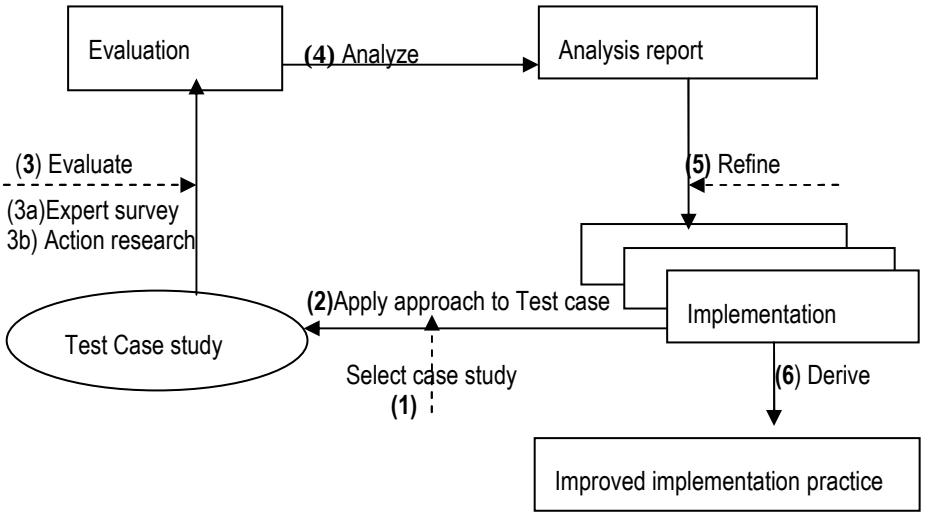
In this chapter, the conceptual approach prescribed in chapter 4, is tested to validate its usefulness in facilitating the requirements identified for inter-organizational service system implementation in volatile contexts. The test process and evaluation of the approach are described. The approach described in chapter four, consists of a new methodology for inter–organizational service system implementation. In this chapter, we describe the test that was conducted on the approach using expert judgment. Eliciting expert opinion is one form of descriptive evaluation method that can be used in design science research (Hevner et al, 2004). This preliminary test used an expert survey to test the usefulness of the approach as whether it can provide decision makers with mechanisms for coordination of dynamics in a distributed network, assist implementers to analyze the appropriate technology environment for a robust technical infrastructure, and balance trade-offs and enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources, for new networks in volatile contexts. The usefulness test case elicited subjective expert opinion on the prescribed support mechanisms for specified implementation objectives, to derive qualitative evaluations.

Evaluation framework

The theoretical framework used as the basis of this evaluation was introduced in section 4.1. All the three U's are equally important for effective decision support (Keen and Sol, 2007). However, this research only utilizes usefulness and usability dimensions to evaluate the support framework. The reason for considering only these two is that the exploratory case study conducted in chapter 2 did not allow identification and extraction of 'usage' related requirements which can only be obtained through interaction between actual users and the applied support framework. This research, however, acknowledges the importance of the usage dimension and recommends it for future research for implementation in volatile contexts.

The summary of the validation steps is presented in figure 5.1 below.

Figure 5.1 Validation summary



The next sections explain the context of this evaluation in the test summary figure 5.1 above. This chapter presents the starting step *(1) selection of the case study*, step (2), *apply the approach to the case and* (3a), *conduct the preliminary evaluation using the expert survey.* In the next section, the case study design and the expert judgment survey design and findings are presented.

5.2 The test case study

The Test case study to test the usefulness of the approach for inter-organizational service-system implementation in volatile environments was carried out by eliciting information from a group of 30 experts, who were independently selected. Designing the case involves decisions about the object and goal of the study, unit of analysis and use of single or multiple case studies (Yin, 2003). The goal of this study is to refine the proposed approach within the usefulness dimension of the framework. The fist step in the validation of this approach is to select and formulate a suitable Test case study.

5.2.1 Selection of the case study

The case study setting is defined from the volatility context for which the five (5) key mandatory implementation requirements were identified. The characteristics of volatility prevalence for this case are detailed in the

exploratory case study in chapter 2, as large public organizations in developing economies. Hence public universities in Africa were selected as an ideal case setting. In addition, the case preference is supported by the introduction of the emerging inter-organizational networks of public organizations in Africa. Again, characteristics of these networks are detailed in the higher education systems consortia case studies from Southern Africa. The network organizations are no-profit, from a similar business domain, with interdependency, based on unreliable technology and a low skill base to implement and support technical implementation projects.

Objective

The objective is to test the usefulness of the implementation approach, to coordinate network activities develop and implement services systems for inter-organizational, business service systems in volatile contexts. The approach consists of a new methodology with a reference guide of methods, techniques and tools for the execution and evaluation of the inter-organizational business network implementation activities, with minimal complexity. Out of the 5 requirements identified for the approach in chapter 4, the following three requirements were appropriate for testing the usefulness dimension of the approach:

Req # 1: *provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.*

Req # 2: *assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.*

Req # 3: *enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.*

5.2.2 Selection criteria

The selection criteria for the case study, was as follows:

Inherent volatile characteristics

Accordingly, the sites that fulfilled the volatility criteria as detailed in the exploratory case study in chapter 2, were selected

The network characteristics

A multi actor network with the same characteristics detailed in the consortia case study in chapter 2 with different but interacting roles and interests at the

parallel and distributed level: service providers, policy makers whose interests are strategic, IT support and the end user who is the core client is interested in delivery of the service.

Incompatible legacy systems and technology resources

A combination of legacy assets, third party software packages, limited outsourced applications and newly built functionality, with all these parts possibly running on different but meager computing resources. In addition there are free and open source applications and web services available to provide potential source of system components.

Innovation

The project is innovative because there is limited or no prior experience for implementing inter-organizational business system. The innovativeness of a service can be related to the technology used, target group in relation to context, the business model used or new service features/application (Turban et al, 2004). In this case innovation refers to all the above elements.
The above criteria led to the selection of experts from institutions referred to in the exploratory case studies namely Makerere University in Uganda, University of Dar es Salaam in Tanzania, Eduardo Mondlane University in Mozambique and the University of Stellenbosch in South Africa.

5.2.3 Set up of case study

The set up of the case study is described following the structure of case studies: the design of the case study, criteria for site selection, collecting evidence and data analysis.

Design of the test case study

At the start of this case study, there was the assumption that, it is possible to overcome the challenges of volatility in implementing an inter-organizational business information system, by using the appropriate support approach.

5.3 Methodology for conducting the case

In this section the methods and techniques used to conduct the test for the usefulness of Approach, are presented.

5.3.1 Overview of the methodology

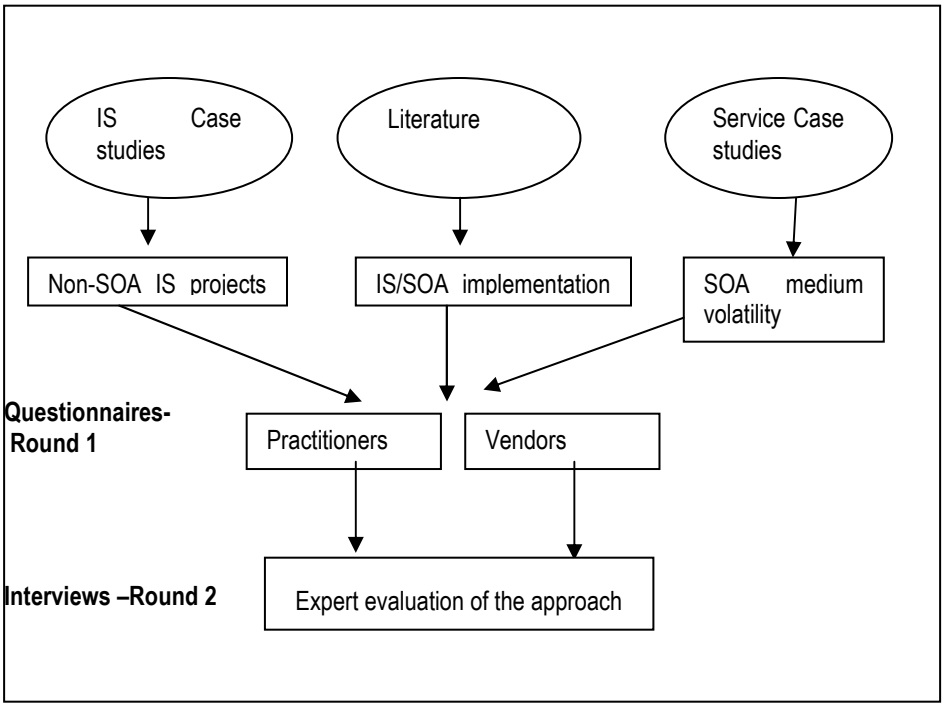
The survey method followed the Delphi approach, which is aimed to elicit information and judgments from participants to facilitate problem solving, planning and decision making (Linstone and Turoff, 1975; Linstone, 1978). The Delphi method is particularly useful in situations where the individuals who

need to interact cannot be brought together in face-to –face exchange of ideas due to time or cost constraints (Kenis, 1995). This is applicable to this research. Using this method information is exchanged via mail, fax or email. In this survey information was exchanged mainly through email complimented by phone interviews.

The Delphi Method

The Delphi method is iterative. The results of the first phase using questionnaires are summarized and the findings used to the second iteration (Linstone and Turoff, 1975). In this case, the survey findings were used in the action case that followed, and thereafter the final evaluation was completed. Accordingly after getting the preliminary results, relationship was maintained with the involved experts for the follow up and gathering sufficient feedback for the validation of the end result.

Figure 5.3.1: Overview of the Expert judgment survey for the implementation approach



5.3.2 Selection of Experts

Forty (40) experts were selected for the expert survey evaluation (see Appendix 5B). The figure of 40 experts was based on the small sampling theory whereby, samples of N ≥30 are recommended to provide better statistical approximations. The target minimum of 30 respondents was important to ensure that the survey data analysis could provide meaningful data interpretation (Spiegel and Stephens, 2000). It was difficult to get a comprehensive, scientific and objective list of practitioners, vendors and researchers from which to base the selection of experts, to ensure a comprehensive validation. To limit subjectivity, experts were selected from the exploratory case study sites presented in chapter 2. In addition, scientific survey documents and indices of technology practitioners in Europe and Africa were used. Other experts were recommended from publications like the *Technology for development* journal, which has an extensive interaction with IT experts from the developing world. From these two sources, a list of IT practitioners in large organizations, researchers and known commercial vendors for IS/Service applications and implementation projects was compiled. The heterogeneous team of experts was based on the following criteria:

The selection of participants was based on the following criteria:

- IS implementation experience/ knowledge= Not less than 10 years.
- Service systems implementation=Not less than 5 years

An important consideration in the selection of experts is whether to use a heterogeneous group of experts or a homogenous one. In order to have a balanced evaluation of the usefulness and usability of the implementation approach for implementation challenges in volatile context, it was necessary to collect information from diverse categories of experts. Accordingly participants were selected not only from implementers, but included other practitioners like researchers, designers and developers as well as commercial vendors with implementation experience in low to high volatility areas. The focus of the survey with the highest number of respondents is the medium to high volatility projects experience. Expert group categories include:

i) Practitioners

- Business IS developers and designers, implementers in public organizations e.g. government institutions and Higher Education ICT implementers
- IS and Service system implementation researchers with experience of volatility in Europe, Asia and Africa
- IS development researchers with track record in developing countries especially Africa

ii) Commercial vendors

5.3.3 Data Collection Instruments

The research method used at the preliminary stage was a questionnaire. The method was largely quantitative to enable elicitation of the findings on

qualitative opinions and suggestions from a wide range and number of experts. In accordance with the Delphi approach the results from the questionnaire survey were used as a starting point for the next level of detailed qualitative research. In this section we define the structure and content of the questionnaire.

i) Questionnaire design[1]

The design of the questionnaire should be in consonance with the objective of eliciting a general evaluation of the usefulness of the prescriptive conceptual model of the approach. The questionnaire used Likert type scale questions with a range from strongly disagree to strongly agree. Likert questions are quick and easy to respond to. They give a wide range of possible scores and increase the statistical analyses available to the researcher (Pallant, 2005). The questionnaire had one open question at the end, to elicit opinion of the respondents about the sufficiency and necessity of the support set proposed for the stated requirements approach. In this section recommendations are elicited.

Questionnaire structure

The questionnaire is structured as follows:

Section 1 (Questions1.1.-1.3)
Validation of expert experience as 10+ years - IS and 5 years –service systems.

In the first section the questionnaire screens the respondents on their experience with implementation of IS and service system projects in volatile settings. The roles within which they participated in the most volatile projects are asked with a view to confirm the required expertise experience for the survey validation. The first proposition made by the research about technology and skills having the highest volatility impact, is tested here.

Lack of adequate technical skills and technology have the most direct and significant volatility impact on IS implementation.

The experts are requested to rank the attributes of volatility by their impact on the critical success factors for IS implementation, introduced in chapter1.

Section 2 (Questions 2.1- 2.6)
The second research proposition that measure the usefulness of the proposed approach is tested in this section.

The prescriptive tools and techniques of the approach have a significant positive effect in supporting the realization of the listed implementation requirements.

[1] For the full questionnaire see Appendix 5A

Accordingly, section 2 elicits opinions about how far the experts agree with the proposed support for each of the 3 requirements listed in section 5.2.1 above.

Section 3 (Questions 3.1 and 3.2)
Section 3 uses an open question to elicit expert opinion on gaps and recommendations for the approach to elicit an open opinion of the respondents about the sufficiency and necessity of the approach. Accordingly, the last proposition is based on an overall evaluation as follows:

The proposed support sets for the requirements, are necessary and sufficient for the prescriptive conceptual approach to facilitate improved implementation practices for inter-organizational service systems in volatile contexts

5.3.4. Expert judgment

The expert validation, a survey research was conducted to elicit expert judgment as to whether the approach is useful for the three specific requirements to resolve the challenges identified for volatile environments in this research. The survey is described in this section. Quantitative and qualitative investigations were used in conducting the survey, the method used for selecting participants as well as data collection and analysis are presented. The evaluation and analysis of the data collected from the experts lead to preliminary findings and inputs into the next stage, for further validation and refinement in the action case study. The definition of an expert adopted for an expert is as follows:
An expert is a person whose knowledge in a specific domain. In this case, the domain is business information system and service system implementation in volatile environments. Expertise is obtained gradually through a period of learning and experience (Turban, 1995). A person's experience can be theoretical, this deals with experience obtained from scientific research or can be practical or it can be a combination of both (Schreiber et al, 2000).This definition explains the scope of expertise that was adopted for this survey.

Methodology for data collection

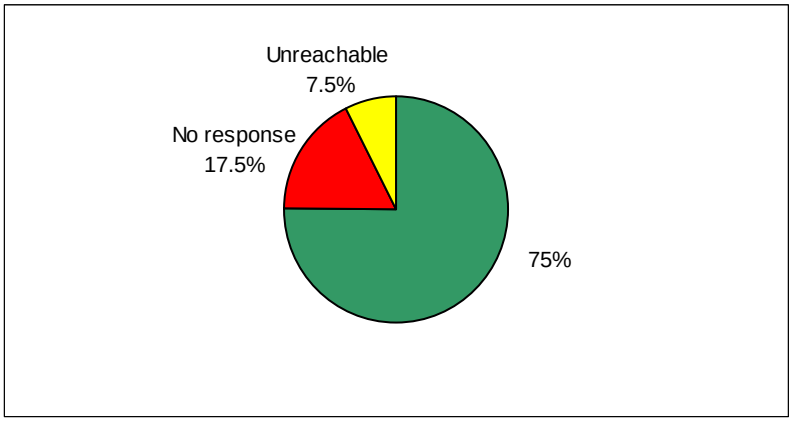
Two options were made available to respondents to fill out the questionnaire and return it either through a website or by filling it out by email. Data collection through a website is gaining popularity and this form of data collection seems to increase (Best and Krueger, 2004). Data collection was anticipated to take one month but it lasted for 3 months. The questionnaires were tested in a trial run with selected participants who are students and colleagues from TUD and the IT support section at Makerere University.

5.4 Data collection

A heterogeneous group of *40 experts* was selected as per the criteria with

researchers, practitioners and commercial vendors who have 10-years-+ experience in IS implementation in general and/or 5 years Service system implementation. There were two options available to filling out the questionnaire: through a website or filling out a template file and submitting by fax. The website was more popular. The attractiveness of this form of data collection seems to increase (Best and Krueger 2004). The data collection process took approximately three months. Figure 5.4 shows reaction of contacted experts. The figure of 40 experts was based on the small sampling theory, where by samples of $N \geq 30$ provide better statistical approximations. This means that the survey data analysis could only provide meaningful data interpretation, from a minimum of 30 respondents returning the filled questionnaire. The initial response got 25 respondents returning the questionnaire. Ten (10) more questionnaires were resent to ensure the target minimum of 30 returns. This was achieved through rigorously following up with phone and email reminders. Figure 5.4 shows the reaction of contacted experts.

Figure 5.4 Reaction of contacted experts



Out of the 40 experts contacted:
30 (75%) filled out and sent back the questionnaire,
7 (17.5%) did not react to the request,
3 (7.5%) were unreachable.

It is concluded that the majority (75%) of the experts filled out the questionnaire and data was collected from these respondents. In view of the survey evaluation it is relevant to observe that the survey got a balanced return of the most experienced experts in terms of longevity of experience in both business IS, and Service systems implementation. The survey got returns from 98% of all respondents selected primarily for their experience in volatile contexts. This was

influenced by the researcher's close association and knowledge of IS practitioners in the field.

5.5 Analysis

The survey tests were conducted using Non parametric tests. Non- parametric statistics refer to tests and methods that are independent of population distributions and associated parameters. These tests were the selected as the suitable option for quantitative analysis that aims to elicit qualitative opinions. The tests are especially valuable for the research data category of non numerical data such as rankings (Spiegel and Stephens, 2000). SPSS was used as standard statistical package to derive some of the relevant quantitative analysis computations. It is suitable for generating survey analysis information for interpretation and tabular and graphical presentations.

The following quantitative analysis steps by (Creswell, 2003 pp.159-161) were followed:

1. Report information about the number of participating practitioners who did not return the survey. A table with numbers and percentages describing respondents and non-respondents is a useful tool to present this information.
2. Discuss the method by which response bias will be determined. Bias means that if non-respondents had responded, their responses would have substantially changed the overall results of the survey (e.g. Wave analysis or respondents/ non-respondent analysis).
3. Identify the tools for statistical analysis and statistical computer program for testing the main questions from the questionnaire. Statistical analysis packages were envisaged for this task, since the data interpretation was to be based on quantitative analysis. SPSS was selected as suitable for generating survey analysis information for interpretation and tabular and graphical presentations. It is recommended as widely used and powerful data analysis package that can handle varying ranges of statistical procedures (Pallant, 2005).
4. Interpret meaning of data: This is the last step of data analysis. Based on the results presented in the previous point, the researcher interprets the data and constructs an evaluation. The evaluation aimed to explicitly answer the initial objective of this exercise to assess the usefulness of the approach.

5.6 Presentation and interpretation of expert survey data

The presentation of the survey results follows the questionnaire design because the data elicitation is progressive and each section fulfils a specific objective within the evaluation. The questionnaire sections and objectives are as follows:

- Section 1- Establishes actual expert levels and participation in volatile

projects, as well as the priority elements of volatility.

- Section 2- Evaluates the usefulness of the approach in facilitating the three requirements.
- Section 3- Elicits recommendations for further improvement on the approach.

A summary analysis for each section is presented by tables and graphs. A grouping of questions that are closely related is done in the presentation of results in section 2. This is followed by the interpretation of the analyzed data. Additional comments to explain context of the findings are provided by the researcher.

5.6.1 Elicitation of opinions about priority elements of volatility

(See section 1 of questionnaire)
This section establishes the background of the experts and elicits their opinion on what influences the most volatility in IS implementation projects measured against the critical success factors of IS implementation.

First, we establish the actual levels of experience for the experts. This is necessary to further confirm the credibility of survey findings, based on actual (not assumed) experience.

Table 5.6.1 (a) Experts IS and service experience

IS experience	No. of experts	%	Service experience in	No. of experts	%
Years of experience			Years of experience		
Below 10	4	13%	Below 5	12	40%
10	23	77%	5years	18	60%
10+	3	10%	5+	0	0

Table 5.6.1 (a) presents an overall summary showing 87% of the experts had 10 year and above experience with IS implementation and, 60% returned 5 years experience with services systems. This is further endorsement to the credibility of the survey findings.

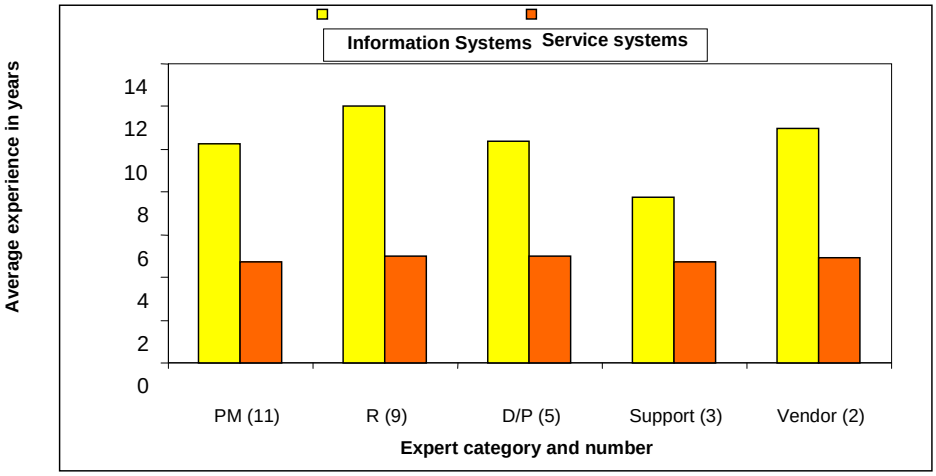
The details of the experts participation category in projects with volatile characteristics survey, numbers per category and their experience (average number of years) in the IS and service system implementation is presented in table 5.6.1(b).

Table 5.6.1 (b) Average experience with IS and service systems implementation by expert category (in years).

Expertise category n=30	No.	IS experience (Av yrs	Service experience (Av. yrs)
Project Manager	11	10.25	4.5
Researcher	9	12.	5.
Designer/Programmer	5	10.4	5
Support	3	7.75	4.75
Vendor	2	11.2	4.6

The tables 5.6.1a) and b) above, confirm the levels of expertise levels required to validate the usefulness of the approach. The selection criteria was a 10-year-+ and 5 yrs experience in business IS and Service system implementation respectively. The findings also confirmed with high percentage, experts as project managers (36%) with practical experience and researchers (30%) in implementation projects affected by volatility characteristics. The project type was in the public sector and the majority went typically beyond the planned schedule. These factors are further validation of expert participation in the typical context of the problem domain and project characteristics considered by the research definition of volatile settings. The results also confirm that service implementation is a new paradigm with comparatively low experience. The expert experience with information systems and service oriented implementation is presented by category in figure 5.6.1 (a).

Figure 5.6.1 (a) Experience with IS and service systems implementation by expert category (in years).



Ranking the factors influencing complexity

In question 1.2, the experts were asked to rank the key elements of IS implementation, that contributed most to the complexity of business IS implementation projects. The ranking of the implementation elements, is based on their impact levels on the critical success factors for IS projects. The success factors which were presented in chapter 1 and 2, are derived from literature sources as the yardstick for IS projects that comply with technical, business and human goals (Mcmanus and Wood-Harper, 2003; Vidgen et al, 2001; Booch, 2003).

The experts used a ranking of 1 to 5 assigned to determine the order of impact for the elements that influence volatility. For this ordinal scale, we used the mode to interpret the findings. The median or mode should be employed as a measure of central tendency for ordinal data. Descriptions using frequencies /percentages of responses in each category can also be applied (Blaikie, 2003) (see figure 5.6.1(b)).

Figure 5.6.1(b) Volatility ranking graph

1=very low 2, = low, 3= moderate, 4= high, 5=very high

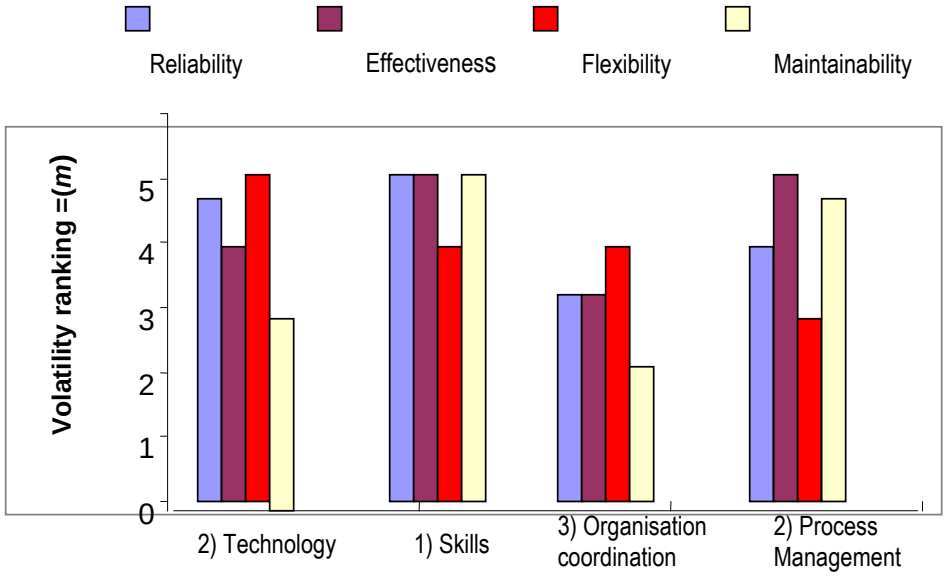


Figure 5.6.1 (b) shows the value score mode (*m*) for the impact of each volatility element, against a critical success factor for IS implementation. An occurrence of *m*=5 for a single element, indicates high volatility impact. Looking superficially at the results above, the preliminary survey result indicate that support for developing technical expertise to implement and support technical projects, has 3 out of 4 factors where *m*=5. This indicates that expert opinion ranks skills development as the number one priority requirement to improve implementation practices in volatile contexts. Technology comes second, with process management. This result also underscores the importance of user–centered approach to implementation.

5.6.2 Section 2-Assessing usefulness of the approach

This section specifically evaluates the *usefulness* of the approach in facilitating solutions for the three proposed requirement stated in section 5.2.1. In section 2, a 5 point Likert scale was used, whereby the experts rated their opinion on the usefulness of the tools, techniques and methods per requirement, on a scale of

1=strongly disagree, 2=disagree,3=Neutral, 4=Agree, 5=Strongly agree. The Likert scale derives ordinal data whereby numbers generally represent verbal statements. The mean, mode and standard deviation were computed in the data analysis. The *mean* (mn) represent the average value score given for the support set per requirement, the *mode* (m) presents the most frequent score, while the *standard deviation* provides a measure of how spread out the dataset is. Similarly to section 5.6.2, the mode (m) was used to interpret the test findings. This is because the arithmetical manipulations required to calculate the mean (and standard deviation), are inappropriate for ordinal data (Blaikie, 2003; Clegg, 1998). For ordinal data, the median or mode should be employed as a measure of central tendency (Blaikie, 2003).

The findings for usefulness test were analyzed based on the following positive indicators for *Usefulness*:

- Low frequency of neutral scores that indicated that more experts have experience to evaluate the support.
- High frequency of *strongly agree (m=5)* scores – Indicates a high endorsement on the usefulness of the support for the stated requirement
- High overall average score per requirement

Table 5.6.2: Responses on the usefulness of the prescribed approach

Give your opinion on the usefulness of the proposed tools and techniques to support the requirement. The approach should:

Req # 1: *provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.* *n=30*		*1=strongly disagree, 2=disagree, 3=Neutral, 4=Agree, 5=Strongly agree.*							
objective	support	1	2	3	4	5	Mn	SD	M
Decision making	Group support systems, Network trade-off guidelines.	0	0	8	12	10	4.0	1.2	4
Define actor, role and responsibilities	Role checklist for a provider/consumer business model	0	0	2	12	16	4.4	0.9	5
Distributed and parallel	Meetings	0	0	0	16	14	4.4	0.8	4

communication	Online forums								
Formalize business collaboration	Letters of intention, Agreements for exploration and contracts for exploitation	0	0	7	15	8	4.0	1.1	4
Req # 2: *assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.* .									
Flexibility of service delivery	-Technology trade off guidelines -Analyse best practice service infrastructures -Three tier architecture	0	0	10	12	8	3.9	0.7	4
Inter-network /parallel access	Remote service strategy	0	0	13	12	5	3.7	1.1	3
Network access and reliability	-Specify minimum requirements -Bandwidth procurement consortia -Bandwidth management guidelines	0	0	4	13	13	3.8	0.6	4
Integration of available system and technology component	IT infrastructure library guidelines Service wrapper	0	0	17	7	6	3.4	0.9	3
Req #3: *enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.*									
Optimize use of best available expertise	-Survey available expertise and identify training needs. -Start nucleus with champion organization. -Inter-network skill pool and resource centre	0	0	2	11	17	4.5	0.6	5
Sustainable capacity building	-Institutional incubators -Free and open source applications and	0	0	9	10	11	4.0	1.0	5

	platforms.								
Distributed and parallel support	Online help desk facility	0	0	11	10	9	3.9	1.1	4
Devolve technical user support	Institutionalize user training. Adopt hybrid training.	0	0	5	13	12	4.2	1.1	4

With regard to the potential usefulness of the proposed support sets for each of the three requirements, the experts were positive about their usefulness in supporting the implementation of volatile environments. This is shown by the highest overall occurrence of (m=4). It was also noted from the results that the experts that the prescribed technology support scored the only two neutral scores (m=3). This may be attributed to the fact that the service paradigm is new and experience with required technology maybe limited, among practitioners. The experts agreed with most with the usefulness of the approach to support the optimization of technical skills which scored with the highest number of 5 (m =5). This is in line with prior findings in section 5.6.1, where the skills deficiency was scored as the highest impact volatility factor, making it the highest priority for improving implementation practices in volatile contexts.

5.6.3 Summary evaluation of the approach

(See section 3 of the questionnaire)
In this section, the experts evaluated overall usefulness of the proposed approach and provided recommendations for further improvement of the approach. There was general agreement that the approach would prescribe the means to the stated requirements leading to improved inter-organizational implementation practices. This is a positive but not a conclusive validation as shown by the expert comments and recommendations. The experts recommended the following additional elements for the Approach:
i) Integration of heterogeneous business systems, departmental data and various services should be given more emphasis.
ii) Tools and techniques for a common development base that maintains individual systems with inter-organizational interoperability.
iii) Tools and methodologies to fast track changes in organizational culture and plan long term business strategies. A suggestion was made to utilize the *Future search* methodology.
iv) Tools and methodologies to model/evaluate existing business processes and compare with proposed new business processes.
v) Monitoring and Evaluation (M&E) tools.

5.6.4 A summary interpretation of expert survey research findings.

The test was conducted as a preliminary validation to provide indications of

usefulness and derive elements for further improvement of the prescribed approach. The survey used the questionnaire returns from 30 implementation /service systems experts, to validate the usefulness of the approach for reducing complexity for inter-organizational service system implementation in volatile contexts. The expert respondents who participated in this survey had a 10 year average in business IS implementation and 5 years for Service oriented systems.

All the research propositions made for each of the three sections of the questionnaire were been supported by the findings as follows:

Section 1: *Lack of adequate technical skills and technology have the most direct and significant volatility impact on IS implementation.*
The experts confirm the lack of technical skills as the biggest challenge for reducing complexity of IS projects implementation in volatile contexts. Consistently 87% *strongly agree* that, service centers and open source development platforms would optimize the low skill base for implementation and support of technical projects.

***Section 2**: The prescriptive tools and techniques of the approach have a significant positive effect in supporting the realization of the 3 listed inter - organizational implementation requirements.*
The methods, techniques and tools for the proposed approach are potentially useful to facilitate the 3 requirements for inter-organizational implementation, as demonstrated by the overall score value of (m= 4).

***Section 3:** The proposed support sets for the requirements, are necessary and sufficient for the prescriptive conceptual approach to facilitate improved implementation practices for inter-organizational service systems in volatile contexts.*
The expert were positive about the usefulness of the approach to resolve the stated requirements but, presented further issues for improvement which can be investigated in further refinement cycles for the approach. The recommendations are highlighted in the conclusion below.

5.7 Conclusion

In this chapter, the usefulness of the approach was tested using an expert judgment survey. According to the experts, the approach is potentially useful to improve the efficiency of the implementation practices for service systems in emerging networks affected by volatility. The usefulness test was conducted by eliciting expert opinion on whether the approach could facilitate three of the five requirements of the approach referred to in section 5.2.1 to satisfy the following:

- To provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks,

- To assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system and
- To enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.

The low returns of neutral scores for assessing the techniques, tools and methods to address specific requirements demonstrated that the experts agreed that the proposed support was useful in the way proposed for each of the 3 requirements. We now relate the expert survey findings to the overall research objective. In chapter 2, the exploratory case study highlighted issues of volatility that constrained the implementation of service system implementation in inter-organizational networks. For such networks working with resource scarcity and, notably deficiencies in skills and infrastructure, the experts agree that the approach proposed in this research, can be used to assist implementation practitioners, to coordinate network activities and sustain business collaboration, prescribe technology requirements, design, develop and support reliable service systems with optimized resources.

However, as indicated in the last section (3) of the questionnaire, the experts also raised gaps in the support sets and further usability issues.
The following points were extracted from the suggestions given by respondents:

- For networks in volatile contexts, additional requirements for tools and methodologies were proposed to include methodologies to change organization culture to roadmap long term business strategies and to model/evaluate existing business processes and compare with proposed new business processes. This is a usability issue.
- Observations were made that trust was not emphasized enough in network sustainability. This will require an explicit component in the assessment of stakeholders' opinions about pre requisites for successful business network formation and sustainability.
- A more explicit role for monitoring and evaluation (M&E) tools and activities in such networks were critical.

The expert endorsement of the usefulness of the approach is a positive preliminary step in this validation. However, it is not conclusive as it is yet to test the approach in meeting the pending usability issues. To complete the evaluation, the usability requirements should be evaluated. This was done using the action research case study in the next chapter.

Chapter 6: An empirical validation of the implementation approach

6.1 Introduction

In this chapter, we discuss the tests conducted using the action research case study, to evaluate the usability dimension of the approach. Usability is a general concept that cannot be measured but, it is related to several usability parameters that can be measured. Measurable usability parameters fall into two categories:

- Subjective user preference measures assessing how much the users like the system
- Objective performance measures, which measure how capable the users are at using the system (Nielsen and Levy, 1994).

The usability test of the approach evaluates subjective measures from the implementers using the approach. Subjective measures fulfil the objective of the meta-analysis for this evaluation aimed at measuring potential for adoption in a limited case study context. To test the usability of the approach, the action research case study was used to evaluate if the approach met the last two requirements, (out of five) which focused on usability. This evaluation is a further refinement of the approach as indicated from the usefulness tests conducted in the previous chapter, using expert judgement. Results from the expert survey which focused on the three usefulness requirements, showed that the approach was potentially useful but, these results were not a conclusive evaluation of the approach, because further refinement was necessary to test the usability dimension.

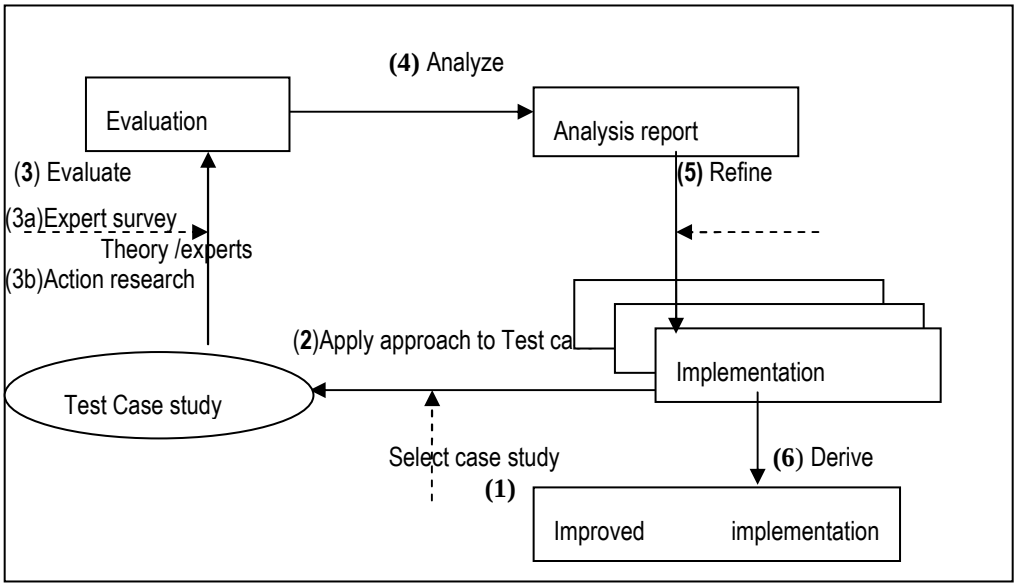
The *Usability* of the approach was tested to see if it could:

Req # 4: *provide means for conducting a user–centred implementation within a controlled process that tracks changing user appreciation and provides feedback.*

Req # 5: *assist the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity*

We first describe the action research case that was used in the evaluation. Next, we describe how the approach for service system implementation was applied in an inter-organisational network. Finally, the results of the usability test are presented, followed by the conclusions for the final evaluation of the approach. The validation stages presented in this chapter are shown as **(3b**) *Action case evaluation* and **(4)** *analyse*, **(5)** *(refine)* in figure 6.1 below:

Figure 6.1 validation context



6.2 Action research case study

In this section we present the inter-university registration information system (IRIS) case study based on the site selection criteria for volatile and inter-organizational networks, presented in section 5.3.2. Action research is a type of investigation combining practice and theory that is designed to cooperate with and support enfranchised actors and groups in a system study (Williams et al, 1988). The strength of this action research case study is to validate the usability of the approach for requirements, which comprise the complex relationships between the people (different stakeholders), the processes (implementation) and the technology (new service orientation). Even with time and cost constraints, it was acknowledged that these usability requirements are dynamic and therefore can only be satisfactorily tested in as close to real life environment as possible.

6.2.1 The inter-university registration information system (IRIS) network

The IRIS implementation project was undertaken by three founder universities of the Research and education network of Uganda (RENU). The three members were Makerere University, Mukono Christian University and Kyambogo University in Uganda (East Africa). RENU is an emerging network formed in February 2006, to initiate higher education collaboration in education and research.

6.3 The IRIS implementation case study

In this section, we describe how the inter university registration system (IRIS) was developed, tested in an interuniversity network 'test bed' of the three universities.

Occasion
The network goal was sustainable quality service delivery through affordable IT resources and development of local skills capacity. The IRIS network was a prime case candidate to test the proposed approach for improved implementation practices in the inter-organisational volatile context. All three universities had an ongoing, incomplete or failed attempt at development of such a system.

Set up of the project
The set up of the project is described following the structure of case studies outlined below ie the design of the project, criteria for site selection, collecting evidence and data analysis.

Criteria for selection
The site fulfilled the criteria of selection defined in section 5.3.2. In addition, the choice of the student registration service for the case study implementation was consistent with the justification given in chapter 2 exploratory case studies. Student administration system is core to university business, and difficult to adapt from commercial software.

Time constraint
In addition the 'test bed' case study should be conducted in a relatively short time frame of at most 5 months from October 2006 to February 2007.

Design of the action research IRIS project
The starting assumption for this case study was that 'it is possible to develop an inter –organisational service oriented business system within a short time frame, that provides value to the users by following an implementation approach that facilitates a user- centred implementation and integrates available technology resources with minimal complexity, to balance the user service formula, technology and the value network. The researcher acted as innovator-participant in the action research case study.

Case objective
The objective of the IRIS case study was to implement an efficient and reliable inter-organizational registration system pilot for the three universities. The objective was achieved by applying the PADTR methodology (introduced in chapter 4) supported by the prescribed support for a user–centred implementation and integration of existing systems and technology components to develop the IRIS. Focusing on the usability requirements to test the approach

referred to in section 6.1, was done in the following broad steps:
For the user centred approach, the implementers

- defined the critical stages for user involvement.
- applied participative approaches and tools.

For the integration of available systems and web components to develop IRIS,

- available systems and web components for IRIS development were reviewed,
- selected and integrated relevant components for the development of IRIS.

To assess the usability dimension, implementers evaluated the proposed methodology as to whether it was usable in supporting the realisation of user functional and non-functional requirements.

6.3.1 IRIS Project evaluation framework

The IRIS project enabled the usability test of the approach, which constitutes of the PADTR methodology and support techniques and tools. The methodology combines the stepwise sequence of phase execution of the waterfall model made up of the phases, Preparation, Analysis, development, Testing and Realisation (PADTR). The phased activities are conducted in an iterative sequence of the spiral model (Boehm, 1988). The implementation support evaluation focused on the usability requirements for the user-centred implementation and selection and integration of available technology components to develop IRIS. The approach recommends a user centred implementation that utilises participative approaches with collaborative approaches for the multi actor context, complimented by requirements management that monitors user appreciation as the system evolves. Using the PADTR methodology, the case study incorporated the basic elements in usability engineering; an empirical user test and prototyping combined with iterative design (Nielsen and Bellcore, 1992).

6.4 Implementation of the IRIS case study

In this section a description of how the Case was implemented using the PADTR methodology is presented. The activities that were conducted and the results for each stage are described.

6.4.1 Preparation

A high level meeting of Academic registrars and Deputy vice chancellors in charge of academic affairs was held to agree and give formal commitment to collaborate on the IRIS implementation. The motivation for the formation of the business network was agreed as the challenge of leveraging computerized information systems across various functions, to reduce high initial and recurrent costs. It was anticipated that the IRIS service implementation network would add value to university business in the following ways:

- Cost effective registration of users for each academic institution.
- Exploit the abundant student resources to prototype such a system at a very minimal cost. If successful, it can be scaled up by replicating the process.
- Synchronize each institutional registration routines through the use of a generic system, later enabling easy information exchange.
- Other value added services.

The anticipated system would ultimately be scalable, permitting each academic institution to build into it additional functionality as per their needs.

As a means of reducing uncertainty for the network collaboration and sustainability, guideline 3.1 was emphasized. The IRIS network was based on prior relational ties and embedded relationships (Granovertter, 1985; Uzzi, 1996). The three institutions had prior IT collaborations as founder members of RENU. The outputs of this meeting were:

- Minutes of meeting.
- Consensus on business agenda.
- Letters of commitment.
- Work plan.
- Formation of the project steering and project management committees.

The project management committee

A team of 6 people was set up to coordinate and manage the project activities. It included 4 members from Makerere University (champion and host) and one from each of the two partner institutions. The team had weekly project management meetings from the inception of the project.

Introducing the PADTR methodology and approach

At the first meeting of the project management committee, a brief was given to the development team (6) and the project management team (6) about the PADTR methodology to be used for implementation. This was a presentation by the researcher on a stage by stage basis. The brief was followed by a question session**.** The developers raised doubts about feasibility of user participation at all stages of the implementation. Concern was also expressed about the modelling skills of the developers, most of whom were apprentice programmers and, whether it was possible to review and integrate available system components and comply with user requirements.

The outputs from the project management team included:

- The work plan (figure 6.4.1 (a); activity schedule) IRIS activities and deliverables (table 6.4.1).
- the implementation role checklist (figure 6.4.1 (b) and role descriptions

(Appendix 6C).

As prescribed by the approach, a role check list was generated to assign project responsibilities, roles and tasks (Maitland et al (2003).

- System review criteria (see section 6.4.3).

Figure 6.4.1 (a) IRIS Activity schedule using the PADTR method

ID	Task Name	Duration	Start	Finish
1	Preparation	98 days?	Wed 10/4/06	Fri 2/16/07
2	Analysis	87 days?	Wed 9/20/06	Thu 1/18/07
3	Development	44 days?	Tue 12/19/06	Fri 2/16/07
4	Testing and Evaluation	31 days?	Fri 2/16/07	Fri 3/30/07
5	Roll-out of pilot application	20 days?	Mon 4/2/07	Fri 4/27/07
6	Documentation	158 days?	Wed 9/20/06	Fri 4/27/07

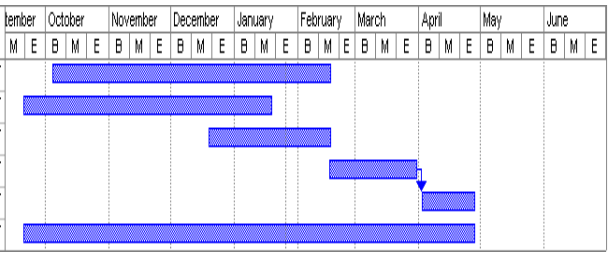


Figure 6.4.1 (b) IRIS Implementation project roles (see Appendix 6.4.1 for descriptions)

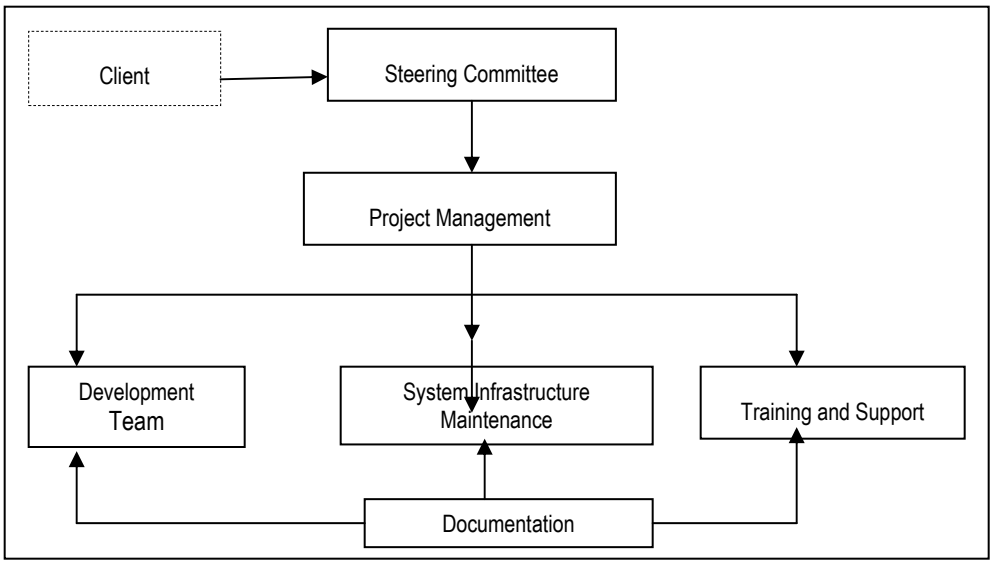


Table 6.4.1: - The IRIS project- Activity break-down and deliverables.

Activity	Sub Activities	Participants	Deliverables/Outcome
1 Preparation	1.1 Identifying participating institutions 1.2 Presentations to various participating Academic Institutions 1.3 Identifying a generic registration procedure 1.4 Identifying and training developers from participating institutions 1.5 Documentation (meetings, presentations, invitations etc)	-Steering committee -Project management team -Developers -Content providers	a) Participating institutions b) List of contact persons within each institution c) Letters of invitation and commitment d) Common business agenda e) Tentative work plan f) An agreed upon registration procedure adaptable to each institution g) List of developers from each institution h) Breakdown of tasks per institution capabilities
2 Analysis	2.1 Requirements elicitation 2.2 Requirements analysis 2.3 Review of available MIS 2.4 Documentation of requirements and MIS reviews	-Project management team -Systems analyst -Developer -Selected stakeholders	a) Preliminary sequence of registration process at each institution b) Stakeholders' meeting to finalise requirements c) List of potential open source MIS for review and evaluation criteria. d) Identification of the best MIS at present to use to in the development of the system

Activity	Sub Activities	Participants	Deliverables/Outcome
3 Development	3.1 Design of logic flow diagrams 3.2 Design of graphical layouts for final system 3.3 Identify and select various open source MIS components 3.4 Development of final system 3.5 Documentation of Development Activities and selection criteria for MIS components	-Development team	a) Logic flow diagrams b) Graphical layouts c) Selected system components **d)** A draft bare bones registration system
4 Testing	4.1 Testing the system at each institution 4.2 Revision of the system based test feedback 4.3 Documentation of requirements for testing, procedures and evaluation.	-Developers -Test groups - IT Support	a) Evaluation report b) A complete and working bare bones registration system c) Test log
5 Roll-out	5.1 Customization of application to each Institution 5.2 Installation of application 5.3 Documentation of the customisation needs	-Developers -IT support	a) A complete and working bare bones registration system customized to the Institution.. b) Scaling-up plan

6.4.2 Analysis activities

Registration profile report and review report of current system

These were the two main inputs into the analysis stage. Requirements Elicitation was preceded by the analysis of the institutional registration profile and work flow. This was elicited using a similar format for all institutions. The aim was to get a better understanding of common registration functionalities and differences. A registration system review report was generated and from this review, the preliminary list of core IRIS services was derived to start off the stakeholder requirements elicitation process.

Stakeholder meeting for requirements elicitation

The elicitation process was a point of focus for the case study because analysis is the trigger of user involvement to define the user value proposition (Booch, 1999; Van de Kar, 2004). This is a focal stage that initiates the usability test of the approach for the user – centred implementation requirement. A stakeholder group meeting was convened to decide the core IRIS services for implementation. The constraints to be considered in the selection of services for the pilot implementation, was business importance and feasibility of execution within the short time frame of 5 months. The elicitation was conducted in 3 stages: brain storming, problem analysis and convergence.

Participants – There were 15 participants from the 3 institutions; Students = 5, Faculty = 4 deans, registrars=4, IT personnel (moderators in charge of the session) =2, rapporteur = 1 (recorded the proceedings and assisted the moderators) and the researcher as participant observer = 1.

The GSS session *A Group support system (GSS)* (pen and paper version), was adopted in the design process (with some limitations), to improvise for the lack of the group support software. The purpose of this methodology was to decide on an acceptable set of core system requirements. The GSS and plenary sessions were loosely structured but productive because the stakeholders were moderately conversant with the registration system, issues and challenges. This adaptation was useful to cater for the success factors of parallel input, anonymity contribution and session recording in negotiation sessions (De Vreede and Muller, 1997). The GSS was conducted as follows: Three 'thinklets' that could be useful to the early phases of the elicitation process and executable in a short time, were selected.

- **Introduction** –An introduction of the objective of the meeting and work procedures were given. A brief about the 'pen and paper' GSS session was presented to enable participants to familiarize themselves with the objectives of the elicitation process, the methodology to be used and process for the session**.**

Stage 1: Brainstorming session (free brainstorm)

To start the brain storming session participants were asked to comment on the preliminary IRIS functionality presented by the developers, with additions, modifications or deletions. The list included a spectrum of registration functions and services which were prepared prior to the meeting. The question was "What services would you like IRIS to provide?" The participants were given a pad of yellow sticky notes and pens to write their answers. The notes were collected and answers collated to derive the functionality that was eliminated or added. The second iteration was put up and the new list with additions and eliminations was generated. The functionality and service list from the brainstorming stage is shown in table 6.4.2.

Table 6.4.2 Stage 1: Brain storming results

Registration and related functions	Service /outputs
1. Student data capture.	Student bio and programme data report.
2. Verification.	Verified student data.
3. Certification.	Id card and certificate.
4. Performance data capture & grading.	Progress grading report.
5. Generate Examination timetable.	Exam timetable.
6. Exam result Data capture & grading.	Examination grades report.
7. Issue academic transcripts.	End of year and graduation transcripts.

Problem analysis (fast focus) - stage 2

In the second stage the list of selected requirements was put to a vote to eliminate further requirements. Participants were asked to eliminate requirements and identify implementation constraints for those requirements. In addition, the participants were told to focus and on core registration solutions that could realistically be executed within the 5 months period. From the list, of functions and services, items 4 to 7 were eliminated. Participants felt that they were not the priority core registration functions and were dependant on items 1, 2, and 3. Besides it was not feasible to implement them within the time constraint. The selected core registration functions are shown below.

Stage 2: Problem analysis results

Registration and related functions	Service /outputs
1.Student data capture	Student bio and programme data report
2.Verification	Student validation (Verified student report)
3.Certification	Id card and certificate

Stage 3 - Convergence: Plenary session to generate solution

A plenary session involving a detailed open discussion that was structured by a question guide, complimented the GSS session. The questions were based on critical common issues and challenges, derived from the registration profiles of the three partner institutions. A detailed discussion on the selected IRIS functionality, regarding process efficiency and effectiveness, was guided by questions that were aimed to determine non-functional requirements, highlight issues and constraints and check completeness. Negotiation issues were not critical. The results are presented in table 6.4.2 (a).

Table 6.4.2 (a) Guide questions for IRIS requirements formulation

Registration step	Guide question	Basic functionality requirements
1.Capturing student information	How should the data be captured?	IRIS needs to support both online data capture as well as a parallel paper-based system to take into account the prevailing conditions within each institution.
	Where should the student data go?	-Faculty -Registrar -Student
2.Verifying student information	What are the critical points of verification?	-Authenticate all relevant documents -Validate Course admission -Verify payment
	Can payment be based on credit units taken by a student?	-Guided by institutional payment policy
3. Certifying registration completion	How should we indicate completion of the registration process?	IRIS must support a hierarchy of outputs that include: -Registration card/certificate -Program/course information, -Ability to generate an examination card/permit for a fully registered student and examination lists -Produce a student ID or directly link into systems that produce student Ids.
	Where should the registration information be transmitted and why?	-Faculties, The library, Dean of students office, Finance department, hospital/clinic, Security department and occasionally to the Ministry of Education and Sports. -Interface and generate standard reports.

Results of the requirements elicitation workshop

The participants agreed that registration consisted of 3 broad steps:

- Capturing student information
- Verifying student information
- Certifying student registration

The basic IRIS requirements for the pilot are summarised in two categories of functional and non –functional requirements in Appendix 6.4.2 (b).

A user satisfaction test was conducted for the group support session using a 4-7-point Likert questions (Den Hengst et al, 2004).The overall conclusion was that all participants were satisfied with the product and the process. (For questionnaire and responses, see Appendix 6.4.2).

6.4.3 Development

The lack of adequate technical skills especially in software development was as key cause of complexity. The individual institutions in the IRIS network did not have the sufficient technical skills, or facilities for development in a distributed environment. As seen from best practice in the consortia case study, the network consolidated scarce programming and support skills into a nucleus resource center hosted by the champion; Makerere University. The IRIS development team constituted of 6 people; 2 qualified developers and the rest were co opted computer science student apprentices from the software incubator at Makerere University. The two partner institutions' contribution was inconsistent and infrequent, because of the physical distance to the development host.

After requirements analysis, the design process began with iterative consultations with the users Wiklund (1994). The iterations used models to elicit user feedback about design requirements. Modelling activities included the following:

- Design of logic flow diagrams (D1)
- Design of graphical layouts for final system.

Other development activities included:

- Identify and select various open source MIS components (D3)
- Development of final system and documentation of development activities and identification criteria for the selection of the various MIS components.

Modelling

Primarily, UML modelling was used, specifically the activity diagrams to capture the operational context, representing the overall hierarchical order by which activities were executed. The technical design for IRIS was sent out to the elicitation workshop participants, to review procedures and information requirements. The current and proposed registration work flows for IRIS are illustrated in figures 6.4.3 (a) and (b).

Figure 6.4.3: (a) Graphical Illustrations of Current registration practice

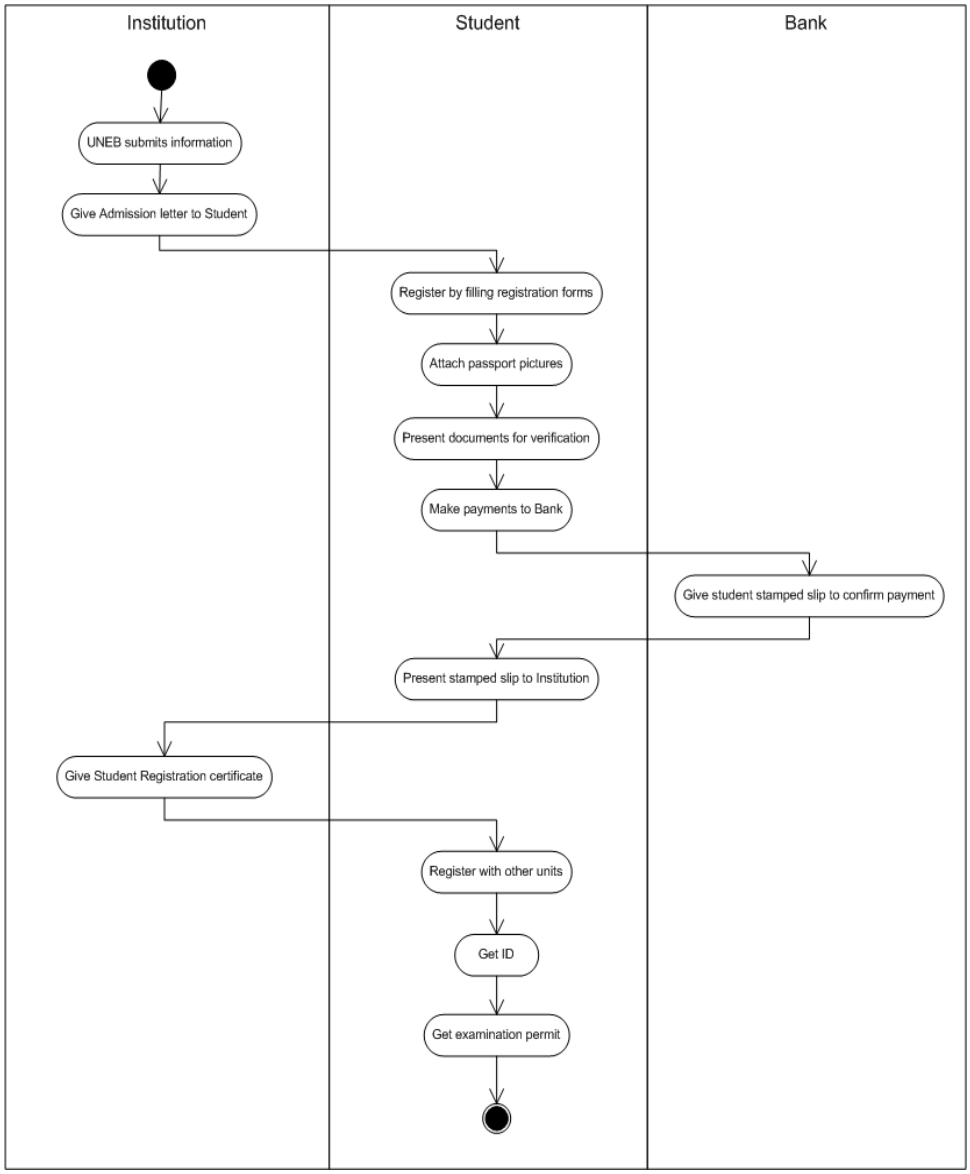
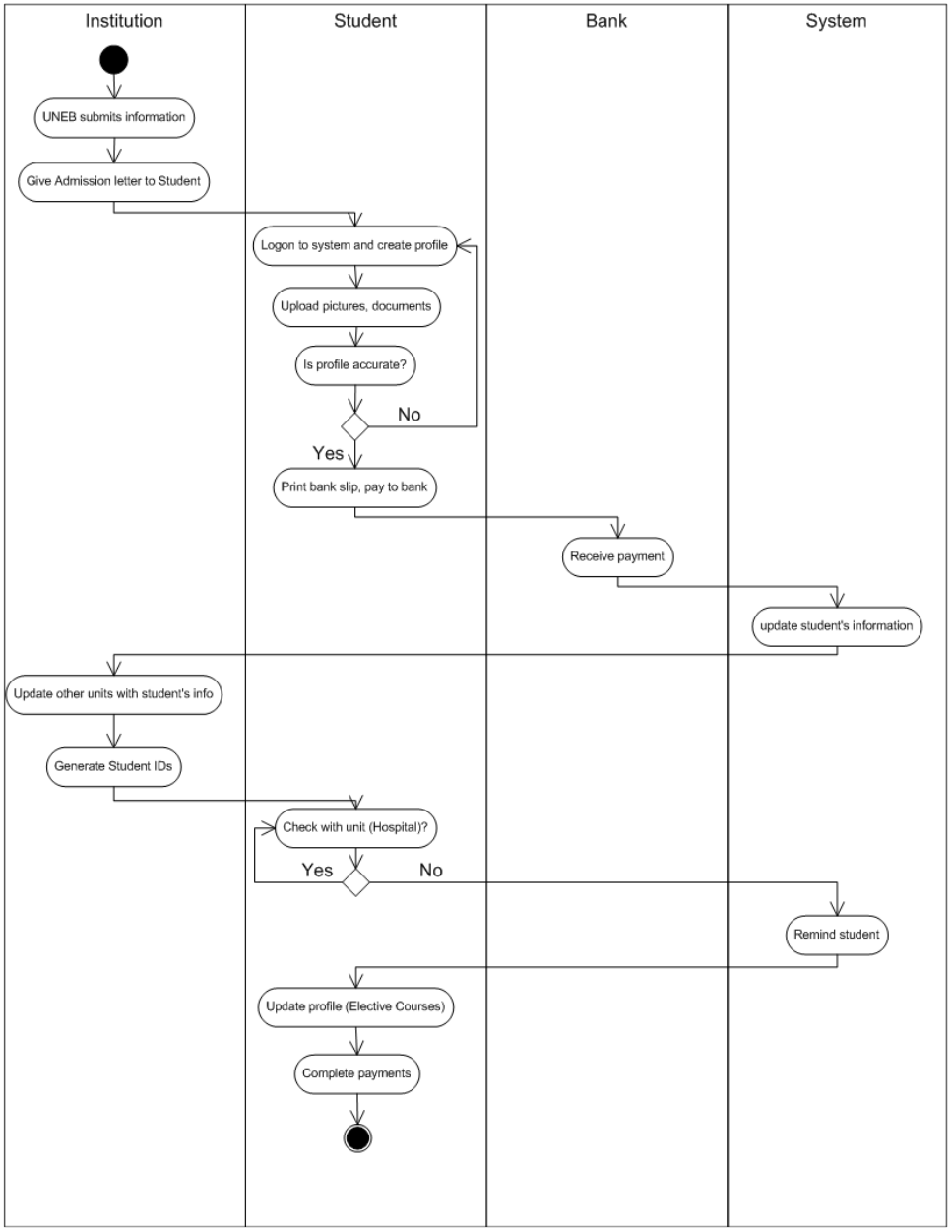


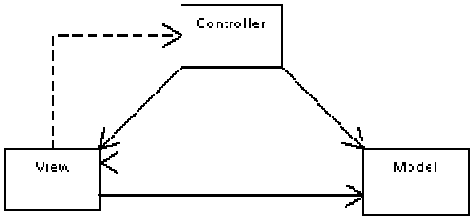
Figure 6.4.3 (b) Graphical Illustrations of proposed IRIS registration practice



Technical architecture for IRIS

After the finalising the design with user consultation, the developers selected the IRIS architecture. In this section we describe the IRIS architecture and selection of components to develop the application, based on the prescribed methods and tools of the approach. This section is also important for the case study usability test objective, to assess whether the approach provides means to select and integrate available technology components and system resources, for networks that need to balance low maintenance with reliable services. The first priority in the selection of development platforms was a technology –free standard that could support a wide range of applications. IRIS was developed around the MVC (Model, View Controller) architecture referred to in section 4.5, in accordance with the design of the supporting (KEWL NextGen) framework.

Figure 6.4.3 (c) MVC Architecture



In accordance with the standard three tier architecture for service systems prescribed in the Approach, the IRIS technical architecture consisted of the following layers:

- An Inter- university campus network.
- The Internet was the second layer of IRIS where all information retrieval from the IRIS portal was requested and provided through the Internet.

Content was availed for the IRIS portal via a connection from the campus networks (via a fire wall) to the Internet (off–peak hours). The minimum technical infrastructure requirements in terms of configuration and various network equipment like routers, firewalls each campus network were prescribed. The prescribed minimum infrastructure capacity for each member institution, were:

- A server with at least a Pentium 3 processor, 256MB of RAM and 1GB of free available disk space, Linux or Free BSD operating system (with all the relevant patches or updates for security),
- Stable LANs from which to access the system, with Ethernet (10/100MB) speeds) or a reliable Internet connection with an average speed of 2KB/s (downlink).
- A fully operational client computers running at least windows 98, with Internet explorer 5 onwards, or any other graphical based operating system equipped with a W3C standards compliant web.

Selection and integration of available and web components

The selection of the development framework was done using the following guidelines stated in section 4.4.4.
A rating of the software criteria was done to select the best option as shown in the table below.

General Software quality evaluation

Grading: 1=Weak, 2=Fair, 3=good, 4=Very Good, 5=Excellent

Factors	Moodle	Mambo	Joomla	KEWL	Chisimba
Ease of installation	5	5	5	3	2
Ease of use/navigation	5	4	4	4	4
Ease of development of system modules/scalability	2	4	4	3	3
Visual appeal and ease of interface re-design	5	3	3	5	5
Availability of documentation	2	4	4	5	5
Level of security	4	3	2	5	5
Total	**23**	**23**	**22**	**25**	**24**

Using this selection criteria, *the Knowledge Environment for Web-based Learning (KEWL)* framework, was adopted as the as the best framework to adopt for the IRIS development. KEWL, (pronounced cool) is a Free and Open Source Learning Management System (LMS) that runs on Apache, MySQL and PHP. It was developed at the University of the Western Cape (UWC) in South Africa, to facilitate research into collaborative online learning. To date 12 African universities including Makerere University are part of the parallel/distributed, user/development forge. This tried and tested, home-grown solution developed by Africans and tailored to African/global requirements, was a sustainable and ideal platform choice for the IRIS implementation case.

The desirable attributes of KEWL platform were the use of existing, free and open software components that would reduce cost, use the best available applications, with low demand on the scarce development resources and support low maintenance and scalability (Brown, 2000). These attributes also supported the IRIS network goal of implementing reliable, sustainable business systems. In reality this principle cannot be strictly observed entirely because existing technologies may not suffice to build a system that fulfils user requirements. In the case of IRIS, implementers agreed that an investigation of existing

applications did not produce components for a complete compliance with user needs.

Application and content design

User participation

As recommended by the user–centric approach, models and tools for elicitation of user feedback for iterative changes should be articulated and, instruments to collect user suggestions for incorporation into the new system should be determined at this stage. The development team identified 3 critical points where user involvement was required. The three stages were:

- Review of the application and content design.
- Review of the user interface.
- The testing and roll out of the application.

Group user representatives for the three groups; student, faculty and registrar were selected. The representatives were the most active and willing participants in each group and their role was to attend weekly project management meetings where progress briefs were given by the lead developer. The representatives were also invited to review the content and proposed design and, communicated progress to their group via the mailing list. Besides the weekly project management meetings, the developers had technical meetings. Communication was frequent via the sub committee mailing lists.

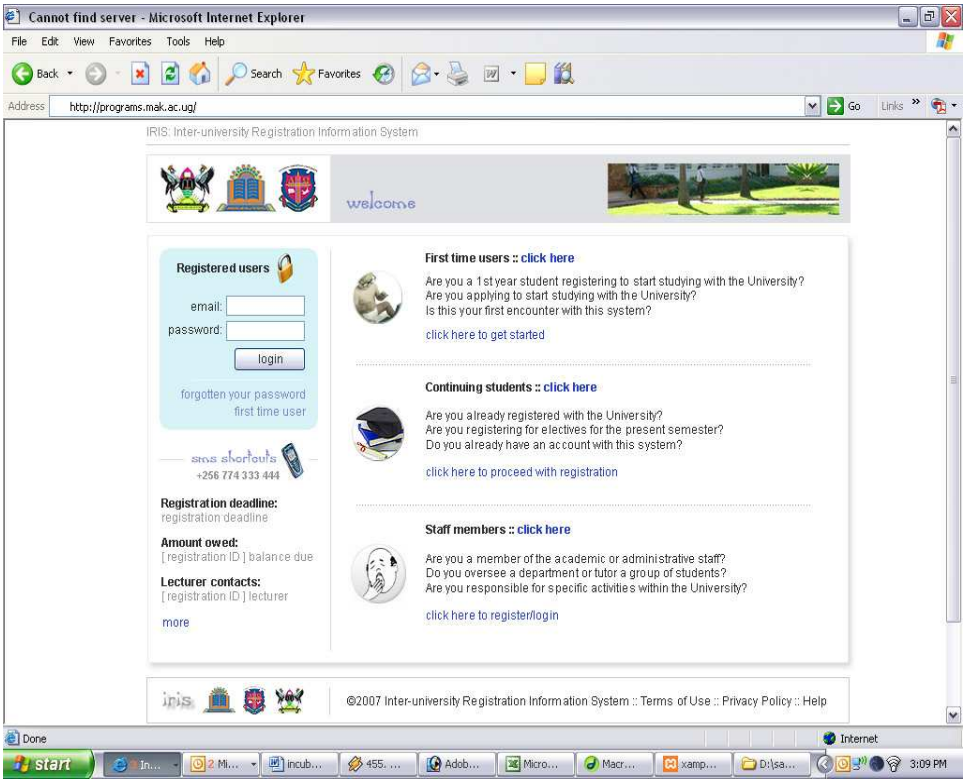
Content and application design

Content was supplied by the academic registrar's office and the design format was largely determined by the current registration forms for student data capture. The forms were reviewed by the registrar's office with the user representatives, to remove redundant data fields and for completeness of data capture requirements. Common data capture elements were processed into the IRIS application design and differences were logged for customisation at individual institutional sites. The content group also described the required formats of the content to include email and phone text communication, web browsing audio and video capabilities. Content here refers to what users will trigger and this includes text, graphics, web pages, emails, audio and video.

The application design was largely dependant on the content description, the technical architecture and selected platforms based on the KEWL framework. The screens emulated the data capture forms prescribed by the registrar. The user group also provided input for the look and feel of the interface; font, colours and text. A graphical artist produced paper prototypes for the key interfaces to be valuated by the users until convergence emerged on the choice. A team of 2 programmers and 3 apprentice students programmed the software, tested it and partially documented the process. After five weeks, the first prototype was delivered for testing by the user group representatives and other

active students. The evaluation of the first prototype was mainly based on the visual aspects, navigation, speeds, ease of use and reliability (see quality assurance test for users; appendix 6A i). Users gave further suggestions on the navigation and icons, colour improvements and the ability to have a single access to all IRIS functions. The 'final' prototype (for the case study purposes), was produced after 4 months in mid February 2007. The IRIS home page and lay out screens are presented in figures 6.4.3 (a) and (b).

Figure 6.4.3 (a) IRIS home page



Documentation was a core element of the IRIS implementation primarily because this was a learning experience that requires iterative refinements of the system. All user feedback was recorded in all test sessions. Quality assurance tests for users and test criteria checks to avoid propagation of faults in the system were developed (see appendix 6 A ii).

Figure 6.4.3 (b) Student data capture screen (Registration)

6.4.4 Testing

The first usage system test was conducted at Makerere University, with 18 students. To run a usage test, the following steps by Isaacs and Walendowski (2002), were used in the case study. Participants were organised in three test groups at three different days in the same venue (see table 6.4.4). This was to enable the developers to manage the number of users but, more importantly this strategy would derive a comprehensive record of responses, problems, and suggestions from a specific user group, without interruption. Besides, different user groups had different functionality interest because of their duties. Students were more interested in the student data capture and registration outputs, while registrars put emphasis on the verification of student data, with finance and the faculty. Application developers noted all problems per user category and tried to solve some problems that cropped up during the test. Informal discussions were also held between the users and the developers to get a better understanding of usage. The two person support team was overwhelmed with supporting and logging user queries for the first test group of 18 students. Brief user guidelines and questionnaires were administered to the three test groups as the mechanism for data collection and enabling interpretation of user feedback. The prototype was evaluated by the user and, feedback was analysed to extract what could be

incorporated by the developers. A test log listing potential points of failure, support and escalation procedures for parallel and distributed help desk were planned. A pre-launch checklist was used to ensure the correct sites and process preparation.

Table 6.4.4 Test groups

Test Group	1. Students: n=18	2. Faculty: n=12	3. Academic Registrar: n=10
Subjects	Undergraduates (12) Post graduate (6)	Humanities(9) Science (3)	Policy manager (3) Registrars (3) Application managers (4)

The results of the usage test

A working IRIS prototype with the following functionality:

- Capture student bio and programme data.
- Verify financial, course and personal data.(link to finance, faculty data base)
- Certify registration.

Not all intended features worked as intended and the discrepancies required in some case, major revisions. Table 6.4.5 summarises the test group findings for each of the requirements.

Table 6.4.5 User summary evaluation of IRIS

Function	Functional requirements	Executed?	Non functional requirements	Executed?
1.Capturing student information	Generate a unique student identifier	No, requires change in university policy. The old registration IDs were retained.	-IRIS needs to support both online parallel paper data capture.	Yes, it was demonstrated as possible.
	Implement various appropriate levels of access rights	Students could only edit their bio data. Other levels were not tested.	support new students continuing or returning students	Yes, registers both groups.
	Capture bio and programme data	Yes All fields, with internal validation.	Reliability, ease of use and accuracy.	Yes but, very slow.
2.Verifying student information	-Authenticate all relevant documents -Validate Course admission -Verify payment	-Could only interface with finance to verify tuition fees. -Faculty interface was not ready to test course verification.	Implement holds and penalties for tuition fees.	No, this was referred to next version.
3. Certifying registration completion	IRIS must Support a hierarchy of outputs that include: -Registration card/certificate -Program/ information, -Examination card -Student ID	All products were demonstrated except for examination card.	Interface with stakeholders Faculties, The library, Dean of students office, Finance department,	Only possible with finance and faculty.
	-provide internal communication links	New students got email account on registration. Users could link to internal email and link to internet.	Registration should be a one stop process.	This was not possible in the short term, because not all departments that should interface with the academic registrar, had ready systems to interface with.

The general impression was that the test subjects were positive about the core IRIS performance. The majority of the core functions were working. The test demonstrated to the test groups that it was possible within a limited context, to capture student bio and course data, verify payment of tuition fees with the

university finance department and faculty (partially) and print the registration report. It was also possible to generate all but one of the products that certify registration. The speed was quite slow, which poses a problem in a real situation where big numbers of students register. The majority of users found the system was easy to use and navigate and were please with the single sign on and links to the university email system and Internet browsing. Financial verification was possible but tedious due to the mount of data search required. Overall, despite the technical problems, the users were very positive about the potential of the IRIS pilot.

6.4.5 Roll out of the pilot applications

After the iterative testing and incorporation of user feed back, the pilot was ready for launching at the three network sites (case study context). The minimum equipment pre-installed were servers at each institution. The planned activities for IRIS roll out were:

- Customization of application to each institution,
- Installation of application on the destination servers for each Institution,
- Documentation of the unique needs of each institution to facilitate customization as well as installation procedures and outcomes.

Results of the service distribution

The system was distributed and tested for parallel and distributed usage at the different participating sites. Although the three tier architecture had been tested and proved able to deliver services at the both the parallel and distributed level, it was evident that a synchronised service delivery at the three campuses was not possible due to the inadequate bandwidth capacity. Synchronisation could only be done off peak. The member institutions are in charge of their data but, they had access to each other‘s data for updates and retrieval of information.

Gaps

The provision of mutual redundancy which was a requirement of this collaboration could not be tested. To improvise the service delivery mechanisms, the service was hosted by Makerere University and mirrored at the intranets of the partner institution. Rotation of the service provision in case of failure was not possible due to the inadequate bandwidth capacities and inadequate technology facilities to enable the provider role at the partner sites. To optimise bandwidth usage, the IT support managers were given a brief on bandwidth management practices, as prescribed in the approach. Bandwidth management here refers to the policies, procedures, expertise and infrastructure necessary to ensure that procurement volume is minimised in an environment of dynamic allocation, proper utilisation, and minimisation of peaks and troughs in the usage pattern. (AAU report for Network requirements, 2004).The distributed user support was also tested at this point. A Common reporting interface for

failures and queries by users from all sites instituted under an existing joint collaboration office was launched at Makerere University, to optimize scarce technical skills. This worked on an escalation basis that starts with local network administration. It was still premature for the partners to review the business agenda but, the first project implementation review was done.

Project review

It should be emphasized, that the IRIS implementation was undertaken as a necessary business collaboration that provided an opportunity for case study research. The project was not experimental for the network institutions and still continues, to be scaled up from the initial IRIS pilot, with lessons from the case study.
After the completion of the IRIS pilot, the project management team (with the developers) convened a project review meeting to assess overall project impact, problems and formulate a way forward. The proceedings of this meeting formed the report to the steering committee for further action. The meeting was both formal and informal in that, we shared views on the guidelines espoused by the approach and, refined them based on empirical evidence (see section 7.1.3). During the review meeting, the researcher administered usability questionnaires to 12 members of the implementation team (includes project management and developers) who are the direct beneficiaries of the implementation approach. The data collection, analysis and responses from this assessment are presented in the next sections.

6.5 Methodology

6.5.1 Data Collection

To collect evidence on the usability of the approach in meeting the two requirements identified in section 6.1, data triangulation using multiple sources of evidence was used (Yin 2003). These included questionnaires and interviews used to assess the usability of the Approach. The source of the evaluation data is the implementer, who is the direct target of the usability goals and overall research contribution, as mentioned in section 1.5.

Data was collected from 12 respondents including developers, IT support managers and technical support using:
i) Questionnaires: Likert scale questionnaires to elicit information on the usability attributes of the approach were applied.
ii) Interviews: The main collection procedure for answering the interview questions was the unstructured open ended interview with selected experts. The interview aimed at eliciting detailed explanations and gaps in the approach. There are different options for conducting interviews such as face-to-face interview, phone interview or group interview in which a researcher interviews participants in a group (Creswell 20003). In this case we used face-to-face

interviews. The interviewees were typically IT support managers in charge of the implementation project.
iii) Participant–observation by the researcher and literature study were engaged.

6.5.2 Analysis

A combination of qualitative and quantitative analysis methods was used to analyse the usability test results of the case study. Analysis of a case study is one of the least developed and most difficult aspect of case study research (Yin, 2003). This was also the case for this applied IRIS case study project. Two general data analysis strategies described by Yin (2003) are 'relying on theoretical propositions' and 'developing a case description' of which the first is preferable. In this case the first strategy was followed by using guidelines from chapter 2 as guidance for the case study analysis.

Qualitative research analysis

Data analysis for the usability test combined qualitative and quantitative methods (Creswell, 2003; Seale et al, 2004). The following generic steps by Creswell were followed to analyze the case study results:

- *Organize and prepare data for analysis:* In this case questionnaires were sorted and arranged in respondent categories. The interviews were recorded and then transcribed.
- *Read through all the data:* the researcher skimmed through the data collection forms and interview transcripts to obtain a general idea of the information and reflect on its overall meaning, the tone of ideas and general impression of the overall depth, credibility and use of the information.
- *Interpret meaning of the data:* This is the last step of data analysis. Based on the objective of conducting the case study, the researcher interpreted the data and constructs and evaluation. The results from the usability test of the approach are presented in the next section.

Independent-samples t-test: The initial analysis conducted for the results of the Likert scale responses from the implementers, used an independent – samples t-test by dividing the implementers into 2 groups; programmers and analysts. An independent – samples t-test is used to compare the mean scores of two different groups of people or conditions (Pallant, 2005). The results from the separate groups test presented no significant interpretation for the usability test and, they were combined in a single sample analysis to derive a meaningful for interpretation. This single sample usability test for users of a product, is supported by Nielsen (1992, 2002). Nielsen points out that usability tests that compare different groups of people using the same applications as (in the t-tested conducted with two sub-divisions of implementers), have no comparative data for the purpose of the present meta-analysis. They do not compare different systems and thus would not contain data to help choice between two design

alternatives.

6.6 Research findings and Interpretation

This section presents the research findings on testing the usability of the Approach to meet the requirements for user–centered implementation and integration of available technology system resources, as applied in the action research case study. Based on these findings, an interpretation of the usability of the approach to meet the two requirements is presented. Lastly, the overall evaluation of the approach is presented.

The case study findings show an overall evaluation indicating that the usability of the approach to meet the 2 requirements was demonstrated within a limited context that was constrained by time and technical problems. The participants appreciated that the tests were done with a skeleton functionality but, agreed that there was potential functionality for scalability.

6.6.1 Usability evaluation

The results from the usability test derived from the implementers are discussed in this section. As per the objective for conducting the case study, the test targeted the developers and IT support managers who supervised the project, for an initial performance test on the usability of the approach, to achieve a reliable service system that complies with user requirements.

Questionnaire responses.

The test subjects filled a questionnaire based on a system acceptance questionnaire from HUSAT research Institute[*], for usefulness and usability research. The questionnaire consisted of three sections. First, back ground questions were asked so that the demographics of the users could be described. Next, four dimensions were mentioned: functionality, satisfaction, clarity and effectiveness. The respondents were asked whether they agreed or disagreed with the statements for each dimension on a Likert scale of 1-5, whereby *1=strongly disagree and 5= strongly agree*. Lastly, this was followed by the open questions section which elicited information about the problems experienced with implementation approach, the functions that worked well or did not work well and why. (See questionnaire Appendix 6B). A quantitative analysis from the data collected with the user's questionnaire was done and was complimented by qualitative feedback from the interviews and observations to derive issues for improving the approach.

The extent to which the test subjects felt the approach was usable is shown in table 6.5.1 a) and (b) below, by the analysis of the mode (m), mean (mn) and

[*] http://www.Iboro.ac.uk/research/esri/hfdc/index.htm

standard deviation (sd).
The results from the test groups regarding usability are presented in the next sections.

Table 6.6.1: Responses on the usability of the Approach

a) Functionality

Usability	n=12							
	Answers: 1=strongly disagree and 5= strongly agree.							
Functionality	**1**	**2**	**3**	**4**	**5**	**mn**	**sd**	**m**
1.I could easily find the potential development components for IRIS on the internet	0	2	5	3	2	3.4	0.9	3
2. The Approach helped me to select potential IRIS components.	0	0	2	6	4	4.16	1.2	4
3. The Approach is helpful in accurately recording and reporting user requirements.	0	2	2	2	6	4.00	0.6	5
4. The Approach guided the user requirements negotiations	0	0	1	6	5	4.33	1.0	4
5. The approach helped me to conceptualize and understand user requirements.	0	1	3	6	1	3.33	0.5	4
6.The Approach made it easy to monitor changes in user requirements	0	0	5	3	4	3.91	1.1	3
7. It was not easy to involve users in the development stages.	0	5	1	6	0	3.08	1.1	4
8. I experienced many technical problems with the integration of existing components	1	3	4	4	0	2.9	0.9	4

b) Responses on Usability factors

Usability factors	n=12							
	Answers: 1=strongly disagree and 5= strongly agree.							
Effectiveness	**1**	**2**	**3**	**4**	**5**	**mn**	**sd**	**m**
9. Using the Approach increased my productivity	0	2	1	5	4	3.91	1.1	4
10.I do not see any advantage in using the Approach	0	1	2	7	2	3.83	0.8	4
11. Using the Approach improved my performance	0	1	4	6	1	3.58	0.7	4
12. I do not need the Approach to active to execute the same task	0	7	2	3	0	2.66	1.2	2
13. Overall I find the approach usable in implementation.	0	0	2	7	4	4.5	0.8	4

Clarity								
14.The Approach guidelines are clear and understandable	0	2	3	4	3	3.66	1.07	4
15. The Implementation stages were logical to follow.	0	0	1	5	6	4.41	1.2	5
16. It is not always obvious what to do next	0	4	4	3	0	2.66	1.2	3
17. The outputs of each implementation stage are clear	0	0	3	4	6	4.58	0.9	5
18. I found the Approach easy to use	0	0	1	5	6	4.41	0.6	5
Satisfaction								
19. The Approach was interesting to use	1	0	3	5	3	3.75	0.8	4
20.Using the Approach saved me time	0	0	4	6	2	3.83	1.4	4
21.It will take a long time for me to learn how to use this Approach	1	6	5	2	0	3.0	0.7	3
22.I would like to use the Approach for future implementation projects	0	0	2	8	2	4	1.2	4
23.I am not satisfied with the end result	1	7	2	2	0	2.4	1.1	2

The results in tables 6.6.1 (a) and (b) above, indicate an overall positive usability evaluation by the implementers, shown by m=4 and the negation of dissatisfaction with the end result; m=2. The exceptions to note are the responses to positive statements, where m=3. In table (a) the approach is evaluated by how well it performs the actual tasks of the two specified requirements. It is noted that the implementers did not find it easy to search and analyse available technology components to develop IRIS as indicated by the neutral response, m=3. This was attributed to the time limits given for the project and limited experience with web search tools. The time constraint narrowed the search and analysis scope for potential development components. The same table also shows that the developers were not able to track changes in user requirements. This maybe attributed to users' erratic responses to requests to verify design elements of the system. Given the passive and erratic response from users, it was not possible to monitor changes in requirements accurately. The lesson from this observation is that, a user-centred approach requires willing and active test subjects. The other possible explanation was the lack of modelling experience by most of the designers. UML use cases were used in a very limited context. The interface had the most active user group (students) and users were satisfied with the aesthetically pleasant modern look and easy- to-use menus.

6.6.2 Open questions

The test subjects were asked, using open questions, what function(s) of the approach worked well for them and what they missed. Eliciting qualitative

opinion about gaps and problems encountered in using the approach, compliments the questionnaire responses by providing details and explanations to the quantitative analysis of the Likert scale responses. See table 6.6.2 (a).

Table 6.6.2 (a) Functions that worked well

Attribute	Remarks
Elicitation and negotiation techniques	-Easy to use and convenient. -Delivered timely negotiations.
Logging/reporting user requirements	Convenient, fast and reliable. Enabled consistency of the requirements handled through out the elicitation process.
-Review of available systems of available internal systems -Selection -Prototyping	-Convenient and fast. -The criteria was easy to apply to available system and made selection quick. -Prototype revived waning user interest and participation in the project.
Overall PADTR a framework	Logical steps and outputs, done iteratively made the implementation flexible and logical to follow.

Problems Areas

The implementers were also asked about the problems they encountered in using the Approach. As expected with all new systems, not all intended features worked as intended. The usability problems indicated by the response of the implementers from the interviews are summarized in three categories in table 6.6.2 (b).

Table 6.6.2 (b) Responses on usability problems

Category	Problem	Remark
Network	-Limited development participation by the partners was the weakest link for sustaining the network collaboration. -The champion was overloaded and less productive because of the unilateral effort. -Distance from development host institution limited partner participation.	-Incentives to sustain developer interest were required. -A virtual development forge over the internet would enable synchronous participation of distant partners and increase productivity.

Technology	-Modelling approaches like the UML use cases were time consuming. -The development team had limited expertise with web search tools for available components on the internet. -Low bandwidth capacity could not deliver synchronized services for the network. Dedicated bandwidth and off-peak operations for a specified period enabled the synchronized tests at Makerere University.	-Modelling approaches that are less demanding for time and skill constraint projects. -The synchronization of services at all 3 institutions is possible during off peak hours. -Mirroring services off peak for updates.
Process	Passive and erratic user response made tracking changes in user requirements difficult.	-Process management methods to ensure active user participation. -Structured and formal methods for getting user feedback.

Case Conclusion

In this chapter, the usability test of the approach conducted in the action case study environment was discussed. The test demonstrated that the approach was usable and showed in a limited context, the type of useful outputs that can be obtained using the approach. The usability test which was based on the last two requirements for the approach, compliments the test for usefulness by expert judgement in chapter 5. This completes the approach evaluation.

We reflect on the case study and the results based on the overall objective of the research. In chapter 2 we discussed issues from the volatile environment that were an obstacle to service system implementation in inter-organizational networks. Issues such as the unreliable infrastructure, the shortage of technical skills, and the unstable socio/economic environment posed an implementation challenge to business collaborations by emerging networks. In chapter 4, five requirements were presented for the approach, based mainly on the volatility issues from the exploratory case study in chapter 2. In this chapter, we described the way we tested the approach, based on the 2 requirements, using the action case study.

With regard to the usability requirements, we tested the approach to see whether it:

- *provided systems developers with means for conducting a user-centred implementation within a controlled process, that tracks changing user appreciation and provides feedback*
- *assisted the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity*

To conduct the case study for the implementation of IRIS, we adopted the PADTR methodology prescribed in the approach, as the overall implementation framework. Within the PADTR methodology, the prescribed development methods, tools, and techniques were applied for the two requirements and evaluated by implementers' satisfaction and subjective opinions.

It was concluded that the approach was usable to achieve a system that complies with user requirements though not essentially a synchronized service system. The standard three tier architecture was tested and approved for service delivery but, the consistent synchronization of services for the three institutions requires a higher bandwidth capacity. The case demonstrated that the approach could support the review, selection and analysis of existing technology components required to develop the application in a limited context. The limitations of the approach to support these two requirements were noted and recommendations made by the implementers, to be incorporated into the next version. Some limitations were constraint based and not necessarily due to faults in the approach.

6.7 Conclusion and recommendations for further research

The IRIS case presents a worthwhile first time validation of this approach. However, the prescriptive implementation approach should be applied to more cases before it can be said to be a "validated" implementation approach. The case study shows that some activities were executed as prescribed and others with modifications, a few were not executed at all and others were not done satisfactorily. The results of the interviews with the experts and implementers present the basis for further improvement of the implementation approach in future projects. A discussion of the activities that might improve the usability of the approach, if they were well executed, is presented.

- *Scan existing technologies*

A comprehensive review and analysis of the available technology components to be short listed for developing the application, should be demonstrated for achieving better results than the IRIS case. In the IRIS case, review and analysis was demonstrated in a limited context that reviewed open source applications available and familiar to the development team. This was attributed to the short time frame within which the IRIS project had to be executed. As the essential precursor for component based development (CBD), review and analysis of existing technologies requires expertise with web search tools, time and effort

before development starts. A better result should be anticipated with a wider scan.

- *Collaborative requirements elicitation and analysis* (A2)

The use of the GSS in projects with high uncertainty of user requirements should be validated further. The IRIS case suggests that with moderate uncertainty of requirements, GSS can be modified to use only those 'thinklets' required for the negotiation process and complimentary plenary sessions. For participants with no prior experience with group decision techniques, training in steps and logic maybe required before the introductory sessions of the elicitation exercise. In addition, a well structured working guide can suffice to provide structured guidance and momentum for useful discussion.

- *Define roles, tasks and responsibilities* (D1)

The case study showed that this activity should also be done explicitly for the development team, in order to anticipate actual loads expected from each institution. It is critical to take stock of developers (and other critical technical skills) available at each institution and their competencies, to plan for the anticipated skill shortage and possible task overload for the champion.

- *Distributed development environment*

The case study revealed a distance constraint that disabled partner institutions from active participation in development hosted at the physical location of the champion. Online facilities to enable a distributed development environment, is critical in such projects to enable participation from partner institutions, by eliminating the distance constraint thereby increasing productivity.

In this research, we investigated the elements of volatility that constrain inter-organizational service system implementations by the emerging networks in developing economies. We formulated requirements to solve these challenges and developed an approach to support implementation in the problem domain. The usefulness and usability of the implementation approach for inter-organisational service systems, was tested and validated. We conclude that improvement of the implementation approach should be a continuous activity and effective recommendations for further research can be made, both for the IRIS project in particular and, the implementation approach in general. IRIS is still undergoing further test and development iterations outside this research that can improve current IRIS functionality and validation of the approach further. Further research into both, should focus on improving the above mentioned activities which were considered essential to substantially improving the implementation result. Every implementation using this approach propagates the improvement cycle of the PADTR methodology and informs improved efficiency and reliability of implementation practices for inter-organisational service systems implementation in volatile contexts.

Chapter 7: Epilogue

Enough research will tend to support your conclusions.

Arthur Bloch

This research started with investigating and identifying current problems and challenges faced by emerging inter-organizational networks in volatile environments, in implementing service systems. The objective was to develop an approach that helps to improve the efficiency and reliability of the implementation practices for this problem domain. In this chapter, we reflect upon the research, discuss the research findings in section 7.1, the research approach in section 7.2 and provide some directions for further research in section 7.3.

Based on the research done to understand the implementation issues and challenges experienced by emerging networks in volatile contexts, develop the requirements, test the approach and interpret test findings, it is concluded that the approach is useful and usable to improve the efficiency and reliability of the inter-organisational service systems implementation process for emerging business networks in volatile contexts. The research output is an approach that consists of a *new implementation methodology supported by, collaborative business systems engineering, service system engineering and process management tools, techniques and reference guidelines.* The contribution of this approach is significant for emerging business collaborations particularly in the developing economies, where there is limited knowledge and experience on how to create and sustain such networks. This conclusion cannot yet, be generalised for all emerging networks in volatile contexts, since the tests were done in a limited case study context, and requires more refinement iterations. As Markus et al (2002) recommended the use of a design artefact on a single project may not generalise to different environments.

The exploratory case studies that were done in chapter 2, for the sub-Saharan universities and S. African university consortia, enriched our understanding of the volatility challenges and enabled the identification of current practice and process issues in intra/inter organisational implementation in environments with characteristic volatility. Based on the issues identified, we formulated the requirements for an approach as a solution to those issues. During the research, we implemented an inter-university registration system (IRIS) pilot, where the new methodology was applied to test the approach in a typical volatile setting of a three university network, in Uganda. The implementers' evaluation gave a strong positive indication for the functionality, satisfaction, clarity, and effectiveness gained from using the PADTR methodology. This was the first

opportunity to test the new methodology used by the approach, and the evaluation was an endorsement of the usability potential of the approach, to improve the efficiency and reliability of inter-organisational implementation. From the researcher's participant/observer role, we agreed with the implementers, that this was a first positive indication but, not conclusive. We considered expert recommendations for further improvements that should be done through more iterations of the approach, in different volatile contexts.

It was concluded that, improvement of the implementation approach should be an on going activity. IRIS is still undergoing further development iterations outside this research and improvements have been made in development by using lessons from the case study. Such improvements include the use of a distributed development environment, which resulted into more productivity from all partner sites and creativity by the development team.

Research conclusion

While we cannot fully generalise our findings, we observe that this approach has been derived from generic implementation best practices, recommended by experts from IS and relevant inter-disciplinary research, and it has an empirically validated potential to respond to empirically researched implementation challenges in volatile contexts. These factors make a strong basis to conclude that the approach can be useful and usable for *all* implementation projects that experience similar constraints. However, it is recommended that when using the implementation approach, practitioners should adjust instructions to the differences in the application situation. This implies that even though this research has focused on emerging inter-organisational networks in the higher education sector, this approach can be used in other public organisations, taking into consideration the uniqueness of the context of application. Such uniqueness may include for instance technical staff issues whereby, other sectors unlike the universities who normally have dedicated IT personnel may have to out-source their technical staff. Beyond these unique context issues, it is our observation that while the basic elements prescribed by the guidelines remain the same, creativity and flexibility in response to the uniqueness of the project, contributes to success. Every implementation using this approach propagates the improvement cycle of the PADTR methodology and informs improved efficiency and reliability of implementation practices for inter-organisational service systems implementation in volatile contexts, irrespective of the sector of application.

In the next sections, we present an overview of how we arrived at this research conclusion.

7.1 Research findings

In this section, research findings are presented through discussing and answering the research questions. The central objective of this research was to develop an approach to improve the efficiency and reliability of inter-organizational service system implementation in volatile contexts. In order to develop such an approach, three research questions were formulated in chapter one. They are discussed below.

The first research question was:

7.1.1 Research question 1

1. What are the current and emerging issues in the implementation of inter-organisational service systems by business networks in volatile environments?

This research question was intended to help us get detailed understanding of the taxonomy of inter-organizational networks and service systems and the issues, problems and challenges involved in their implementation in volatile environments.

This research question was answered in chapter one, and further elaborated in chapter two. We learnt that inter-organizational systems are extremely hard to design, implement and manage because they have multiple actors. In addition, the implementation of a service-oriented system requires an assembly of the three elements of the service formula, enabling technology, and actors in the network organization.

The case study with three sub–Saharan universities and the South African university consortia confirmed that, service system implementation was an innovation in volatile contexts and, it was constrained by complex challenges caused by the volatile environment. The following five constraints were identified:

Issue 1: The complexity of the multi actor inter-organisational environment

The emerging business networks in the case study showed characteristic interdependencies of technology and technical skills compounded by the multi–actor setting. It was evident from the findings, that the bureaucratic decision making and communication structures, observed for the volatile context would not be amenable to network collaboration. As researchers in the field confirm, the activities in inter-organisational networks are dynamic and, the decision making is capricious and unstructured. Hence network coordination is a priority issue that requires support (De Bruijn, 2002; Powell, 1990).

Issue 2: The unreliable technology infrastructure in the emerging networks

Case 1 (implementation practice and challenges in Sub-Saharan universities), showed that in volatile environments, system reliability is critically compromised by the unreliable technology infrastructure, lack of resilience in legacy systems and monolithic structures, as well as inadequate bandwidth and latencies. In addition the case also showed that technology was a core interdependency for the network, because it is a high cost investment. A reliable infrastructure is the core technology requirement for a reliable service delivery and this is a focal support requirement issue (Liljander et al, 2002; Parasuraman et al, 1985, 1988, 1991).

Issue 3: The shortage of technical skills

In this research, we established that solutions for the technical skill deficiency were rated highest by the expert judgment, because skills pose the highest risk to all three elements of the service implementation; the network, the service formula and the enabling technology. From the exploratory case study, it was revealed that organisations in volatile environments lacked adequate technical skills to implement and support technical projects and, this deficiency contributed highly to the implementation project failures. Literature sources confirmed this observation (IDRC-Guidelines for institutional maturity report, 2000; Walsham, 20000; Roche and Blaine, 1996; Heeks, 2001; Mundy, 2001; Odedra and Kluzer, 1988).

Issue 4: Deficient requirements analysis process

Case study findings showed unreliable systems where user involvement in specification and performance evaluation was negligible or non existent. Accordingly, the lack of user participation in systems implementation contributed to the underutilisation or lack of adoption of systems. The involvement of users in requirements elicitation, analysis, design and development of systems has been documented as the primary success factor to realising system implementation goals and adoption (Booch, 1999; Swanson, 1998; Nelson, 1990; Davis, (TAM), 1989)

Issue 5: Complexity of integrating varied legacy components and available system resources

The integration of the relevant elements presents considerable complexity due to the diversity of the existing systems components. Exploratory case study revealed that organisations in merging networks have independently evolved IT system mainly over the past 20 years, combining legacy assets, third party software packages, limited outsourced applications and newly built functionality, with all these parts possibly running on different but meagre computing resources. These systems are difficult to test and upgrade, leading to high maintenance and low scalability. Resource scarcity in the emerging

networks entails that, useful elements from existing system resources should be integrated into the new service, to open up systems for business partners, and third parties (Arsanjani, 2005; Brown, 2000).

As a result of the above five issues, it is a challenge to improve implementation practices for the emerging inter-organisational networks in volatile contexts, to increase operational efficiency, enhance responsiveness to users and enable adaptability.

7.1.2 Research question 2

2. What implementation mechanisms can be used to implement inter-organizational service systems in volatile contexts?
In chapter three, we discussed this research question to provide a possible way forward to derive the relevant mechanisms for improving implementation practices in volatile contexts. The potential solutions discussed included, IS development, collaboration engineering, process management and service implementation theories. We first discussed the dominant methodologies, models and approaches that have been used for the implementation of business information systems to facilitate and manage business processes at the parallel and distributed levels of the organisations.

Information system development

We presented Collaborative Business System Engineering (CBSE), the *waterfall model* as the basis for IS development, combined with the *Spiral model* (as introduced by Boehm, 1988), to support component based development (CBD). Collaborative business engineering is recommended for the multi coordination of multi actor activities, especially negotiations and decision making. CBD presents development advantages for quick adaptation, incremental improvement and modelling. Prototyping approaches were also recommended for interface and data oriented projects, to elicit iterative user feedback and manage evolving requirements. In addition process management theories are useful to inform development of process support and criteria for validation of out puts.

Next, we studied the service development theories to get a detailed understanding of critical service elements and how they can support the reduction of complexity for inter- organizational business collaboration.

Service framework issues
It was established that service system implementation required an assembly of three elements; the service formula, the enabling technology and the network organisation. Therefore, service system implementation for inter-organizational networks in volatile contexts should consider the interdependencies among these elements and the trade offs that would be required to provide the required

service value. Trade off guidelines are a critical element of the requirements, because the prevailing unreliable infrastructure, inadequate technical skills, organizational and process challenges indicate that the trade-offs between the technology and service value can be high.

Technology infrastructure

Technology deficiencies in volatile settings indicated that technology and service quality tradeoffs are high. To resolve this deficiency, the emphasis of the technology requirement should therefore be on how to achieve a robust technical architecture, for reliable service delivery, with low maintenance and increased scalability. The standard three tier architecture is ideal for distributed service system development and delivery but, synchronisation of services is typically technology intensive especially, requiring adequate bandwidth to support remote service delivery. We concluded that the type of services will be limited by the inadequate bandwidth whereby, synchronisation could only be done outside peak time operations. It is important to underscore that adequate bandwidth capacity is a transient but critical enabler in the network service implementation and coordination. Due to the prevailing shortage, prescribed bandwidth management approaches must be a component of the approach in the short term. This includes large volume procurements (consortia); good procurement practice, and efficient management and utilisation (human resource capacity); improvement of policy and regulatory environments (lobbying); addressing physical access constraints (technology) and sustainable cost recovery policies (Association of African universities, report, 2004). This view is supported by best practice as seen from the S. Africa inter-organisational business collaborations, which were enabled by a precursor of bandwidth procurement consortia.

Process management theories

The investigation of process management theories was relevant to devise relevant coordination mechanisms that take into account the complexity of the combined institutional relationships, values, goals and volatile environment. Project management as one of the most basic forms of management used to control projects, is critical to the success of the implementation project but, not entirely sufficient for dynamic activities because, it assumes reasonable stability of tasks, goals and teams De Bruijn et al (2002). The primary goal for non profit public organisations is not profit but, delivery of reliable services that can improve realisation of business goals. It was observed that for effective project management, implementers in volatile contexts must consider before the project commencement, elements with the greatest potential risk towards the success of the project. The main ones include, the coordination of multi tiered project teams at the parallel and distributed levels, to deliver the system within the completion schedules, the inadequate institutional budgets (usually no specific budget for implementation is availed at institutional level) and the inadequate expert skills and experience to implement and support technical projects. Project

management should therefore, be used in combination with an appropriate governance model that is preceded by the formation of bandwidth procurement consortia and formalised relationships with agreements, letters of intention at the exploitation phase of the network and contracts at the exploitation.

The implementation process

To improve the reliability of the implementation process and resulting services, emphasis was put on the user–centered approach. Active management of requirements involves three activities: eliciting, organizing and documenting the system's required functionality and constraints; evaluating changes to these requirements and assessing their impact; and tracking and documenting tradeoffs and decisions. This requires participative approaches that can be combined with collaborative techniques to elicit requirements that are suitable for networks in volatile contexts. Improvisations for cheap, fast and easy to use modeling techniques must be employed. Paper prototypes and pen and paper GSS sessions structured by *thinklets* were used effectively to elicit user appreciation.

To address the low technical skill base for development and support of technical projects, we considered lessons from the consortia case study for short-term solutions. In the short term, networks can start a nucleus skill pool hosted by the champion who is better endowed in skills and technical facilities. The *nucleus resource model* showed that sharing of best practice during the project leads to s more capacity development and eventually scales up into the skill pool. Best practice recommendations that should be adopted for long term solutions include: IT planning strategies and budgeting by institutions, establishment of resources centers and inter-expert skill pools, adoption of open source applications and platforms to develop capacity and, training hybrids to adapt systems to local needs (Earl, 1989; Mundy, 2001).

On the above basis, theories and empirical study of network formation combined with IS development approaches, evolutionary approaches and process management, presented potential mechanisms for formulating requirements to improve the efficiency and reliability of implementation practices for inter-organizational business systems in volatile contexts.

7.1.3 Research question 3

3. How can we support the process of improving inter-organizational service system implementation in volatile environments?
After understanding the challenges and mechanisms for the requirements of the problem domain, the third issue addressed was to devise ways to improve the service systems implementation practice for emerging networks affected by volatility constraints. This research question is directed to the researcher to develop a new implementation approach for emerging inter-organizational networks in volatile environments. The approach consisting of a *new*

implementation methodology (PADTR) supported by, collaborative business systems engineering, service system engineering and process management tools, techniques and reference guidelines is described in chapter 4.

Based on the exploratory case and the literature review, five requirements, focused on usefulness and usability, were formulated for the approach to prove that it could be used to improve inter-organizational service systems implementation for business networks in volatile settings. The usefulness of the approach was tested and evaluated to see if it could:
Req # 1: *provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.*

Req # 2: *assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.*

Req # 3: *enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.*

The usability of the Approach was tested and evaluated to see if it could:
Req # 4: *provide system developers with means for conducting a user–centred implementation, within a controlled process that tracks changing user appreciation and provides feedback.*

Req # 5: *assist the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity.*

The implementation approach was developed on the basis of the five requirements. The approach was structured using Sol's (1990) analytical framework for designing methodologies using three dimensions: '*way of thinking*, '*way of working*, '*way of modelling* and '*way of controlling.'*

The framework for the approach

To present the approach, the '*Ways of*' framework for structuring and designing methodologies was used (Sol, 1990). This pragmatic framework has been used to construct design approaches and methodologies for new problems areas in numerous studies, for example, for information system design (Shrijver, 1993; Berbraeck, 1991; Wierda, 1991), for business reengineering and the design of organizational coordination (Eijck, 1996; Lare, 2003; Vreede, 1995) and for research decision support (Meinsma, 1997). Using this framework, it is possible

to characterize design methodologies by their mode of thought, modelling constructs, working method and management.

Way of thinking

The way of thinking of an approach expresses the research perspective of the application domain of the implementation methodology. The underlying assumptions are made explicit. This perception determines the way of modelling, way of working and way of controlling. The way of thinking is often expressed in guidelines, rules of thumb, do's and don'ts, metaphors and design theories.

View on the problem domain

The network organisation has characteristic volatility. It is non profit, similar business domain, with fundamental resource scarcity especially in technical skills and technology. There is inadequate knowledge and experience for service system implementation and therefore learning is part of the implementation process. Network creation is greatly influenced by embedded relational ties.

The inter-organizational service system implementation combines three basic elements namely, the enabling technology, a service formula demanded by users and this service supplied by a network of organizations. For the emerging networks with resource scarcity, the unreliable technological infrastructure and skill deficiencies indicate that technology /service formula, service formula/network tradeoffs are high.

Trade off guidelines

Based on the description of the network resource interdependencies and innovativeness of the project, guidelines that support reliable service delivery, network formation, coordination and sustainability and reliable infrastructure were developed as the essential starting point to balance trade-offs. To deal with factors related to tradeoffs between technology and the volatile network, and the volatile network and service formula, the following guidelines were formulated and improved with input from the implementers in the IRIS case study.

	Trade –off Guidelines
Service formula	▪ The implementation approach must start with investigation of the targeted user's profile context and needs. ▪ User requirements must be considered based on the capabilities of the available technology components and resources. ▪ The targeted user has to participate in all phases of the implementation process.
	▪ Implementation must start with the core system functionality and users must frequently test the in-between results of the design decisions, provide feedback to the developers to incorporate evolving changes of the system.
Technology	▪ Network actors in volatile contexts should only start to develop and test applications after investigating available technology components for system development and evaluating the extent of compliance with user requirements. ▪ Organizations must project and periodically plan for required technical skills training and facilities, in the long term.
	▪ A nucleus of the proven existing IT architecture and technical support skills availed by leading partner(s) is a necessary precursor to implementation.
	▪ The network champion should initiate the gradual development of a skill pool through shared technical best practice and facilities, in the short term.
	▪ The sustainability of reliable network information services should be the primary guide for resource interdependency. Revenue models are desirable but secondary.
Network coordination	▪ The network membership will be limited to partner organizations that are involved in the implementation and/or eventual provision of the service, with changing role emphasis at different phases; the customer, application developer and content provider are the core of the network at the exploration phase, the service provider, content provider and customer are the core roles of the network during the exploitation phase.
	▪ Reduce uncertainty by using embedded relational and social ties when creating the network.
	▪ At the start of the project, role check list must be checked and actors to fulfil each role must be decided. Roles change must be anticipated and planned for during the development and roll out process.
	▪ Take into consideration when creating a business network that the value of network membership and working with partners with an established reputation in an innovative project, supports learning, gaining experience and a competitive advantage.
	▪ Take into consideration when creating a business network that the value of network membership is determined by the optimisation of technology and technical skills to realise the business goals.

The way of working and modelling

The approach presents a way of working that is complimented with the way of modelling. In the way of working we specified steps and corresponding activities that should be undertaken, for the implementation project. The activities, tasks and deliverables are specified in the PADTR methodology under the following stages; Preparation, Analysis, development, test and roll out (PADTR). The prescribed implementation methodology for the multi–actor volatile context combines the elements of the *stepwise* waterfall model and the *iterative* sequence of the spiral model of the evolutionary approaches (Boehm, 1988). These two characteristics of the PADTR methodology are suitable for the innovation of implementing services systems by emerging networks, where business the requirements are not well formed by and where it is difficult to determine how the proposed solution will perform in practice**,** to enable user learning and feedback as the system evolves. The methodology uses quick and cheap prototyping techniques to support the iterative design (Nielsen, 1994; Booch, 1999; MacManus and Wood-Harper, 2003; Boehm, 1988).

In the way of modelling, techniques or improvisations that are cheap and fast were prescribed. During the implementation process analysts, designers and developers should use fast and cheap models to help stakeholders to incrementally describe, visualize and understand their selected service options. Modeling for volatile contexts, should adapt the CBD approach models steps to understand the user context by using simple flowcharts, defining the architecture and providing the solution (Brown, 2000). Collaborative engineering techniques like an adaptation of the GSS to pen and paper version structured by *thinklets*, are essential parts of the methodology to facilitate timely multi actor decision making and network coordination. Software engineering approaches like component based development (CBD) that facilitate incorporation of legacy and other relevant technology components and resources are part of the implementation methodology. A user–centred approach that includes iteration, management of user requirements, (Booch, 1991) and participative approaches (Cooper 2000) were used to ensure reliability. We observed, however, that user centred approaches requires willing and active users as well as adaptation of formal means to provide feedback for improving the system iterations. Guidelines that apply for each stage should be considered to guide trade-offs. The outputs per phase are presented in table 7.1.3.

Table 7.1.3 Deliverables per phase

Element	Value network	Technology	Service formula
Phase			
Preparation	Letters of intention, Agreements	Overview of technological gaps and requirements	Overview of system collaboration requirements
Analysis	-Project work plan -Tasks roles and responsibilities.	Overview of technical options -Functional and technical design	-Draft service description -Detailed service description (thru analysis iterations)
Development	Work procedures	Application design	Communication formula
Testing	Project/Business evaluation report	technical support evaluation	Usage evaluation
Realization	Roll out plan	Network technical report	-Pilot system -Incremental roll out

The way of controlling

Coordination mechanisms should consider the complexity of the combined institutional relationships, values, goals and the volatile environment. Project management as one of the most basic forms of management used to control projects, is recommended to manage the implementation project. In addition, other process management techniques, such as the appropriate governance model and guidelines to handle resource interdependencies between participating organizations are recommended. Network members should note that control mechanisms differ at the exploration and exploitation phases. During the exploration process management elements are required to commit participants and create inspiration to form and sustain the network. These include prospects for gain and incentives for cooperative behaviour, letters of intention and agreements to initiate commitment. During the exploitation stage relevant governance mechanisms and contracts that include service level agreements (SLA's) and performance indicators must be enforced by mutual agreement. Standardisation of operations should be balanced with institutional autonomy. Conflict situations, are best resolved using change management approaches before the project starts. If conflict arises, gaming can be used.

Improving inter-organisational service systems implementation in volatile contexts

The approach was tested based on the usefulness and usability requirements. The test for usefulness was used expert judgment (Hevner et al, 2004) and usability was evaluated using the action research case study (Yin, 2001). The test summary for the usefulness and usability of the approach are summarized in table 7.1.3.

Table 7.1.3 Test summary of the implementation approach

Test	Objective (Can the Approach?)	Methodology	Result	Evaluation
Usefulness	**Req # 1:** provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks. **Req # 2:** assist implementers to analyse the appropriate technology environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system. **Req #3:** enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects	Expert judgment survey 30 experts with experience: 10 yrs= IS implementation. 5 yrs = service systems. Experts included : -researchers -designers -developers -vendors Using Adelphi Approach Questionnaires. Evaluation on: -Ranking volatility factors. -Support sets for the 3 requirements. -Sufficiency and necessity of the prescribed support.	1.Order of ranking for issues to improve reliability and efficiency of Implementation process i). Technical skills ii).Technology and User issues iii).Organisational coordination 2. Prescribed support scores: -Service support scored lowest approval -Skill support –cored the highest. 3. The prescribed support was necessary and sufficient for volatile contexts, with additional recommendations.	Usefulness The Approach is potentially useful to improve the efficiency and reliability of implementation practices for service systems in emerging business networks affected by volatility. (see sections 56.1 -5.6.3)

Usability	**Req # 4:** provide means for conducting a user–centred implementation within a controlled process that tracks changing user appreciation and provides feedback. **Req # 5:** assist the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity .	Action research case study Implementer evaluation with questionnaires and interviews Case: Inter-organisational network of 3 universities in Uganda. -Prevalent volatility characteristics -Implementation of an inter-university registration system (IRIS) pilot in 5 months -Used PADTR methodology with -User-centred approach -Review, analysis, selection of system components. -CBD and process management guidelines	Functions of the Approach were usable. Implementers were: Satisfied with: - Logic and flow of PADTR -Clarity -Effectiveness But, comments: -Inadequate support -Modelling skills -Review of available system components was limited due to time constraint. - Passive user participation	Usability The Approach was usable for the specified 2 requirements . -Limited case context can implement Service system with three tier architecture. -Synchronised service delivery cannot be realised in the short term, due to inadequate bandwidth. -Service can be hosted by champion and mirrored at partner sites intranets. (see section 6.6.1 for details.)

7.2 Review of the research methodology

After the discussion of the research output in the last section, we reflect back on the methodology used. The choice of the research perspective was based on the research objective instead of the research topic (March and Smith, 1995). The objective is stated in section 1.6.

The research strategy

For the research strategy, we combined the design science and behavioural science paradigms to create and evaluate an implementation approach to

improve efficiency and reliability of implementation practices for business networks in volatile contexts (artefact). We used the two paradigms to delineate the problem using behavioural science, and develop useful and usable solutions as prescribed by the design science paradigm. The ill structured nature of the problem and lack of sufficient theory made it difficult to fulfil our research objective from a deductive point of view. Secondly, the problem could not be tackled from a single perspective or using a single discipline. To get a detailed understanding of the issues and problems of inter-organization service system implementation in volatile contexts, we had to follow the behavioural science paradigm in the initial phase of the research (chapter 2), using the inductive–hypothetic research strategy (Sol, 1990). The exploratory case studies enabled us to obtain more knowledge about implementation process and practice challenges, to derive a descriptive model and to determine requirements of the problem situation. Based on the requirements, we were able to design the artefact, i.e. the approach.

Research instruments

A variety of research instruments were used to conduct this research:

In the initial phase of the research, we used an exploratory case study to get a detailed understanding of the current volatility issues for the emerging business networks in volatile contexts and derive issues for formulating requirements. During the latter phases of the research, we used expert judgement and action research case study to test the usefulness and usability of the approach. We combined different research instruments (also called 'triangulation') to achieve a comprehensive test and evaluation (Yin, 2001; Mingers, 2001; Gable, 1994; Lee, 1991). The experts used in the tests, were subject matter professionals with vast experience and capable of forming an accepted scientific opinion for service systems implementation in volatile contexts. The action case study conducted for the usability test enabled the researcher to assume a dual role as participant/observer to study a unique process of the IRIS implementation project objectively (Yin 2003). It is concluded that design science research approach was appropriate means for realising the research objective. It is noted however, that the application of rigorous evaluation methods is difficult in design–science research, as confirmed by (Tichy (1998) and Hevenr et al (2004).

Literature review

Two types of literature relevant to this study are distinguished. The fist one is general academic IS literature that espouses prior research theories in the problem domain. The second type is the service system specific literature. The first general kind was useful to gain a better understanding for system engineering and IS development theories for organizations. On the general IS development and specifically in developing economies, it was observed and supported by authors in the IS field, that the literature on IS and developing

economies is still limited and dominated by case studies of IS projects, which cannot provide a basis for generalised solutions to implementation failure (Heeks, 2000). IS development, literature, established journals like *MS Quarterly, ICT for development* were regularly consulted to understand the current focus for IT innovations and conferences were especially useful for understanding the management of implementation projects as well as monitoring innovations in applications development.

Research benefits

The research benefits combine practical and academic relevance:
The benefit for business networks in the volatile contexts is that an implementation approach for inter-organizational service systems that covers the most critical, complex requirements for volatile contexts, has been initiated using an empirical validation. The approach provides emerging networks in volatile environments, particularly in the higher education sector, with insight into ways to make the implementation process more efficient and reliable. Using this initial design of the approach, organisations can build capacity for adoption of new, flexible, reusable and collaborative approaches suitable for volatile contexts, to optimize scarce resources, improve implementation practices, the resulting services and gain competitiveness and strategic relevance.

On the academic front, research can build further on the adoption of the following concepts which are relatively new in developing economies.

- Service-oriented implementation
- Collaborative business engineering approaches from a new inter–organizational perspective (Den Hengst and De Vreede, 2004).

7.3 Recommendations for further research

In this section outstanding issues that were not handled during the research process and significant recommendations from the experts are presented as useful indicators for further research.

In chapter 6 we tested the usability of the approach using the IRIS action research case study. The IRIS case study provided an opportunity for the first trial of an empirical validation of the implementation approach because, it was appropriate and accessible, to test a limited number of parameters within the constraints of time and cost. Even though both tests cases showed that the approach was useful and usable, further investigation should be conducted to assess the usefulness and usability in a normal implementation project, where parameters can be tested with more complexities involved. An example to illustrate this situation could be a regional inter-organisational network, as opposed to a national network. Secondly, the innovation was based on specific business area; higher education. These observations lead to two requirements.

Recommendation 1: test the usability and usefulness of the approach in a real inter-organisational implementation project, with more diversity in stakeholders.

Recommendation 2: test usability and usefulness in a large public organisation outside higher education.

In chapter 4 the 3U's; Usefulness, Usability and Usage were introduced as basis of the five requirements (Keen and Sol, 2007). Usefulness addresses the value added by the approach to the decision making processes, Usability deals with the interaction between people, processes and technologies and the Usage dimension deals with how the approach is embedded in the decision process. Even though all the 3 U's are equally important, in effective decision enhancement, in this research we only considered the usefulness and usability dimensions to evaluate the approach. The reason for leaving out the usage dimension is that in the exploratory case study conducted in chapter 2, we could not identify and extract any usage related requirements for the approach since they can only be obtained by understanding the way actual users interact with the approach. However, we acknowledge that 'usage 'is an important dimension that must be addressed for completeness of the approach. This is the basis for the third recommendation.

Recommendation 3: 'Usage' related requirements should be identified from an empirical evaluation to complete the test parameters of requirements for an effective approach to improve the efficiency and reliability of processes for inter-organisational service systems implementation in volatile contexts.

In chapter 6, the IRIS implementers presented their evaluation of the approach as to whether it facilitated the need for user–centred implementation. One of the issues they identified was the need for active and structured monitoring of user requirements. It was observed from the test groups that, in spite of user feedbacks and prompt incorporation of changes by the development team, there was some considerable discrepancy between the expected functionality and the actual application. This observation points to a gap in modeling techniques for monitoring and incorporating changes in user requirements, to narrow that gap between user value and actual application**.**

Recommendation 4: Define appropriate modelling techniques that optimise resources and encourage active user participation and feedback to increase system relevance to users in inter-organisational network projects with resource scarcity.

Among the additional tools and requirements recommended from the expert survey in chapter 5, was the *future search* (FS) methodology to change

organization culture to roadmap long term business strategies. [*]FS was taken as a significant proposal that addressed an analysis gap and appropriate for the volatile context because it combines low technical skills, comprehensive elicitation, stakeholder inclusiveness, cheap, fast and effective ways of designing the future systems.

Recommendation 5: conduct research on the future search methodology for changing organizational culture and strategic planning of long term business strategies, for new business networks in volatile contexts.

In chapter 6 we noted that measurable parameters of usability fall into two categories; subjective user performance measures and objective performance measure which measure how capable the users are, at using an artifact (Nielsen and Levy, 1994). In this research we opted for the subjective measures because they are quick to test and fulfill our research objective of assessing usability, to derive indicators for system adoption. Objective measures on the other hand, can provide answers to subjective views based on the expected performance of an artifact; what works well and what does not, thereby helping to improve design. As Nielsen (1997) noted, interactive systems also need to be liked by customers, but no amount of subjective preference will make a product viable if users can't use it**.**

Recommendation 6: Identify and test appropriate objective performance measures for the approach, in a real implementation project, to complete the usability test profile of the approach.

[*] *http://www.futuresearch.net/method/whatis/index.cfm*

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Appendix 2A: Exploratory case study Questionnaire/Interview protocol

SECTION A – (*IT support Head and/or Head of Planning)*

1 Introduction

1.1 Give a brief description of the major characteristics of the IIS project.
1.1.1 Project title/System Name
1.1.2 Objectives
1.1.3 Participating universities
1.1.4 Start and end dates

2. **Origin/Motivation**

2.1 Who, or what organization took the initiative to start the IIS implementation
2.2 When did the project start?
2.3 What universities were the original participants?
2.4 What was the motivation behind starting this IIS effort?
2.5 Could the start of the IIS effort be justified with a cost /gain analysis for all participants?
2.6 Did the participating universities have some joint organizational forum in which they met before the start of the IIS project?
2.7 Was there before the start of the project a non computerized, formalized structure of information exchange that could be linked up with?
2.8 What were the initial expectations of the IIS, both with respect to main benefits and side effects?

SECTION B – Network implementation project *(IT support head, Systems Manager or IS implementation coordinator)*

3. Participants
3.1 Who were the individual representatives (name and designation) of the participating universities in the initial IIS specification and how were they selected?
3.2 What was the level of automation at the individual participating universities/organizations?

a)-Networked campus with IS

b)-Rudimentary network and systems

c)-No network, manual operations

(*Please avail relevant university IT documentation for illustration*.)

3.3 Can this IIS implementation be regarded as automation of already existing processes, or does it allow for new processes and functions?

3.4 Did participating organizations have adequate skilled personnel for the following areas of IS implementation?

Implementation area	Actual No. of personnel and training levels.	Required No. of personnel & training levels.
Systems analysis and design		
Systems programming, testing		
Roll out		
Total		

4. Methodology

4.1 What are the strategic objectives of your university/ organization with respect to the use of information?

4.2 How was consensus in respect to IIS implementation achieved? Was there any awareness courses or other support tools? If so, who were the target audience?

4.3 What level of IIS did you opt for and why?

a)-shared application and hardware platform

b)-Shared application

4.4 What methodology or approach was used to implement the IIS. Why was this approach chosen?

4.5 Describe the implementation process under the following sub stages:

4.3.1 Specification –participants, roles, support environment for decision making.

4.3.2 Design – who designed the system, stages and tools.

4.3.3 Testing – How was the user testing conducted?

4.3.4 Roll out – What strategy was used and why?

4.6 Has a physical network been set up? Is there a joint use of data? Of software? What standardization if any was required? Did any form of centralization take place?
4.7 At what management level were the participating organizations involved in the implementation of IIS?
4.8 Was the implementation of IIS documented? If so can this documentation be used for the case study? (where necessary, certain information can be treated with confidentiality).

SECTION C - *IT Head (Administrative role)*

5. Inter-organizational IS Management.

5.1 Who manages the IIS?
5.2 Who pays for the cost of the IIS?
5.3 What measures with respect to individual organizational control were taken in order to implement IIS?
5.4 Did the participating organizations transfer competencies to the inter-organizational structure?

6 Challenges

6.1 What were the major obstacles in the implementation of the IIS
6.2 After the initial implementation, did some participating universities abandon and new universities join the IIS? If so, under what conditions?
6.3 If standardization has been enforced, what parties were more satisfied with the results and what parties were less satisfied?
6.4 In what ways do you consider the IIS implementation to have limited or going to limit freedom of operation of the participating organizations?
6.5 Did the implementation encounter obstruction from participating parties or factions within or outside the universities?
6.6 Are there additional applications that have been developed which were not anticipated at the outset of the project?
6.7 What are the structural changes, if any that have occurred in the organizational environment of the participating universities?

SECTION D

7. Assessment/Evaluation *(Key system operators and Users (2 users per unit)***.**

7.1 Do you consider this IIS implementation a success, partial success or failure and why?

7.2 What are the Monitoring and evaluation mechanisms in place?

List benchmarks, Performance indicators and SLAs used by the consortium to monitor and evaluate service.

7.2.1 What are the benefits of a service based IIS in terms of:

- IIS Performance visa avis intra model
- optimizing support and management staff, Recurrent costs (maintenance, bandwidth, Software license**)**

7.3 What in your view are the necessary conditions for successfully implementing interuniversity Information systems of this kind?

7.4 What was the main cause of obstacles encountered in implementing the IIS?

7.5 What people should be interviewed and what materials should the researcher study in order to gain a comprehensive picture of the IIS implementation under consideration?

END

Appendix 4A: Bandwidth management guidelines

The following issues derived from literature, are compiled from a higher–education perspective. They should be applied to all member institutions with technology scarcity and multiple demands in order to devise a plan for adequate and sustainable bandwidth access to the Internet.

- What is the key driving motivation for access to the Internet, and how is this best served? High level need and justification, are critical factors in resource allocation and sustainability.

- How much bandwidth is needed by each institution currently? What is the projection over the next five to ten years? In many of the studies, guidelines for realistic assessment of needs have been given. *The amount of bandwidth per networked PC, assuming good practice in bandwidth management, is a better indicator of real need as opposed to campus population*.

- At what level would the cost be considered reasonable? This will relate to the funding model of the institution. In the context of public universities, most are still grossly under-funded, and yet they are constrained in avenues of income, realistic fees based structures being generally politically undesirable.

- How much money is each institution able to spend on bandwidth? This challenge is related to the above issue of reasonable cost, in a resource limited environment with multiple demands. It would be best in this context, to work out a percentage of gross income that should be reasonably spent on ICT services and systems, and specifically bandwidth access. *The gap between the gross value of such percentage expenditure and the cost of what is considered reasonable bandwidth per networked PC will guide business partners about required support for each institution*.

This leads into quantification of required bandwidth through balancing strategic need and resources, and is a critical element in sustainability.

Pre-requisites to efficient utilisation of Bandwidth

1) IRM staff must acquire capacity to address issues ranging from bandwidth management; mirroring content; negotiate, monitor and enforce service level agreements, not only to the local point of presence, but to what is accepted as the Internet backbone.

2) It is a given that expertise and resources for dealing with viruses and spam must be in place before bandwidth management starts: these should pre-requisites, rather than elements, of bandwidth management.

3) Line staff (eg in Libraries) and IT support staff must acquire capacity to address issues ranging from bandwidth management; mirroring content; negotiate, monitor and enforce service level agreements, not only to the local point of presence, but to what is accepted as the Internet backbone.

4) Capacity building challenges and ability to negotiate copyright issues (mirroring, etc) are components of efficient utilisation.

5) Creating common platforms that support interactive online work within a bandwidth limited environment.

Forming Bandwidth consortia guidelines

- Cultural fit where political agenda are of less importance should give a more successful consortia formula.

- Minimum imposition of standards on organizational operations to accommodate all differences. Synchronizing the core system activities to meet the big discrepancies in capacity or requirements has proved difficult and led to failed consortia.

- An agency or independent operating / coordination body must be external to the network. This should be lean to minimize overheads.

- Strategy should not be technology driven. Adding value through unique services by shared implementation should be the goal.

- Clear and enforceable contractual relationships: Contracts will spell out pre-conditions of membership; rights and obligations; benefits and responsibilities.

Source: adapted from Institutional networking guidelines, AAU report, 2005

Appendix 5A: Expert survey Questionnaire

1. This questionnaire has 3 sections and a total of 8 questions that require short answers.

Aim of the questionnaire

To evaluate the [2]*usefulness* of the proposed prescriptive approach in improving implementation practices for inter-organizational service-oriented business information systems in volatile environments.

Objective of the approach

The approach aims to improve inter-organizational service system implementation by fulfilling three implementation requirements identified for usefulness in inter-organizational service systems in volatile contexts. It is aimed at improving current implementation practices to manage the environmental context complexity, caused by volatility.

Research overview

This research deals with designing an approach to improve the efficiency and reliability of inter-organizational service systems implementation practices by emerging public organization networks in the developing world. In this research we note that such networks, work with unpredictable environments and resource scarcity. We recommend use of repeatable processes for inter-organisational service-oriented business IS implementation to improve management of complex implementation challenges caused by environmental volatility, without having to change the focus of the core business processes.

Manifestations of volatility are unstable technology infrastructure, low technical skills base to implement and support IT projects, unstable political /social environment and chronic funding shortages. Such environments are characteristic of organizations in developing economies.

Researcher: Nora K. Mulira, *Email*: n.mulira@tbm.tudelft.nl , nora@dicts.mak.ac.ug ,Faculty of Technology, Policy and Management
Section: Service Systems Engineering (SSE), Delft University of Technology (TUDelft), Netherlands.

[2] Davis (19890), in his Technology Acceptance Model (TAM), describes usefulness as a fundamental determinant for the acceptance of an information technology. Keen and Sol (2006) state that effective decision support or enhancements is based on the 3 U framework: *Usefulness, Usability* and *Usage.*

Request
The study has selected 30 experts in the fields of Service Oriented architectures (SOA) and business information Systems (IS) implementation in general, to evaluate the *usefulness* of the proposed prescriptive approach for satisfying the three usefulness requirements for inter-organisational service systems implementation in volatile environments.
Guarantee of anonymity Research results will be used anonymously and only within the scope of the research thesis or any potential research papers.

Thank you for participating in this survey.

Section 1

(Questions1.1.-1.2) The first part of the questionnaire requires information about your organization, your occupation and expertise in relation to service oriented architecture (Service systems)/IS implementation approaches. The rest (Section 2 and 3) concern your views and evaluation of the proposed prescriptive approach based on the three (3) requirements.

Background information

Name:
Occupation:
Organisation:
Email address: Date:

1.1 Participation role: In which capacity were/are you involved in the IS/SOA implementation?
Please tick your role category for IS/SOA implementation (Do not tick more than 2 options) Project Manager

Researcher ☐

Designer ☐

Programmer ☐

Support ☐

Vendor ☐

Other (please specify)_____

Please tick duration of your experience with:

i) Business IS implementation

10 years+ ☐ Below 10years ☐

ii) SOA implementation

5years ☐ Below 5 years ☐

1.2 Ranking volatility attributes:

Please rank the following implementation elements in terms of their impact on the critical success factors for IS implementation projects. The success factors for the research focus are: *Reliability, effectiveness, flexibility, maintenance*

Ranking scale 1=very low 2, = low, 3= moderate, 4= high, 5=very high

Implementation element	Ranking
1. Technology	
2.Technical skills	
3. Organizational coordination	
4.Process management (User)	

Section 2 (Questions 2.1- 2.3) Please indicate with tick (√),

i) Your level of experience with the proposed tools, techniques and methods.

ii) Level of usefulness in supporting the stated requirement for managing complexity in implementation projects for volatile contexts.

Give your opinion on the usefulness of the proposed tools/ and techniques to support the requirement

Qtn 2.1 **Req # 1:** *Provide decision makers with mechanisms for coordination of dynamics in a distributed network.* *n=30*		*1=strongly disagree, 2=disagree, 3=Neutral, 4=Agree, 5=Strongly agree.*				
objective	support	1	2	3	4	5
Decision making	-Group support systems -Network trade-off guidelines					
Define actor, role and responsibilities	Role checklist for a provider/consumer business model					
Distributed and parallel development and communication	-Project management -Online development Meetings -Online forums					
Formalize business collaboration	-Letters of intention, -Agreements for exploration and contracts for exploitation					
Qtn 2.2 **Req # 2:**. *Assist implementers to analyze the appropriate technology environment for a robust technical infrastructure, with balanced trade-offs.*						
Flexibility of service delivery	-Technology trade off guidelines -Analyse best practice service infrastructures -Three tier architecture					
Inter-network /parallel access	-distributed development forge -Remote service strategy					
Network Access and reliability	-Specify minimum requirements -Bandwidth procurement consortia -Bandwidth management guidelines Bandwidth procurement consortia					
Integration of available system and technology component	IT infrastructure library guidelines Service wrapper					

Qtn 2.3 **Req # 3:** *Enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources.*						
Optimize use of best available expertise	-Survey available expertise and identify training needs. -Start technical resource nucleus with champion organization. -Inter-network skill pool and resource centre					
Sustainable capacity building	-Institutional incubators -Free and open source applications and platforms					
Distributed and parallel support	Online help desk facility					
Devolve technical user support	Institutionalize user training. Adopt hybrid training					

Section 3 **(Questions 3.1 and 3.2)**

This section provides the summary evaluation of the usefulness of the proposed approach and the key gaps for improving implementation practices, for inter-organizational service systems in volatile environments.

Question 3.1

Please indicate with tick (√), the extent to which you agree with the completeness of proposed requirements, for inter-organizational service system implementation.

Requirement	**Opinion** *1=strongly disagree,* *2=disagree,3=Neutral, 4=Agree,* *5=Strongly agree*				
	1	**2**	**3**	**4**	**5**
Req #1: *Provide decision makers with mechanisms for coordination of dynamics in a distributed network.*					

2. **Req # 2:**. *Assist implementers to analyze the appropriate technology environment for a robust technical infrastructure, with balanced trade-offs*.					
3. **Req # 3:** *Enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources*.					

Question 3.2 In summary, what additional requirement and/or tools would you recommend for the approach to support implementation of inter-organizational service systems in volatile contexts?

Thank you for taking the time to complete this questionnaire.

Appendix 5B: List of experts for the expert judgment survey

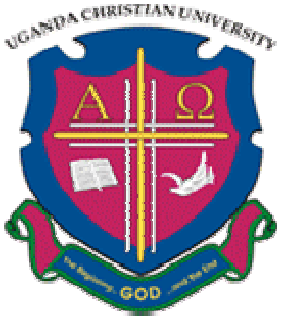
Categories of expertise are R=Researcher, P=Practitioner (developers and designers), V=Commercial vendors.

No	Expert Name	Expertise	Organisation	Position
1.	Helmi Dreijer	P\CV	Technical Services Information Technology University of Stellenbosch, South Africa	Director: mwd@maties.sun.ac.za
2.	Robert. Janz	P	Technical Director Information and communication Technology University of Groningen , Netherlands	Director r.f.janz@rug.nl
3.	Francis Tusubira	R/P	Directorate of ICT Support (DICTS) Makerere university, Uganda	Director tusu@dicts.mak.ac.ug
4.	Sajda Qureshi	R	University of Nebraska, Omaha , US	Research coordinator for IT in development journal squreshi@ist.unomaha.edu
5	Francisco Mabila	P	Informatics centre Eduardo Mondlane university (CIUEM)- Mozambique	Deputy Director mabila@uem.mz
6	Martin Leary	P\R	University of East London	Researcher
7	Maria Beebe	R\R	Global Networks Center to bridge the digital divide Washington state University. USA.	Director beebem@mail.wsu.edu
8	Chrisanthi Avgerou	R	MIS Department, London School of Economics, UK	Professor c.avgerou@lse.ac.uk
9	Derek Keats (Prof)	P/R	African virtual open information Resource (AVOIR) S.Africa Information and communication services University of the Western Cape	Coordinator AVOIR, Executive Director dkeats@uwc.ac.za
10	Bert Geers	P	Program for International Cooperation on Institutional development (CICAT), TU Delft, Netherlands	Project Coordinator and Consultant e.m.a.geers@tudelft.nl

11	Timothy Waema	R	University of Nairobi, Kenya	Professor
12	Miriam Mukasa	R	University of East London	:m.w.mukas@uel.ac.uk
13	Els Van de Kar	R/P	TU Delft	Kar, Els van de
14	Kenneth Kazumi	R/P	UDSM University of Dar es salaam	Lecturer/ researcher
15	Nicholas Rwendeire	V	Integrated Tertiary Systems , South Africa Computer Point Ltd-Uganda	Project manager :nrwendeire@elitechnology.net
16	"A J Erasmus"	R	University of S.Africa (UNISA) in Pretoria	ERASMAJ@unisa.ac.za
17	Devindra Ramnarine	P	Governance and Institutional Development division Commonwealth secretariat	Advisor Public sector Informatics d.ramnarine@commonwealth.int
18	Lishan Adam	P/R	University of Stellenbosch	Professor/Consultant Lishan@ictfd.net
19	Richard Wait	P	Department of IT, Scientific computing/ International science programmes Uppsala University Sweden	Professor Richard.wait@it.uu.se
20	Roger Okot-Uma	R/P	Commonwealth Secretariat	ICT Programme Coordinator. Okutuma@aol.com
21	Ernest van Laere	P	ITU	ICT consultant
22	Ali Ndiwalana	P	DICT, Makerere University	E- learning manager Ally@dicts.mak.ac.ug
23	Steve Smithson	P/R	Department of Management London School of Economics	
24	Sam Muniafu	R/P	TU Delft/Moi Uinversity	Lecturer/Systems administrator s.m.muniafu@tudelft.nll
25	Apolo Kyeyune	P	Directorate of ICT Makerere university	Planning manager akyeyune@dicts.mak.ac.ug
26	Paul Lwettute	R	Kyambogo university	Researcher
27	Soekie Swanepoel	P	University of Pretoria	Librarian soekie.swanepoel@up.ac.za
28	Gwenda Thomas	p	Gaelic	Director man.d@library.wits.ac.z

				a
29	Hamid Mugisha	P	KIU	Lecturer
30	Marble Bwenge	R	UCU Mukono, Uganda	Researcher

Appendix 6A: QUALITY ASSURANCE AND TESTING CRITERIA



Inter-university Registration Information System

Part (i): QUALITY ASSURANCE

March 2007

INTRODUCTION

Inter-University Registration Information System (IRIS) is a basic registration system to be used across three universities namely: Makerere University, Kyambogo University, Uganda Christian University. The system is geared towards addressing the following needs:

- Cost effective registration of users for academic institutions
- Exploitation of the abundant student resources to develop, scale and maintain such a system.
- Synchronization/unification of the various academic institutions' registration (and later, other) routines through the use of a generic system.

IRIS should include among others, the following capabilities:

- Registration of students
- Automated creation of student email accounts for the academic institution
- Automated removal of student email accounts upon completion from the academic institution (if absolutely necessary)
- Comprehensive searchable database of students
- Automated archival of students' records upon leaving the academic institution

QUESTIONNAIRE INSTRUCTIONS

Use A, B, C, and D where necessary as follows:
A – Very Good B- Sufficient C- Insufficient D- Poor

PERSONAL DETAILS

1. Name…….....
   .....
2. Occupation……...
   …….
3. How do you rate your computing skills (tick appropriate)?
   - Excellent: ……
   - Very good: ……
   - Good: ……
   - Modest: ……
   - Weak: ……

APPEAL AND SUITABILITY

1. How would you rate the general appearance of the system?
   a. Very good ☐
   b. Good ☐
   c. Fair ☐
   d. Poor ☐

2. Comment on visibility of the text (would you increase/decrease the text size for clarity?)

   …….

3. Do you find the menu tabs descriptive enough and logically arranged?

   ……

4. Do you find the content on the login page suitable for your main expectation of this system?

   ……

5. Comment on the grammar, spelling and sentence construction of the reports, links and text descriptions.

   …….

6. Comment on the ease of locating a required task?

   …….

7. How easy do you find it to control the sequence of your actions?

   …….

INFORMATION PRESENTATION AND FEEDBACK

1. Do the search results give the level of detail you would expect?

   ……

2. Comment on the speed of the quick search components?

   ……

3. Comment on the response speed of the registration system(How long does it take to return registration reports)

   ……

4. Is the feedback precise and straight to the point?

   ……

OTHER COMMENTS

1. Did you notice any errors or unexpected feedback?(if no skip to 4)

   ……
2. Identify any errors encountered.

   .....

   .....

   .....

   .....

   .....

   .
3. How easy was it to recover from the errors?

   .....
4. Mention any components that you expected but were unavailable

   ……

   ……

   ……

   ……
5. Did anything about this system confuse you or seem unclear?

   ……

   ……

6. What would you recommend to make this system easier to use?

   ……

Thank you for your cooperation

Part (ii) TESTING CRITERIA

TESTING CRITERIA

Testing is to be carried out at every stage of the system in order not to carry errors through the stages of the system. The table below shows the testing procedure at every stage.

Activity	**Testing procedure**
Establishment of a collaborative tool (CVS)	• Check if CVS server is running. • Check if the CVS users are being authenticated and able to check in and check out modules.
Creation of databases, creation of the registration process, Producing reports like registration card/certificate, and others, Functionality for uploading files, Creation of an alert system for students to complete registration.	• Check if the registration process has taken place that is if a student or staff who has registered has his or her credentials in the iris database. • Check if a user can login using an email address automatically created for him or her and password. • Check if informative messages are sent to users of the system when they are supposed to be sent to them. • Check if reports are being produced accurately. • Check whether the documents are being uploaded to the server and whether the documents can be downloaded

	by the administrators to compare them with the original documents.
Security integration	• Check if the security levels are set properly that is a user access what he or she is allowed to access.
Automatic creation of email on registration.	• Check if an email address is created after one has registered.
Creation of a search based on the multiple criteria	• Check whether the searching system is done adequately.
Deployment	• After deployment a system has be tested on whether it works at the different Universities perfectly. • The reliability and availability of the system is checked. • The speed of the system is checked. • Navigation of the system is checked.

Appendix 6B: Implementer evaluation questionnaire

Dear participants,

This Questionnaire is a tool designed to assess the implementer's satisfaction with the implementation approach used for the Inter-university Registration Information service (IRIS). The questionnaire consists of three parts. Part 1 includes closed ended questions about the usefulness, clarity, efficiency, support/help, satisfaction and functions of the approach. In part 2, open ended questions are directed to identify the favourite functions of the approach, its missing characteristics and any problems faced during usage. In order to gather demographic information about participants, background questions are asked in the last part of the questionnaire. The results of the questionnaire will be used only for academic purposes. We thank you for your help and cooperation.

Part 1
Please indicate how much you agree or disagree with each of the following statements by marking the proper point on the right hand scale.

Approach Functions

	Strongly agree				Strongly disagree
1.I could easily find the potential development components for IRIS on the internet.	5	4	3	2	1
2. The Approach helped me to select potential IRIS components quickly.	5	4	3	2	1
3. The Approach is helpful in accurately recording and reporting user requirements.	5	4	3	2	1
4. The Approach guided user requirements negotiations.	5	4	3	2	1
5. The approach helped me to conceptualize and understand user requirements.	5	4	3	2	1
6.The Approach made it easy to monitor changes in user requirements	5	4	3	2	1
7. It was not easy to involve users in the development stages.	5	4	3	2	1
8. I experienced many technical problems with the integration of existing components	5	4	3	2	1

Effectiveness

	Strongly agree				Strongly disagree
9. Using the Approach increased my productivity	5	4	3	2	1
10.I do not see any advantage in using the Approach	5	4	3	2	1
11. Using the Approach improved my performance	5	4	3	2	1
12. I do not need the Approach to active to execute the same task	5	4	3	2	1
13. Overall I find the approach usable in the implementation of service systems.	5	4	3	2	1

Clarity

	Strongly agree				Strongly disagree
14.The Approach guidelines are clear and understandable	5	4	3	2	1
15. The Implementation stages follow a logical order.	5	4	3	2	1
16. It is not always obvious what to do next	5	4	3	2	1
17. The outputs for each implementation stage are clear	5	4	3	2	1
18. I found the Approach easy to use	5	4	3	2	1

Satisfaction

	Strongly agree				Strongly disagree
19. The Approach was interesting to use	5	4	3	2	1
20.Using the Approach saved me time	5	4	3	2	1
21.It will take a long time for me to learn how to use this Approach	5	4	3	2	1
22.I would like to use the Approach for future implementation projects	5	4	3	2	1
23.I am not satisfied with the end result	5	4	3	2	1

Part 3

24. D o you have a favourite function in the Approach? If yes, please explain.
25. Is there anything that was omitted in the Approach? If yes, please explain.
26. Did you have any problem with using this Approach? If yes, please explain.
27. What did you think of the resulting IRIS services?
28. Do you have any further remarks and/or suggestions to improve the IRIS implementation approach?

Background questions.

Your role in the implementation of IRIS:

- Project Manager
- Analyst
- Designer
- Developer
- support

I have experience with the following development tasks:

- Programming
- Systems Analysis
- Design
- Others, like…….

Appendix 6C: Role Checklist for the IRIS Project

Role	Actor	Tasks
High level policy management	Steering Committee	1. Manage the project scope and change requests 2. Provide appropriate and timely resources for efficient and effective project completion 3. Provide on-going guidance and direction to the project team 4. Provide regular feedback to the project team on performance vs. expectations 5. Act as the final decision maker on unresolved project issues.
Project Leadership and management.	Project Management Team	1. Oversee and direct, adherence to business requirements, development of functional and program specifications, relational database design, programming, testing, implementation and documentation for modules 2. Schedule and assign resources to ensure that applications satisfy users' needs and are completed within agreed upon time parameters 3. Monitor the status of the technical resources and tasks 4. Work with the Technical Lead to manage and oversee the system development process including systems analysis, technical design, coding, testing, and turnover to production of the application
User Guidance and feedback.	Client	1. Provide user requirements to create the system. 2. Provide feedback to Management to manage the project including the timeline, work plan, testing, resources, training and documentation of procedures 3. Provide a clear definition of the need by way of concise responses during system evaluation 4. Sign-off on project deliverables 5. Put to use the developed system.

Technical system development	Development Team	1. Plan, schedule, and coordinate activities related to system development 2. Present all Design Overview Documents 3. Perform audit reviews on tested module. 4. Provide technical proficiency on business process design, database administration functions for project implementation, maintenance, enhancement and training. 5. Design modules (forms, reports, and interfaces) 6. Perform unit testing on modules (forms, reports, and interfaces) 7. Update systems data and prepare conversion requirements
System and project Documentation.	Documenter	1. Document all design overview activities. 2. Document progress on the project and it's subsidiary activities at various stages. 3. Create and maintain technical documentation based on design changes or creation criteria.
***Hardware and software Management for system implementation.**	System Infrastructure Maintenance Team	1. Ensure the application software/hardware is consistent with the technical environment and standards 2. Provide technical system and database maintenance for: a. Backup and recovery systems b. Network and related hardware systems 3. Install and upgrade server and application software 4. Provide database administration support for systems development and upgrades.
User Support and training (both during and after completion of the system)	Support and Training Team	1. Provide end user training during and after implementation 2. Provide help desk support after implementation 3. Assist in the distribution and configuration of workstations for the "end user community" enabling the system ran un-impeded 4. Provide support for network problems, security problems, access issues and other related issues that may compromise system performance

* Includes the servers, network printers, operating system, databases, user security, and network connectivity

List of abbreviations

List of Abbreviations

BE	Business Engineering
CBD	Component Based Development
CBE	Collaborative Business Engineering
CBSE	Collaborative Business System Engineering
HTML	Hyper Text Markup Language
IP	Internet Protocol
IS	Information Systems
ISP	Internet Service Provider
ICT	Information and Communication Technology
IT	Information Technology
PADTR	Preparation, Analysis, development, Testing, Roll-out
PHP	Hypertext Preprocessor (recursive acronym)
RAD	Rapid Application Development
SLA	Service Level Agreement
TAM	Technology Acceptance Model
TTM	Technology Transition Model
UML	Unified Modeling Language
WAP	Wireless Application Protocol
WML	Wireless Mark-up Language
XML	Extensible Mark-up Language

Summary

Introduction

Public organizations in the developing world are undergoing a gradual but irreversible change, due to innovations in information and communications technologies. The emergence of business networks, among such organizations, indicates an increasing interdependence and a search for solutions to regain waning strategic relevance and competitive advantage. In this research we note that, the emerging public organizational networks in the developing world, work in unpredictable environments with resource scarcity. This environment is volatile and a potential obstacle to improving implementation practices for emerging networks. To find solutions that can improve the reliability and efficiency of the implementation practices, we focused on the implementation challenges that emerging inter-organizational networks currently face in implementing service systems for business collaboration. We defined solutions that use repeatable processes for inter-organizational business IS implementation, avoiding the need to change the focus of the core business processes.

Research arguments

In this research, we argued that the current approaches can not improve reliability and efficiency of implementation practices required by the emerging networks in the developing economies. The new network actor organisations must overcome a volatile environment and additional complexity of operating in a multi actor setting. Although the literature on IS implementation is vast and relatively mature, we did not find an integral view on the specific problem domain of IS implementation in a volatile context. Available literature that prescribes approaches for the design and implementation of service-oriented systems in inter-organisational business networks is predominantly focused on commercial organizations in industrialized countries. Useful elements can be selected from these approaches but, they are not adequately prescribed and validated to manage the complexity of volatile challenges and to improve implementation practices.

We asserted further that, by adopting *repeatable* processes for the implementation of inter-organisational service systems, uncertainty of managing complex challenges caused by volatility in emerging networks in developing economies is *reduced*. The envisaged added value of network business collaboration is to offer of business opportunities through generation of new innovative services and products, without the need to change the focus of core business processes.

In addition, theory and empirical evidence shows that inter-organizational systems are hard to design, implement and manage because they have multiple

actors, each with their own value systems and interest. Based on these observations, it was concluded that there is a need for innovative engineering approaches, including design theories, design heuristics, modelling techniques and environments, in which this new organizational context for service delivery can be tested and evaluated from a strategic, operational and technological perspective. Inter-organisational service systems implementation in volatile contexts is a prime candidate for such a research innovation.

Research objective

Therefore the objective of the research was formulated as:
To develop an approach that supports the improvement of efficiency and reliability of the implementation process, for inter-organizational service systems in volatile contexts.

Research questions

1. What are the current and emerging issues in the implementation of inter-organizational service systems by business networks in volatile environments?
2. What implementation mechanisms can be used to implement inter-organizational service systems in volatile contexts?
3. How can we support the process of improving inter-organizational service system implementation in volatile environments?

Research methodology

To address the research questions, the design science paradigm was followed to create and evaluate an approach for inter-organisational service system implementation for new networks in volatile contexts (artefact). The artefacts that were created during the research included a methodology and a system prototype. At the beginning of the research, the behavioural science paradigm was followed to develop a descriptive model and the requirements of the problem situation. Various research instruments were used in the design science research strategy. A literature search was used to obtain the initial starting point of the research, compare findings and refine emerging ideas from both the exploratory and the action research case studies. The exploratory case study methodology was used in the initial phases of the research to derive a better understanding of the volatility issues, challenges and problems that constrain implementation for inter-organizational business collaborations. Using the action research case study methodology, the researcher assumed the dual role of participant/observer to study and evaluate a unique process of inter-organisational system implementation. The expert judgement survey was also used to gain insight with respect to the usefulness of the support approach.

Current and emerging issues in inter-organisational service system implementation in volatile contexts

In chapter 2, an exploratory case study was carried to help us understand the

implementation issues, challenges and problems experienced in practice by emerging business networks in volatile contexts. Two cases from higher education institutions were chosen. The first one was the intra university case which involved three universities; Mondlane in Mozambique, Dares Salaam in Tanzania and Makerere in Uganda. The three universities represented large public institutions with typical characteristic volatility. The second one involved three types of university consortia in South Africa. The first case revealed a dynamic and complex environment of recurrent challenges caused by volatility, which contributed to under utilized or failed IS implementation projects. The second case showed challenges and lessons for managing technology and skill interdependencies, network coordination and sustainability. The exploratory case clearly demonstrated that an approach to support improved efficiency and reliability of implementation practices should consider these constraints and issues. From this empirical investigation the following questions are derived for further investigation, to inform possible mechanisms that can be used for service system implementation by emerging networks in volatile contexts.

- How can an inter-organisational network be created from independent organizations, with varied technical skills and technological infrastructure?
- How can a user –centred implementation process for a service system, be managed to elicit and monitor user requirements at all stages?
- How can we derive an inter-organizational technological infrastructure, to integrate varied systems resources and support a reliable service delivery?
- How technical skills for the implementation and support of technical projects, be developed and sustained?

Principles of service system implementation in volatile contexts

In chapter three, a literature review was conducted to identify a number of initial theories to study the problem under investigation. The concept of service systems implementation in an inter-organisational setting was explained in relation to potential methodologies that could provide a possible way forward to improving implementation practices in volatile contexts. The principles of service system implementation that could be used to support an appropriate methodology for improved implementation in the volatile contexts were identified and explained. The relevant mechanisms discussed to derive potential solutions were IS development, collaboration engineering, process management and service implementation theories. For the overall implementation framework, the dominant methodologies, models and approaches that have been used for the implementation of business information systems to facilitate and manage business processes at the parallel and distributed levels of the organisations, were discussed first. The descriptive conceptual model of the approach was the result of this abstraction.

Supporting inter-organisational service system implementation in volatile contexts

Based on the issues and problems identified in the exploratory case study, five requirements to be satisfied were formulated for an approach that can be used to improve implementation practice for new networks in volatile contexts. Three of the requirements were focused on the useful dimension, and two on the usability of the approach. An approach consisting of a *new implementation methodology (PADTR) supported by, collaborative business systems engineering (CBSE), service system engineering and process management tools, techniques and reference guidelines* was developed on the basis of the requirements. The approach is aimed to model and improve the implementation process in volatile contexts. The approach was structured using the dimensions of 'way of thinking', 'way of working', 'way of modelling' and 'way of controlling.'

Way of thinking

The way of thinking expresses the underlying philosophy of the approach. The perspective taken of the problem domain is stated and the underlying assumptions are made explicit. It delineates the view on the problem domain and provides an overview of the methodological principles the support framework is based on, making the underlying assumptions explicit. The way of thinking determines the way of modelling, way of working and way of controlling. It is often expressed in guidelines, rules of thumb, do's and don'ts, metaphors and design theories.

The view taken of the problem domain is the implementation of the inter-organisational service systems by emerging inter-organisational networks of non-profit public organizations, in volatile contexts. The member organisations are of similar business domain, with fundamental resource scarcity especially in technical skills and technology. There is inadequate knowledge and experience for service system implementation by the network members and therefore learning is part of the implementation activities. Creation of the network is greatly influenced by embedded relational ties.

The project undertaken by these new networks is the inter-organizational service system implementation, which combines three basic elements; the enabling technology, a service formula demanded by users and this service supplied by a multi-actor network. Actors must consider trade-offs between the three elements. For the emerging networks with resource scarcity, the unreliable technological infrastructure and skill deficiencies indicate that technology/ service formula, service formula/network tradeoffs should be high.

The creation of such networks is influenced by an internal need for resources and a commitment to an external problem or opportunity. The internal network factors consist of the business model and prior business relational ties. The

technology must support services demanded by the users but these demands are not clearly established. The networks needs support to negotiate trade off between the service system elements and to coordinate activities in the network in order reduce complexity and improve implementation practices for the business system implementation. Based on the network resource interdependencies and innovativeness of the project, consideration should be given to network formation and coordination factors that influence sustainable business collaboration, robust technical service architecture, and user value in a reliable service delivery. Guidelines were formulated to deal with factors related to tradeoffs between technology and the volatile network, and the volatile network and service formula (see section 7.1.3).

Way of working

In the way of working, suitable steps and corresponding activities that should be undertaken, to improve the efficiency and reliability of the implementation process were specified for volatile contexts. The prescribed implementation methodology for the multi–actor volatile context combines the stepwise sequence for phase execution of the waterfall model, made up of the phases, Preparation, Analysis, development, Testing and Realisation (PADTR). The phased activities are conducted in an iterative sequence within the spiral model (Boehm, 1988). The approach recommends a user centred implementation that utilises participative approaches with collaborative approaches for the multi actor context, complimented by requirements management that monitors user appreciation as the system evolves. The PADTR methodology, incorporates the most basic elements in usability engineering; an empirical user test and prototyping combined with iterative design These two characteristics of the methodology, are suitable for the innovation of implementing services systems by emerging networks, where business requirements are not well formed by users and where it is difficult to determine how the proposed solution will perform in practice. Iteration enables learning and user feedback especially during the exploration network phase. Software engineering approaches like component based development (CBD) that facilitate incorporation of legacy and other relevant technology components and resources, are part of the implementation methodology. Guidelines that apply for each stage should be considered to guide technology, network and service value trade-offs.

The way of controlling

For the way of controlling, it was recommended that coordination mechanisms should consider the complexity of the combined institutional relationships, values, goals and the volatile environment. Project management as one of the most basic forms of management used to control projects, was recommended to manage the implementation project. In addition, other process management techniques, such as the appropriate governance model and guidelines to handle resource interdependencies between participating organizations were

recommended. Network members should note that control mechanisms differ at the exploration and exploitation phases of the network. During the exploration process management elements are required to commit participants and create inspiration to form and sustain the network. These include prospects for gain and incentives for cooperative behaviour, letters of intention and agreements to initiate commitment. During the exploitation stage relevant governance mechanisms and contracts that include service level agreements (SLA) and performance indicators must be enforced by mutual agreement. Standardisation of operations should be balanced with institutional autonomy.

The way of modelling

During the implementation process, models assist stakeholders to incrementally describe, visualize and understand their selected service options. This is particularly useful to support implementers, designers and developers. The CBD approach presented useful modelling techniques for the development context, to understand the context and provide the solution. Modelling techniques or improvised adaptations that are cheap and fast for the volatile context were prescribed. Useful techniques for the development stage included component architecture modelling and context modelling which describes the proposed system in the defined business area. Paper modelling for modelling interfaces was useful for eliciting active user feedback. CBSE using Conceptual modeling of networks assists understanding the overview of network actors and roles. Object oriented was recommended for dynamic modeling for applications. 'Thinklets' were useful for modeling group sessions. Pencil and paper group support sessions that are structured by *thinklets* were adopted (with some limitations on functionality) due to the lack of GSS software. Conflict situations, are best resolved using change management approaches before the project starts. If conflict arises, gaming can be used. For the process design, useful ways of modeling include prototypes, scenarios and storyboards.

When using the implementation approach, it was recommended that practitioners should adjust instructions to the differences in the application situation. While the basic elements to the guidelines remain the same, creativity and flexibility in response to the uniqueness of the project, contributes to success.

Testing and evaluating the approach

The *usefulness* of the approach was evaluated by expert judgment to see if it could:
Req # 1: *provide decision makers in the network with mechanisms to manage the dynamics in the coordination and sustainability of distributed business networks.*

Req # 2: *assist implementers to analyse the appropriate technology*

environment for implementing a robust technical infrastructure, with trade offs that balance user value, scarce resources and a reliable service system.

Req # 3: *enable implementers to assess and prescribe means to develop a sustainable expert skill pool and technical resources to optimize the low technical skill base for implementation and support of ICT development projects.*

The experts were positive overall about the proposed support sets for the specified implementation objectives. According to the expert evaluation, the prescribed tools and methods were useful in varying degrees. The proposed support for optimising skills ranked highest while the technology environment for robust service architecture got the most neutral scores. This was partially attributed to the lack of familiarity with the service implementation support, since the service phenomena is comparatively new. The expert opinion was that the approach was potentially useful but raised some usability issues and made recommendations, some of which were recommended for further research.

The *usability* of the approach was tested using the action research case study, to prove if using the approach would satisfy the following requirements:

Req # 4: *provide means for conducting a user–centred implementation within a controlled process that tracks changing user appreciation and provides feedback.*

Req # 5: *assist the system developers to select and integrate available system components and technology resources into the new system, with minimal complexity*

In the action case study, the PADTR methodology, which is the framework of the approach, was applied in the implementation of an inter-university registration system (IRIS) pilot in Uganda, which represents a network in a volatile context. The implementers, who are the direct beneficiaries of the approach, evaluated functionality: if it was easy to use, effective, clear and how satisfied they were with the methodology. The evaluation confirmed that the approach was usable in a limited context to derive a service system that complied with user requirements. There were minor discrepancies between expected user and actual IRIS functionality which were attributed to the passive participation of users in the design and development process as well as deficient modelling skills on the part of the implementers. An adaptation of paper prototyping reactivated user interest in the design of the interface. Implementers also successfully selected and integrated system components from open source applications and utilised an open source framework for the development platform. The implementers noted the need for a distributed development environment to allow full participation of partners. A synchronised service delivery for all three institutions was not possible due to limited bandwidth

capacity but mirroring of the service was adopted at off peak times. Overall, the approach applied using the PADTR methodology demonstrated usability and showed some useful products that could be delivered in a limited context. Further refinement iterations should pay attention to the outstanding issues noted by the implementers.

Research benefits

The research benefits combine the practical and academic relevance:
The benefit for business networks in volatile contexts is that, an implementation approach for inter-organizational service systems that covers the most critical and complex requirements for volatile contexts has been evaluated using an empirical validation. The approach provides emerging networks in volatile environments, particularly in the higher education sector, with insight in ways to make the implementation process more efficient and reliable. Using this initial design of the approach, organisations can build capacity for adoption of new, flexible, reusable and collaborative approaches suitable for volatile contexts, to optimize scarce resources, improve implementation practices and the resulting services and to gain competitiveness and strategic relevance.

On the academic front, research can build further on the adoption of two concepts which are relatively new in public institutions of the developing economies; Service-oriented implementation and Collaborative Business System Engineering (CBSE) approaches from a new inter –organizational perspective (Den Hengst and De Vreede, 2004).

Conclusion and recommendations

Based on the research conducted in this problem domain, it is our strong conviction that the implementation approach developed for inter-organizational service system implementation is potentially useful and usable to improve the efficiency and reliability of the implementation practices for emerging networks in volatile contexts. While we addressed a number of volatility issues in implementation, more issues that require further research were highlighted during the evaluation phase of the approach. These issues include testing the usability and usefulness of the approach in a real implementation project, with more varied complexity in stakeholders, uncertainty in requirements and bigger business networks. The second area for further research is to test the approach in other public networks beyond the higher education scope that was the focus of this research. The third possible direction is to identify ‘Usage’ related requirements from practice to complete the set of requirements for an effective approach, to improve the efficiency and reliability of processes for inter-organizational service systems implementation in volatile contexts. We also recommended further research into appropriate modeling techniques that optimize resources and encourage active user participation and feedback to increase system relevance to users. We incorporated proposal of relevant methodologies recommended from the expert judgment like future search

methodologies (FS), to be studied as potential additions to the approach, to change organizational culture and strategic planning of long term business strategies, for new business networks. The last possible direction for further research was to identify and test appropriate objective performance measures (as opposed to subjective) for the approach, in a normal implementation project, to complete the usability test profile of the approach.

Samenvatting

Inleiding

Publieke organisaties in ontwikkelingslanden worden geleidelijk doch onomkeerbaar veranderd door innovaties in de informatie- en communicatietechnologie. De spontane vorming van netwerken van deze organisaties duidt op een toenemende wederzijdse afhankelijkheid en toont aan dat men op zoek is naar oplossingen om het strategisch belang en de concurrentiepositie uit een neerwaartse spiraal te halen. In ons onderzoek constateren we dat opkomende netwerken van publieke organisaties in ontwikkelingslanden zich bevinden in een onvoorspelbare omgeving en dat ze moeten werken met schaarse middelen. De omgeving is volatiel (d.w.z., zeer dynamisch en daardoor vaak onzeker) en daardoor een mogelijk obstakel bij het verbeteren van de methoden om zulke netwerken te implementeren. Om oplossingen te vinden die de betrouwbaarheid en de efficiëntie van de implementatiemethoden verbeteren hebben we ons vooral gericht op de uitdagingen waarmee inter-organisationele netwerken tegenwoordig worden geconfronteerd bij het implementeren van diensten die de onderlinge samenwerking moeten ondersteunen. We hebben oplossingen gedefinieerd die zijn gebaseerd op herhaalbare processen voor het implementeren van informatiesystemen voor inter-organisationele bedrijfsvoering, zonder daarbij de kernprocessen van de betrokken organisaties uit het oog te verliezen.

Stellingname binnen dit onderzoek

In dit onderzoek stellen wij dat de gangbare benaderingswijzen de betrouwbaarheid en efficiëntie van de implementatiemethoden niet kunnen verbeteren, terwijl dit wel wordt vereist door de bedrijfs-netwerken die zich in opkomende economie"en aan het vormen zijn. De nieuwe actor-netwerken moeten bestand zijn tegen een volatiele omgeving en moeten bovendien kunnen omgaan met de additionele complexiteit van het werken in een multi-actor omgeving. Hoewel er uitgebreide en gedegen literatuur bestaat met betrekking tot de implementatie van informatiesystemen, hebben we daarin nog geen volledig beeld aangetroffen van ons researchonderwerp, d.w.z. het domein van de implementatie van informatiesystemen gecombineerd met volatiliteit. De beschikbare literatuur over methoden voor het ontwerpen en implementeren van service-georiënteerde systemen in inter-organisationele netwerken richt zich vooral op commerciële organisaties in geindustrialiseerde landen. Hoewel uit de beschreven benaderingen nuttige elementen kunnen worden overgenomen, zijn deze onvoldoende uitgewerkt en gevalideerd om praktisch bruikbaar te zijn voor het beheersen van de complexiteit van het probleem van volatiliteit en voor het verbeteren van de implementatiemethoden.

We stellen verder dat het gebruik van herhaalbare processen voor de implementatie van inter-organisationele diensten zal helpen om de onzekerheid te

verminderen bij het beheersen van de complexe uitdagingen die het gevolg zijn van de volatiliteit in opkomende netwerken in ontwikkelingslanden. De voorziene toegevoegde waarde van de inter-organisationele samenwerking bestaat uit kansen voor nieuwe bedrijvigheid door de ontwikkeling van innovatieve diensten en producten; de doelstellingen van de kern-bedrijfsprocessen hoeven daarvoor niet te worden aangepast.

Daarnaast tonen we door middel van zowel theoretisch als empirisch onderzoek aan dat het ontwerp, de implementatie, en het beheer van inter-organisationele systemen ingewikkeld is: er zijn meerdere actoren bij betrokken, die elk kun eigen waarden en belangen hebben. Op basis van deze observaties hebben wij geconcludeerd dat een innovatieve benadering nodig is, inclusief een ontwerptheorie, ontwerp-heuristieken, modelleertechnieken en -omgevingen, waarin de nieuwe organisationele context voor het leveren van diensten kan worden getest en worden geëvalueerd vanuit een strategisch, operationeel, en technologisch perspectief.

Onderzoeksdoel

Het doel van ons onderzoek kan daarmee als volgt worden geformuleerd:

Ontwikkel een aanpak die de ondersteuning biedt voor het verbeteren van de efficiëntie en de betrouwbaarheid van het implementatieproces van inter-onganisationele diensten in een volatiele context.

Onderzoeksvragen

1. Wat zijn de huidige en opkomende problemen bij de implementatie van inter-organisationele diensten door bedrijfsnetwerken in volatiele omgevingen?
2. Welke methoden kunnen worden gebruikt om inter-organisationele diensten in volatiele omgevingen te implementeren?
3. Hoe kan het verbeterproces van het implementeren van inter-organisationele diensten in volatiele omgevingen worden ondersteund?

Onderzoeksmethodiek

Om de onderzoeksvragen te beantwoorden werd het ‘design science’ paradigma gebruikt, door eerst een benadering voor het implementeren van een inter-organisationele dienst (het artefact) te ontwerpen en deze vervolgens te evalueren. De artefacten die tijdens ons onderzoek zijn gecreëerd omvatten een methodologie en een prototype van een systeem. Bij aanvang van ons onderzoek is het paradigma van de ‘behavioural science’ aangehouden; hierbij werd een beschrijvend model ontwikkeld en zijn de eisen en randvoorwaarden van de probleemsituatie in kaart gebracht. Bij de onderzoeksstrategie uit de ‘design science’ zijn verschillende onderzoeksinstrumenten gebruikt. Literatuurstudie leverde een startpunt voor ons onderzoek en werd gebruikt om

resultaten te vergelijken en om de ideëen die voortkwamen uit de verkennende en de 'action-research' case studies te verfijnen. De methodiek van verkennende case studies werd in de initiële fasen van het onderzoek gebruikt om een beter begrip te krijgen van de problemen en uitdagingen die het gevolg zijn van volatiliteit en die de implementatie van inter-organisationele samenwerking hinderen. Tijdens de 'action-research' case study werd door de onderzoeker een dubbelrol gespeeld, die van deelnemer en die van waarnemer. Hierbij werd het implementatieproces van een specifiek inter-organisationeel systeem bestudeerd en geëvalueerd. Tenslotte is onder experts een enquête uitgevoerd om inzicht te krijgen in de bruikbaarheid van de ondersteunende aanpak.

In de 'action-research' case study is de PADTR methodiek (het raamwerk van onze aanpak) toegepast op de proef-implementatie van een inter-universitair registratiesysteem (IRIS) in Uganda, dat zich kwalificeert als een network in een volatiele omgeving.

Onderzoeksresultaten

De onderzoeksresultaten zijn van zowel practisch als academisch belang. Het resultaat voor bedrijfsnetwerken in volatiele omgevingen is dat er een aanpak is ontwikkeld voor de implementatie van inter-organisationele diensten die aan de meest kritieke en lastige eisen in volatiele omgevingen tegemoetkomt, en dat die aanpak empirisch is gevalideerd. Onze aanpak verschaft opkomende networks in volatiele omgevingen, in het bijzonder in de sector van het hoger onderwijs, inzicht in methoden om het implementatieproces efficiënter en betrouwbaarder te maken. Door onze benadering te gebruiken, kunnen organisaties de mogelijkheid creëren om nieuwe, flexibele, herbruikbare, op samenwerking gebaseerde benaderingen in te voeren die geschikt zijn voor volatiele omgevingen en waarmee schaarse middelen optimaal worden benut, de implementatiepraktijk en de resulterende diensten verbeterd, en de concurrentiepositie en de strategische relevantie verbeterd.

Conclusie en aanbevelingen

Op basis van het uitgevoerde onderzoek is het onze stellige overtuiging dat de ontwikkelde aanpak voor de implementatie van inter-organisationele diensten nuttig en bruikbaar kan zijn voor het verbeteren van de efficiëntie en de betrouwbaarheid van de implementatiemethoden voor opkomende netwerken in volatiele omgevingen.

Curriculum Vitae

Nora Kasirye Mulira was born in Kampala, Uganda, on the 22nd May, 1961. She studied at Gayaza high school, Makerere University in Uganda, and at the London School of Economics (LSE) in the United Kingdom for her Masters degree (MSc. MIS). After getting her masters degree, she worked with the Statistics, Management and Information Branch (SMI) in the then department of health (DoH) in London, for two years. Thereafter, she joined Makerere University Institute of computer science as a lecturer in MIS and became director in 1997. In addition to teaching, she supervised student research and did consultancy work. In 2001, she moved to the Directorate of ICT Support (DICTS), as the deputy director in charge of the IS implementation, which constituted the integrated tertiary administrative system for Makerere university. Mulira has done extensive research, publications and consultancy work in technology (ICT) interventions for socio/economic initiatives both at the national (Uganda) and regional (Africa) levels. Notable projects include the *Development of Uganda's information infrastructure agenda* funded by *Info*Dev (World bank), *Application of ICT in the HIV/AIDS response in Eastern & Southern Africa* (IDRC) and networking for the Association of African universities; *(AAU) bandwidth initiative.*