How Community Based Policy Management can improve access to the Solas Online Community

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A dissertation submitted to the University of Dublin, in partial fulfilment of the requirements for the degree of Master of Science in Health Informatics 2008.

Declaration

I declare that the work described in this report is, except where otherwise stated, entirely my own work, and has not been submitted as an exercise for a degree at any other university.

Signed: _____

Sinéad Kellett

10th September 2008

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I would also like to thank my parents, friends and Paul for their constant encouragement, support and above all patience.

"We have long been expecting that you would tell us about the ….life of your citizens…. What is the nature of this community?… For we are of the opinion that the right or wrong management of such matters will have a great or paramount influence on the state for good or for evil"

-Plato, Republic (360, BC)

Summary
Solas is an online community for sick children, a private network created by the Centre for Health Informatics which is trialling at a single site on the ward of an acute national paediatric hospital in Dublin. The tool facilitates communication with peers, via email, chatrooms and video conferencing along with facilities to entertain and educate, to alleviate the boredom of long hospital stays. There are a wide selection of resources available through Solas but it has become apparent to those administering the system that these resources need to be augmented and customised in order to facilitate the diversity of users (age, maturity, sickness levels) and the expansion of the community to other hospitals. In addition, the Solas creators face challenges ensuring the online community adheres to policies pertaining to children's use of the internet and the online functionality it enables. Easily incorporating these policies into the use of the system in a flexible and transparent manner has been an obstacle to date. To address the challenge of resource management and policy modelling this thesis proposes the Community Based Policy Management System (CBPMS), a system consisting of a formal model of the online community and its members, a clear definition of its state transitions and a service oriented architecture for deployment. Community Based Policy Management has been shown to be successful at addressing the challenge of efficiently managing other complex heterogeneous information systems. This report describes the integration of Solas with CBPMS, and the configuration of the integrated system with a researched set of policies pertaining to children's use of the internet both in open and restricted environments. The literature was collated from a number of stakeholders including Government, Educational Departments, Parental and NGO sources. The integrated Solas and CBPM system was then evaluated using Heeks, Mundy, and Salazar's (1999) ITPOSMO methodology which suggests that there may be general, concrete, and practical advantages to integrating CBPMS with Solas. Finally this project concludes with suggestions for future work.

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List of abbreviations

AAP	American Academy Paediatrics
AUP	Acceptable Use Policy
BR	Benefits Realisation
CBPMS	Community Based Policy Management System
CBPM	Community Based Policy Management
CHI	Centre Health Informatics
CPDS	Community Policy Decision Service
CPMS	Community Policy Management Service
CRMS	Community Record Management Service
HCIS	Healthcare Information System
KDEG	Knowledge Data and Engineering Group
IAB	Internet Advisory Board
ICT	Information Communication Technology
NCTE	National Centre for Technology in Education
NGO	Non-Governmental Organisation
PDP	Policy Decision Point
PBM	Policy Based Management
RBPM	Role Based Policy Management
RAIS	Resource Authority Management Service
TCD	Trinity College Dublin
UI	User Interface
UKCGO	United Kingdom Children Go Online

1.0 CHAPTER ONE – INTRODUCTION

1.1 Online Communities

The explosive diffusion of the Internet since the mid-1990s has fostered the proliferation of online communities. An online community is a group of people with common interests who use the Internet (web sites, email, instant messaging, etc) to communicate, work together and pursue their interests over time (http://www.commoncraft.com). An Internet community means different things to different people. For some it conjures warm, fuzzy reassuring images of people chatting and helping each other. For others it generates dark images of conspiracy, subversive and criminal behaviour and invasion of privacy (Preece, 2000). There are hundreds, if not thousands, of them varying wildly in size and focus. Whatever one's hobby, political view, or religion, one will almost certainly find somewhere to voice opinions to like-minded people. The ability to interact with like-minded individuals instantaneously has considerable benefits, however online communities have bred some fear and criticism. This communication medium can serve as dangerous hunting grounds for criminals, such as identity thieves and stalkers, with children particularly at risk.

1.2 General Motivation

Solas is one such online community, a private network created by the Centre for Health Informatics (https://www.cs.tcd.ie/chi/) which is trialling at a single site on the ward of an acute national paediatric hospital in Dublin with over 100 users to date. Solas (meaning Light) can be accessed by following the link http://www.solas.ie.

The tool creates a fun environment for children to communicate outside of their isolation ward, play games and music, as well as chat, text, and email to alleviate the boredom of long hospital stays. Solas aims to:

- Provide these children with a richer means of interaction and communication with the outside world
- Enhance a sense of presence and connectedness between these children and the familiar people, places, and things that might strengthen their psychological well-being and overall healing potential.
- Provide the children with creative and educational tools (music, art, stories, and facilitate them sharing experiences while they are in isolation)

The Solas creators hope that through the provision of a web-based resource, children will be able to foster the development of new friendships with other members of the Solas community. It is the intention that the children will be able to continue using it after their hospital stay allowing them to be part of an online community and share their experiences with others in similar circumstances (Solas Needs Assessment).

"Technology isn't the most important factor in [online] communities. Members are." (Hagel & Armstrong, 1997). Making Solas a safe environment for the users is a challenging task and one which is the goal of this research. Literature review suggests that communities are more likely to succeed when early social planning constrains the community just enough to discourage inappropriate behaviour while facilitating the community's evolution (Preece, 2000). Achieving this balance requires skill, sensitivity and acknowledgement that the community's purpose and needs may change over time.

While safeguards are in place to ensure Solas is a safe online environment, the Solas system developers currently face difficulties controlling access to site content and usage across a wide span of ages, maturity and sickness levels. Site access and content is currently controlled by the site kiosk but with the diversity in the background of its users this has proved cumbersome to manage and will be an even bigger issue if the tool is offered to other hospitals. According to Preece (2000) the development and sustainability of an online community must focus on the community's needs prior to making decisions about the technology and social planning. There are two main parts to the process: software design and sociability planning. Usability is concerned with the appropriateness of the software design for community members' tasks and the community's purpose. Sociability describes the appropriateness of the social policies and plans for guiding social interactions. Both have been identified as key components of successful online communities and as development proceeds they invariably become more closely integrated. Since the Solas inception over two years ago it has become apparent to the Solas creators that a more expandable and scalable solution is desired both in usability and sociability terms, a solution which allows a more customisable approach to the resources of Solas. These issues, if not tackled, will inevitably threaten the successful rollout of Solas into other hospitals. In addition to offering a technical solution to the management of resources within Solas, this research will incorporate into the solution, collated policies in relation to best practice for children accessing the internet in both restricted and open environments.

1.3 Community Based Policy Management

The tool suggested to facilitate the policy modelling and resource access control for Solas is the Community Based Policy Management System (CBPMS). CBPM is a research project currently underway with the Knowledge Data and Engineering Group (KDEG) at Trinity College Dublin. The community based approach to modelling policies and resources aims to address the challenge of efficiently managing complex and heterogeneous information systems. The term community is adopted to describe a unit of an organisation. Although it can be spoken of as having a high-level function with respect to the organisation to which it belongs, the successful performance of the community is dependant on the actions of the individuals who are members of it (Feeney, Lewis, Wade, 2007). At its simplest a Policy Based Management System (PBMS) is considered to be a system that receives policy decision requests and returns policy decisions. In the case of access control policies, it is assumed that the requests include information which allows the policy system to identify a subject, an action and a target and that the decisions contain information which allows the receiving process to either permit or deny access to the requested resources (Feeney et. al, 2007). The CBPM differs from traditional PBM in two ways; by modelling the organisation primarily on the organisational units that constitute it (such as user types, user needs, teams etc.), and their relationship to the resources controlled by the organisation rather than focusing on the positions of individuals within the organisation and their relationships to resources. The second difference between CBPMS and PBM is that CBPM models the organisation independently of its decision making structure.

The issue of controlling access to resources and incorporating the policies of the organisation or governing structure is neither unique to the healthcare nor online community environment. Feeney (2007) describes experiments where CBPMS has been utilised to manage access to resources and resolve policy conflicts when they arise. These experiments include:

- Physical Security Management in a Ubiquitous Computing Environment. This experiment involved utilising the software implementation of the CBPMS with the policy language to specify access control policies to manage the physical security of a simulated environment, and to manage access to the presence information of users within that environment.
- Other online communities: Oscailt, with means 'open' in the Irish language, is an open source content management system, designed for open publishing Internet news sites. In this study the Oscailt project was modified to provide support for the CBPMS. The results concluded that the

model provided a more accurate description of the organisation's function than the former role-based model had allowed. In particular, the fact that the model associated privileges with functions, allowed limited autonomy and made the hierarchy of decision making clear were highlighted as advantages over the flat role-based structure – since these were features of the way that the organisation worked in practice that were not captured by the existing role configuration.

- Consitutional modelling, an abstract example, where the CBPMS was used to dynamically model a wide range of organisational forms. This experiment was undertaken to look at how the model could be applied to the problem of modelling the structures of human political states.

The latest development by KDEG in this field proposed by Feeney, Lewis and O'Sullivan (2007) describes a case study showing how the CBPMS schema and architecture provides flexible, dynamic and extensible policy based management capabilities to the providers of services and mashups.

1.4 Objectives

This report endeavours to assess the current access control issues within the Solas online community, and examines the feasibility of designing and integrating Solas with a simple CBPM system to resolve the access issues hampering Solas optimal usage and expansion. The following thesis statement is adopted:

This thesis aims to implement and validate a model of Solas and CBPMS so that the integrated system provides a flexible and robust way of handling access to the system and its resources.

This statement can be broken down into the following distinct sub-goals which need to be achieved in order to validate the research:

1. Examine the current access control issues with Solas – the motivation for this research
2. Understand the use and architecture of the CBPMS
3. Ascertain local and international guidelines pertaining to children's use of the internet both in a restricted and open environment
4. Implement a version of Solas which has been integrated with CBPMS
5. Evaluate if the current access control policies within Solas are eliminated by integration with CBPMS

1.5 Chapter Outlines

Chapter two describes the research methodology chosen to carry out the project. Chapter three describes the background information on Solas and the fundamentals of CBPMS. It also details the requirements gathering exercise highlighting the access issues which Solas has faced to date and how the stakeholders envisage the software to be used going forward. Chapter four describes the literature and state of the art review with respect to both local and international legislation in addition to guidelines for internet access policies. This research was used as input to the system design phase. A summary is given in Chapter five of the design process to structure the implementation of Solas and CBPMS at both a functional and technical level. Chapter Six describes how the design phase of the project was carried out; configuration of the CBPMS services, modification of Solas user interface, and modification to the Solas source code to handle access requests through CBPMS. Chapter seven evaluates the possible success or failure of the system using the 'ITPOSMO' method developed by Heeks, Mundy and Salazars (1999) which describes a conception to reality gap which is often the cause of failure for systems. Finally chapter eight provides conclusions and recommendations for further work.

2.0 CHAPTER TWO – RESEARCH METHODOLOGY

Chapter Overview

This chapter describes how a research strategy was chosen for this project.

2.1 Choosing a Research strategy

The primary objective of this research was to explore if Community Based Policy Management can improve access to the Solas system. To achieve this goal the research objective was divided into the following sub-goals:

1. Examine the current access control issues with Solas – the motivation for this research
2. Understand the use and architecture of the CBPMS
3. Ascertain local and international guidelines pertaining to children's use of the internet both in a restricted and open environment
4. Implement a version of Solas which has been integrated with CBPMS
5. Evaluate if the current access control policies within Solas are eliminated by integration with CBPMS

Choosing a research strategy is a process of seeking out a procedure that will yield answers to the research questions posed. This enables the research to draw a comparison between the published and newfound evidence.

The two major philosophical approaches available in research are positivism and interpretivism (Galliers, 1991). Positivism is the belief that from an objective standpoint the world can be accurately analysed and described without the influence of the observer tainting the result in any way (Levin, 1988). Burrell and Morgan (1979 cited Maunsell 2002 p52) defined the approach as one that "seeks to explain and predict what happens in the social world by searching for regularities and causal relationship between its constituent elements".

Myers (1997) suggests that a positivist seeks quantitative data in order to prove a theory with the hope that this will lead one to be able to predict the result of a phenomenon. For this reason it is accepted that when studying the chemical or physical world that this is the most appropriate approach to take. The application of positivism to the occurrences in a social context is thought by some to be questionable

because different interpretations can be gleaned from social phenomena (Hirschheim 1985, Galliers 1991).

Interpretivism takes the view that by adopting a subjective view and involving oneself in an event, a better understanding of that event develops. To this end, for a qualitative approach, the understanding developed by the researcher is integral to the output of the process. The investigator cannot take a position that is non-influential and is therefore biased. Interpretivism, hence gives a more significant personal appreciation to the object of the study (Marshall and Rossman, 1989). As a research method it seeks to discover the *why* behind a set of circumstances rather than recording that they merely exist. The criticism levelled at Interpretivism is that it does not allow for rigorous examination of results because it has sought to envelop greater understanding of the subject (Lee,1989).

The selection of the methodology is simply dependent on how the researcher views the world. It is a function of how one obtains, processes and absorbs information from the surroundings and the subject matter. In seeking a methodology, the researcher has an array of choice in the field of policy gathering and policy management, from both the positivism and interpretivism schools of thought.

2.2 Selection of Study Type

Marshall and Rossman (1995) assembled a structure of how one might go about selecting a methodology which is summarised in Table 1:

	Study Purpose	Research Question	Research Strategy	Data Collection Techniques
Exploratory:	To investigate little-understood phenomena To identify or discover important categories of meaning To generate hypothesis for further research.	What is happening in this social programme What are the salient themes, patterns, or categories of meaning for participants? How are these patterns linked with one another	Case study Field study	Participant observation In-depth interviewing Elite interviewing
Explanatory:	To explain the forces causing the phenomenon	What events, beliefs attitudes& policies are shaping this phenomenon? How do these forces interact to result in this phenomenon?	Field study Case study Ethnography History Multi-site case study	Participant Observation In-depth interviewing Document analysis Questionnaire Survey
Descriptive:	To document and describe the phenomenon of interest	What are the salient behaviours, events, beliefs, attitudes, structures, and processes occurring in this phenomenon?	Field study Case study Ethnography	Participant observation In-depth interviewing Document analysis Unobtrusive measures
Predictive:	To predict the outcome of the phenomenon.	What will occur as a result of the phenomenon?	Experiment Quasi-experiment	Survey Questionnaire Kinesics/proxemics

Table 1 - Research Methodologies

2.3 Selected Research Strategy for this Project

As the primary aim of this research is to speculate intelligently if the current access control policies within Solas are eliminated by introduction of a CBPMS, the research

strategy followed is positivist, i.e. this is demonstrated by constructing an experiment, designed to test the capabilities of the CBPMS against the Solas organisational structure and resources. For this project Solas and CBPMS were integrated whereby CBPMS was configured with both the Solas organisational structure and a set of researched policies. This integrated system was then tested by following the ITPOSMO model with input from the current Solas Facilitator, the onsite administrator of the Solas system in the form of an interview. A second test environment was then created whereby a dummy hospital community, resources, and policies were modelled within CBPMS and integrated with Solas. The purpose of this second experiment was to validate the CBPMS ability to model multiple hospitals with differing access policies.

The experiments in question were devised in order to validate, in as concrete a manner as possible, the existence of practical advantages and resolution of some/all of the access issues currently experienced by the Solas administrators. These are a consequence of the organisational model and resource control capability that is embodied in the CBPM system. The complexity of the issues reported by the Solas administrators render it practically impossible to prove that a CBPM system will lead to superior outcomes than a role based approach, however it is possible to show that the CBPM system does offer measurable advantages in certain areas. One can make a strong argument that these advantages are likely to lead to superior outcomes in a live implementation. This positivist method was preferred over an interpretive approach as the ultimate goal of the project was to ascertain the feasibility of CBPMS and Solas integration from a user perspective and not just whether or not it is logically or computationally possible.

Due to the diverse and cross discipline nature of the overall research various different data gathering techniques were used to achieve the sub-goals of the report, namely:

- Descriptive methods by way of interview analysis with the Solas Facilitator and administrators to understand the current issues.
- The Solas Needs Assessment, created by CHI, was used to study the Solas system, its motivation and the original intention for the system usage. The field work for the Needs Assessment was carried out between November 2005 and March 2006. Thirteen interviews with children and families were carried-out. Two focus groups were also held with ten staff from the hospital ward who came from a range of disciplines. Children and parents were asked a range of questions about the experience of their illness (to assess physical, psychological and social impact). They were asked how

they kept themselves entertained and how they communicated with others while in hospital. They were also asked how they thought a computer system could help them to communicate and to pass the time in hospital. The were then shown the Solas prototype on a laptop computer (although functions such as email, texting, chat and video conferencing were not actually working as there was no internet access available on St. John's Ward). They were asked for their opinions on the prototype and asked whether there was anything they would add/change. The staff focus groups were presented with questions and the Solas prototype in a similar way. The answers from parents, children and care staff were interpreted as part of this research. The full Solas Needs Assessment is detailed in Appendix A.

- The creation and implementation of the CBPMS is in its infancy. Papers detailing the successful experiments to-date were reviewed and working examples of CBPMS were analysed.
- Exploratory methods by way of internet searches were conducted, white papers and books on internet safety topics were reviewed to collate information on best practice and defined policies for children's use of the internet. Various stakeholder groups and bodies pertaining to internet safety for children in Ireland were contacted and their responses incorporated into the formalised policies recommended as part of the research.

Chapter Summary

This chapter described how and why the positivist method was chosen as the best research strategy for this project and the variety of data gathering techniques required to support this methodology. The next chapter describes the initial knowledge acquisition required to commence research for this project, i.e. the fundamentals of CBPMS and the Solas project.

3.0 CHAPTER THREE - PROJECT BACKGROUND

Chapter Overview

In order to realise the primary objective of this research i.e. How Community Based Policy Management can improve access to Solas system, model governing body policies and resolve potential policy conflict, it was necessary to understand the motivation for both systems. This chapter introduces the CBPM and the Solas system. The main challenges of the current Solas system are addressed under 'Requirements Gathering' in section 3.3.

3.1 Community Based Policy Management

Community Based Policy Management is, fundamentally, an attempt to provide a framework which can empower human organisations to structure and organise their interactions with information systems in such a way as to achieve the high-level goals of the organisation as effectively as possible (Feeney, 2007). Policy Based Management systems allow rules to be specified that apply to classes of entities rather than individuals. These classes might serve as abstractions to group similar network devices together (Boros, 2000), or they might group individuals together on the basis of them having similar roles in an organisation (Sandhu, 2000). The community based approach to policy management, on which this project will focus, relies upon modelling the organisation (in this case, the Solas community) and its resources independently of its decision making structure. The organisation is represented as a hierarchical tree of communities with permissions defined on a finite set of its resources. The organisation's policies are considered to be decisions about choices in the behaviour of a system (Feeney et al, 2007). Operationally the policy decision engine receives requests on resources from a community member, and returns policy decisions. In the case of access control policy, it is assumed that the requests include contextual information which allows the policy system to identify a subject, an action and a target, and that the decisions contain information which allows the receiving process to either permit or deny the requested access to the organisation's resources (Feeney, 2007).

3.1.1 How CBPMS differs from traditional role based models

The use of grouping abstractions is not unique to policy systems, and is common to many types of traditional access control management systems (Feeney, 2007). Modern PBM systems aim to extend the scope of the grouping abstractions, enabling

rules to be specified to classes of entities, classes which apply across heterogeneous systems and networks, and are applicable and meaningful on multiple managed information resources (Sloman, 1994). The most basic element of the CBPM model, which differentiates it fundamentally from existing role-based PBM approaches, is the fact that the model of the organisation is primarily based on the organisational units that constitute it (such as divisions, departments, teams and working groups), and their relationship to the resources controlled by the organisation, rather than focusing on the positions of individuals within the organisation and their relationship to resources (Feeney et al, 2007).

3.1.2 Fundamentals of CBPM

3.1.2.1 The Community

A unit of an organisation is a composite, complex entity. The term community is adopted to describe a unit of an organisation. Although it can be spoken of as having a high-level function with respect to the organisation to which it belongs, the successful performance of the community is dependant on the actions of the individuals who are members of it (Feeney et al, 2007).

A community within an organisation is considered to have certain properties:

- It has a relationship to the resources of the organisation, autonomous of its membership.
- It is the subject of actions within the organisation, autonomous of its membership.
- In order to consider a unit within an organisation as being the subject of actions, it must also be considered as being capable of taking decisions.

Taking an example of an organisational structure, say a typical hospital, the following (partial) hierarchical tree of communities might exist:

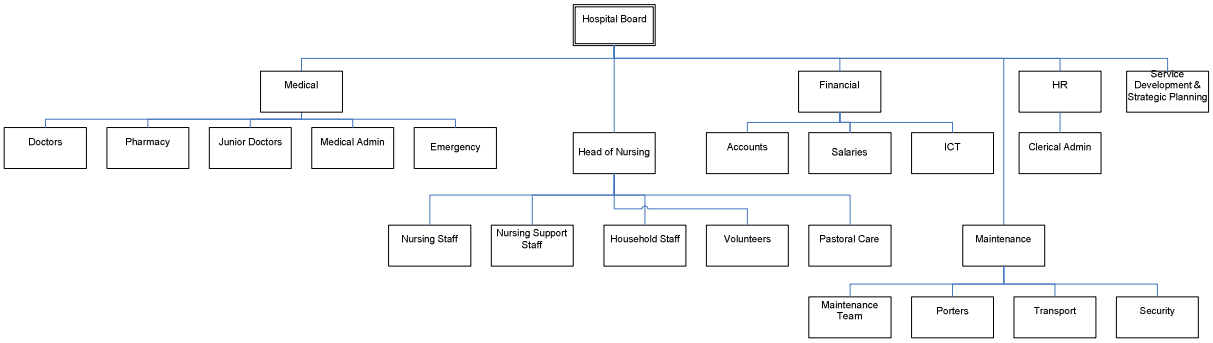

Figure 1 - Partially expanded Hospital Community Structure

In this example 'Hospital Board' has six child communities, 'Medical', 'Nursing', 'Financial', 'HR', 'Maintenance', and 'Service Development & Strategic Planning'. These communities further expand into sub-communities to represent entities within departments. The 'Nursing Staff' Community, for example, make decisions on behalf of all its members.

3.1.3 Community Membership

The communities within an organisation include individual members. Each individual who belongs to the organisation is a member of the community that represents the entire organisation, i.e. the root community. As one descends the organisational tree, a sub-set of the individuals who are members of the organisation are members of each community directly beneath it in the community hierarchy. A membership policy can be defined for each community, a policy which can be evaluated to map a subset of the members of the parent community to the members of the child community (Feeney et al, 2007). This mapping of individuals to the communities in terms of membership also incorporates an inherent hierarchy. In other words an individual can only be a member of a community if he is also a member of its parent. In the Hospital example in Figure 1 it is impossible for an individual to be a member of the 'Salaries' department without also being a member of the 'Financial' Department.

3.1.4 Modelling System Resources

From the CBPM point of view, a system resource is any entity or object that the organisation wishes to apply policies to, e.g. a database, a file system, a network router. As Feeney, 2007, explains each of these resources, be it an entity or an object, has a finite number of valid actions that may be taken upon it. In order to

model the authority over resources possessed by the communities within an organisation's hierarchy of authority, and in particular to allow communities to possess limited authority over resources, a means of modelling resources so they can be sub-divided into smaller units of authority is required, i.e. the creation of a resource target tree (Feeney, 2007). A resource action tree on the other hand, defines the set of actions which can be carried out on the set of resource targets.

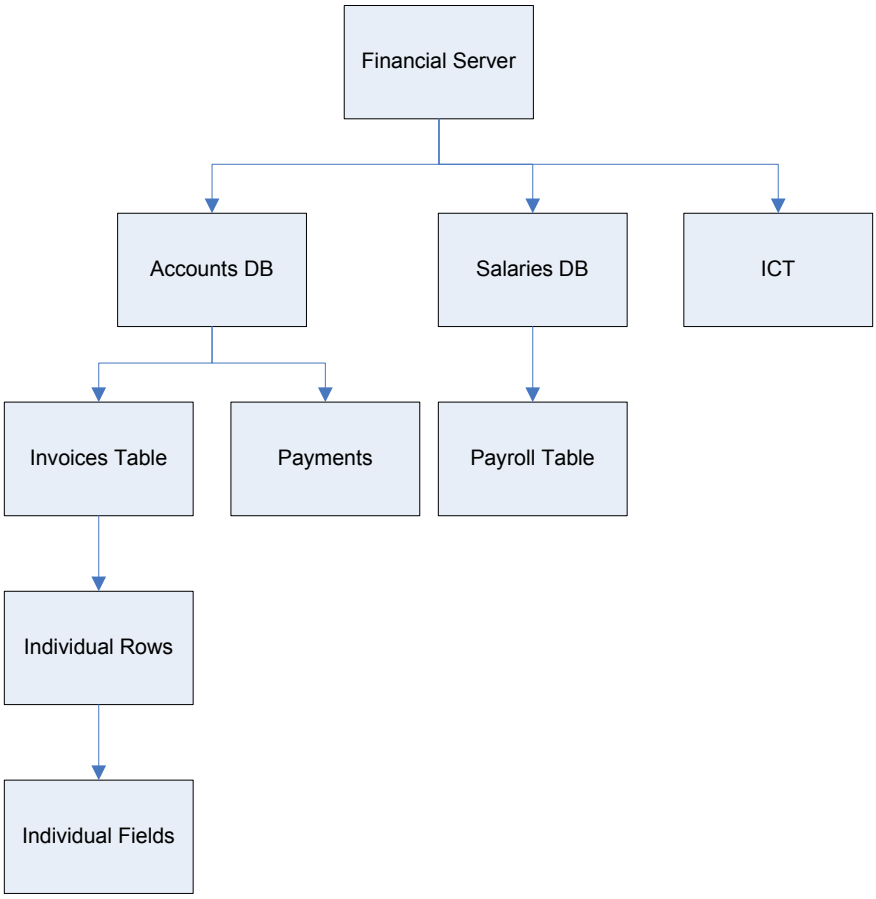

Figure 2 - Possible Target Tree for Hospital Financial Database Server

There are two Databases in the Target Tree described in Figure 2, one for Accounts Records and one which holds the salary for hospital vendors.

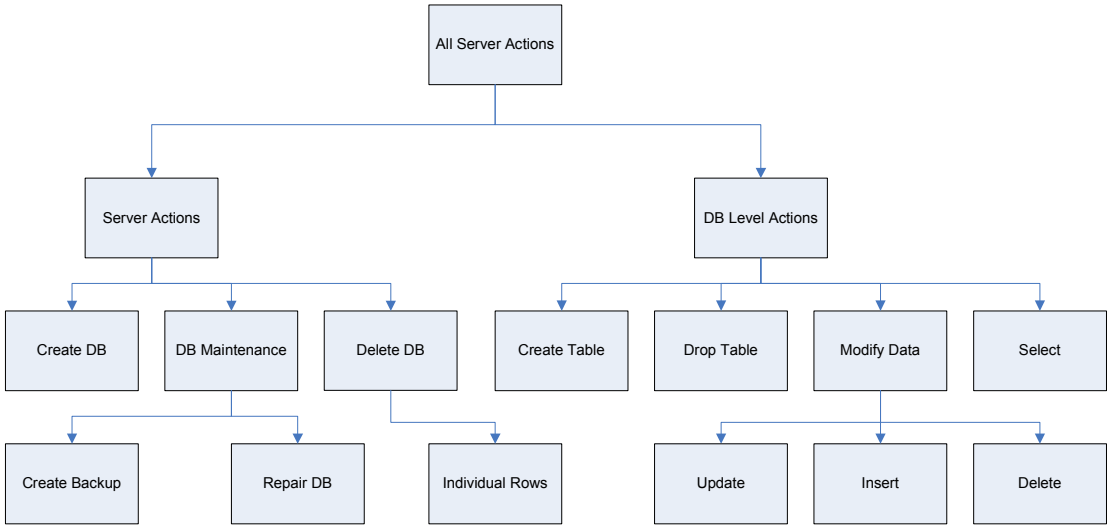

Figure 3 - Possible Action Tree for Financial Database Server

Possible server actions on the Resource Action Tree in Figure 3 are database creation or deletion, or modification of the table structure within the database.

3.1.4.1 Policy Modelling

As already mentioned, the community policy engine is modelled independently to the organisational model. Policies are seen as the decisions governing how individual members of the community can access the resources. These decisions are intended to allow a community to fulfil its function and goals (Feeney, 2007). Each community possesses a set of policies which dictate how the community's authority of resources can be acted upon by the members of the community. The CBPMS will permit or deny the member of an organisation accessing a resource based on their community membership, and whether or not that community has been granted permission to access the resource. When a policy permits an individual member to exercise the authority of the community upon a resource, it is stated that he acts on behalf of that community and he is considered to be acting as an agent of the community which has approved his actions through its policies (Feeney et al, 2007). In the Hospital example, Figure 1, the Financial Department may possess authority to carry out a broad range of operations on the database containing data on its accounts, e.g. updating invoices and payments received, without reference to the root community (Hospital Board), however, it may not create a new account in the database as this action on the resource is not permitted at that level and may be only carried out by a community with such control, i.e. the root community.

3.1.5 CBPMS and its capacity to model online communities

The initial work on this area of research concerned itself on modelling Internet communities for the purpose of applying policy based management solutions.

An online community consists of:

- People who interact socially as they strive to satisfy their own needs or perform special roles such as leading or moderating
- A shared purpose, such as an interest, need information exchange or service that provides a reason for the community
- Policies: in the form of tacit assumptions, rituals, protocols, rules
- Computer Systems: to support and mediate social interaction and facilitate a sense of togetherness (Preece, 2000).

Internet communities are differentiated from traditional bureaucratic organisations in a number of ways. They mostly depend upon volunteer labour. They are widely distributed and often all community interaction is electronic. They tend towards flat hierarchies and often have wide membership involvement in decision making. They can be composed of multiple autonomous sub-communities with independent decision making mechanisms and different internal organisations who frequently split (or fork) or merge together (Feeney, 2007). Solas is an example of such a community albeit on a very small and simplistic scale. Online communities generally experience problems expanding for the following reasons:

1. They lack any means of regulating access to project resources and management responsibilities in a controlled way.
2. They have often remained centred on a single individual maintainer, responsible for all decision making, who becomes a bottleneck to management, thus restricting the expansion of the project.
3. Larger projects, which have succeeded in attracting greater numbers of members, have had problems in integrating the various sub-systems, which work in practice as autonomous projects, require a large amount of manual negotiation and often depend on a single maintainer to carry out management functions (Feeney et al, 2007).

Solas is accessed from a single site, and because of the small number of users, issues 2 and 3 above have not yet been realised. However, should Solas become a multi-site deployment, as desired, with a significant growth in its user base this will certainly be

an issue. For these reasons, a CPBM approach has the potential to be particularly attractive for controlling access to resources within Solas.

3.2 Solas Project

3.2.1 The origins of Solas

The Centre for Health Informatics, Trinity College Dublin has been developing and researching virtual environments for children in hospital since 2001. The culmination of this work has resulted in two key developments:

- Áit Eile (meaning Another World) http://www.aiteile.ie

Áit Eile is accessed by children nationwide from hospital schools. Site use is supervised by a hospital based teacher at all times.

- Solas (meaning Light) http://www.solas.ie.

Solas is effectively an extension to Áit Eile, although both projects run concurrently. The main difference between the two projects is how and where they are accessed. Solas, targets a more specific user base as it caters for children who are confined to an isolation ward. These children are not physically well enough to attend a hospital school, so the need existed for a more mobile solution for use on the ward.

Although Áit Eile and Solas share much of the same functionality and experience many of the same issues in terms of access to resources, it is the Solas online community which is the focus of this project.

3.2.2 The Need for Solas

Approximately 10-15% of children under 18 years of age have a chronic physical illness or condition (Tak, 1995) and for a child, going to hospital can be a daunting experience. A number of research studies illustrate that the facilitation of communication and the provision of appropriate educational material militates against these effects.

The Solas project focuses on creating a virtual community that aims to empower seriously ill children to combat the medical and emotional challenges they face on a daily basis. This secure online environment facilitates communication with peers, via email, chat rooms and video conferencing along with activities to entertain and educate.

3.3 Solas Usability

Solas is accessible to children up to and including 18 years of age with various IT skills and diverse levels of wellness. Solas is administered by personnel within CHI: The Solas Facilitator and the System Administrator. The Solas Facilitator is the person responsible for the onsite administration of the Solas system. Once admitted to hospital, children are given a username and login by the Facilitator upon the parent signing a disclaimer permitting their child to use the tool. The decision was taken to target 8 – 18 year olds (although there are younger children that use it). The System Administrator is the main Solas developer and support agent based in Trinity College Dublin. Solas currently provides the functionality in the Table below:

Features	Solas
Communication	
Instant Messenger	√
Text Chat	√
Video Conferencing	√
Forum	√
Noticeboard	√
SMS	√
Email	√
Blog	√
Diary	√
Entertainment	
Web Links	√
Games	√
Art	√
Music	√
Audiobooks	√
Features	Solas
Web Links	√

Table 2 - Solas Functionality

This functionality is accessed through links from the Solas colourful homepage:

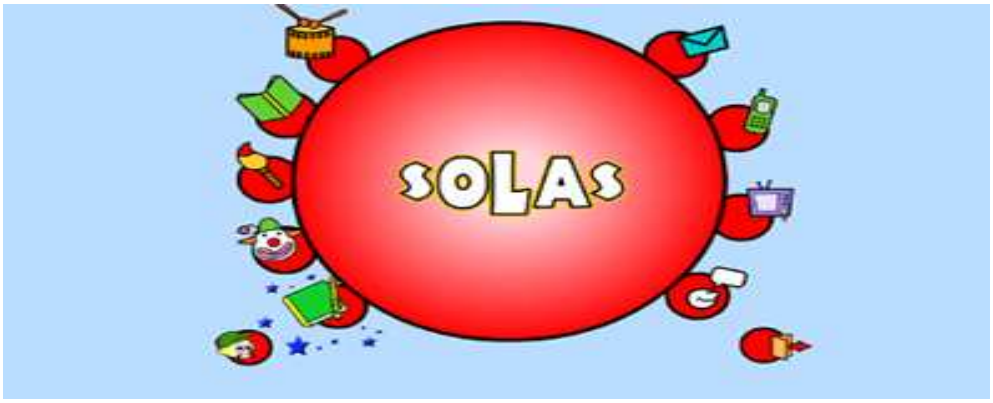

Figure 4 Solas Home Page

It should be pointed out that the majority of functions accessed through the site are considered to be 'safe', e.g. art, drumsteps, games. The scope of this functionality is limited to the child's interaction with Solas and as such the functionality does not pose any threat to the child or enable one child to endanger or cause offence to another. There are certain internet-enabling features accessed through Solas, however, which could be used to cyber bully e.g. the web links, email, SMS, and as such have the potential to be harmful if used inappropriately. It is controlling access to these resources that is of concern to the Solas project board, and for this reason it was the focus of this research.

Once an account has been set up and a laptop distributed to them, children on the ward are free to access Solas. Currently when the child logs in their role will determine what functionality they have access to. Websites are programmed in Kiosk mode on the laptop which is controlled on a laptop by laptop basis. This is a safety measure to ensure that the children can access only the Solas website or sites contained within Solas, and are not permitted free access to the World Wide Web. Parents are usually, but not always present, when the child is online. As mentioned this contrasts with the use of Áit Eile which is supervised by a member of the teaching community. As such Áit Eile is governed by the guidelines of the National Centre for Technology in Education (NCTE), the Government's agency on the use of information and communications technology (ICT) in education. Since Solas is not accessed in an educational domain there is a question over the ownership of, and adherence to, the policies that govern the access to the site. Currently no policies or guidelines exist at hospital level.

3.4 Requirements Gathering

In software engineering, requirements gathering encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product, taking into account the possibly conflicting requirements of the various stakeholders. Requirements gathering is critical to the success of a development project. According to the Food and Drug Assistance Company successful user requirements specification should have the following properties (http://www.fda.com/):

- It describes the functions that a system or system component must or should be capable of performing
- It is generally developed by the user in the initial stages of a system development or system selection process
- It is written in general terms and specifies what needs to be done, not how it will be done
- It is independent of the specific application program (technically non specific) that will be written or purchased

Conducting a requirements gathering exercise was necessary to answer the first research sub-goal in section 1.4, i.e. examine the current access control issues within Solas.

The approach taken to requirements gathering was to answer the following questions:

- What are the main access issues faced by the users and administrators of Solas?
- Why do these issues exist?
- Where do the creators see the future of Solas?

In order to answer these questions the Needs Assessment for Solas was reviewed and informal interviews were held with the current Solas facilitator and developers. From this analysis came frequently raised issues and concerns which are discussed in section 3.4.

3.5 Issues and Areas of Concern for Solas Creators

The following are the main issues identified and interpreted from the above sources.

3.5.1 Handling the needs of children of different ages with different interests

Solas content targets the 8-18 year old age group. The interests of a typical 11 year old will generally differ significantly to the interests of a typical 17 year old (Willard, 2002a). Similarly one would expect that the content and functionality appropriate for a child varies as the child grows towards adulthood (as is the case with the film and music age-related censorship policies). For example the highly popular social network site Bebo (http://www.bebo.com) has a minimum age requirement of age 13, according to the Bebo Acceptable Use Policy. No preventative measures are put in place to ensure younger children are not using this site (however moderators do assess site content and can revoke access upon suspicion of misuse). Upon visiting the Solas hospital, the author learned that Bebo was often viewed by children below this age. This could happen intentionally, if the request for Bebo was granted by the Solas Facilitator, or inadvertently, as the request for site access could have been permitted to the previous user which remains on laptop after use. Currently it would be possible to set up and allocate various roles to represent children of different ages, however, this could become complex and difficult to manage as the number of websites increase, and any changes to offerings or access guidelines would require a change to individual roles.

3.5.2 Maximising the Solas offerings in a safe environment without the need for supervision

'There is a duty of care on behalf of any others here who are operating with the children to ensure that they are monitored the whole time'.

This statement made by a Health Care Professional when interviewed during the creation of the Needs Assessment for Solas, encapsulates one of the main issues to the success of the Solas project to date, i.e. providing supervision on the ward while the site is being accessed by the children. Currently Solas only operates in an unsupervised environment with restricted content. When collating information for the Solas Needs Assessment, monitoring internet access was outlined as a huge concern for staff. The nurses outlined that they are not in a position to monitor usage because of an already heavy workload. To sidestep this issue Solas creators have endeavoured to provide a solution that does not need constant supervision, i.e. Installing Solas in 'Kiosk' mode. Children are currently permitted access to a restricted number of websites where content and suitability have been screened. Any addition or removal to the sites offered must be done on an individual laptop basis. This is an obvious drain on resources as children can very often have different tastes

and needs, and the turnover of children at the hospital can be quite high. In addition to the difficulties in managing the site content using this method effectively compromises the potential offering to the children in instances where it may be possible to provide supervision.

There is a widely held view amongst the staff of the hospital that the internet would be very valuable for these children that a way should be found to safely provide it to them. It is clear that while kiosk mode goes someway to resolve the concerns of care givers it compromises exposure to a much greater pool of information on the World Wide Web. It was felt by all interviewed that while there are issues to be determined as regards monitoring, the benefits for the children are huge and so these issues should not be insurmountable, 'because it would be such a positive thing', according to a nurse interviewed as part of the Solas Needs Assessment.

Regarding open access to the internet it must be pointed out that to simply offer a tool as a means to search the internet freely would detract somewhat from the goals of Solas. The creators have strived to offer a wide variety of online activity to entertain the children and in essence are neither promoting nor encouraging open searching on the internet. It should be stressed that supervision should not be considered a requirement of the system. It is the author's opinion, however, that if supervision exists on the ward and if best practice dictates that it is permissible to certain age groups then the access privileges could be extended to offer open searching on the internet which would be particularly attractive to the older children. The researched recommendations on internet policy will be discussed in chapter 4.

The concerns over supervision are not unique to a project like Solas are echoed in an interview with Don Bains, Deputy Head and IT coordinator, Station Road School, UK. When asked about the importance of supervising children using technology he reported "When we first got into this, I mean, I remember feeling very fearful. You know, oh God, we've invested a lot of money in these machines, I couldn't possibly let children loose without supervision" (cited in Holloway and Gill, 2003).

Deputy Head Bains in his interview goes on to suggest that overly restricting access is unnecessary as technology abuse is in the minority of cases, "what we found is that you have a cluster or a room full of these machines and you allow pupils access, they will treat…the hardware and software very respectfully. Very rarely do we get problems in the IT rooms or the clusters. Where we've had problems it's tended to be with the individual machine in the corner of a classroom, which probably doesn't get used very much anyway and we can only assume it has been targeted by somebody

who themselves are not particularly interested in IT. People who go into the IT rooms, in their own time, are by definition converts anyway"

The concern expressed by Solas staff that any use of the internet needs to have very effective restrictions should be heeded, however denying access to the internet and missing out on such a great information, communication and learning resource is not the answer. Understanding and dealing with negative issues is a better way to protect children (Distefano and Giagnocavo, 1997).

3.5.3 Undocumented Access Policies

"It's a problem at the minute. I can't see it being a problem forever, it's just for us to sit down and get an idea of policies and procedures and what we're going to do…" (Healthcare worker, cited in Solas Needs Assessment). This was a statement made during the original Solas Needs Assessment. It was made in relation to internet access, expressing the observation that policies and procedures need to be established to handle Solas users' internet access. Whilst installing Solas in kiosk mode goes some way towards controlling access, this use of this tool is not supported by any research concerning what is appropriate for the children to view in terms of content. Currently this decision and discretion rests with the Solas Facilitator, the onsite administrator of the system. For Solas to be considered safe for children it is apparent that research needs to take place into collating defined policies and guidelines in terms of access control and content. Any resource currently accessed on the Solas machine falls under the responsibility not of the NCTE, as is with Áit Eile, but of the Solas development team based in Trinity College. In addition to the dilemma of policy ownership lies the conundrum of how to tie these policies into the access rights of the system. Few hospitals have defined acceptable internet usage or age related policies in relation to internet access for patients and until these are defined, managed and easily incorporated into the system this will continue to raise challenges for the Solas project.

3.5.4 Conflicting Hospital Policies

To configure Solas with one researched set of policies, while likely to be a considerable improvement to the current setup, this is not necessarily going to lead to rollout or acceptance of the tool on a hospital-wide scale. The reason being is that, each hospital within Ireland sets its own policies in relation to hospital IT. Although this is not currently encountered by Solas (as it is only in use at a single site), it is the author's opinion that if this system is to be accessed either wholly or partially in

multiple hospitals it will need to support different hospital policies in a smooth and transparent manner. Therefore while configuring Solas with a hard-coded researched set of policies may ease the anxieties of many hospital boards, this may not represent the views of all hospitals, nor will it realistically suffice in operation when legislation may require policy change.

3.5.5 Supporting the concerns of parents and carers - Handling children with special needs

It was proposed by those designing Solas that for security reasons children using email and texting facilities should be limited to have contact with a predetermined list of people. This would consist of relatives and friends whose parents could potentially verify as being suitable for contact. The option of being able to text from the Solas system was extremely popular with both the children and parents interviewed. There was an exception in the case of one child under ten whose parent was trying to hold off allowing her child have a mobile phone for another year or two. Solas Facilitators could, on occasion, revoke access to the system, e.g. a 14 year old showing signs of aggressive or abusive behaviour may be deemed an unacceptable candidate for email or SMS privileges. If such a situation were to arise it would be currently difficult to revoke access to resources. Access to a resource must be revoked on a role basis and a special role must be created for the individual in question. The system can prove, therefore, cumbersome to manage. Currently the system cannot efficiently model blanket policies that apply to all special cases or exceptions.

3.5.6 Accessing Solas from home

If the tool is to be accessed from the patients' home it is not currently governed by hospital guidelines but is governed instead by Trinity College as it is here the web-server resides and where the user database is created. It is the author's opinion that Trinity College Solas Administrators need guidance as to how best to set the policies in the system and how to change these policies in a simple manner. According to Preece (2000) the ideal situation for many online communities is to have developers institute unimposing by-laws that provide just enough guidance to start the community but are sufficiently flexible to allow it to evolve. Content and access has been set according to the knowledge and experiences of the Health Informatics team in Trinity College but without the guidance of formal legislation.

3.5.7 Evolving Policies

Online communities (like Solas) are dynamic; they continually change and evolve, influenced by participant personalities, the activities of the group and sometimes external influences (Preece, 2000). For instance what may be important early in the life of a community may not be as significant later on. While not currently an observed issue, if Solas is to develop and be accessed from multiple hospital wards it will need to be adaptable in a world where technology tends to grow at lightening place, and legislation is often applied retrospectively. Currently a change in hospital policy with respect to functionality within the system requires changes to be made to a role and/or individual laptop basis which, in this author's opinion, would be very difficult to manage on a larger scale.

3.5.8 Future of Solas

At present, both Áit Eile and Solas coexist and are available to their respective target groups. However, as the projects provide very similar services it is proposed that they are merged together in order to increase long-term maintainability. In addition, several extensions are proposed which aim to boost user acceptance and increase satisfaction particularly among the adolescent users. Since the start of the Áit Eile and Solas projects, the Centre for Health Informatics has focused strongly on providing an environment, which allows children to partly escape isolation and get involved in communication with peers. As such Áit Eile and Solas could be considered to be amongst the very first online social networks, as this concept was not widely popular when the project started in 2001. Since then, a multitude of such networks and online communities have emerged, reaching unforeseen popularity among children and adolescents. Going forward, if a single tool is to be used as envisaged, the need for policy modelling will be more acute. Solas will be required to support multiple policies and scenarios, and to resolve policy conflicts should they arise.

3.6 Summary of Requirements Gathering

A 'new' Solas must be able to:

1. Continue to appeal to children of a variety of ages, maturity and skill levels in line with legislation and best practice.

2. There are a wide selection of resources available through Solas but these need to be augmented and customised in order to facilitate the diversity of users and expansion to other hospitals, therefore the author suggests implementing CBPMS access to resources instead of kiosk mode.
3. Extend functionality if accessed in a supervised environment. Provide restricted access when children are not supervised (as will be the case in the majority of instances)
4. Represent both supervised and non-supervised access rights for the users in line with best practice policy.
5. Be flexible to model multiple hospitals with potentially differing policies.
6. Handle children whose biological, emotional or maturity level may fall outside the 'norm'.
7. Support home access.
8. Handle evolving policies.

Once the requirements were gathered they were verified with the current Solas Facilitator and the Solas Director in CHI.

Chapter Summary

This chapter introduced both the CBPMS and Solas systems. The main access issues facing Solas stakeholders were addressed, issues which are currently hampering further success of the software. These issues were collated as the requirements for Solas integration with the CBPMS and as such were used to steer the design phase. The next chapter details researched current legislative guidelines, policies, and international best practice regarding children's access to the internet, SMS, in numerous environments with a view to establishing guidelines for Solas, and configuring these guidelines in the CBPMS.

4.0 CHAPTER FOUR – LITERATURE ANALYSIS

Chapter Overview

This project examined whether utilising CBPMS to access the Solas system will help resolve the access challenges and issues currently hampering its deployment into other hospitals. It was necessary to extensively research current legislative guidelines, policies, and international best practice regarding children's access to the World Wide Web (albeit in a restricted environment), SMS, and Email in hospitals, homes and schools to establish how to best configure a CBPMS for the Solas environment. The findings from this literature review, along with the requirements gathered in Chapter three, were used as input to the design of the integration of CBPMS with Solas.

4.1 Establishing Policies for Solas

Putting basic policies in place helps members know how to behave, what to expect from each other and provides a framework for social growth (Preece, 2000). According to Preece communities are more likely to succeed when early social planning constrains the community just enough to discourage inappropriate behaviour while facilitating the community's evolution. Achieving this balance requires skill, sensitivity and acknowledgement that the community's purpose and needs may change over time. Childnet International is a charity established in 1996 to support both children and parents on how to stay safe and get the most out of online technology, and to work in partnership with others around the world to help make the Internet a great and safe place for children (http://www.childnet.com). Childnet has consistently argued that setting effective child protection policies online must involve Government, Law enforcement, industry regulators and hotlines, NGOs, parents and carers, schools, teachers and children themselves. In response to the Byron Review (http://www.dcsf.gov.uk/), a six month government study in UK which announced the first national strategy for child internet safety, Childnet argues that it is important that real multi-stakeholder participation is achieved in order to produce a meaningful and consistent message, and to avoid duplication of work. In the case of Solas, the hospital in which the website is accessed would also need to be considered as a stakeholder since the hospital has a duty of care toward the children.

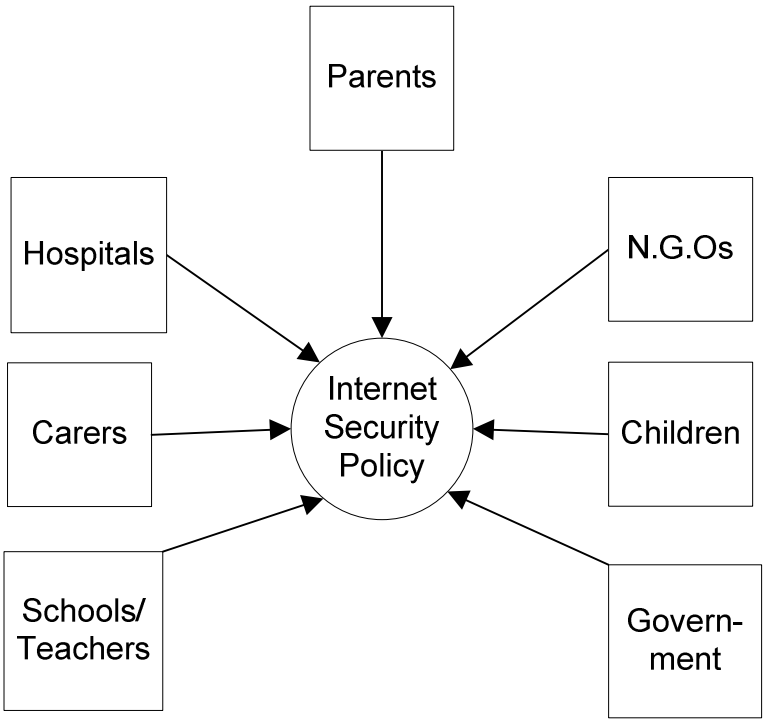

Figure 5 - Stakeholders for Safe Internet Use

In their 2004 survey, 'UK Children Go online' (UKCGO), gathering the internet experiences of young people and their parents (http://www.lse.ac.uk), Livingstone and Bober conclude a balanced approach to regulation is vital if society is to steer a course between the twin risks of exposing children to danger or harm and of undermining children's opportunities to participate, enjoy and express themselves fully. Focussing on either dangers or opportunities, without recognising the consequences of particular policies or provision for the other, is likely to be problematic, undermining either children's rights or their safety. If we accept Childnet's stakeholder analysis for setting policies in relation to Internet safety then consideration should be given to the views of leading organisations in each of the stakeholders categories when attempting to create a legal, informed and fully supported internet access policy suitable for children of all ages. The next section collates the views of the stakeholders in Figure 5 with a view to establishing an agreed internet policy.

4.1.1 Government

The main challenge in setting formal internet polices is that the Internet functions in a global context whereas the law operates in a localised one.

The Irish Government has recently set up the Office of Internet Safety (OIS) which was established to protect the community at large, and in particular children, against the potential dangers of the Internet. Supporting the work of the OIS is the Internet Advisory Board (IAB) carrying out research and safety awareness campaigns. Finally, the NCTE is a fully-funded agency of the Department of Education and Science.

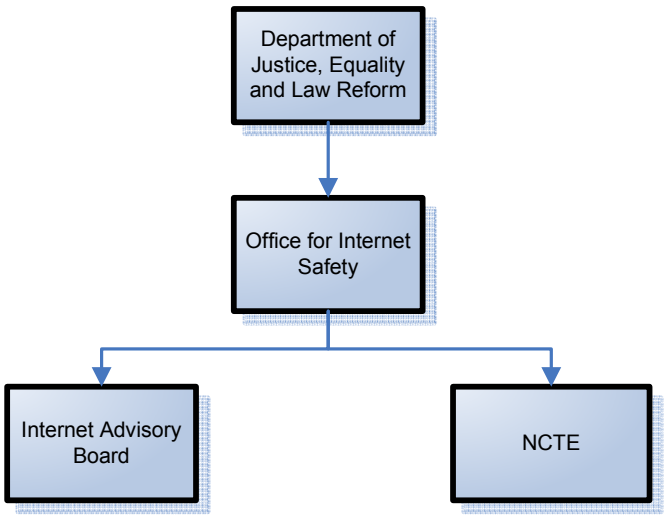

Figure 6 - Established Government Bodies for Internet Safety

While conducting this research each of the above groups were contacted to request data on age related guidelines for Internet usage. Although excellent work appears to be underway informing and educating teachers, parents and children about the dangers and risks associated with internet activity, it was established that, rather worringly, no concrete guidelines for age related Internet use have been incorporated into Irish Legislation. The NCTE have different educational programmes for primary and secondary schools, which would suggest there is at very least an acknowledgement that what is appropriate content for older children may not be appropriate for the younger ones.

4.1.2 N.G.Os

The American Academy of Paediatrics (AAP) is an organisation of 60,000 primary care paediatricians, paediatric medial sub specialists and paediatric surgical specialists dedicated to the health, safety and well-being of all infants, children, adolescents, and young adults. In 2006 the academy produced an information booklet for parents

entitled 'The Internet and Your Family'. In it the academy details age-based guidelines for children's Internet use. These guidelines are summarised below:

4.1.2.1 Up to age 10

Children at this age need supervision and monitoring to ensure they are not exposed to inappropriate materials. Parents should use Internet safety tools to limit access to content, web sites, and activities, and be actively involved in their child's Internet use. No minimum age is given for online access.

This is consistent with Solas' current Internet access where children have access to limited content and websites, and are therefore protected from inappropriate content. If supervision cannot be guaranteed, as with current Solas use, then open access should not be permitted.

4.1.2.2 Ages 11 to 14

Children at this age are savvier about their Internet experience; however, they still need supervision and monitoring to ensure they are not exposed to inappropriate materials. Internet safety tools are available that can limit access to content and websites and provide a report of Internet activities. Children this age also need to understand that personal information should not be given over the Internet.

This is consistent with Solas' current Internet access where children have access to limited content. Supervision, as already mentioned, cannot be guaranteed so open internet searching should only be permitted if/when supervision is possible.

4.1.2.3 Ages 15 to 18

Children at this age should have almost no limitations on content, websites, or activities. Teens are competent internet users; however, they still need parents to define appropriate safety guidelines. A parent should be available to help their teens understand inappropriate messages and avoid unsafe situations. Parents may need to remind teens what personal information should not be given over the internet.

This is not in line with the current Solas configuration as there are no age related access privileges permitting older children more extensive content and searching capability than younger children. In response to the Byron Review on Children and New Technology, Childnet urges those responsible for setting policies to consider what the risk is to children *not* being able to access technology, and how those who are unable to access the Internet might be placed at a disadvantage. This is especially true when considering that all teenagers interviewed during the Solas Needs Assessment mentioned that they would really like more accessibility so that they could

access educational sites with Junior and Leaving Certificate study guides and past papers, for example. Missing vast amounts of the school year was an inevitable consequence of the illnesses of the children yet this could be significantly reduced through Solas with more flexible access to the internet.

4.1.2.4 Schools/Teachers

According to Webwise (http://www.webwise.ie), an Irish government initiated information and advice website for schools, there is no specific legislation governing Internet safety at school level despite the fact that 99% of Irish schools now have access to broadband (http://www.ncte.ie).

The NCTE's Internet safety strategy for schools includes a combined approach of the following actions:

- Creating an Acceptable Use Policy
- Improving Technology
- Making students, teachers, and parents aware of the Internet risks and educating them to minimise these risks

The Internet Safety Strategy makes no references to age related guidelines, however since 2006 the NCTE has undertaken an education programme to support educators about safe and responsible use of the Internet targeting children between the ages of 8 to 14. One could imply that children below this age are not suitable candidates for the Internet or have limited need or desire to go online before this age if it is not acknowledged as part of the school curriculum. Interestingly, both the UKCGO (UK Children Go Online) survey of 2004 (http://www.lse.ac.uk/collections/children-go-online/UKCGOsurveyreport.pdf) and SAFT 2003 survey (http://www.ncte.ie/InternetSafety/Publications/d1736.PDF), both investigating children's use of the internet and online behaviour, restrict their target audience to children aged nine years and over, which suggest there could be some truth in this assumption.

Looking further a field to international guidelines, in her book "Safe and Responsible Use of the Internet: A guide for Educators", Willard (2002b) makes the following recommendations for children of school-going age:

4.1.2.5 Primary Education (Up to 10)

If it is a requirement for primary education aged children to use the open Internet, they should do so online in highly structured environments. Students in elementary school are too young to be fully informed about Internet dangers and should not be

expected to be able to engage in safe behaviour in unsupervised environments. When children are of elementary school age, their use of the Internet should be almost exclusively in "safe Internet spaces" – environments that provide access to only pre-reviewed educationally appropriate sites. There are simply too many sites that are inappropriate information resources for students at this level of their education.

This is consistent with Solas' current Internet access where children have access to limited content and websites in a non-supervised setting. If supervision were possible in a Solas setup open internet searching could be provided to the children of this age group.

4.1.2.6 Late Primary/Early Secondary Education (Ages 11-14)

Willard (2002b) recommends engineering a gradual opening of the levels of access, rather than providing precocious and curious middle school students with wide open access. Instead middle schools may want to generally limit student access to Internet safe spaces, but allow specific exceptions.

This is consistent with Solas' current Internet access where children have access to limited content and websites. Supervision, however, is mentioned as essential for this age group, yet currently Solas is unable to guarantee this for children of any age. If supervision were possible in a Solas setup, open internet searching could be provided to the children of this age group.

4.1.2.7 Secondary Education (Ages >14)

Willard (2002b) notes that when students are in middle school and high school, access should be more open and the focus should shift to instruction on basic safety skills, supervision, monitoring, and responsive discipline. Willard goes on to argue that the primary protection at this point should be the students own skills and motivation. The focus must shift to the importance of making choices on the Internet that are in accordance with the teenager's emerging sense of personal identity and moral values. At this age, students will be demanding more freedom with the Internet at home. They will also be old enough to understand issues related to the potential dangers or inappropriateness of certain materials and to successfully utilize safety skills.

Once again, this recommendation is not in line with the Solas configuration for older teenagers as there are no access configurations permitting older children more extensive access privileges.

4.1.3 Children

According to the Byron Review it is only through children and young people playing an active part in supporting and protecting themselves and their peers, that they will feel confident and safe using these [Internet] services.

According to Willard (2002a), information and communication technologies have a profound impact on the external influences of behaviour. As young people grow, their emerging cognitive development enables them to gain increasingly accurate perceptions of the world around them. Three principal external influences combine with this emerging cognitive development to affect moral development and behaviour (Willard, 2002b). These factors are:

- Recognition that an action has caused harm. When a young person engages in inappropriate action and recognizes that his or her action has caused harm to another, this leads to an empathic response, which leads to feelings of remorse.
- Social disapproval. When a young person engages in inappropriate action and recognizes that others have become aware of and disapprove of this action, this leads to "loss of face" and feelings of shame.
- Punishment by authority. When a young person engages in an inappropriate action and this action is detected by a person with authority over the young person, this leads to punishment imposed by the person in authority, which can lead to feelings of regret, but also can lead to anger at the authority.

In her book "Computer ethics, etiquette and safety" Willard (2002a) has the following recommendations when designing site sociability:

- Help young people learn to do what is right in accordance with their own personal values, regardless of the potential of detection and punishment.
- Help young people understand how actions can cause harm to people they cannot see.
- Help young people learn to use effective decision-making strategies to help guide their behaviour in a responsible way.

These recommendations would seem to suggest the creation of an Acceptable Use Policy (AUP) for Solas inviting input and feedback from children who use the system. Acceptable use policies are also recommended by the IAB (http://www.iab.ie) and NCTE (http://www.ncte.ie) as appropriate forms of boundary settings. Regularly

revisiting and updating of the AUP is required (with input from the children) to maintain the acceptability and usability of Solas. The Solas Facilitator regularly approaches the children for feedback regarding site material and content to ensure it is kept up to date and relevant for the users. As mentioned, any requests for new site content must be incorporated/removed on each individual laptop.

4.1.4 Parents and Carers

In regulating their children's internet use, parents face several challenges, not least that they often lack the expertise to do so, especially compared with their children (Livingstone and Bober, 2004). Since computers are often located in private rather than public rooms, and since children may seek privacy online, even evading parental monitoring, parents' attempts at regulation are not easy to implement, mainly because the majority of children do not want restrictions and want to protect their privacy from parents. Notwithstanding pressures to rely on parents to regulate their children's access to and use of the internet, it is worth noting that parents themselves favour a multi-stakeholder approach (Livingstone and Bober, 2004) emphasising the importance of:

- Stricter regulation
- More education
- More content suitable for children
- Improved technology

The UKCGO research on parental regulation for mediation of children and young people's media use finds that parents regulate media use in a number of ways (http://www.lse.ac.uk):

- Restrictive guidance (rules for how long a child should access internet)
- Suggesting websites for the child to visit
- Technical monitoring
- Shadowing

It is difficult to realise tangible policies from the above social solutions as restrictive guidance is very much individual to the parent, however, if a survey were carried out and conclusive guidelines for this method were drafted, it certainly would be a welcome addition to the policy settings for Solas. 63% of parents questioned in the UKCGO survey emphasise the importance of shadowing as a regulatory method in the

home. This high percentage could suggest that a majority of parents would favour Solas being accessed in a supervised environment.

No references were found in the research literature purporting parental organisation's collective beliefs on age related internet guidelines. When interviewed for the Solas Needs Assessment the vast majority of parents were extremely enthusiastic about the possibility of having internet, email and SMS functionality available to their child while out on the ward. When a child is on the ward, a parent is usually there with them at all times. Staff felt it may be possible for parents to monitor the use of the internet by his/her child. However there are issues when putting the onus of responsibility on the parent. Staff in the same breath expressed concern that some parents are more lenient than others. If there are two children sharing a room this could cause difficulties, e.g. one child being permitted to access sites which the parent of another child may take issue with. Signing a consent form to put the responsibility on the parents is one option, however, staff had reservations about the potential dangers of passing the responsibility to the parents:

'If the parent signs a disclaimer then I presume the hospital is, you know, happy. But, you know, it depends….worse case scenario they [the child] get on to some awful site or whatever and then to the parent you say "Oh you signed a disclaimer". Then they go to the press and then "Oh, At <hospital> my child was allowed look at this…."' (Nurse, as cited in Solas Needs Assessment).

In the case of one child under 10 the parent interviewed was trying to hold off allowing her child having a mobile phone for another year or two. The parents of two children under ten felt that they were too young for using email. It is important, therefore, that although legislative policy and best practice may dictate that some degree of online functionality is appropriate for children of all ages, parental belief in what is best for their child must be considered. The facilitators should be able to, upon parental request, easily revoke any access permitted by standard policies.

4.2 Similar Initiatives

The problem controlling access to resources in an online hospital environment like Solas appears not to be unique. In the USA there is a similar online community initiative underway called PC-Pals which is sponsored by the Starlight-Starbright Charity. PC-Pals provides paediatric patients with a variety of entertaining and educational software and access to 'Starbright World' an online community for seriously ill teens. Upon program uptake the hospital signs legal agreements assuming all responsibility for laptops and how they are used. In contrast to Solas

where there is currently no age restriction on child registration, 'Starbright-World' is only open to children from the ages 13-20 which, according to Director of Online Programs, is based partly on regulations set down by the the children's online protection policy (http://www.coppa.org). This policy has strict guidelines pertaining to the collection of data for children under the age of 13 which requires more stringent acceptable use policies to be defined, and parental consent to be given in relation to any data collected about the children. The decision to limit the minimum age to 13 avoids unnecessary administrative burden on the administrators of the Starbright-World system, and does not appear to be a suggestion of the unsuitability of the tool for a younger audience. It is worth pointing out that Starbright started out as a 'private network' but similar issues to Solas, i.e. resources to maintain the system and access by the diversity of potential users, would be a reason why they have now two separate projects – PC pals and the new Starbright world which is a discussion forum for over 13s.

The Australian arm of the Starlight-Starbright charity has a similar online community called 'Livewire' (http://www.starlight.org.au/). This community has 3 levels of access according to age, i.e. 13-15, 15-17, 17-older, however only the age group 15-17 and 17-older are permitted to use the online communications tools. The decision to restrict the online community functionality to these older age groups is a cultural one according to the charity's director as the creators found that in their experience Australian 13 year olds are less mature than their American peers.

If successful, this research topic could potentially be of use to other online communities for sick children.

4.2.1 Summary on recommendations from Policy literature

There are no easy answers to the question of whose responsibility it should be to guide children through the opportunities and dangers online. Involving multiple stakeholders allows for maximum flexibility and, hence, better regulation (Livingstone and Bober, 2004). Researching available literature for each of the stakeholder groups, the following conclusions can be made for Solas to comply with legislation and international guidelines:

- It is not a legal requirement to vary internet access according to age, however best practice and advice suggests this needs to be the case. Solas should, therefore, change its current 'no-age' access rights for children. Generic content appealing to an 8-18 years audience was the

target age group of the Solas project, however this needs to be categorised by age to reflect both children's interests, ability and maturity.

- There should be three access age groups, children aged under 10, children aged 10 to 14, and children aged 15 to 18.
- Children under 10 should only have restricted access to predefined sites in an unsupervised environment.
- Children aged 10 to 14 should have restricted access to internet in an unsupervised environment. If supervision is possible open internet access may be granted.
- Children aged 15 to 18 should have full internet access. Supervision is recommended but it is not essential. Content filtering is recommended. It is the author's opinion that this recommendation is likely to prove controversial amongst different hospitals where some may, despite policy recommendations, remain nervous about children accessing open internet, especially in an unsupervised domain. It is the recommendation of this author that any configuration of the system should adhere to the expressed wishes of the hospital board and it should be possible to revoke any access privileges previously granted.
- Solas should have a clearly defined Acceptable Use Policy shaped by input from the users of Solas. As mentioned the Solas facilitator already actively seeks input from the children to the content of the site. It is this author's opinion that this process needs to be extended to cover correct online behaviour and reporting procedures for misuse.
- Although legislative policy and best practice may dictate that some degree of online functionality is appropriate for children greater than nine years of age, parental and health care professional belief and in what is best for an individual child should overrule any access permitted by policies.

Chapter Summary

Research and literature was reviewed to discuss and review state of the art for local and international best practice in relation to policy gathering and children's access rights to the internet. Literature from the major stakeholders for children's welfare was reviewed with a view to establishing common ground for internet policy. The main findings from the research were summarised. In the next Chapter, Design, it will be shown how the data gathered during the policy research, as outlined above, was used to steer the design of the CBPMS to model the Solas online community and integrate with the Solas system.

5.0 CHAPTER FIVE - DESIGN

"No clear formula for developing successful online communities has been defined but the community-centred development process paves a path to follow" (Kollock, 1998).

Chapter Overview

This chapter describes the design approach taken to integrate Solas and CBPMS both from a functional and a technical point of view. Attention to detail at the design phase is imperative to ensure that all the required functionality is accessible by the relevant users, and inaccessible to those not permitted to access the Solas system resources. Recommendations from the literature review in section 4.2.1 and the requirements gathering exercise in section 3.5 were used to steer the design.

Tools Used

The Unified Modelling Language (UML) was used to structure the functional and technical design. UML is a graphical standardised modelling language that is commonly used amongst the software development community to express designs and to specify the artefacts and components of a software system (Si Ahir, 1998). Two types of UML diagram were used; use cases and sequential diagrams. The UML use case diagram allows for the specification of high level user goals that the system must carry out. More formally, a use case is made up of a set of scenarios. Each scenario is a sequence of steps that encompass an interaction between a user and a system. UML sequential diagrams, on the other hand, emphasize the order in which things happen. The Swim Lane process mapping methodology was used to map the user processes for both processes that have changed with the introduction of the CBPMS to Solas, and for processes that are new with the introduction of the CBPMS.

The requirements gathered in chapter three along with the policy findings researched during the literature review in chapter four, were used to steer the approach to the design, and are reflected in the design output.

5.1 Design Scope

The core objective of the research is to implement an integrated CBPMS and Solas system which will resolve the access issues experienced by the Solas administrators. The scope of the implementation was limited to meeting the requirements that could be achieved within the project timescales.

Solas requirements

1. Continue to appeal to children of a variety of ages, maturity and skill levels in line with legislation and best practice.
2. Implement a more robust and flexible solution than Kiosk mode access to resources.
3. Extend functionality if in a supervised environment. Provide restricted access when children not supervised (as will be the case in the majority of instances)
4. Represent both supervised and non-supervised access rights for the users.
5. Be setup to represent multiple hospitals with potentially differing policies.
6. Handle children whose biological, emotional or maturity level may fall outside the 'norm'.
7. Handle evolving policies
8. Support home access.

Revisiting the requirements it was decided that requirements 1 through 7 could be addressed. Requirement 8 requiring home access to Solas will be revisited as part of future enhancements in Chapter 8.

5.2 Design Approach

The approach taken to meeting each of the in-scope requirements above are detailed below:

1. Retain all current functionality within Solas. Abolish user roles and utilise CBPMS functionality. Differentiate between the different age groups for the users as per research recommendations in Chapter 4. This will mean functionality can be controlled and set according to age groups.
2. Implement CBPMS access to resources instead of kiosk mode.

3. Set up one set of access policies to model the scenario when children are supervised. Extend functionality to open internet access for older children as per policy research in chapter 4 for situations when supervision is possible. It should be possible to overrule this setting to satisfy hospital or parental concern, and situations where supervision cannot be provided.
4. Configure access policies to govern scenarios where children are not supervised (as will be the case in the majority of instances).
5. Model two hospitals with differing access polices, one modelling the policy research from the literature and one to model a fictitious example with different policies. This will demonstrate system flexibility and a multi-hospital configuration.
6. The integrated system should have governing policies for children who are not permitted access to the Solas resources (or have restrictions different to the 'norm').
7. Configure the system so that it is 'future-proof', i.e. it is easy to amend the access polices should it be necessary to change the policies going forward.

5.3 Functional Design

Purpose

The purpose of the functional design was to describe at the user level how the Solas system will be used post integration with the CBPMS. The output of the Functional Design was used as input to the Technical Design Phase. The Functional Design carried out as part of this research involved the creation of a series of use cases to describe how the functionality within Solas would be used by each of the user groups post integration of Solas and CBPMS.

Approach

In order to describe how the Solas system would operate post integration with the CBPMS it was necessary to understand how it is currently used, referred to as 'As-Is' modelling. This process involved two stages:

- Identifying and categorising the Solas users (As-Is)
- Describing the use cases of the roles performed currently by the users (As-Is)

Once the As-Is scenarios were identified, it was then possible to examine how they would change post integration with CBPMS, referred to as 'To-Be'. This process involved two stages:

- Describing the roles of the users once the CBPMS has been integrated (To-Be)
- Creating Sequential diagrams for new functionality introduced (To-Be)

5.3.1 Identifying the Solas Users

Currently four types of users of Solas have been identified, i.e. The Child, the Parent (Family member), the Solas Facilitator and the Administrator. In order to keep inline with existing use of the system, no new roles are envisaged once both systems are integrated.

5.3.1.1 Super Users

The Child and the Parent are the main users of the system. Parents can, upon request, be set up as users to keep in contact with their child during their hospital stay although the parental functionality is considerably limited. This project will focus on the principal user, i.e. the child.

5.3.1.2 Support Users

Currently there is no distinction between the access rights of the Solas Developer and that of the Solas Facilitator, i.e. the Facilitator has full administration rights, and there is no separate role created for them. How both roles use the system is somewhat different, however. The Administrator/Developer is based in TCD and is responsible for the development and maintenance of the Solas system. The Solas Facilitator on the other hand is the person responsible for the onsite administration of the Solas system, she may be assisted on the ward at times by a healthcare worker (i.e. Play therapist). It is the intention that both roles remain in existence once the CBPMS has been integrated into Solas, however each role will change based on additional functionality and support processes.

5.3.2 As-Is Use Case Diagrams for Solas Users

The following sections define through use case diagrams how the three main users identified in 5.3.1 currently interact with the Solas system.

5.3.2.1 The Child User

The Child is the principal user of Solas. Currently when the child logs in their role will determine the functionality they have access to. Figure 7 shows a graphical representation of the 'As-Is' role based approach to controlling access to a Solas resource depicting the scenario when a child attempts to send an email.

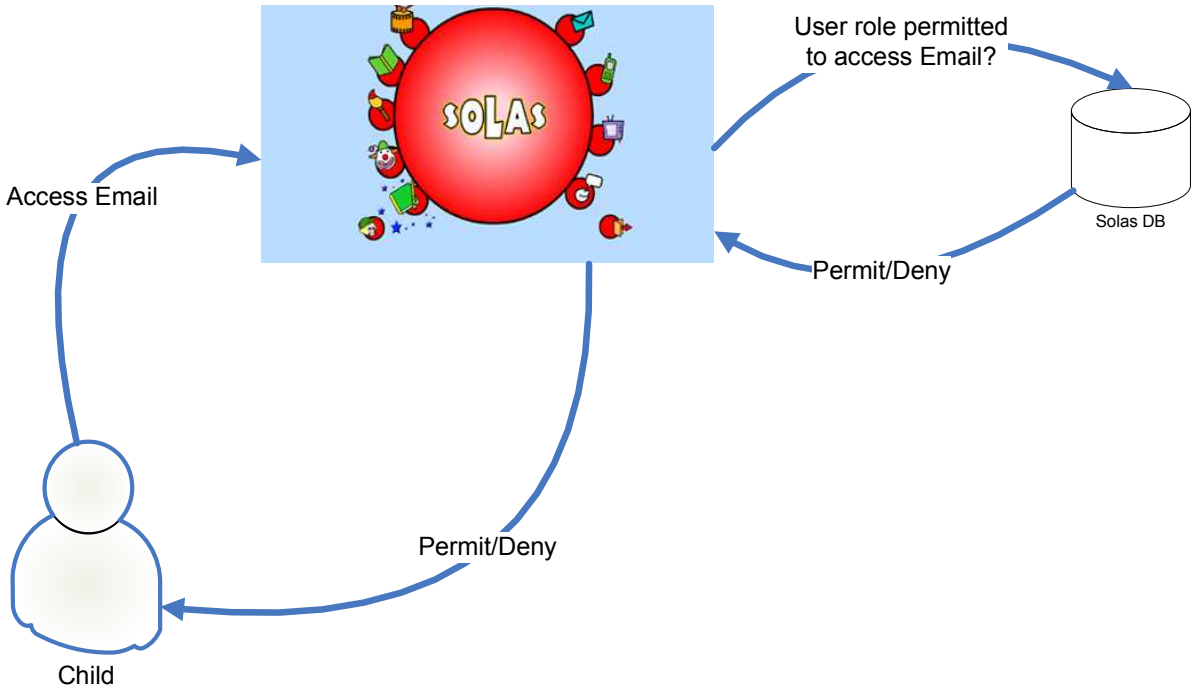

Figure 7 - Role based access to Solas

The 'As-Is' Use Case for the child user is shown in figure 8.

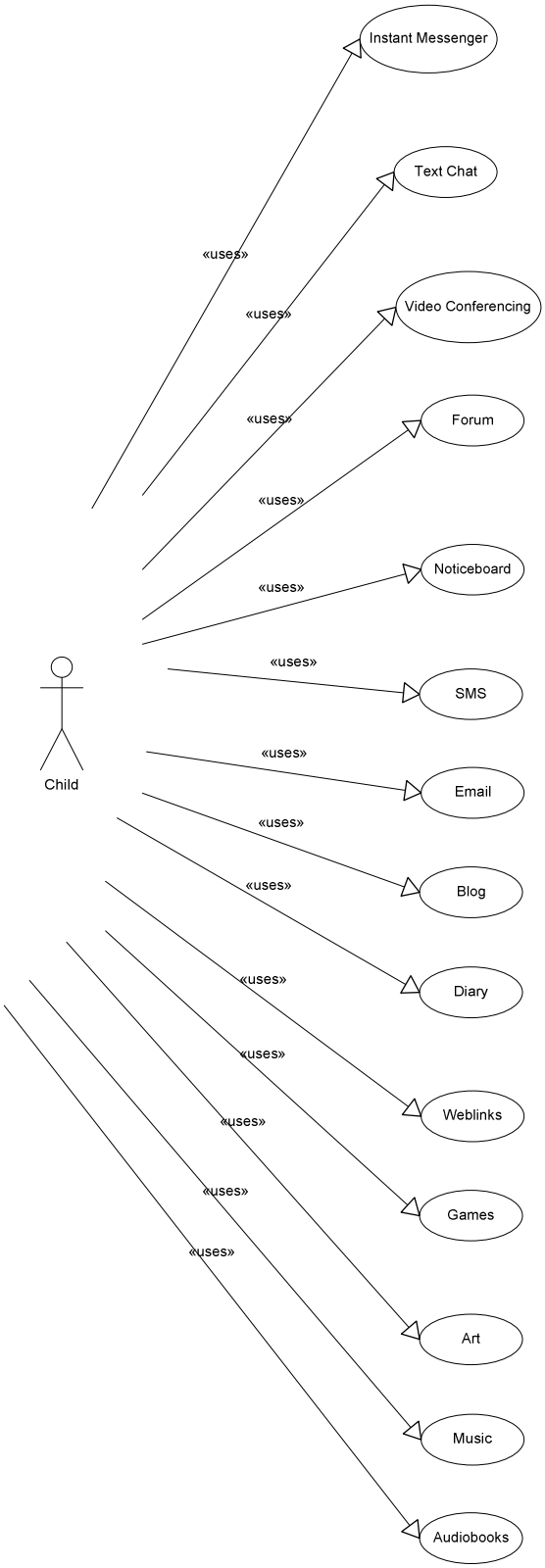

Figure 8 - Child 'As-Is' Use Case

5.3.2.2The Solas Facilitator (Hospital based administrator)

The Solas Facilitator is the person responsible for the onsite administration of the Solas system. The functions that the Facilitator typically carries out are as follows:-

- Registration – Add New Solas User
- Manage Contacts – View/Edit Email and SMS contacts for the child
- Add Contact – Add Email/SMS contact for the child
- Manage Images – Add/Delete accessible websites
- Manage Blogs – Monitor content of posted blogs
- Manage Music – Upload music files

The 'As-Is' use case for the Solas Facilitator is detailed in figure 9:

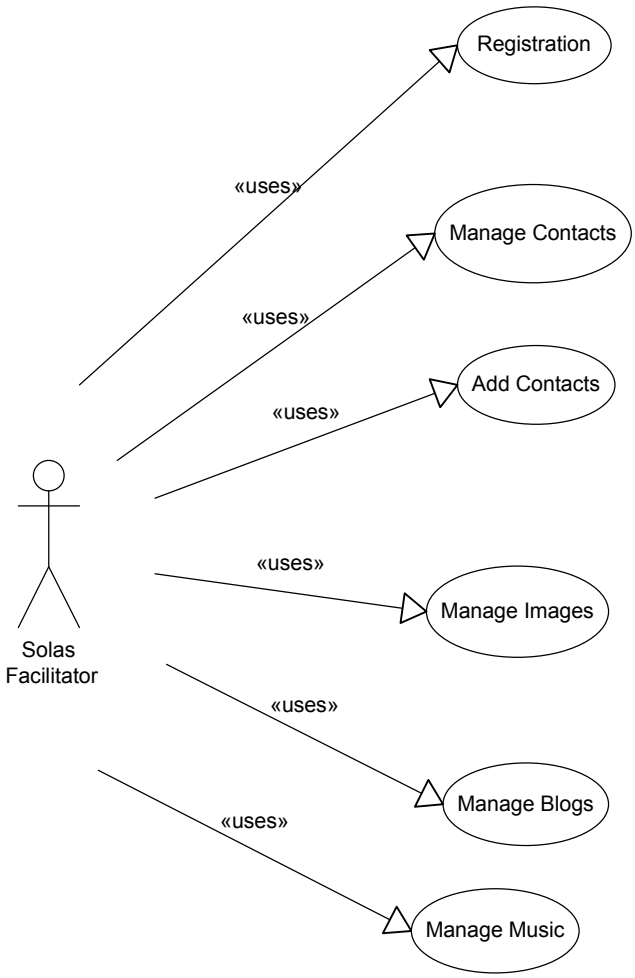

Figure 9 – Solas Facilitator 'As-Is' Use Case

5.3.2.3Solas Developer (TCD based System Administrator)

TCD currently have two research assistants working full-time on the development and maintenance of the Solas system. As mentioned, currently there is no differentiation between the access rights of the TCD based administrators and the on-site Facilitators. The 'As-Is' Use Case for the Administrator is, therefore, identical to the 'As-Is' Use Case for the Facilitator in Figure 9.

5.3.3 'To-Be' Use Case Diagrams for Solas Users

The following sections define through a series of use case diagrams how it is envisaged the three main users identified in 5.3.1 will interact with the integrated Solas and CBPM system going forward.

Upon introduction of the CBPMS, it is the recommendation of the author that there should be a distinction between the Administrator's role and the Solas Facilitator role

which are technically one in the same but functionally quite different. More specifically, it should be the responsibility of the administrator to look after the interaction of Solas and the CBPMS whereas the Solas Facilitator should only modify the policies as required, and are therefore not exposed to the complexities and intricacies of the CBPMS. Upon integration of Solas and CBPMS the administrator role should be performed by a person who has the skills, expertise and time to manage potentially complex community structure creation and policy management, and not a Solas Facilitator whose only involvement or knowledge of the CBPMS should be to ensure that the users belong to the correct community, and they can maintain hospital policies once in operation. Figure 10 shows at a high level how the users will interact with Solas and CBPMS for this implementation.

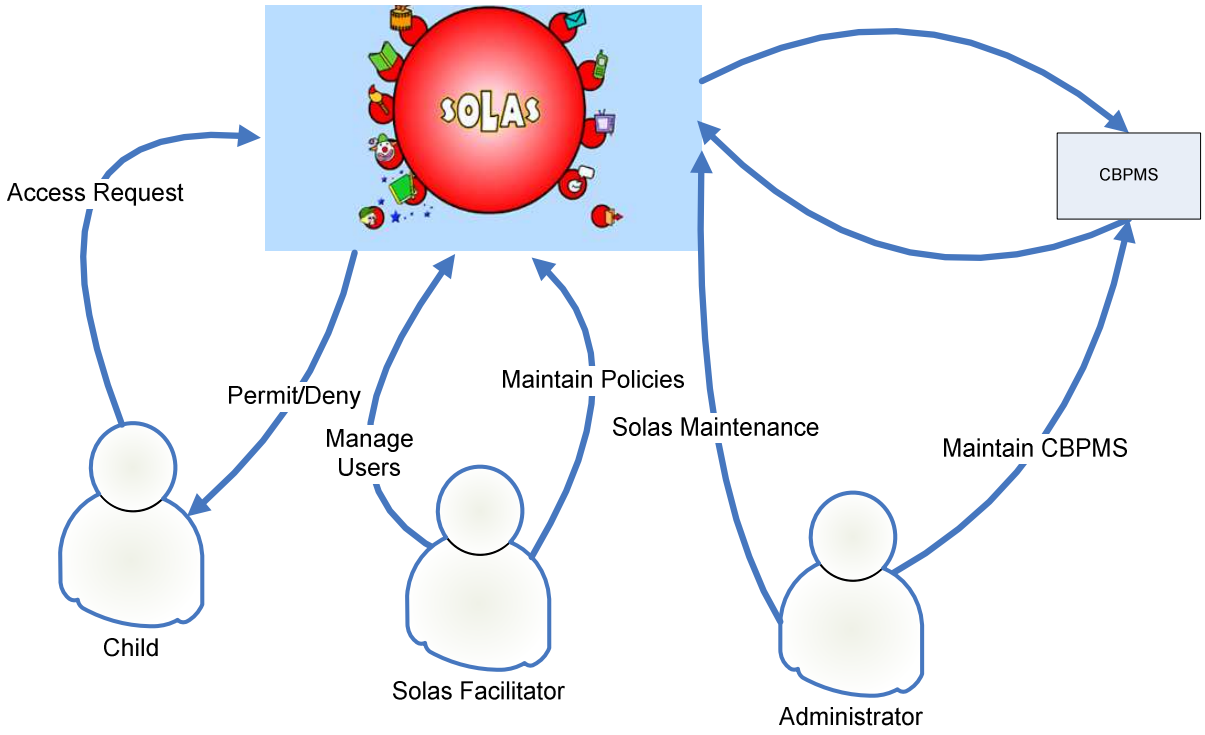

Figure 10 - User Interaction with Solas and CBPMS

5.3.3.1 Child User

It is important to point out that introducing the CBPMS to manage the Solas resources should not have an impact on the usability of the system from a child's point of view. The child should have no visibility when attempting to access email, web or internet, that the system is verifying the access via the CBPMS. If figure 10 is compared to

figure 11 below it is clear that the child will interact with Solas as before but the resource access is controlled not by the role based approach but the CBPMS by supplying contextual information (age, community, supervision) to determine if access is appropriate (N.B. Contextual information will be discussed during the technical design in section 5.5).

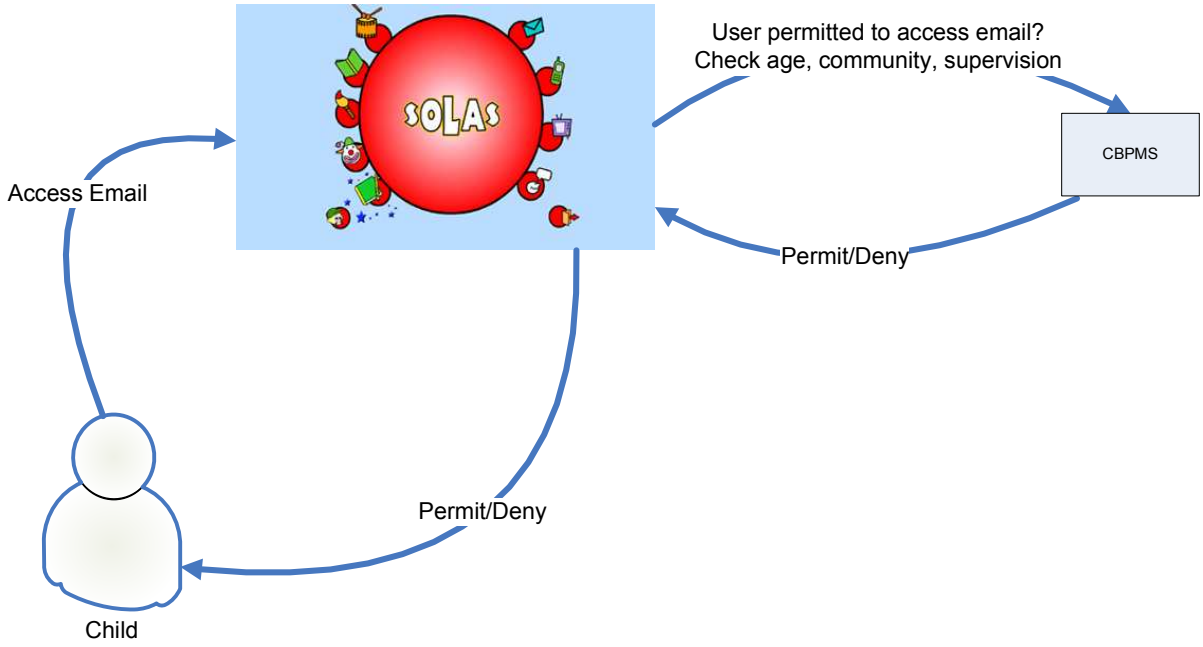

Figure 11 - Child interaction with Solas post implementation with CBPMS

As summarised in the researched literature in section 4.2.1 there is a very strong emphasis on the importance of supervision when accessing the internet in an open environment. When supervision is neither possible nor desired, as will be the case for the majority of Solas instances, access should be restricted. In essence, therefore, there are two 'To-Be' Use Cases for a child; one Use Case for when the child is supervised, the other when they are unsupervised. Simplified 'To-Be' use cases for the child users are shown below.

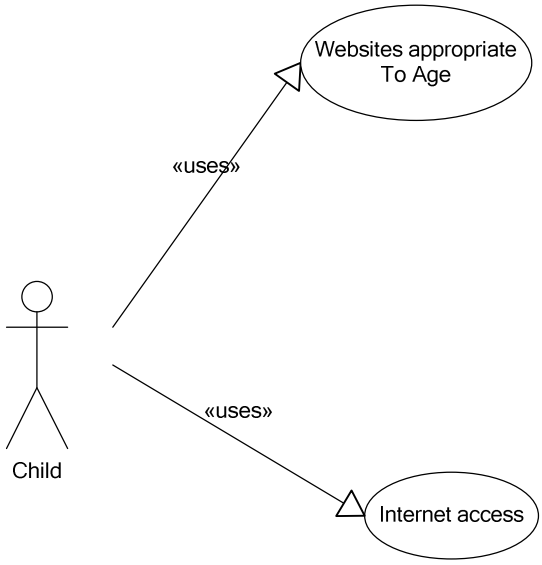

Figure 12 - Child 'To-Be' Supervised Use Case

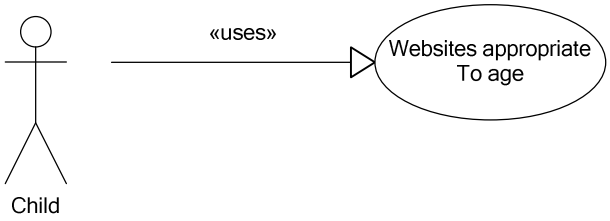

Figure 13 - Child 'To-Be' Unsupervised Use Case

5.3.3.2Solas Facilitator

In addition to the functions currently performed, with the introduction of the CBPMS, the Solas Facilitator will be required to:-

- Add users to Communities
- Change user community membership (i.e. to handle supervision and special needs)
- View Access Policies for Individual communities
- Set Access Policies for Individual communities

As these functions directly relate to operations within CBPMS the Solas Facilitator would, ordinarily, be expected to acquire a reasonable knowledge of the CBPMS. It is the opinion of the author that this system is difficult to use without some formal training on the concepts of CBPMS and basic programming principles. Therefore it was deemed necessary to design a simple interface to the CBPMS system within Solas

which would effectively incorporate the above functions to the Solas system and keep the complexities of the CBPMS from the Solas Facilitator. The user interface design is discussed in 5.5.3.

The 'To-Be' use case for the Solas Facilitator once CPBMS has been integrated is depicted in figure 14.

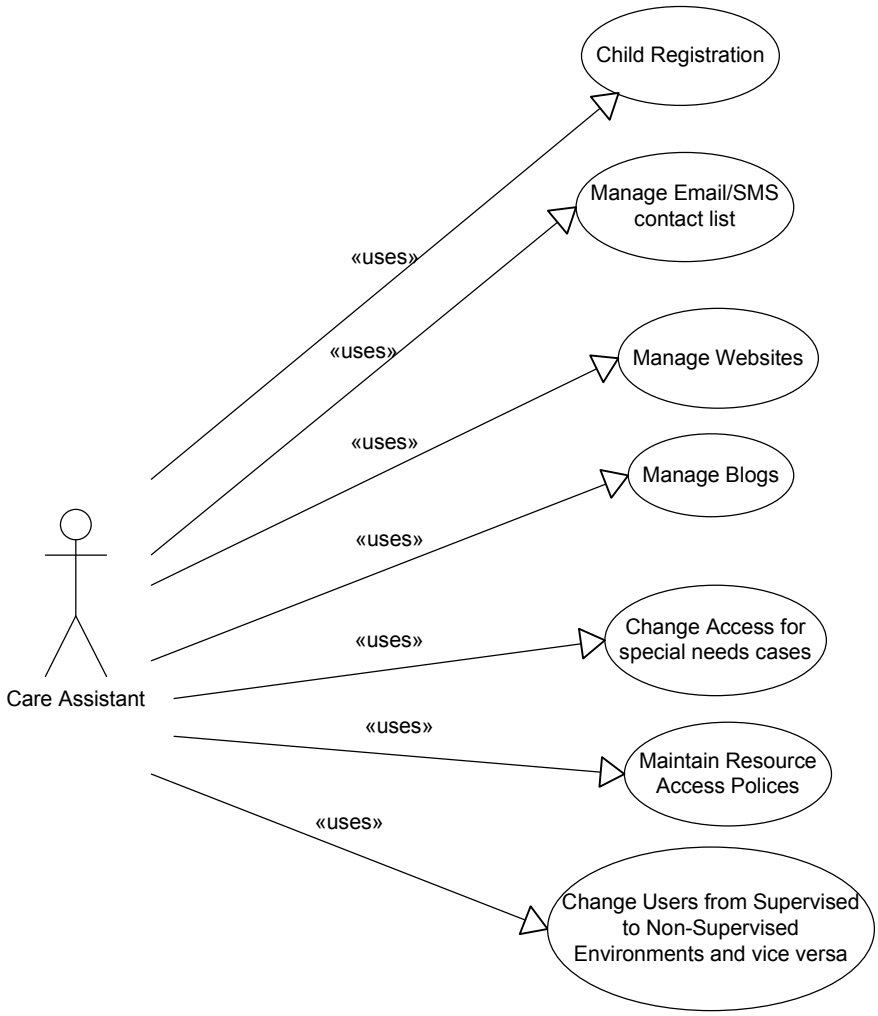

Figure 14 – Solas Facilitator 'To-Be' Use Case

5.3.3.3Solas Developer/Administrator

It will be the responsibility of the Administrator to perform the following tasks as required:

- Create/Delete communities
- Create/Update/Delete membership rules for communities

- Create/Update/Delete resource authorities
- Create/Update/Delete community policies
- Delegate Resource Authority

The above tasks are all required to be carried out via CBPMS and not through Solas. An interface could easily be built to allow the administrator to effectively carry out these tasks via Solas, thereby maintaining a single system support requirement. This was not addressed during this research as the focus for this feasibility study was to ascertain if the access issues were resolved by introduction of the CBPMS and if the integrated system met the system requirements specified in chapter three, and not whether it could be made more user-friendly for the Administrator. Integrating the Solas system to include an interface for creating and maintaining the CBPMS structure will be discussed in Chapter eight.

The 'To-Be' Use Case for the Administrator is shown in figure 15.

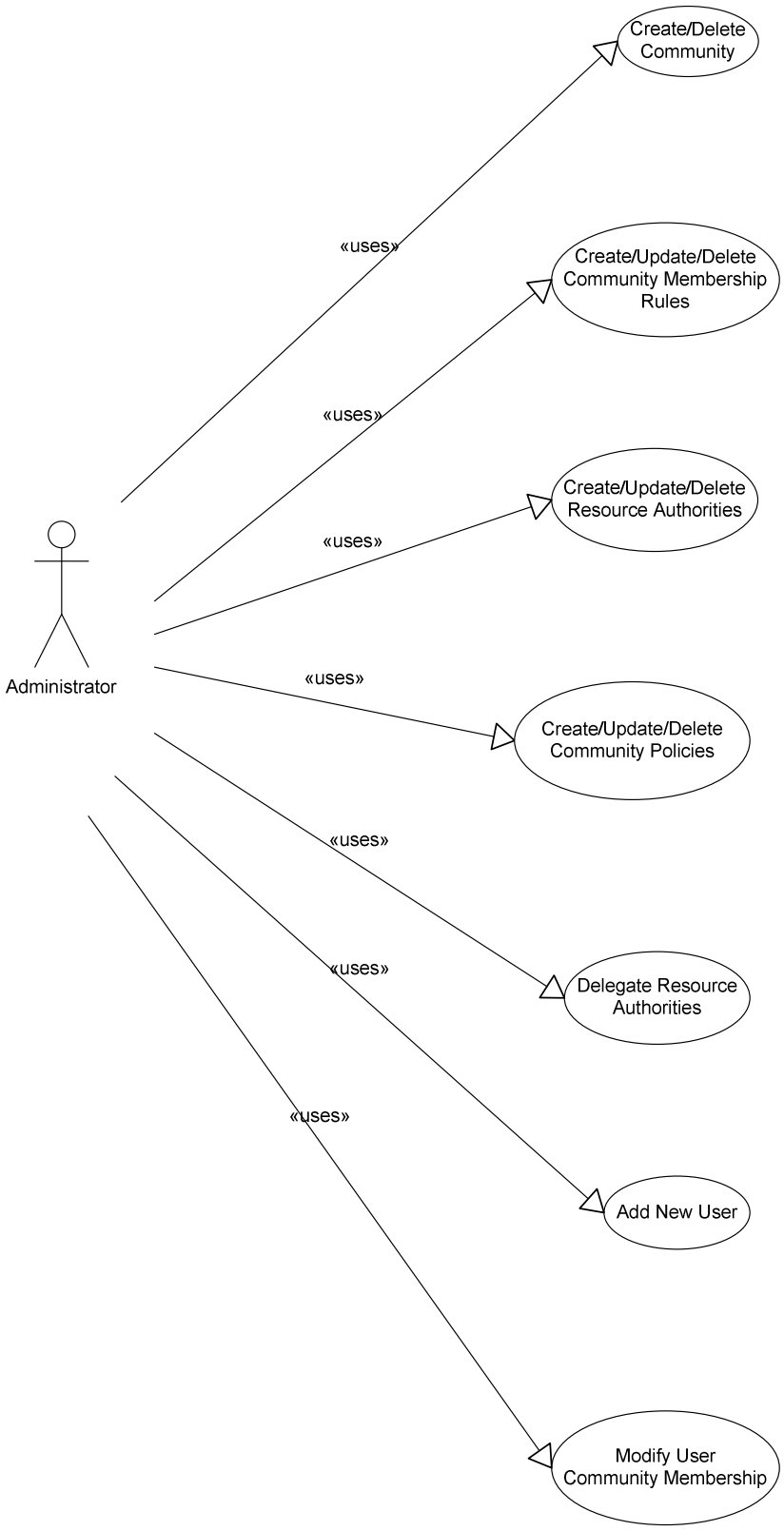

Figure 15 - Developer 'To-Be' Use Case

5.4 Technical Design

Purpose

The purpose of the technical design was to describe the system changes and enhancements required to support the functional design.

Approach

The approach to the technical design addressed the following:

- How the services in CBPMS must be configured to represent Solas user community hierarchy
- How Solas resources are controlled and managed in CBPMS
- What low level system changes must be made to Solas source code (interface and access controls) to integrate with CBPMS
- Describe the changes to existing user processes and new user processes

5.4.1 Sequential Representations of User Access

UML sequential diagrams were used to describe two instances:

- When a child accesses a Solas resource
- When a Solas Facilitator attempts to view or access a policy

The administrator's interaction will take place directly with the CBPMS, so does not require a technical design specification within Solas.

5.4.2 Child Resource Access

When a child attempts to access a Solas resource (e.g. a website) this causes Solas to issue an appropriate decision request to the policy decision service provider. The policy decision service provider evaluates the appropriate policies for the request and returns the result of the evaluation to Solas in a form that is understood by Solas, see figure 16. N.B. The CPDS referenced in Figure 16 will be explained in more detail in section 6.1

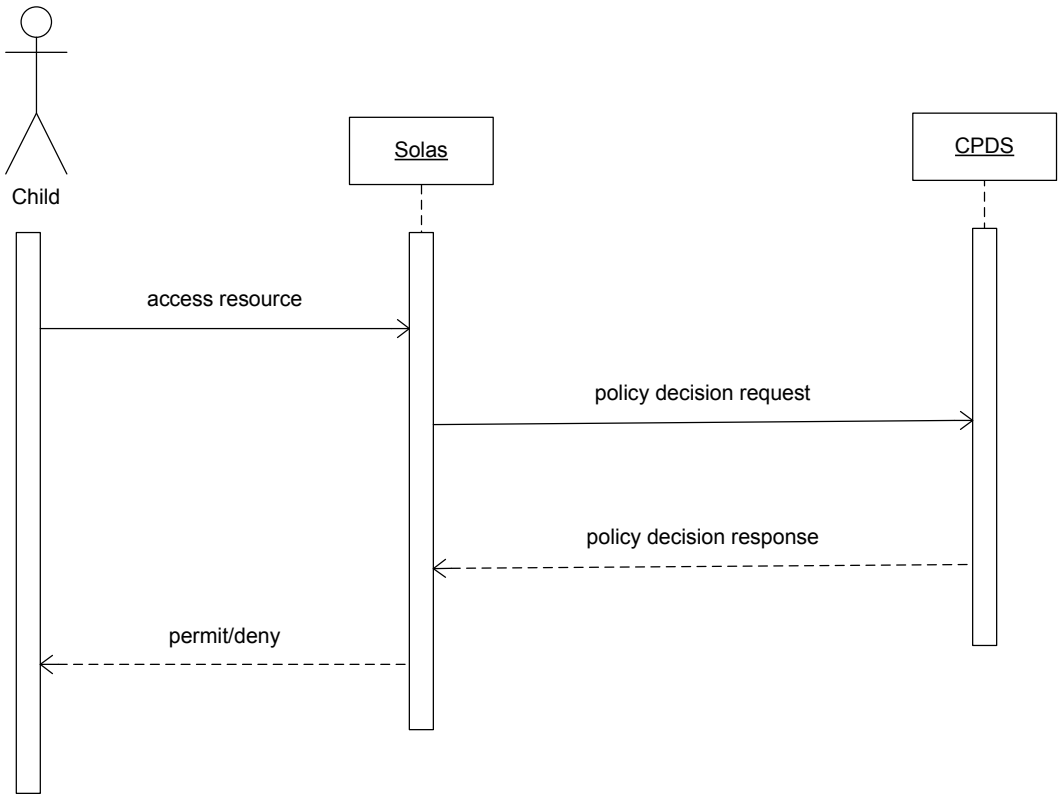

Figure 16 - UML Sequential Diagram for Child Access to Solas Resource

5.4.3 Solas Facilitator

When a Facilitator attempts to modify a policy request an event is initiated which causes Solas to send a policy management request to the Policy Management Service Provider. The Policy Management Service Provider updates the state of the system and sends a response back to the facilitator. The CPMS will be explained in more detail in section 6.1.

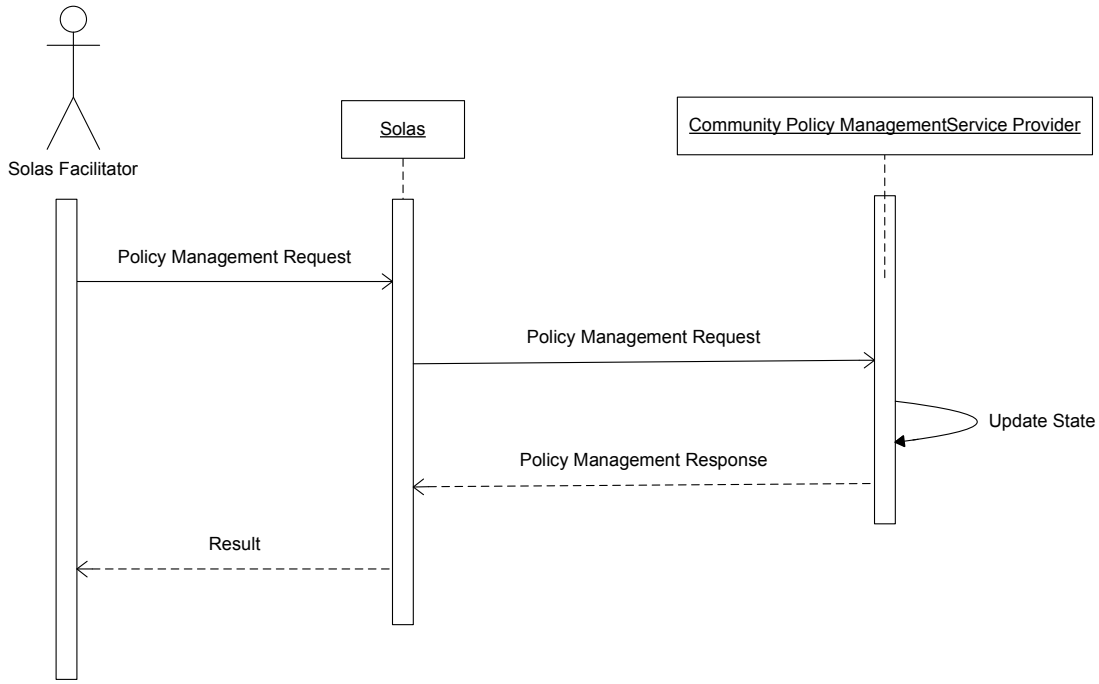

Figure 17 - UML Sequential Diagram for Solas Facilitator to Manage Policies

5.4.4 Steps Required to Model the Solas organisation in CBPMS

When modelling the CBPMS to represent a particular organisation it is important to stress that there is no right or wrong way to configure an organisation within the tool; the flexibility of the architecture and its ability to model various scenarios are, it could be argued, its strongest assets.

Feeney (2007) identifies five essential steps to model an organisation, like Solas, in the CBPMS:

1. Identify and model the hierarchical tree of Solas units (communities).
2. A resource authority model is defined for each of the resources to which policy based management will be applied.
3. The authority possessed by each of the Solas communities with respect to the resources managed by the entire organisation is specified.
4. Membership rules for each community are specified.
5. A community policy set is defined for each community which maps the authority possessed by the community to authority that the individual members of the community may exercise on behalf of the community.

Step 1:Defining and Modelling the Solas Hierarchy

Figure 21 shows the hierarchical model chosen to represent the Solas organisation.

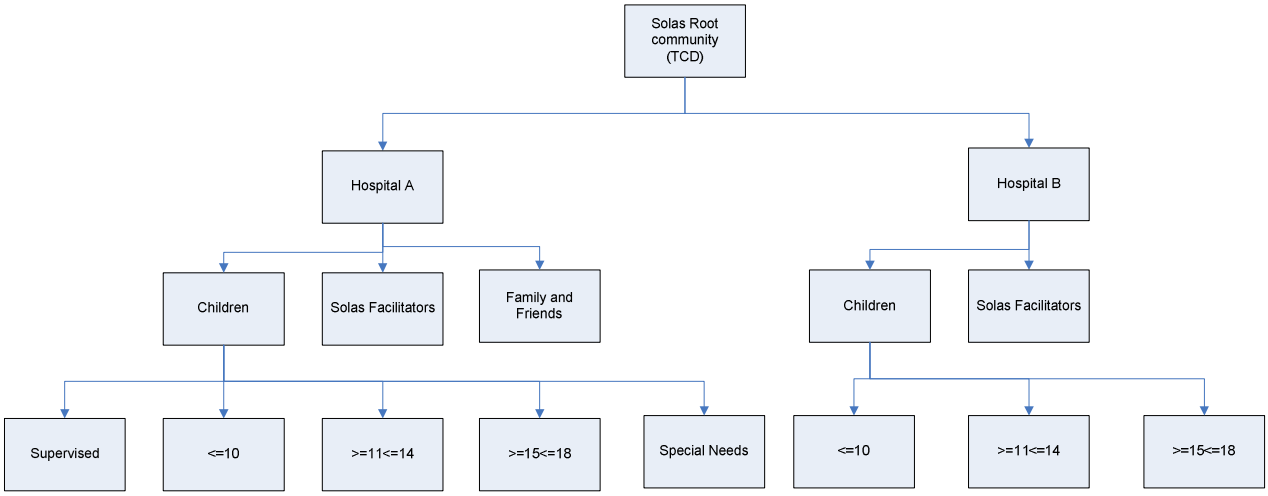

Figure 18 - Proposed Solas Community Structure

5.4.4.1 Community Hierarchy explained

Hospital A

The motivation for choosing the community structure for Hospital A above was to reflect the findings in the literature review and the requirements gathering exercise, i.e.

- That there should be three access age groups, children aged under 10, children aged 10 to 14, and children aged 15 to 18.
- In addition to the three age groups it was deemed necessary to create a 'Special Needs' community. The intention for the creation of this community is that any child who for behavioural or cultural reasons cannot belong to, or is not permitted by a guardian to belong to an age-group community, they will belong to a different community whose policies shall be created to taken into account their special needs. In this instance, members of this community will be denied access to all online functionality. In practice this community could be sub-divided into several communities depending on the different classifications and hospital requirements for special needs. For example a parent may be supportive of their child

accessing internet and email content, however do not permit their child to engage in mobile phone technology (i.e. SMS). To represent this scenario a second 'Special Needs' category should be created with different resource access policies. For simplicity this scenario will not be modelled but it should be pointed out that this is easily represented with a reconfiguration of the suggested Solas community structure.

- There was a very strong emphasis from the literature review on the importance of supervision when children access the internet in an open environment. A separate 'supervised' community was created to make supervision a possibility, although not a requirement. Once a member of this community the user will be governed by the policies of the supervised community, which may be configured with a higher set of access rights as per the literature research. It should be stressed that a child can only belong to one community at any one time, however it is possible to be moved from one community to another as and when required. It is the possibility of changing this community membership and belonging to different communities with different policies that makes supervision possible. As was pointed out, children are often supervised on the ward, however this supervision cannot be guaranteed so the default community membership for each child will be the age group community of the child where they are permitted to view content appropriate to their age and are not permitted open access of the internet. The benefit of setting up this supervised community means that when unsupervised children will have different (potentially less) access rights than when they are supervised thus satisfying hospital and parental concern over access.

Hospital B

The motivation for choosing the community structure for Hospital B was to simply introduce a test scenario to model different policies to Hospital A. The configuration of Hospital B is different to that of Hospital A in the following ways:

- It does not contain a supervised community. The reason for this is to represent a scenario whereby a hospital cannot provide supervised access to Solas so all access will be granted to the children at the age group level which will be configured to give the children access to content for their age group and no more.
- Children with special needs at Hospital B are not permitted to use Solas so the 'Special Needs' community was not created.

- Friends and family at Hospital B are not permitted to use Solas so this community was not created.

The following table gives a description for each of the communities detailed in Figure 18

Community Name	Community Description
Root Community	Solas Root Community is the parent community which has two children, i.e. Hospital A and Hospital B with different community structures assigned to each hospital. Solas Administrators/Developers will be the members of the Solas Root Community.
Hospital A	Hospital A and its children communities will be configured to represent the policies of the literature and the Solas requirements. This hospital community is created should blanket policies need to be applied to all communities of this hospital.
Solas Facilitators (Hospital A)	Represents the community of potential facilitators at the Hospital, (e.g. Play Specialist, Hospital Teacher etc.).
Children (Hospital A)	Represents the community of children at Hospital A. The reason for setting up a community of children in addition to the individual child age groups would be if a situation arose where it was needed to set a policy governing all children and not just a single age group.
Family and Friends (Hospital A)	This community represents the parents and friends of the sick children in Hospital A. Setting up a community for these users means that separate policies can be configured for these users.
Supervised (Hospital A)	This community represents the entire community of supervised users in Hospital A. Users are members of this community if a 'supervised' membership variable is set. See Table 4.
<=10 (Hospital A)	This community represents the community of users at Hospital A who are aged below 10. Members of this

	community will be unsupervised.
>11<=14 (Hospital A)	This community represents the community of users at Hospital A who are aged between 11 and 14. Members of this community will be unsupervised.
>=15<18 (Hospital A)	This community represents the community of users at Hospital A who are aged between 15 and 18. Members of this community will be unsupervised.
Special Needs (Hospital A)	This community represents the community of users at Hospital A who have special needs (i.e. immaturity, sickness level).
Hospital B	Hospital B and its children communities were introduced for testing reasons. The purpose was to demonstrate how the hierarchical structure can represent multiple hospitals with differing community structures and different policies.
Children (Hospital B)	Represents the community of children at Hospital B. The reason for setting up a community of children in addition to the individual age groups is if a situation arose where it was needed to set a policy for all children and not just one age group.
Solas Facilitators (Hospital B)	Represents the community of potential facilitators at Hospital B, (e.g. Play Specialist, Hospital Teacher).
<=10 (Hospital B)	This community represents the community of users at Hospital B who are aged below 10. Members of this community will be unsupervised.
>=11<=14 (Hospital B)	This community represents the community of users at Hospital B who are aged between 11 and 14. Members of this community will be unsupervised.
>=15<=18 (Hospital B)	This community represents the community of users at Hospital B who are aged between 15 and 18. Members of this community will be unsupervised.

Table 3- Solas Community Description

Step 2:Defining the Solas Resource Authority Model

A Resource authority model is required to describe the resources controlled by the Solas community, a model which defines a resource in terms of sets of actions and targets. This model defines the actions that are defined on the particular resource, how the resource can be sub-divided into distinct targets and how these targets and actions are related to each other by the implies authority relation.

A single resource model is required for the Solas system with 3 target nodes, web, SMS and Email.

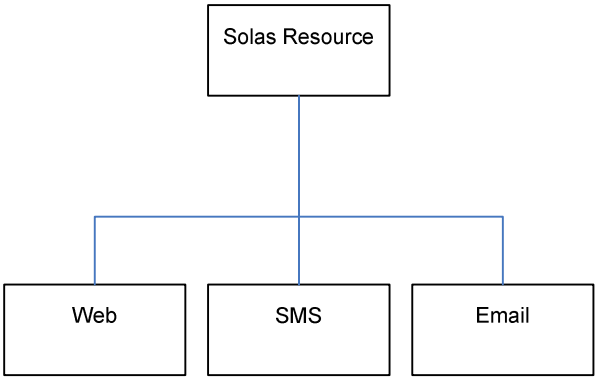

Figure 19 - Solas Resource Target Tree

The Resource Action Tree can be viewed in figure 20:

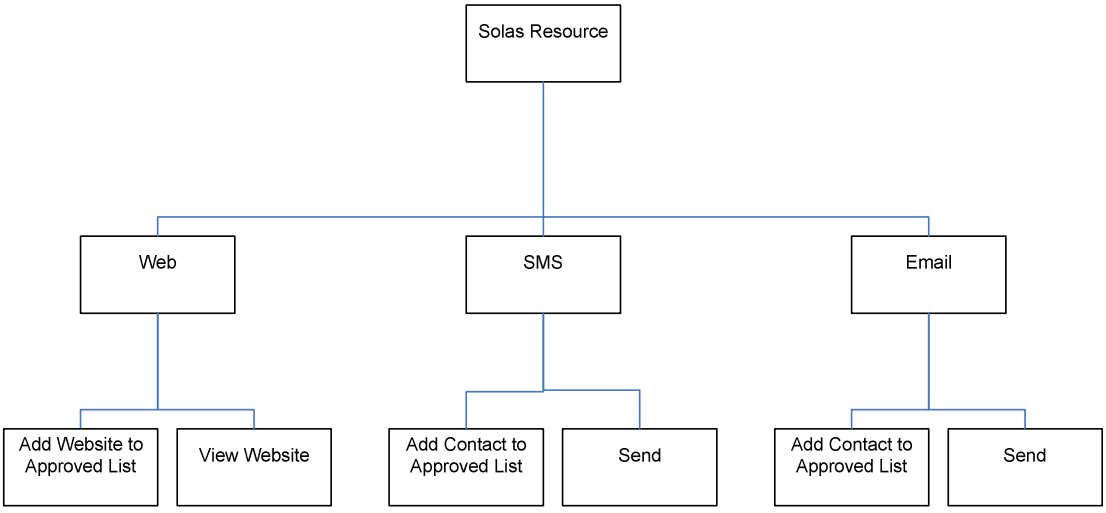

Figure 20 - Solas Resource Action Tree

Step 3:Defining the authority possessed by each of the Solas communities

It was decided to give each community all the authority for the Solas resource (to make things simple) and use different policies in different communities to set the access rules, see 6.2.7

Step 4:Defining Solas Community Membership Rules

The communities within an organisation include individuals in a membership capacity. Each individual who belongs to the organisation is a member of the community that represents the entire organisation: the root community. As one descends the Solas organisational tree, a subset of the individuals who are members of the organisation are members of each community directly beneath it in the community hierarchy. A membership policy must be defined for each community, a policy which can be evaluated to map a subset of the members of the parent community to the members of the child community (Feeney, 2007). This mapping of individuals to communities in terms of membership also incorporates an inherent hierarchy. An individual can only be a member of a community if he is also a member of its parent. For example a child aged under 10 at hospital A can only be a member of the under 10 community if they are also a member of the 'Children' community directly above it in the tree (figure 18).

By successively defining membership policies for each community within Solas, as we descend the hierarchical tree of the organisation, all of the members of the organisation are mapped to the communities to which they belong. If the community membership rule returns a positive result when a particular individual actor's identity is passed as a parameter to the rule, and if the membership rule for all of the community's parent communities also returns a positive result, until the root of the tree is reached, then the individual actor is said to be a member of the community (Feeney, 2007).

The membership rules for each community in figure 18 are defined in Table 4

Community Name	Community Membership Rule
Solas Root Community TCD	Every user is a member of the Root Community
Hospital A	Is a member if 'Hospital A' context variable is set
Solas	Is a member if 'Facilitator' context variable

Facilitators (Hospital A)	is set
Children (Hospital A)	Is a member if 'Child' variable context is set
Family and Friends (Hospital A)	Is a member if 'Family' context is set
Supervised (Hospital A)	Is a member in a context where 'Supervised' context variable is set. See section 5.6.
Under 10 (Hospital A)	Is a member if child is aged under 10
11-14 (Hospital A)	Is a member if child is aged under over 10 and less than 15
15-18 (Hospital A)	Is a member if child is aged 15 or over
Special Needs (Hospital A)	Is a member if child has special needs, i.e. a 'special needs' variable is set.
Hospital B	Is a member if 'Hospital B' context variable is set
Children (Hospital B)	Is a member if 'Children' context variable is set
Facilitators (Hospital B)	Is a member if 'Facilitator' context variable is set
Under 10 (Hospital B)	Is a member if child is aged under 10
10-14 (Hospital B)	Is a member if child is aged under over 10 and less than 15
15-18 (Hospital B)	Is a member if child is aged 15 or over

Table 4 - Solas Community Membership Rules

Step 5:Define Solas Community Policy Set

Defining the Community Policy set allows individual members to exercise the authority over the resources possessed by those communities they are members of. Each community possesses a set of policies which dictate how the community's authority over resources can be acted upon by the community membership (Feeney, 2007). The community policy set is considered to be the set of decisions made by the community. The policies set for the Solas communities are defined in Table 5 below:

Community Name	Community Policy Set
Solas Root Community TCD	Solas Root community has ultimate resource authority therefore all actions are permitted on the Solas resource.
Hospital A	Permit all actions on the Solas resource for Hospital A
Facilitators (Hospital A)	Permit all actions on the Solas resource for Hospital A.
Children (Hospital A)	All actions should be permitted on the Solas resource for Hospital A
Under 10	Permit email, SMS and websites for under 10 age group. This is for unsupervised scenarios.
>=11<15	Permit email, SMS and websites for 11-15 age group and websites for under 10 age group. This policy is active in unsupervised scenarios.
>=15<18	Permit email, SMS and websites for 15-18 age group and websites for 11-15 age group and websites for under 10 age group. This policy is active in unsupervised scenarios.
Supervised	Permit email, SMS and open internet access. This policies for this community are active when supervision is possible.
Special Needs	Deny Email, SMS, websites and open internet access.
Hospital B	Permit all actions on the Solas resource for Hospital B
Children (Hospital B)	All actions should be permitted on the Solas resource for Hospital B
Solas Facilitators (Hospital B)	All actions should be permitted on the Solas resource for Hospital B
Under 10 (Hospital B)	Permit email, SMS and websites for under 10 age group in Hospital B. This is for unsupervised scenarios. This policy is active in unsupervised scenarios.
>=11<15 (Hospital B)	Permit email, SMS and websites for 11-15 age group and websites for under 10 age group in Hospital B. This policy is active in unsupervised scenarios.
>=15<18 (Hospital B)	Permit email, SMS and websites for 15-18 age group and websites for 11-15 age group and websites for under 10 age group in Hospital B. This policy is active in unsupervised scenarios.

Table 5 - Solas Community Policies

5.5 Process Changes

The following section details the changes to existing processes and the introduction of new process resulting from the integration of Solas and CBPMS

5.5.1 Changes to Existing Registration Process

The introduction of CBPMS requires additional information about the child to be entered at time of registration, namely the CBPMS community to which the child belongs. Figure 21 highlights in yellow the additional step in the registration processes required. Note the user community information is stored not in the CBPMS but in the Solas SQL database and retrieved and passed to the CBPMS as contextual information when querying user access. This is discussed in more detail in Chapter 6.

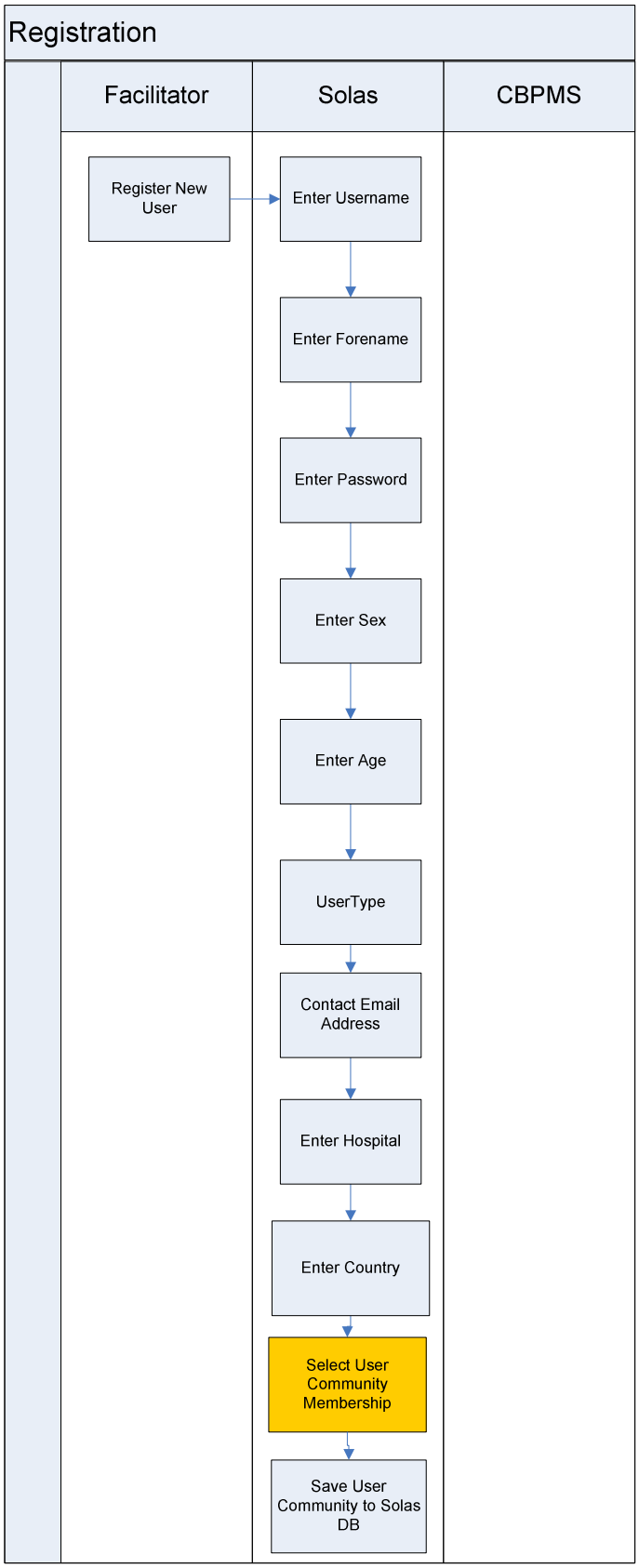

Figure 21 – New Child Registration Process

5.5.2 Introduction of New Processes

The integration of CBPMS with Solas will see the introduction of two new processes, i.e. set access policies, and change user membership (i.e. to handle system supervision and special needs).

Set access policies

When the Solas Facilitator logs in they should have permission to view and modify the policies of the hospital to which they belong and no other. This should be administered by the Solas developers as part of the resource delegation and policy setup of the CBPMS. The process flow for the setting policies is shown in figure 22. Changes to the existing Solas UI (discussed in 5.5.3) will make this possible through Solas without needing to access the CBPMS directly, although this is technically possible.

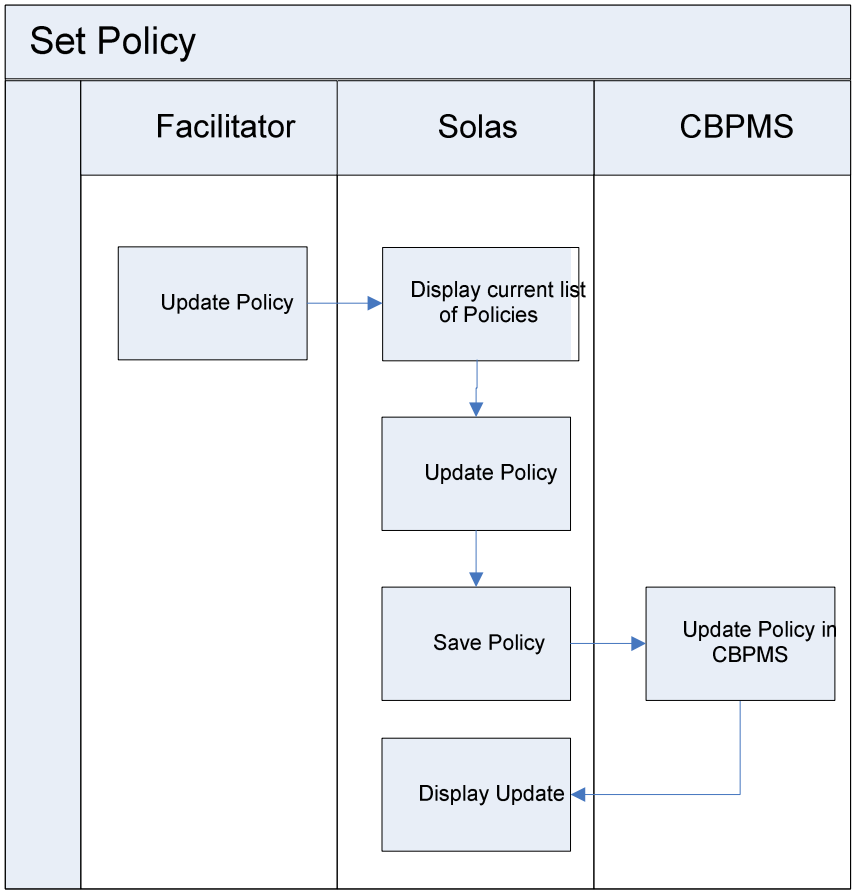

Figure 22 - Set Policy Process

Change User Membership

The literature research on children's access to open internet as per chapter 4 strongly recommends the presence of supervision, particularly for the younger age-groups. As

already mentioned supervision should not be seen as a requirement of the system, as it is not possible to guarantee resources to manage a supervised environment, nor was it the intention of the system creators who strive to secure the future of a system which is accessible by children 24x7 in isolation wards. Supervision, however, if possible can open up an additional level of access for the children as they can view not only the sites that they are permitted according to their age group but also open searching privileges. This added functionality is likely to entice older users to the system in particular.

There are a number of ways supervision could be handled within a system like Solas from setting password requirements for access to specific resources, to distribution of supervised usernames and passwords upon system access. Both methods have the drawback of requiring passwords which would be impractical to manage and keep uptodate.

Upon registration it is envisaged the child will be assigned to the age-group community (or the 'Special Needs' community) appropriate to them which will allow them access to web content suitable for their age group(or needs). This setup should be the default. It was decided based on the literature to have a different set of policies for a supervised scenario which could be easily maintained by the Facilitator. Once a member of this community, a child will have access to open searching on the internet. What remains, then, is to design, how this transitioning of community membership should be done within Solas. To achieve this it was necessary to add an additional 'User Management' page to the Solas website. This user management page should allow the facilitator to change a user's community from their set age-group to the supervised community (and vice-versa when returning to an unsupervised scenario).

The User Management will also cater for the second scenario that might require the Facilitator to revoke resource access, i.e. when a child may be deemed unsuitable for the age community they have been assigned to (for maturity or sickness level reasons) or perhaps a parent has asked that their child has no access to internet content (even in a restricted context). The author envisages that changing a user's membership would result in removing them from their age group to the 'Special Needs' community which is the community of users with no internet privileges. The process flow for changing a user's membership is as per figure 23 below.

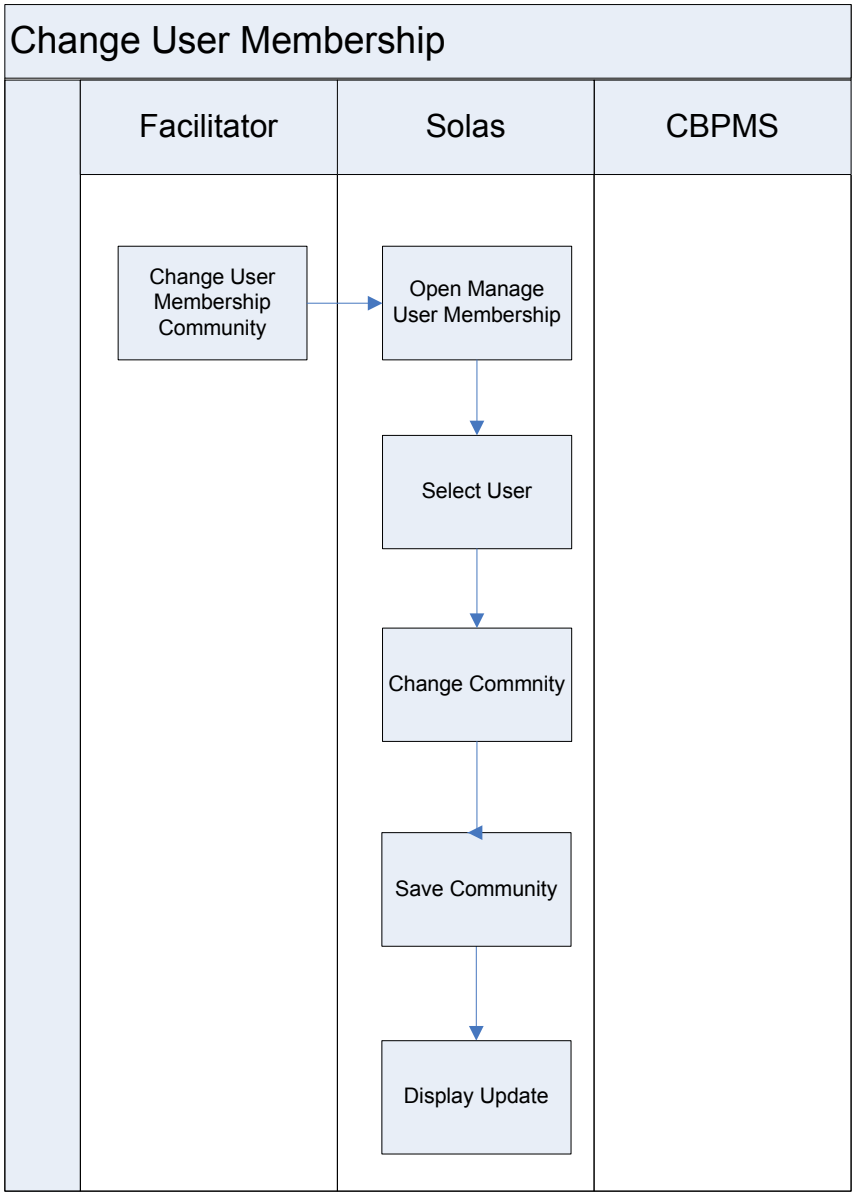

Figure 23 - Change Membership Policy Process

5.5.3 User Interface Design

According to Velasco (2005) good user interface (UI) design can spell the difference between acceptance of a software product and its failure in the marketplace. If the end-users find the software to be too cumbersome or difficult to understand, an otherwise excellent product could be doomed to failure. It is for this reason that it was necessary to incorporate elements of CBPMS maintenance within Solas itself rather than requiring Facilitators to update both Solas and CBPMS independently.

The user interface was introduced primarily for the Facilitator, i.e. the hospital-based administrator, to ensure basic CBPMS functions can be carried out through Solas, and to preserve a seamless integration between the two. This approach also avoids unnecessary administrative burden requiring dual system access and upkeep, an approach which would prove cumbersome in the real world. It was recommended as part of the further research in chapter eight to explore the possibility of incorporating further UI functionality to the administrator's remit.

Based on the requirements gathering exercise in section 3.5 and design phase discussed in the previous chapter the requirements for Solas UI were identified as the following:

- It should provide an indication of which community a user is a member of
- It should allow the user to change community membership
- Changing and setting community policies should be permitted

Currently when the Facilitator logs-in and selects the administration icon they are presented with the screen in figure 24 below. The functionality and usability presented to the user at this stage is already described in the use case in figure 7.

Figure 24 - Solas Facilitator system administration screen

5.5.4 Modifications Required to the Existing UI

This section describes the design of the modifications required to the existing Solas User Interface to incorporate the CBPMS in Solas.

5.5.5 Modifications to Existing Pages

- Two changes were made to the administration page in figure 24, as described: It was decided that two new buttons should be added, one called 'Manage Users' to allow the user to change community membership and the other called 'Policy Management' which, when clicked, will allow the user to view and modify the hospital policies for Internet, Email and SMS. Figure 25 shows the existing Registration Page.

Figure 25 – Existing Solas User Registration Page

An additional drop down box was added to the Registration page. This drop down box entitled 'community' allows the facilitator/administrator to assign the user to a community upon login. The options for this drop down as per Table 6:

Hospital A	Hospital B
Under 10	Under 10
11<15	11-15
16+	16+
Special Needs	
Family and Friends	

Table 6 - User Community Drop down options

Website Management

- There already exists a page within Solas for the addition of websites for viewing by the children. In order to lessen the changes required this screen was kept, however it was decided that an additional 'community'

field should be added to allow the facilitator to specify which community(s) is allowed to view the site.

Figure 26 - Existing Solas Website Maintenance

5.5.5.1 Additional Pages Added to the Solas environment

Policy Management

Once the facilitator has logged in, if they wish to manage policies they should be able to do this from the administration menu as managing policies is essentially an administrative task. Following this link should take the Facilitator to a page displaying the policies for each community where the facilitator can update the existing hospital policies in relation to Internet, Email and SMS.

User Management – Handling Supervision and Children with Special Needs

An additional User Management page was added to handle the changing of user communities. This page has two fields, i.e. a scroll bar list of user names and a drop down list of communities with an update button to save once a community has been selected.

Design Summary

This chapter described the project design phase. The Requirements Gathering exercise and the research collated from the literature review were used to steer the design decisions towards the future vision of the Solas project. Design was approached in two separate stages, functional design and technical design. Through a series of UML use cases and sequential diagrams it was shown, from a user point of view, how the Solas system will be used post integration with the CBPMS. Process diagrams show how the user processes will change once Solas has been integrated with CBPMS. The technical design focussed on configuring the CBPMS and the

changes required to the Solas interface and source code. The next chapter will describe the implementation of the design process.

6.0 CHAPTER SIX – IMPLEMENTATION

Putting basic policies in place helps members know how to behave, what to expect from the site creators, and provides a framework for social growth (Preece, 2000).

Chapter Overview

In the previous chapter the functional and technical design of the integration of Solas and CBPMS system were described. In this chapter consideration will be given to the implementation of the design.

Solas was installed on the author's laptop which had internet access enabling the laptop to connect to the CBPMS on the Trinity Server for testing purposes.

The implementation of the design was carried out in three stages:

1. Modelling Solas online community and researched policies in CBPMS
2. Changing Solas User Interface to reflect CBPMS functionality for the Solas Facilitator user as per 'To-Be' use case in figure 14 and sequential diagram in figure 17.
3. Modifying Solas source code so that when a child attempts to access a resource the request is validated through the CBPMS as per figure 16.

6.1 Implementation Challenges

The biggest obstacle faced when integrating the Solas and CBPM systems was the lack of clear and concise documentation for both systems. The easy to use intuitive Solas interface made it possible to understand the functionality of the system without the need to reference a user guide, however the program is written in java with no supporting administration manual and badly commented code. Locating the relevant sections of code to tweak was frustrating and 'hit-and-miss' at times.

CBPMS, like Solas, suffers from lack of supporting documentation. The absence of such essential reference material impacted the pace of this research project, and was further hindered by the lack of an intuitive interface. Once mastered the CBPMS services are relatively easy to use and debug, however the amount of effort required to master the CBPMS functionality could have been more productively spent implementing more of the requirements of the Solas system.

Another challenge worth mentioning is that both Solas and CBPMS are continually evolving projects. As mentioned earlier it is envisaged that Solas is tending towards a social networking environment rather than a simple online community, yet this was not available when implementation commenced. Also, there is a project underway at TCD to improvethe poor CBPMS interface which would have been very useful had it been available at the time of implementation.

6.2 Modelling Solas online Community in CBPMS

The conceptual architecture of the Community Based Policy Management System, decomposes the system into four basic component services:

- The **Resource Authority Management Service** (RAIS) and the **Community Record Management Service** (CRMS) both provide access to the repositories containing the records of the resources and the communities managed by the system respectively.
- The **Community Policy Decision Service** (CPDS) is the component of the CBPMS which interacts with policy decision consumers. The CPDS is the Policy Decision Point (PDP) and serves the function of retrieving and evaluating the policies that correspond with particular policy requests.
- **Community Policy Management Service** (CPMS) acts as the Policy Enforcement Point for the community model itself and in particular it enforces access control policies to the Community Record Management Service (CRMS).

According to Feeney (2007) by decomposing the system into four services in this manner, much of the CBPMS system can be treated as a set of 'black boxes' and the specification can be simplified when describing the functionality required to support the organisational modelling approach. Figure 27 (modified from Feeney, 2007, p. 109) shows how the services interact with one another when a user attempts to access a resource, and when a user tries to make a change to the community structure or policies.

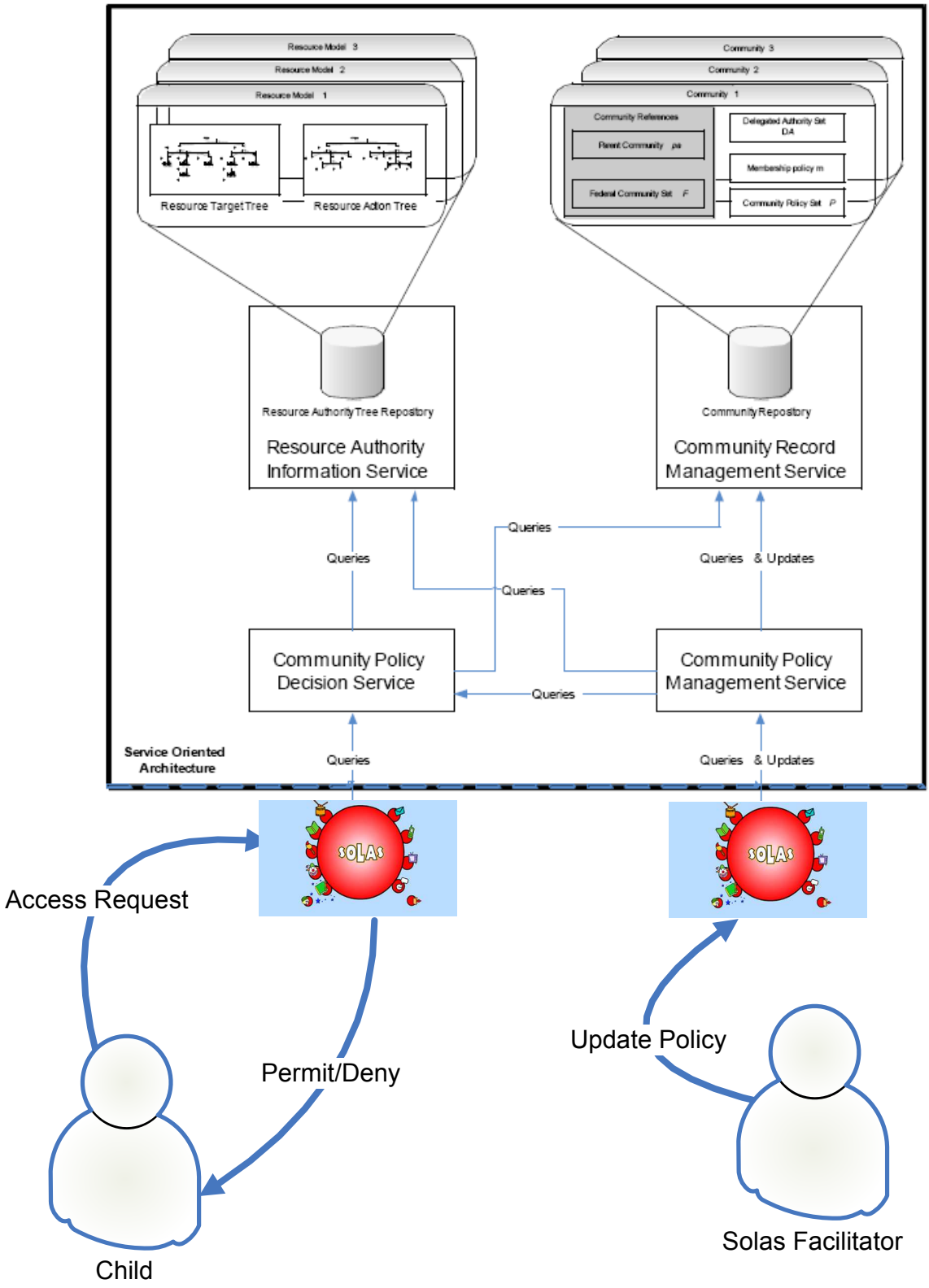

Figure 27 - CBPMS Service Interaction

6.3 Setting up the Solas Community Hierarchy in CBPMS

The CBPMS used is currently hosted on the following Trinity college server http://chewy.cs.tcd.ie/cpms/test.php.

By navigating to the Test suite link the user is presented with individual links to the four services highlighted in figure 28:

Figure 28 - CBPMS Services

In Chapter five the steps required to model the Solas organisation in CBPMS were presented and the design concepts discussed. In this section the five steps are once again presented with a description of the service and functions used to implement each step.

Step 1:Identify and model the hierarchical tree of Solas communities.

The CRMS has a number of functions designed to model the hierarchical structure of the organisation. Note not all functions of the CBPMS were necessary for the scope of this project so they will not be discussed. The following is a description of the functions used to model the Solas organisation in figure 18.

- The Genesis function was called to create a new root Community, i.e. 'Solas Root Community'. This function creates a parent community with unique node ID.
- The 'Spawn' function was called to create a sub community of the parent Community, i.e. 'Hospital A' and 'Hospital B'. The function was then invoked multiple times to spawn the children communities to create the Solas community hierarchy as in figure 18. Each child is created with a

unique ID. A list of all the node I.D's generated can be found in Appendix B.

Step 2:Setting up the Solas Resource model

A resource authority model is defined for each of the resources to which policy based management will be applied. The Solas resource tree has three nodes, one for email, SMS and internet as per figure 19. The RAIS service contains the 'Add Resource' function which was used to create the Solas resource. The Solas resource URI created is http://chewy.cs.tcd.ie/cpms/rais.php#solas.xml.

Step 3:Resource Authority

The 'Grant' function was used to grant the Solas Root community authority to the Solas resource.

Step 4:Delegating the Solas resource

The authority possessed by each of the Solas communities with respect to the resources managed by the entire organisation needed to be specified. The 'Delegate' function made this possible. In essence the root community (the community with ultimate authority) delegated authority to its children, and subsequently these children further delegated the Solas resource down the hierarchical tree. It was decided to give every community all the authority for the Solas resource (to make things simple) and use different policies in different communities to set the access rules, see 6.2.1.

Step 5: Setting the Solas community Membership rules

The Gatekeeper function in the CRMS was used to assign membership rules to each of the communities according to the membership rules defined in the design processes in Table 4.

Each time the gatekeeper is called the user must specify the ID of the community to which the rules are being applied, the policy language being used and the policy specification, i.e. the community membership rule. The policy language used is 'ac' which is variant of C-TRBAC.

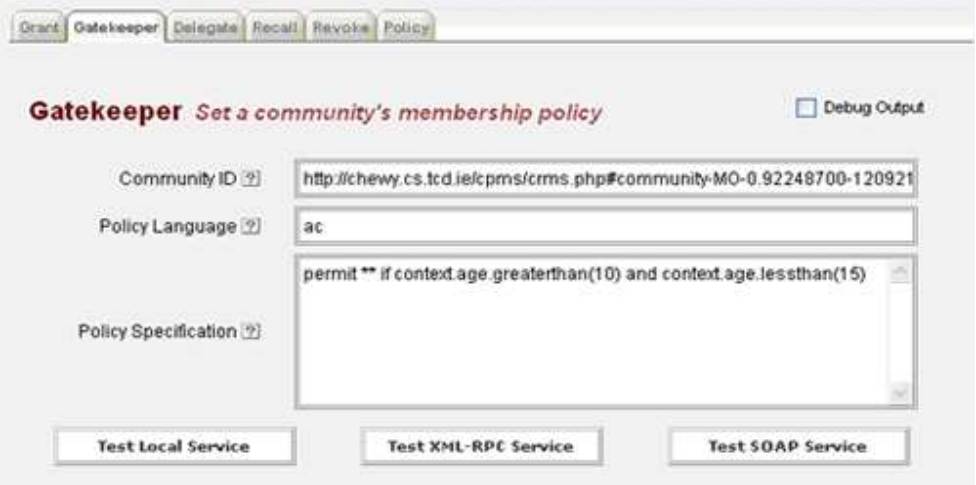

Figure 29 - Setting a Community's Membership Rule

The example in Figure 29 denotes the membership rule for the node in the hierarchy http://chewy.cs.tcd.ie/cpms/crms.php#community-MO-0.92248700-1209214424.xml. The rule states that a child must be aged over 10 and less than 15 to be a member of this community.

6.3.1 Setting the Solas Community Policy Set

A community policy set was defined for each community which mapped the authority possessed by the community to authority that the individual members of the community may exercise on behalf of the community. The 'Policy' function was called in the CRMS to set the policies for each of the communities defined in Table 4. As can be seen in Figure 30, the community ID is specified, along with the policy scope (the resource that the policy is applying to), the policy language and the policy itself. This example is referring to the 'Hospital A' policy whereby all actions are permitted if the 'approval' context is set.

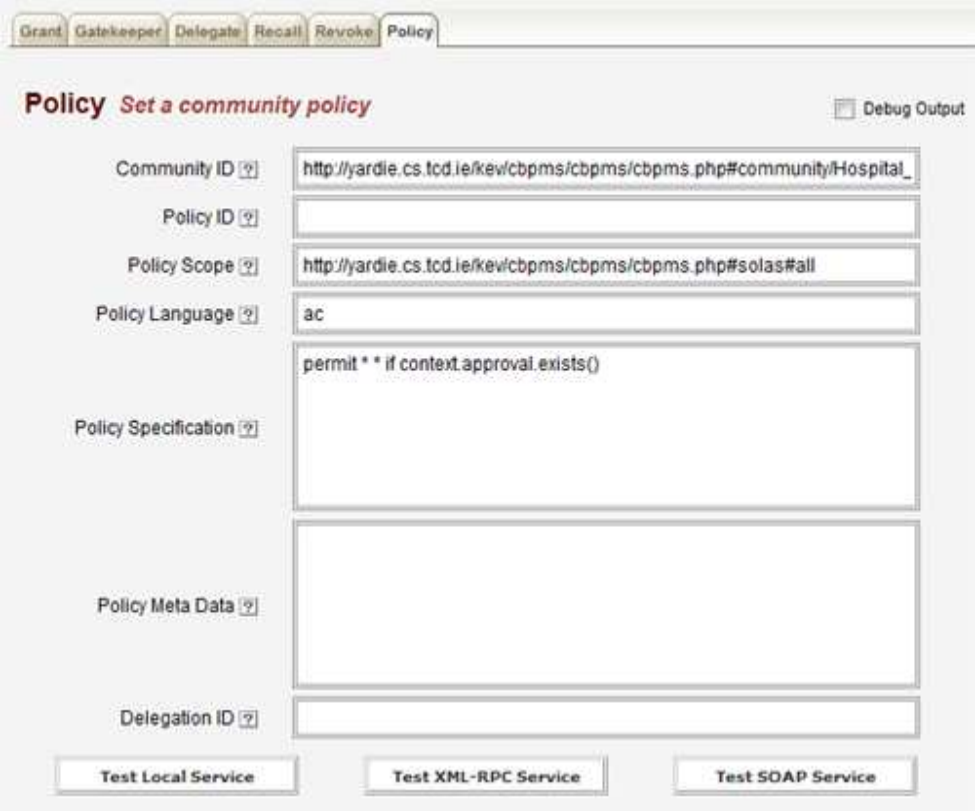

Figure 30 - Setting Community Policies

6.4 Configuration Summary

Figure 31 shows the process flow summary of how the services were used to configure the CBPMS to model Solas. As can be seen from the diagram the majority of the configuration was carried out in the CRMS and RAIS, with the CPDS and CPMS used to test the configuration.

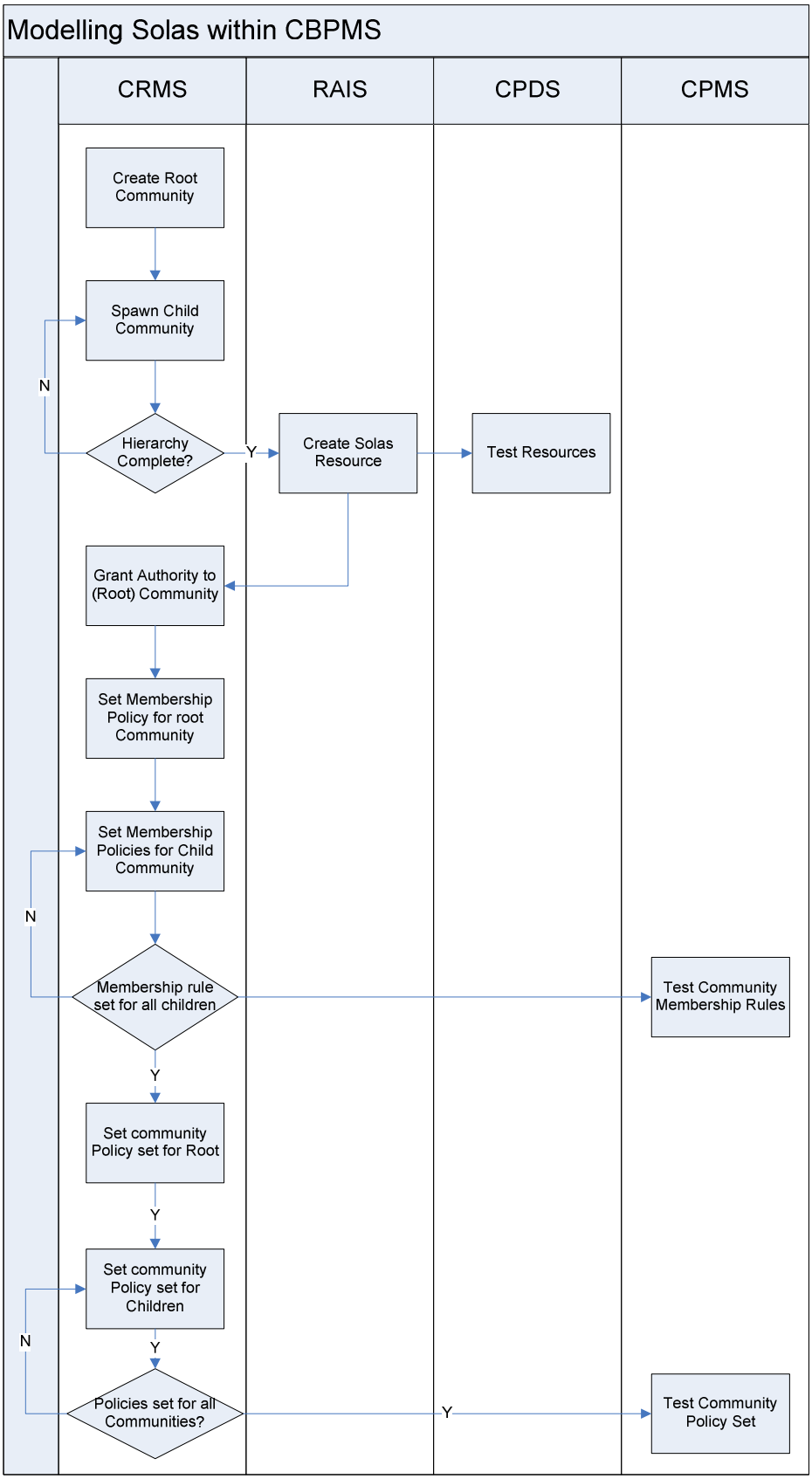

Figure 31 - Process flow of CBPMS Service Configuration and Testing

The full listing of all communities generated, the URI, Title and description can be found in Appendix B.

6.5 Changing Solas User Interface

This section describes the changes that were made to the Solas interface to implement the requirements as per the design.

6.5.1 Modifications to Existing Pages

Two changes were made to the Solas administrator login page (index.jsp) in figure 18, as described: Two new buttons were added, one called ' Manage Users' to allow the user to change community membership and the other called 'Policy Management' which, when clicked, allows the user to view and modify the hospital policies for Internet, Email and SMS.

An additional drop down box was added to the Registration page (registration.jsp), below. This drop down box entitled 'community' allows the facilitator/administrator to assign the user to a community upon login. The options for this drop down are 'Under 10', '11<15', '16+', 'Special Needs', 'Family and Friends', 'Care Staff'. A database field was added to save the community details for the user to the 'users' table.

Website Management

There already exists a page within Solas to manage websites (AddNewWebsite.jsp) for viewing by the children. In order to lessen the changes required this screen was kept, however instead of entering the age permitted to view the site a 'community' field was added to allow the facilitator to specify which community is currently allowed to view the site. Figure 34 shows the new website management page.

Figure 32 - New Website Management Page

6.5.1.1 Additional Pages Added to the Solas environment

A new folder called 'Policy Management' was created in the Java project. Within this new folder two new .jsp files were created – one for the policy screen (policies.jsp) and one for the user maintenance (usermngmnt.jsp) screen described below.

Policy Management

Once the facilitator has logged in and selected the 'Manage policies option' from the administration menu this will take the facilitator to the policies for each community as per screen shot in figure 35 where the facilitator can update the existing hospital policies in relation to internet, email and SMS for each community.

Figure 33 - Manage Policies Screen

User Management

The intention of the user management screen is to allow the user to change a child's community membership. This will be used in two instances, i.e.

- When supervision is possible so user access can be changed from the users' age-group community to the supervised community giving them greater levels of access. Similarly this page should be used when it supervision is being revoked so a user can be reconfigured back to their age-group access rights.
- When a facilitator considers it necessary to change a user from their age-group community to the 'Special Needs' community thereby lessening their access privileges.

Figure 34 displays the new User Management screen.

Figure 34 - User Management Screen

6.6 Modifying Solas source code

Solas is programmed in the Java programming language. To recognise the new functionality of the CBPMS it was first necessary to import two libraries into the Solas project, namely:

- Java CBPMS client library
- XML RPC Library

6.6.1 Additions to the Solas source code – Recognising the CBPMS

In order for the current version of Solas to utilise the CBPMS, which was configured to represent the Solas organisation and resources in section 6.2, it was necessary to give Solas visibility of the CBPMS and its configuration. This was done by adding the following code in Table 6 to the existing Solas java project in Table 6:

Step	Code inserted
1. Set the community IDs	String rootCommunity = "http://chewy.cs.tcd.ie/cpms/crms.php#community-AT-0.33650300-1205927809.xml"; Note: This step was carried out for all communities
2. Set the proxy URI	String CBPMS_URI = "http://chewy.cs.tcd.ie/cpms/solas.php";
3. Set the Solas Resource	String solasResource = "http://chewy.cs.tcd.ie/cpms/rais.php#solas.xml";
4. Create the policy decision client	Client policy_client = new Client(CBPMS_URI);

5. Set the various relevant context variables	pc.setValue("community", rootCommunity);
	pc.setValue("resource", solasResource);
	pc.setValue("target", "*");
	pc.setValue("action", "all");

6. Set the community membership for each user	pc.setValue("groups", "users, under 10, ...") This step was carried out for all communities

Table 7 - Steps to Modify Solas Source Code

6.6.2 Controlling access to a resource via CBPMS

In the current version of Solas when a child attempts to access a resource, Solas checks whether the user is permitted access based on the set permissions of their role. If the role is not permitted access to the resource, the user will not be either. Once the code modifications in Table 6 were made to the Solas java project it was necessary substitute the access control points within the current code with a call to the policy decision client providing the relevant context variables. The purpose of this action was to ensure that when a child attempts to access a resource instead of the role based access to the resource, the policy decision client is called along with the user's community membership and relevant contextual information to ascertain whether they should have access to the resource (Email, SMS, websites).

6.6.3 Code changes required to Manage Policies

As policy management is a user process that did not exist with the current version of Solas, additional functions needed to be written to make this a possibility within the

system. The following functions were created and added to the source code to make the maintenance of policies possible for the Solas Facilitator.

Function description	Function Code

Set a policy rule for a particular resource	if(policy_client.setPolicy(rootCommunity, "email", "p1"))
	{
	System.out.println("set new policy OK!");
	}
	else
	{
	System.out.println("failed to set new policy!");

Call the Decision Method	PolicyDecision pd = policy_client.decision(pc);
Print the Decision Result	System.out.print("Policy Decision Returned: [" + pd.getDecision() + "] : " + pd.getMessage() + "\n" + pc.getAsXML() + "\n");
Retrieve a policy from a community	policy_client.getPolicy(rootCommunity, "email");
Print a policy from a community	String pol = pol System.out.println("The policy rule for email is: " + pol);

Table 8 - Functions Required to Support CBPMS integration

6.7 Implementation Testing

Once the systems were integrated it was necessary to conduct a level of testing to ensure that the single system met the requirements as described in section 3.3. There are a number of types of software testing, categorized by what is being tested and the purpose, or objective, of the test (Hambling et. Al 2006). Based on the objective of the research and the timescale for the implementation, the following levels of testing were carried out:

Usability testing – To ensure the system was usable for both the Facilitator and the Child users.

Functionality *testing* – To ensure the system offered the required level of functionality to satisfy the user requirements.

Numerous testing scenarios were created and followed to ensure the system passed the level of testing required. These test scenarios are detailed in Appendix C including expected and actual results.

Chapter Summary

The purpose of the chapter was to implement the technical design described in previous chapter. The first step of the implementation looked to model the Solas community structure and its policies in CBPMS. The CBPMS architecture was explained and the process describing the role each of the services played in the configuration was described. Once the CBPMS was configured to represent Solas community and its resources, its goals and researched policies, it was then necessary to change the Solas User Interface to reflect the CBPMS functionality introduced for the Solas Facilitator. Finally it was necessary to modify the Solas source code so that requests for access to the resources are validated through the CBPMS. Usability and functionality testing were then performed on the integrated system. The next chapter looks at the evaluation of Solas now that it has been integrated with CBPMS.

7.0 CHAPTER SEVEN– EVALUATION

Chapter Overview

This report endeavoured to assess the current access control issues within the Solas online community, and examine the feasibility of integrating Solas with a CBPM system to resolve the issues which hamper Solas optimal usage and expansion. The development of the design of CBPM model and the integration with Solas has been described in detail in chapter 5, while the implementation has been described in chapter 6. It remains, however, to be seen whether this CBPMS can be easily integrated into the Solas environment to deliver a practical capability. This chapter sets out to validate the basic goals of this thesis, defined in chapter 1, by following the ITPOSMO model. It goes on to detail initiatives which could be undertaken to lessen the impact of risks on the success of the project.

7.1 Outcomes realised by integrating Solas and CBPMS

In his book the Information Paradox, Thorpe uses the CRIME methodology for classifying the potential outcomes for the implementation of an IT system. System outcomes are classified under 5 headings, i.e. Created, Reduced, Increased, Maintained, Eliminated. The outcomes realised by integrating Solas and CBPMS are described in Table 8:

Created	Reduced	Increased	Maintained	Eliminated
• Ability to model policies for several hospitals • Ability to change access to resources when policy changes • Ability to model policies for children with special needs • Ability to model supervised and unsupervised scenarios • Ability to safely cater for the interests of different age groups		• Efficiency in managing users • Potential offerings to children (due to ability to model supervised and non-supervised environments • Management uptake of system • Children's safety using Solas • Compliance to best practice	• Existing Service offerings to children • Children's interaction with the system	• The necessity for user roles • Risk in breech of policy violation • Time taken to update individual laptops with children's preference • Time taken to clear individual laptops of material not suitable for the 'next' user

Table 9 - Classification of System Outcomes

7.2 Choosing an Evaluation Strategy

Once the outcomes have been identified what is then required is a system to evaluate these outcomes to ascertain and quantify their benefits in a live implementation. Two methodologies were considered for evaluation, namely the ITPOSMO method developed by Heeks, Mundy and Salazars and the IS Success model proposed by DeLone and McLean in 1992 (cited in DeLone and McLean, 2003).

Firstly the IS Success model was considered. DeLone and McLean put information as the output of an information system or the message in a communication system and noted that it can be measured at different levels. These levels include the 'technical

level', the 'semantic level', and the 'effectiveness level' that is based on the communications research of Shannon and Weaver (1949):

- Technical level of communications as the accuracy and efficiency of the communication system that produces information.
- The semantic level is the success of the information in conveying the intended meaning.
- The effectiveness level is the effect of the information on the receiver (DeLone and McLean 2003, p.3).

This method has been heavily critised by some (Seddon, 1999) claiming the IS Success Model, neglects to refer to other categories, dependant variables or factors that determine IS success. Boon's 2003 work analyses DeLone and McLean's IS Success Model, and concludes that it has merits for testing IS Success, however the model does not completely explain the complexity of information systems.

The preferred method chosen to evaluate the Solas and CBPMS integration is the ITPOSMO method. Heeks, Mundy and Salazars (1999) describe why healthcare systems succeed or fail. They have developed a model, known as 'ITPOSMO' which describes a conception to reality gap which is often the cause of failure for systems. The basis for their argument is that the larger the gap between the current realities and design conceptions of a new healthcare information system (HCIS) the greater the risk of failure. This model is known as the 'ITPOSMO' model because of its seven dimensions:

- Information
- Technology
- Processes
- Objectives and Values
- Staffing and Skills
- Management and Structures
- Other resources: money and time

This model has been chosen to evaluate the integration of CBPMS with Solas for the following reasons.

1. Conception-reality gap assessment is a simple but effective management tool for those involved in the development of information systems.

2. ITPOSMO model has the value to examine 'why' introducing an information system project in similar organizational settings results in a varied degree of change. This is particularly advantageous as Solas and CBPMS integration can be independently evaluated using this methodology in different hospitals.
3. The model has the capacity to assess the implementation stages of the Solas and CBPMS integration. Therefore, it represents a more holistic framework for research. A knowledge base drawn on ITPOSMO dimensions can also allow the opportunity to share and communicate the reasons of success and failure of different Solas and CBPMS implementations at different hospitals systematically.
4. The model recognized that 'social and organizational factors' are not just question of relatively objective realities, but also of relatively subjective perceptions and values.

Although this project has identified some potential health benefits by using Solas (Section 3.2.1), the system could not be wholly described as a strict healthcare system which is defined as a system used to effectively and reliably store and analyse data relating to the health of a population (http://www.acdi-cida.gc.ca/). Nonetheless many of the key points and arguments regarding system success made by Heeks et al. hold true to smaller multi-disciplinary endeavours, such as this project.

From studying several successes and failures of large scale Healthcare Information Systems they observe that "a successful HCIS will be one that tends to match its environment in relation to technical, social and organisational factors; the latter including the perceptions of key stakeholders". They feel that reducing the size of the organisational change that needs to take place for the implementation of a HCIS increases the chances of its success. This project has endeavoured to minimise the impact by keeping the look, feel and functionality of Solas and CBPMS integration as close as possible to the existing version of Solas.

7.2.1 Information

Child user

Once the system is operational there is no change to the functionality from the main user's perspective, i.e. the child. This in turn means there is no additional information required to use the system and the child should have no visibility of any interaction

with the CBPMS. From this point of view, the conception-reality gap is therefore quite small and would suggest a positive chance of system uptake.

Facilitator

Facilitators, however, will be required to deal with minimal new information, i.e. the categorisation of new users according to age and ability, handling supervison and special needs, and keeping the hospital policies up-to-date. In reality hospital polices are not likely to change very often, however, this additional information maintenance could suggest a moderate conception-reality gap and therefore a threat to the success of the project. It is this author's belief, however, that additional time required to maintain the policy information could replace time currently spent individually updating laptops with children's preferences. This can be achieved more efficiently system wide. A system trial could ascertain how much of a time saving this could amount to.

Administrator

From the administrators point of view inputs to the CBPMS would be required every time a new hospital joins the Solas community or there is a legislative change which may require a reconfiguration of the community structure. For this the administrator would require an in-depth knowledge of the CBPMS and the system configuration that would be required for each of its four services. In a world where technology moves at a faster pace than legislation it is difficult to ascertain how often this would be a requirement. Nonetheless this is an administrative input that doesn't currently exist and therefore should be perceived as a possible threat to the success of the project. It is the author's opinion that consideration will need to be given as to how the administrative staff will receive the new policy information and it will need to be established whether this is part of the administrator's responsibility or an additional role needs to be created.

7.2.2 Technology

Solas is currently hosted on a server in TCD. For a live implementation a server would be required to host the CBPMS, however this could be hosted on the same machine as long as there is sufficient processing power to deal with the rule processing. Extra capacity would need to be added should the number of policy rules significantly increase. The number of rules recommended as part of this report does not require an additional server nor any additional processing power. If the solution is to be rolled out to other hospitals a scoping exercise should be carried out to ascertain if more

processing power is required to accommodate the new community configuration and rules.

The author recommends the following further tests to be carried out:

- *Compatibility testing* – To ensure Solas and CBPMS integration is compatible with the hardware, operating systems, and other software packages that it will be working with.
- *Performance testing* - Performance testing determines how well the CBPMS performs in terms of the speed of computations and responsiveness to the user. The author experienced no delays in accessing resources or pages that were introduced to the program environment, however, this could be an issue if the number of rules per hospital were increased or the community structure became complex.
- *Scalability testing* - to ensure that the software will function well as the number of users, size of data sets, or other factors change from small to large values. This is particularly important if the number of hospital's configured in the CBPMS were to grow. This project was tested against two hospitals, however it would need to be verified in a large scale environment.

7.2.3 Processes

Machieavelli probably hit the nail on the head when he said:

It must be considered that there is nothing more difficult to carry out, nor more doubtful of success, nor even more dangerous to handle, than to initiate a new order of things.

The processes that the system requires, for the most part already exist within the current version of Solas. From the principal user point of view, i.e. the child, they will have no visibility that their requests to access a resource will go via the CBPMS. The processes currently carried out by the Facilitator will have minor changes in terms of the additional information that is stored about each of the users (i.e. Age, Hospital, Community) but the input steps and order of this data entry will remain the same. The policy maintenance and supervision processes do not exist so will need to be clearly defined, and documented, to ensure they are used appropriately and as required. For the administrator new Solas administration processes will also need to be defined for the addition of a new hospital in terms of community structure and policy creation and maintenance. As already pointed out the infrequency of the use of

the administrative processes could be considered a concern if documentation is not created and easily accessible for CBPMS maintenance.

7.2.4 Objectives and Values

The motivation for this work was driven by the need to resolve the access issues currently experienced by the Solas developers. The requirements of this work were to design an integrated system which could:

1. Continue to appeal to children of a variety of ages, maturity and skill levels in line with legislation and best practice.
2. Implement CBPMS access to resources instead of kiosk mode.
3. Extend functionality if in a supervised environment. Provide restricted access when children not supervised (as will be the case in the majority of instances)
4. Represent both supervised and non-supervised access rights for the users.
5. Be setup to represent multiple hospitals with potentially differing policies.
6. Handle children whose biological, emotional or maturity level may fall outside the 'norm'.
7. Support home access.
8. Handle evolving policies.

The lack of such functionality with the existing version of Solas was seen as a threat to the expansion and future uptake of the system by other hospitals. All the requirements were met in this project, except for requirement regarding home access for Solas which will be discussed under future enhancements for Solas in Chapter 8. The project has demonstrated that by integrating Solas with CBPMS it is possible to represent multiple and unique hospital policies in a simple and effective manner. The CBPMS can be easily modified to reflect updated policies either through a change in legislation or hospital demand. The ease at which the administrators can maintain the policies could be seen as a very strong indication of the success for live implementation of the project.

7.2.5 Staffing and Skills

The following section describes the staffing and skill level required to support Solas and CBPMS.

7.2.5.1 Staff

No additional roles are required to support a CBPMS integration with Solas. Consideration should be given as to who's responsibility it should be to keep the policy information up-to-date, this could be an existing role or a role could be created explicitly for this purpose. If the system is to be rolled out to multiple hospitals inevitably more Facilitators would be required to support this system, however this requirement for local onsite user support would be required with or without CBPMS integration. As the Administrator role in the system maintenance is on an adhoc basis no additional administrative resources are envisaged for single or multi-site deployment.

7.2.5.2 Skills

Child user

No additional skills are required from the child using Solas.

Facilitators

If Solas integrated with CBPMS is to be used at additional sites all facilitators will require basic computer competency. Facilitators would need to be trained on the fundamentals of CBPM community hierarchy and the requirement for basic policy management. With the creation of a simple user interface from Solas to the CBPMS the necessity for the exposure to the CBPMS, as demonstrated, is avoided.

Administrator/Developer

The intricacies of the CBPMS will need to be mastered by the administrator, however, as they will be the resource responsible for the configuration and maintenance of the system. It is the opinion of the author that the CBPMS is difficult to use without a computer science background as it uses an XML command-based interface. At the time of writing of this report the CBPMS was being revamped with a more intuitive user interface of its own. This, unfortunately, was not ready for use for this project however could be used going forward to simplify the tasks and skill levels required to operate the system.

7.2.5.3 Facilitator Usability

In order to ascertain the usability of the Solas system post integration with the CBPMS the current Solas facilitator was chosen as an excellent candidate to critique the

system due to their knowledge of the current Solas system and their understandings of the access issues to date. The underlying principles of the project, the methodology used and objectives were explained. They were then taken through the integrated system and its new functionality and asked to give their opinion on the integration. The questions asked and answers received are documented below.

How do you find registration of a user in Solas post integration with CBPMS?

"The registration of a user post implementation is quite straightforward and very simple as it would mean I simply need to select a community for the user in addition to the other fields like personal details and age. It is not complicated and is only a small addition to the way I register a user at the moment anyway"

How do you find the managing of websites within Solas post integration with CBPMS?

"The management of websites is also simple as the process is in line with the current Solas practice of websites being allocated to age groups instead of all users".

Do you feel the system adequately caters for children with special needs?

"Yes, the current community structure caters for children with special needs but probably not each and every scenario so after a trial period of the current setup perhaps a revised sub-categorisation of communities for children with special needs could take place. At times I overrule age-related guidelines and permit access to sites for a younger age group than that suggested by the site creators (e.g. Bebo, though with full parental permission). The community hierarchy suggested here doesn't support this."

How do you find the maintenance of policies within the Solas system?

"The maintenance of policies is straightforward and it seems very easy to change the policies across the age groups in a single step from a single page in the site. I don't think this is a screen I will need to visit very often, once we set the policies and we are happy they are working ok. The special needs community may change as new special cases arise but time will tell how much this would be required and in what level of detail".

Do you think the introduction of supervision is useful? Do you think it is simple to create a switch a user from a supervised to a non-supervised environment?

"Supervision on the ward isn't possible at the moment. If Solas is merged with Ait Eile then this could become a definite possibility. I think it is very straightforward changing between the supervised and non supervised environments so it shouldn't make it difficult to manage even if it was something we were using quite often. We would need to ensure, however, that the children are returned to the unsupervised scenario once the period of supervision ends. Perhaps this could be after a certain amount of time….they are automatically returned to their age group community or an explicit command by the supervisor. Either way a policy and process would need to be created to support this capability".

Do you feel the introduction of policy management within Solas will make the role of the Solas facilitator easier to carry out?

"Although managing Solas through Site Kiosk is time consuming, it is presently manageable as the number of Solas users on the hospital ward is currently quite small (approx 3 - 5). Since the initial discussions collating the requirements for this research, discussions have taken place to involve another ward (in the same hospital), offering the same functionality to the children. This inclusion would see the population of Solas users at least double. I believe this could potentially lead to a greater need for the integrated Solas and CBPMS solution".

Do you have any recommendations for the use of Solas post integration with CBPMS?

"I feel believe that extending the number of resources covered by the CBPMS could be very beneficial. For example, the online 'chat' feature is currently seldom used to its potential owing to the current small population and the differing levels of wellness experienced by the users. Also, children are most likely to chat with their peers and currently age is not indicated on the pop-up chat screen. An alternative to this would be to display a community icon after each child.

If the number of hospitals involved were to increase, then the community hierarchical structure may need to be modified to create a 'super' community of Solas Facilitators. The purpose of this would be to support the Facilitators at each hospital as going forward it is envisaged that the role of the Facilitator will likely be performed by less technical staff, like a nurse or a play therapist who may require technical assistance, particularly when handling exceptions or children with special needs".

Comments on Facilitator Feedback

Overall the response from the Facilitator is both positive and encouraging for the future development of the system.

Regarding the Special needs and allocation of certain sites to children who are not legally old enough to access to these sites, a judgement call will need to be made as to whether this setup is permitted. The hierarchical community structure and policies set as part of this research do not permit such access, however it is possible to permit this if a community is created whose policy set reflects this. The author does not recommend this practice when there are clearly defined age limits on certain sites which should be respected.

The recommendation from the facilitator that there should be a 'super' facilitator is particularly welcome. This would lead to a revised community hierarchy as per Figure 35.

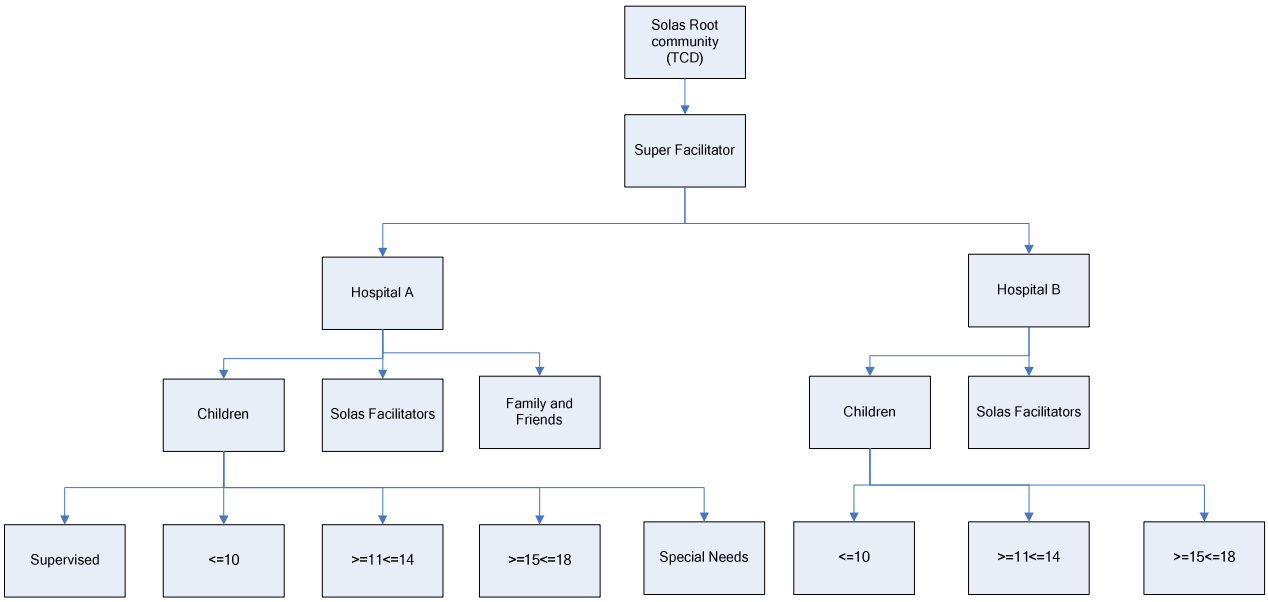

Figure 35 - Revised Solas Community Hierarchy

This configuration suggests that, with the future vision of Solas, there may be a 3rd role which had not previously been considered. Going forward if some/all of the future Solas Facilitators are not technically competent perhaps it would be worth assigning the policy management responsibility of the facilitator role to the 'super' facilitator therefore leaving the user maintenance and supervision control to the facilitator who will be more 'hands on'. Should the facilitator require technical assistance with the functionality they can turn to the super facilitator. It is clear that more discussion needs to take place before this reconfiguration is agreed. It is hoped that this research

has demonstrated the adaptability of the CBPMS to the introduction of new roles and responsibilities.

7.2.6 Management and Structures

'It's a problem at the minute. I can't see it being a problem forever, it's just for us to sit down and get an idea of policies and procedures and what we're going to do…' (Clinical Nurse Manager)

This was a statement made during the original Solas Needs Assessment. It was made in relation to internet access, expressing the observation that policies and procedures need to be established to handle Solas users' internet access. Whilst installing Solas in kiosk mode goes someway towards resource management, this method has proved cumbersome and inefficient. As shown in this research the CBPMS gives a flexible way to configure Solas with a researched set of policies. Hospitals will be free to configure their users' access to Solas to keep in line with their own policies, procedures and IT resources. It is this author's opinion that the addition of the CBPMS to Solas will be strongly welcomed by management indicating a greater possibility of system uptake to date.

7.2.7 Other resources:Money and Time

The system was designed as part of a research project. The costs involved were negligible as it was designed on already existing platforms. Therefore there were no drawbacks in terms of time and financing, leaving a small conception-reality gap. However if the system were to be adopted as a functional model for Solas going forward it would require a computer programmer to adapt, extend and launch it, which would require more hardware and investment of time and money. A programmer is already assigned to the Solas project, however, so there is no additional programming resource required.

7.3 Roadmap to Solas success

As discussed, although there is a wealth of evidence to suggest the integration of CBPMS and Solas is likely to be a success, the ITPOSMO method for system evaluation has revealed several potential stumbling blocks to the implementation of Solas and CBPMS integration in a live environment. It is this author's opinion that few, if any, of these are 'show-stoppers', however they should not be dismissed as to do so would counteract any potential benefits realised.

According to Thorpe (2003) Business Change Management Programme is an essential element in the realisation of benefits from IT enabled change. Without a planned and conscious programme of Business Change to accompany a technology roll out, people will not change. Or, change will be slow and partial. The potential from new IT capabilities will not be taken up, old habits will re-assert themselves, organisational inertia will triumph and investment will be wasted. In short, there is a wealth of evidence to suggest that benefits do not arise from the implementation of technology but from the changes that it enables (Thorpe, 2003). Applying this concept to Solas and CBPMS means that the real benefits will only start to flow when the work practices of those involved in its operation and support are transformed.

Thorpe describes Benefits Realisation (BR) as a management process which helps ensure that the 'business' (in this case the hospital) achieves the benefits that arise from the introduction of changes – usually new process, systems or technology. The BR process seeks to define and understand all aspects of the project, from the strategic objectives, through the outcomes expected, how these will be measured, and the business, organisational and IT changes required to create the whole programme.

A key component of the Benefits Realisation process is the formulation of a ResultsChain™. The ResultsChain™ network shows a pictorial view of a project. It is created by identifying the required outcomes and all the initiatives required to support or contribute to these in some way. As such it provides an easy to understand, pictorial view of the programme as a whole.

The final *outcomes* are the benefits that will be delivered from the programme, while intermediate outcomes are points at which progress towards the final goal can be measured.

Initiatives are intended to focus on identifying the business changes that are required to be implemented in order to fully utilise the capability delivered by the programme.

Assumptions surrounding changes or outcomes are also captured. Documenting them in this way draws attention to them and they can be challenged early in the programme, and if necessary risk mitigation strategies can be implemented to manage them.

Following the ResultsChain™ methodology, figure 37 maps the outcomes already identified in Table 8 highlighting the supporting initiatives and assumptions required to realise the ultimate outcomes. Ignoring the supporting initiatives will prevent maximum system uptake.

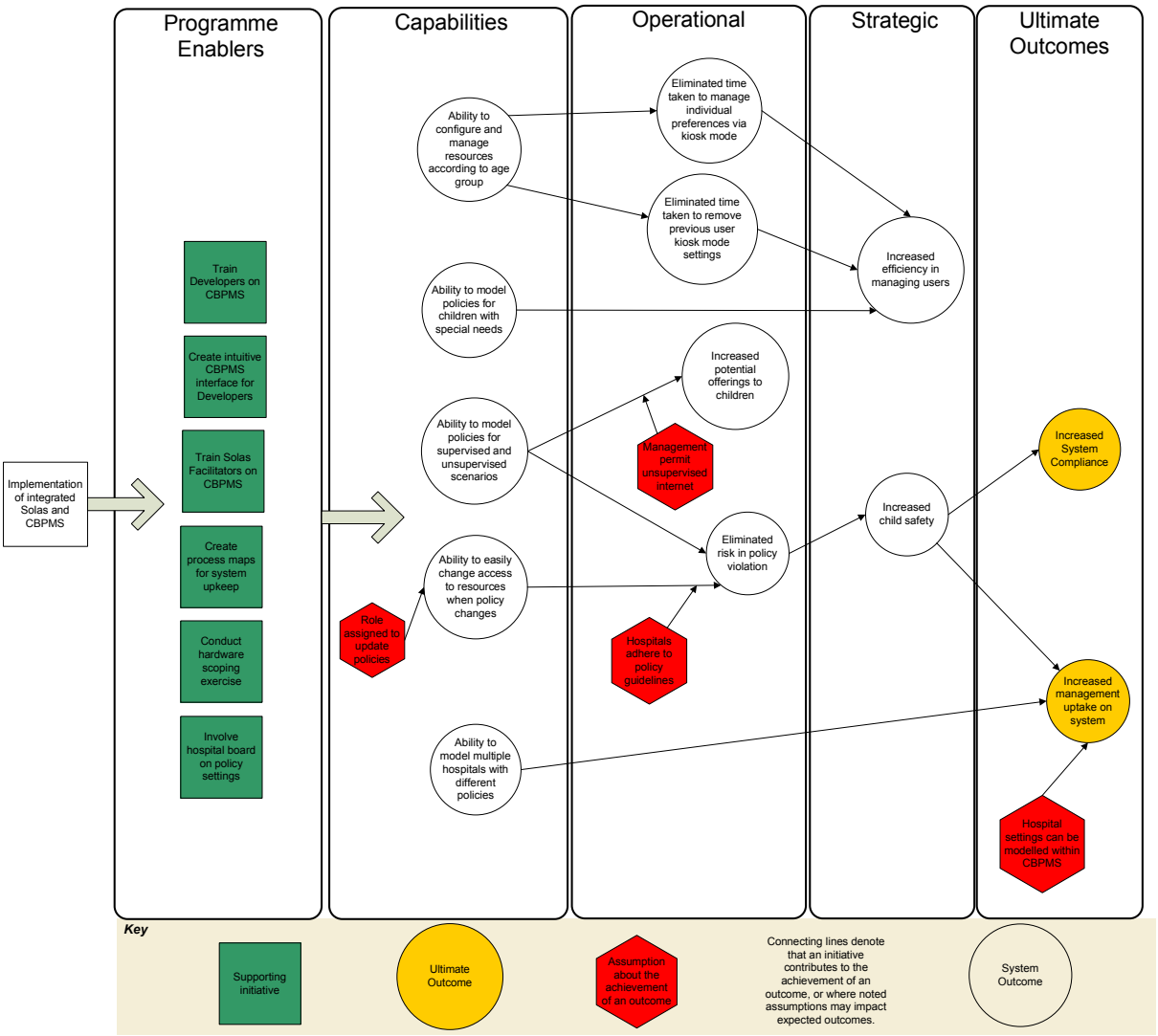

Figure 36 - Solas and CBPMS Results Chain

As can be seen in Figure 37 the following supporting initiatives are recommended for Solas and CBPMS integration:

- Train Developers on CBPMS
- Train Solas Facilitators on relevant CBPMS fundamentals (user maintenance, policy management)
- Create CBPMS interface for administrators
- Create Process Maps for CBPMS upkeep
- Conduct hardware scoping exercise for maximum performance
- Involve hospital board in policy settings

Once a ResultsChain™ is created, Thorpe goes on to recommend the creation of a benefits realisation plan which should have the following elements:

- A definition of the structure and roles that will be required in order to manage benefit delivery.
- A specification of the monitoring and reporting process to be applied
- A full description of the required benefits, which will include:
    - A definition of how each benefit will be measured
    - A statement of the target and current position of the item to be measured
    - Identification of who is accountable for benefits achievement
    - A method for measuring and assessing the level of benefit achievements
    - A schedule of when benefits will be achieved (benefits stream)
    - An analysis of the assumptions and risks associated with achieving the benefits

In addition to the ResultsChain™ measure suggested above the author also suggests creating a Solas Acceptable Use Policy as suggested by the literature research in Chapter, which should be clearly visible to all users on the website. It is important that the AUP should adhere to the recommendations set out in the Byron review and that it should promote positive use of technology, rather than just spelling out a list of 'don'ts'. This could potentially be different for each hospital depending on their individual policies. The AUP for each hospital should be maintained in accordance with legislation and the expressed wishes of the hospital.

Chapter Summary

The CRIME method for classifying outcomes of system implementation was applied to the Solas/CBPMS integration. The ITPOSMO model for system evaluation was then applied to these outcomes. It can be concluded that the Solas and CBPMS integrated system has a relatively high chance of success for the following reasons:

1. The site content will be more appealing and relevant to the specific age group of the child

2. The system can model supervised and unsupervised environments which the current system cannot, which may, if desired, provide extended functionality to the users.
3. The system will be compliant in terms of best practice recommendations.
4. The system can model a variety of hospital with different policies regarding children's access rights.
5. The system will cater for children with special needs by setting up a community and policies dedicated to them.
6. The process for updating and maintaining policies within Solas is very simple.
7. No change to functionality from main users perspective (i.e. child)
8. Additional input required from Facilitators when registering a user (i.e. child's age, hospital etc) already has an existing process to support this.
9. No additional hardware or software is required to support the CBPMS integration with Solas for single site implementation
10. The integration has been endorsed by the current Solas Facilitator.

Risks or possible reasons why the system may fail include:

1. Administrators need to update the CBPMS every time a hospital joins the Solas network or a change is required to the Solas community structure. This administration does not currently exist and could be perceived as cumbersome from a user point of view.
2. Information should be gathered to ensure policies are maintained within the system. This could prove difficult and time consuming as policies are not currently clearly articulated by government bodies and relevant stakeholders.
3. The CPBMS and its services will need to be mastered by the administrator. Using the CBPMS requires an understanding of all four services. Because of the ad-hoc requirement to modify policies or change the community structure these skills will be difficult to master without regular exposure to the system

4. Potential Hardware requirement (either processing power or additional server) if CBPMS is used to handle multiple hospitals.
5. Training will be required to support the users in the use of the new system. Consideration will need to be given as to who should deliver the training and how this knowledge is transferred going forward.

This chapter concluded with the creation of a ResultsChain as part of the Benefits Realisation roadmap for the successful implementation of Solas and CBPMS integration to counteract the risks identified during the system evaluation. Chapter 8 concludes the research with conclusions and suggestions for future work.

8.0 CHAPTER EIGHT – CONCLUSIONS AND FUTURE WORK

This chapter summarises the findings of this work, compares the results achieved in the previous chapter with the goals of this research, and evaluates to what extent those goals have been reached. It then continues to assess the overall impact of the work, and suggests the major areas in which further research is suggested.

8.1 Project Objectives

The following section describes how the project objectives were met.

8.1.1 Examine the current access control issues within Solas

This objective was achieved by interviewing the Solas Facilitator and Developers and by interpreting the expressed concerns of the system stakeholders which had taken place as part of the system Needs Assessment study. The study concluded that current administrators of the system were reporting difficulties carrying out the following:

- Handling the needs of children of different ages with different interests
- Maximising the Solas offerings in a safe environment without the need for supervision
- Configuring Solas to handle conflicting hospital policies
- Supporting the concerns of parents and carers when handling children with special needs
- Assigning responsibility for policies governing home access for Solas
- Handling evolving Policies

8.1.2 Understand the use and architecture of the CBPMS

In order to achieve this objective CBPMS and traditional role based access were researched and CBPMS was examined in several environments, e.g. the oscaillt online community, physical security management in a ubiquitous computing environment, constitutional modelling, and a Mashup modelling case study.

8.1.3 Collate local and international guidelines pertaining children's use of the internet

This objective was met by reviewing literature from the major stakeholders contributing to children's online safety as recommended by the charity Childnet. These stakeholders included parents, hospitals, N.G.Os, Carers, Government, Schools and children themselves. From the literature a concise set of guidelines were established which were used to steer the design and implementation stages of the project.

Research indicates that open searching can be safely configured within the Solas and CBPMS tool, so, should children want to explore other topics than that which are on offer via the predefined sites, the integration with CBPMS will make this possible but only if supervision is present. If a hospital board is uncomfortable about free searching or cannot offer supervision this can be disabled via the policies set at the community level in the CBPMS.

8.1.4 Implement a version of Solas which has been integrated with CBPMS

This objective was achieved in four steps:

- The CBPMS configuration for Solas was designed based on the findings from the literature review and the requirements gathering exercise.
- Solas structure was modelled in CBPMS
- Solas user interface was modified to incorporate new CBPMS functionality
- Solas source code was modified to allow requests to be processed via the CBPMS

8.1.5 Evaluate if the current access control policies within Solas are eliminated by introduction of CBPMS

By using the ITPSMO method for evaluating systems this objective was met. Following this methodology resulted in Solas being evaluated under seven categories (Information, Technology, Processes, Objectives and Values, Staffing and Skills, Management and Structures) to ascertain its success rate for future implementation. The reasons for possible success were highlighted along with benefits, risks and risk mitigation initiatives in the form of a results chain.

8.2 Future work

This project raises recommendations for Solas and CBPMS implementations and further development ideas on the integration.

8.2.1 Solas and CBPMS further development

This project raises recommendations for Solas and CBPMS implementations and further development ideas on the integration.

- It is envisaged that with further programming work the integration of Solas and CBPMS could be expanded to included all Solas resources and not just those selected for this project (Internet, Email and SMS) thus applying the same principles and levels of control to all features.
- It is the author's opinion that an excellent enhancement to the Solas and CBPMS integration would be to set legislative baseline policies. Although every hospital should be permitted and encouraged to set their own policies in relation to Solas resources, as discussed this should be in accordance with the researched legislative guidelines. Any attempt by the Facilitator or Developer to set a configuration which breeches the baseline policy settings should be flagged to the user (Facilitator/Developer). Having this functionality will prevent accidental misuse of the configuration and therefore avoid potential liability or danger to a child.
- Solas developers could create blacklists of websites preventing children accessing harmful websites. In other words if a child accessed a website that was already classified as dangerous or inappropriate for their age range, Solas could deny access. It would very simple to do this via CBPMS and similar to the white-list of websites for each age group, a blacklist could be created which could vary according to community. This may appease hospitals who are on the one hand anxious about children surfing the internet openly, but on the other hand may wish to offer the children a greater degree of flexibility in their content than that offered by standard screened weblinks.
- An obvious extension to the work carried out for this project would be to extend the graphical interface as suggested as part of this research to include functionality for the Solas developer to create a graphical tool to create and mange the community structure, resources, membership rules, authority and community polices through the Solas application directly and not be required to effectively managed two systems. This use of the system would then be as per figure 38 below:

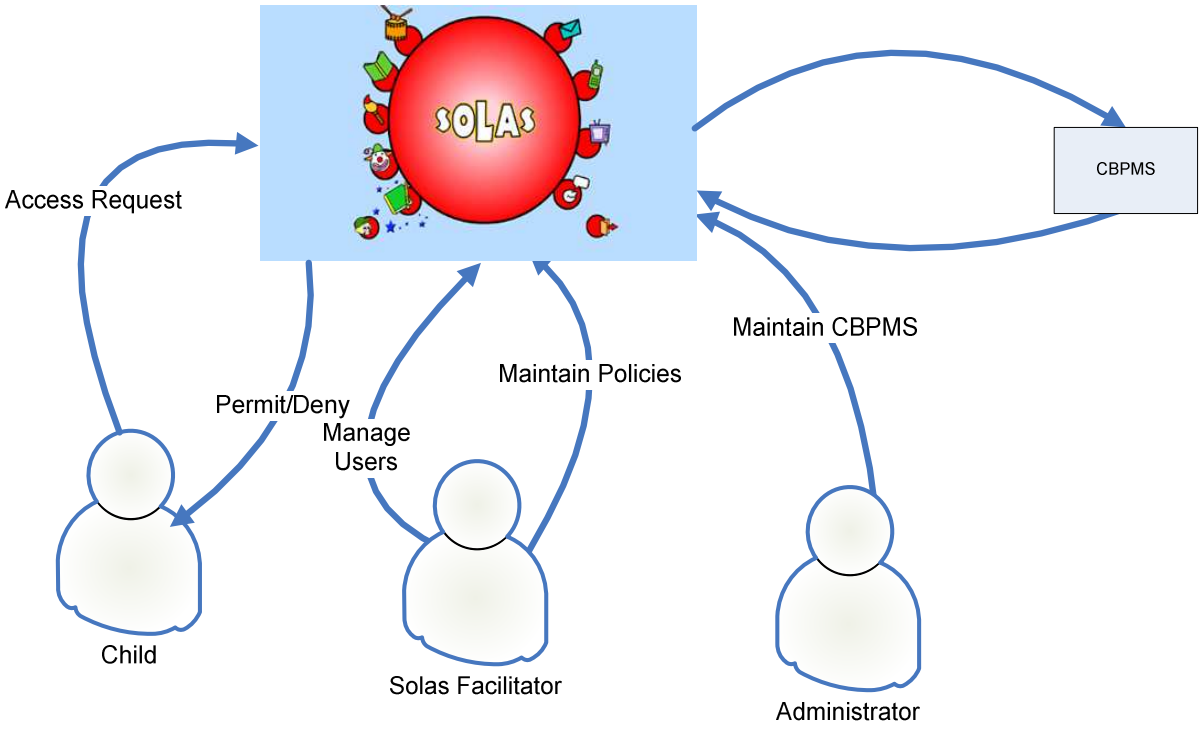

Figure 37 - Future User Interaction with Solas

Suggestions for the interface might look like the following in Figure 39 and 40.

Figure 38 – Graphical Tool to Manage Community Structure and Resources (as cited in Feeney, 2007)

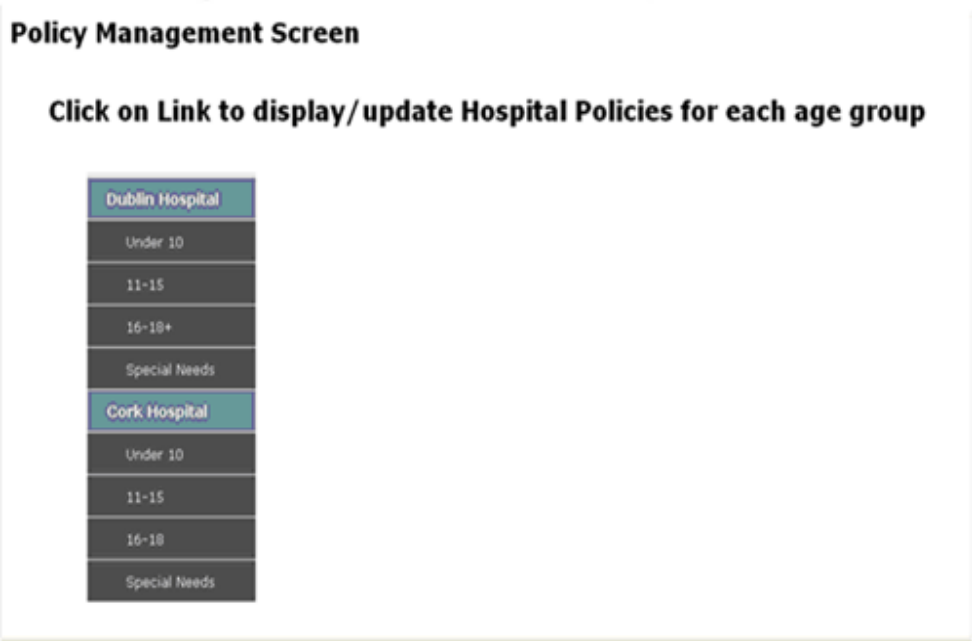

Figure 39 - Enhanced Solas Policy Management

- The benefits of CBPMS could be extended to resolve the Solas home access issue whereby it is not currently clear who is responsible for users accessing the system outside the hospital and how this should be handled within Solas. A similar research strategy would need to be undertaken to set clear policies and guidelines for home use, and to design how best to model this in CBPMS environment. This project has demonstrated that CBPMS is a flexible tool which can support a variety of scenarios and configurations.
- If a hospital were to allow children open internet access then the providers that allow children onto their networks at all should prominently advise the use of child-friendly search engines (Carr, 2001)

8.3 Conclusion

The process of investigating, designing and partially implementing an integration of Solas and CBPMS has proved to be a valuable and useful endeavour. Disseminating and delineating the possibilities of introducing a policy management tool to resolve the access issues currently experienced by the Solas developers has encouraged a process of research, analysis and evaluation of policy management and online communities. The end result is seen as a single integrated system for the child user and facilitator, incorporating policy best practise, and an enhanced method of controlling access to

the system for the developers. Further research, analysis and development of the systems integration should ensure a healthy future for the Solas online community.

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APPENDICES

Appendix A. Solas Needs Assessment

Appendix B.Solas Community Membership ID nodes

Hospital A

http://chewy.cs.tcd.ie/cpms/crms.php#community-CR-0.41533800-1209208082.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-YO-0.75640000-1209208532.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-DK-0.64185300-1209215970.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-TF-0.56111900-1209211297.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-ZC-0.88617600-1209213923.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-MY-0.18971700-1209214192.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-MO-0.92248700-1209214424.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-GF-0.81665100-1209215007.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-WI-0.15579200-1209214474.xml

Hospital B

http://chewy.cs.tcd.ie/cpms/crms.php#community-LH-0.27773900-1209208562.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-CM-0.49891100-1209813326.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-DW-0.24460700-1209813426.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-HW-0.98161300-1209813567.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-NA-0.35112200-1209813613.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-DE-0.06561000-1209813684.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-GV-0.90765500-1209813786.xml
http://chewy.cs.tcd.ie/cpms/crms.php#community-NI-0.00864000-1209815318.xml

Appendix C. Solas and CBPMS integration Testing Scenarios

Test Name	Objective	Steps	Expected Result	Actual Result
Permit access Hospital A	To ensure users are permitted to access the resources appropriate to their community as per community policy set in Table 5.	1. Select login for child who is aged 15 2. Login to Solas as this child. This child should have access to email, SMS and websites appropriate to their age group 3. Open up 'websites' section of Solas.	User should be permitted to view websites appropriate to their age and the age group below that.	User is permitted to view websites appropriate to their age and the age group below that
Deny access Hospital A	To ensure users are denied access to the resources which are inappropriate to their community as per community policy set in Table 5.	1. Select login for child who is aged 15 2. Login to Solas as this child. This child should have access to email, SMS and websites appropriate to their age group 3. Open up 'websites' section of Solas.	User should not have access to search engines as this is not appropriate for their age group	User does not have access to search engines as this is not appropriate for their age group
Change Membership Hospital A	To ensure users can be changed from existing assigned community to the Special Needs community	1. Login to Solas as Facilitator 2. Go to Solas Administration Page 3. Click on User Management 4. Change a User's Community membership to the 'Special	User's community should be saved to the 'Special Needs' community	User's community is saved to the 'Special Needs' community

		Needs' Community 5. Save Update		
Special Needs Hospital A	To ensure a user cannot access open internet when they are a member of the 'Special Needs' community	1. Login to Solas as Facilitator 2. Go to Solas Administration Page 3. Click on User Management 4. Change a User's Community membership to the 'Special Needs' Community 5. Save Update 6. Login to Solas as user whose membership is just changed to 'Special Needs' 7. Go to view websites	Websites page should not display any search engines	Websites page does not display any search engines
Supervision Hospital A	To ensure a child can access the open internet when members of the supervised community	1. Login to Solas as Facilitator 2. Go to Solas Administration Page 3. Click on User Management 4. Change a User's Community membership to the 'Supervised Community' 5. Save Update 6. Login to Solas as user whose membership has just been changed to 'Supervision' 7. Go to view websites	Websites page should not display any search engines	Websites page not displays search engines
No Special Needs – Hospital B	To ensure that it is not possible to assign users	1. Login to Solas as Facilitator 2. Go to Solas Administration Page	User should not see the 'Special Needs'	User does not see the 'Special Needs'

	to the 'Special Needs' community as Hospital B does not support this configuration	3. Click on User Management 4. View the community membership drop down box for a user.	community as an option	community as an option
No Supervision – Hospital B	To ensure that it is not possible to assign users to the 'Supervised' community as Hospital B does not support this configuration.	1. Login to Solas as Facilitator 2. Go to Solas Administration Page 3. Click on User Management 4. View the community membership drop down box for a user.	User should not see the 'Supervised community' as an option	User does not see the 'Supervised' community as an option