4. TECHNICAL FEASIBILITY STUDY

This chapter covers the details of the technical feasibility study. The details covered include study of existing options. This approach helped to understand how to re-use these options in a better way, and the kind of customization required. It also helped to unveil the problems in implementing these systems. The study was then focused on the new technology that could eliminate these problems and also have a futuristic approach to serve the stakeholders on a large scale. Cloud computing technology was studied in detail as a solution to the problem. Feasibility to re-use existing blocks and integrate them on the cloud platform was the primary focus of the technical study. SOA approach was adopted to implement the same. The final technical framework was again studied with two approaches based on the cloud platform. The frame work of best feasible solution is described.

4.1   Steps in technical feasibility study

Technical feasibility study was conducted for the current options available. This study revealed that health care systems require the compliance with the many conventions pertaining to interface of applications, protocols for communications and privacy and safe keeping standards imposed by various bodies like the HIPAA. Standards at multiple levels are to be adhered to like HL7 **Orvis N & Hufnagel S (2009)** for health care system communication and data sharing of data at the globe level. There are other standards like EHRcom- CEN EN 13606 Electronic Health Record Communication, CDA- HL7 Clinical Document Architecture, WADO, CDA: DICOM SR: Structured Reporting, IHE RID, IHE XDS and many more **Eichelberg M & Namly T (2006)**; **Given P (2009); Beale T & Heard S (2008).** Currently many health care systems that are based on open source standards are available like the Object Management Group OMG and HSSP, a joint-venture of HL7, are applications that provide interfaces and services based on the standards like OpenEMR virtual appliance, SequelMed EMR and openEHR. The diagnosis and prediction of NCDs have been possible with the implementation of Data Mining Techniques. This is true for diseases like coronary heart diseases and diabetes **Palaniappan S & Awang R (2008); Sa-ngasoongsong A and Chongwatpol J (2012); Rajesh V & Sangeetha V (2012); Shouman M, Turner T, Stocker R (2012)**. There are many websites that offer tools for risk prediction of different NCDs[1]. **Lindstrom J & Tuomilehto J (2003)** have come out with a tool,

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[1] http://www.medindia.net/patients/calculators/cardiacrisk.asp.

The Diabetes Risk Score, this is a utility that can be used for the prediction of type two risk for diabetes, there are many web sites that offer these tools that can be used free of cost[2]. Some of these technology options could serve part of our requirements; however, these options have little to match up to the prerequisites of a system that is flexible, scaled up or down, is unified and secure that can be relied upon and its availability is assured, as specified by the NGOs for this cause. The re-use of systems that exist, would mean a huge capital investment upfront in order to implement, manage the cost of operations and the infrastructure. The main deterrents to IT adoption in the health care sector has been the high upfront cost, **Praveen S et al (2011)** this can be overcome by the use of Cloud computing. In-house datacenters get converted to remote applications on the Cloud, leaving the users with no worry of infrastructure allocation and upfront investment **Edward G (2011).** A case study was conducted to evaluate if power of Cloud computing can be leveraged in the field of education, this helped in understanding the different business models and the Cloud based services that could be deployed[3]. A survey was conducted online using Google Docs, and it was observed that this method helped to reach out to a large number of students easily. The students also found it easy to use Google Docs forms. The study helped in concluding that Cloud computing paradigm can be leveraged for the education sector[4]. Based on the foregoing the power of the cloud was extended to the social cause, as one of the primary requirements was to easily reach out to the large section of the senior citizens community. Based on the findings and analysis of the requirements of the different end users of the system the following solution strategy is proposed.

- The utility computing feature makes the Cloud computing technology as the best option to be considered for building the SCWM. This will reduce the upfront investment and based on the utility, the operational expenses can be incurred.
- The other benefits of Cloud computing that makes it a good option to be considered is ease of deployment, process as be demand cost effectiveness for delivery of services. Hence Cloud computing is a good option for designing the SCWM.

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[2] http://www.framinghamheartstudy.org/risk/diabetes.html

[3] https://docs.google.com/spreadsheet/pub?key=0AocZgAZt9JhNdGN0WlZVc3BjSzFnVEF2VFhDUFlQTWc&output=html

[4] http://www.igi-global.com/article/cloud-computing-paradigm-indian-education/67546

4.2 Technical Requirements for Users
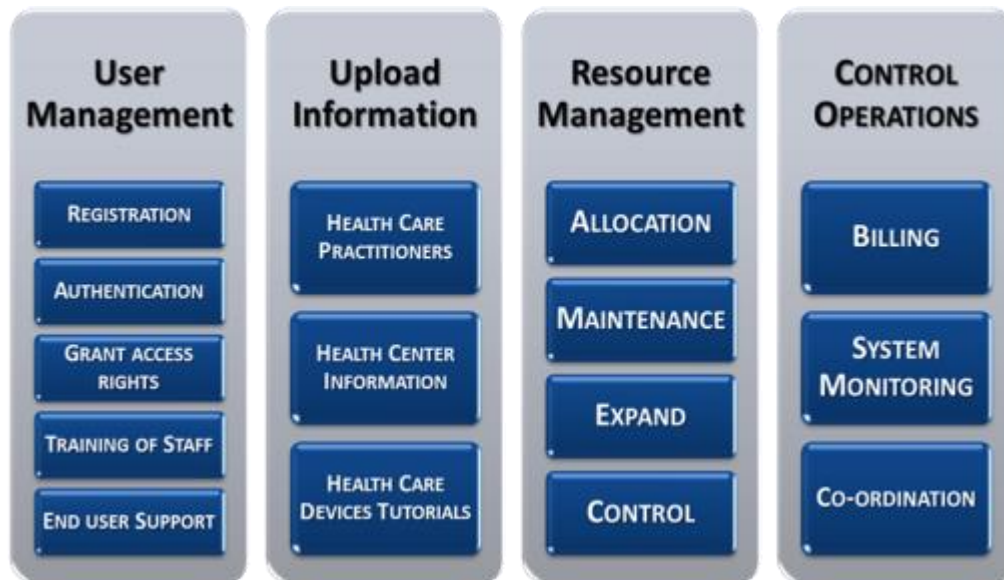
The users in consideration for technical feasibility are

- End Users [Senior Citizens]
- System Administrators

The figure 4.1 shows the consolidation of the user requirements.
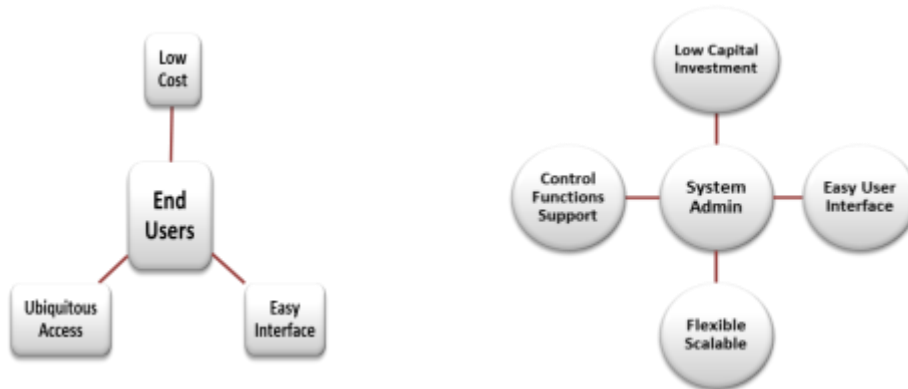
Figure Error! No text of specified style in document.**.1 Consolidation of User Requirements**

The control functions support for system admin is shown in figure 4.2

Figure Error! No text of specified style in document.**.2 Control Functions Supported for System Admin**

4.3 Cloud Computing

From the technical review about Cloud computing it is evident this is the technology recommended for community projects. As the Cloud-computing paradigm is based on utility computing, the optimal computing resources required can be purchased on-demand from a virtually unlimited supply. The investment needed upfront is less and this paradigm changes the expenses to operational expenses, hence it entails shifting of capital investment risk for under or overprovisioning to the Cloud computing vendor **Edward G (2011)**. This meets most of the requirements raised by the NGOs for the SCWM system. The utility computing is a self-service model of Cloud computing that allows the consumers to use their IaaS. This spares them the hassle of upfront infrastructure investment and management.

Cloud computing has an inlaid emphasis on service orientation. A wide range of different heterogeneous services are included under its fold, this is the reason for the categorization of the cloud services into different delivery models that gives the option to bound them as solutions. The most common categorization is based on SPI which comprises of Software-as-a-Service, Platform-as-a-Service and Infrastructure-as-a-Service model.

Software-as-a-Service(SaaS)

The Software services typically have a browser-based user interface with some APIs for user authentication, data collection, data storage, query and reporting. There are a wide range of domains where SaaS is used, the most popular areas is customer relationship management (Salesforce.com, Netsuite). Salesforce.com represents one of the best known examples of Software-as-a-Service (SaaS). Desktop productivity is provided by Google Apps, Zoho and the list is endless with other services available for billing, financials (Intuit), legal, human resources (ADP, Workday), backup and recovery (Mozy), and many other domains.

Platform-as-a-Service (PaaS)

Platforms represent frameworks and common functions that the applications can leverage and implement so that they don't need to re-develop a new system from scratch altogether. Services

include programming language interpreters and compilers, development environments, and libraries with interfaces. Platform services with focus on specific areas like data storage, identity management or any other business intelligence systems are available so they can be readily used by application developers. Some examples are Google App Engine, Microsoft Azure, Force.Com, and Intuit Partner Platform.

Infrastructure-as-a-Service(IaaS)

The infrastructure services are divided into three sublevels. One level comprises of providers of simple co-location (facilities) services. The next is the hardware that includes memory, computation and storage facility. The next is the virtualization which includes the provisioning, virtualization and billing of the services. Ama Amazon Elastic Compute Cloud (EC2) is an example of Infrastructure-as-a-Service (IaaS).

Delivery Models of Cloud Computing

Public clouds

This kind of Cloud delivery model is applicable for services are offered through the cloud platform by Vendors of cloud computing services for the facility of the public which means that anybody can use or deploy the services of the cloud. The resources can be availed dynamically through the Internet platform. Many third-party services providers also hosts these services and manage the allocation of resources and processing of the bills for utilizing the computing facilities. The main advantage of this is the low cost and high level of scalability.

Private clouds

Enterprises who wish to leverage some of the advantages of the cloud at the same time also reduce the risks has given rise to model of cloud computing that is restricted and the term coined to designate this is the private cloud. A private cloud is typically hosted at the premise of the organization and is restricted to their private network link and it not highly scalable.

Apart from this we also have other models like the community cloud that could be restricted for government or health care. Hybrid cloud utilizes the capability or public and private cloud depending on the requirement of the organization. The same is the case with Partner clouds where many companies who are into outsourcing services provide the same through the public clouds.

4.4   Cloud Computing for SCWM

Since the main requirements of the senior citizens was health care services; hence at this point it was necessary to analyze if Cloud computing be leveraged to overcome the challenges in the health care sector? The following are the main technological aspects of cloud computing which were identified as the drivers for adopting the same for SCWM.

Scalablility: The Cloud infrastructure gives the power of scalability for storage of data, incremental power for processing with the growth of data. Thousands of servers are incorporated which offer huge processing power.

Hardware virtualization: The main benefit of this facility is the great amount of flexibility that it offers and this makes the customers get the feeling of having dedicated resources allocated to themselves for infrastructure, processing power, and storage on a computing platform.

Sandboxing: The sandboxing technology enables the reduction of the overhead costs for every virtual machine. This is possible as the virtual machine runs its individual kernel instance that makes it possible to have an improved efficiency of the system.

Cloud controller: The cloud controller provides interface for different computing operations for administration, management controlling and maintaining of the entire system.

Load Balancing and Caching: The cloud provides the benefit of enormous capacity for caching and balancing across the internet for a large scale.

Flexibility: It can handle very small or large processing tasks and can be adjusted in real-time to match the demand.

Efficiency: Computing resources are pooled so the processing power is efficiently utilized.

One of the major modules in the SCWM pertains to health services. Technical review about health care technology revealed the challenges in this area, so would cloud computing option stand out as a good option to offer health care services? The following discussion throws light on the same.

The figure 4.3 shows a consolidation of the main technological aspects of Cloud computing which were identified as the drivers for adopting the same for SCWM. The analysis presented includes the parameters which represent the challenges faced, a comparison with the current health eco-systems, Cloud competency to change the same and the concerns about Cloud adoption is presented in table 4.1.

Figure Error! No text of specified style in document..**3 Drivers for Cloud Computing**

Cloud Service Delivery

Cloud services itself are a specific type of (SaaS). It has three distinct layers.

Cloud computing Power: If the enterprises need to deliver a service, then this layer provides all the resources required for storage, network and servers. This layer delivers the computing power as a service.

Cloud Platform: The enterprises may require a platform that utilizes the computing power of the first layer to develop services. This is offered in the second layer.

Cloud Services: The enterprises may utilize the computing power of the first layer and the platform of the second layer and create a service which is delivered through this layer.

Concerns for Adopting the Cloud for Health Care

Security

The cloud is option is a solution that is a cost effective one. But the down side to this mainly pertains to risks of security and privacy that is responsible for impeding its wide adoption. If the health records are stored on a cloud server hence the main concerns are of privacy, security and access control. This is mainly because; the patients would not be able to completely exercise control physically on their personal health data, as the data of sensitive nature would controlled by servers do not assure of strong privacy at all.

Standards

The different organizations like Health Insurance Portability and Accountability Act (HIPAA) have imposed standards and regulations that have to be implemented for security, interface and communication of the different health care systems. This is cause for additional hindrances to the cloud adoption in different services in the industry. Turning health records over to a service provider who is an outsider has the potential liabilities and risks that health practitioners are wary which are both real and perceived, in. These concerns were fuelled due to the various data leaks encountered in high-profile data in recent years.

Shift in work culture

An industry that cannot afford server downtime is health care. The concerns have made the health care personnel and beneficiaries to believe that the complete adoption of the cloud could require not only too much effort but it also may involve a complete shift of work culture.

Table Error! No text of specified style in document.-1 Comparative Analysis of Cloud Competency and Cloud Concerns

Parameter	Current Health Eco-System	Cloud Competency	Cloud Concerns
Capex	High	✓ Low Capex	
Standards Compliance	Compliance with standards, privacy by regulations	✗	✓ Not as per standards Expected
Flexible	Cannot scale up or down	✓ Flexible ✓ Distributed ✓ Scalable ▪ Can serve a huge number of beneficiaries ▪ Can accommodate the growing number of images and medical records	
Resource Overhead	➢ Allocation ➢ Management ➢ Maintenance	✓ Load Balancing ✓ Virtualization of Resources ✓ Auto Provisioning of Resources ✓ No overhead of Resource Management & Maintenance	
Administration	✓ User Management ✓ Billing ✓ System Monitoring ✓ Control	✓ Dashboard interface o User Management o Control ✓ Metering & Monitoring ✓ Billing for Pay-per-user	
Efficiency	Unable to focus on Core business	✓ Can focus on Core Business	
Security	Implemented based on regulation	✗	✓ Not as per standards Expected
Existing Investment	High Capital Investment on technology and training of Staff	✗	✓ Have to scrap old systems to move to Cloud ✓ loss of existing investment ✓ Major change in

			work culture

4.5   Roadmap for cloud adoption

The cloud services layer offers enormous flexibility for enterprises to host business services through the SOA in the cloud environment. Experts predict that the Cloud adoption is inevitable in the coming decade. As the IT has evolved to be a service oriented industry, the challenge for IT services is agility that helps the enterprises can stay ahead of their competitors by utilizing the power of technology. This can be delivered by the power of SOA. The SOA offers a flexible, standards based architecture, that provides a modular approach for the delivery of IT services. It also has the capacity to seamlessly integrate internal and external third party services based on the business requirements. The approach for enterprises to adopt the cloud would be first to transform the IT architecture based on SOA. By this approach, the services in the cloud can be accessible, visible, extendable, and adhere to standards. Hence we may conclude that SOA is the roadmap to cloud adoption.

4.6   SOA for Health care

Before proceeding to leverage the potential of the Cloud, the possibility of integrating the existing health care options available off the shelf is to be determined. **Jensen C (2012)** has reported that the existing technology for health care services can be leveraged by implementing SOA. SOA based health care systems are approved by HIPPA regulations **Juneja G et al (2008)**.The benefits of SOA applied to health care is shown in figure 4.4.

Figure Error! No text of specified style in document.**.4 SOA for Health care**

## 4.7 SOA integration of SOA for Cloud Adoption

In SOA loose coupling is implemented horizontally, across different applications and systems. As a consequence there are a set of standardized interfaces that are made available to make it possible for every part of the system to be manageable as an independent unit, it can be migrated, scaled, monitored, without making any change in the behavior of the complete system. Loose coupling in the cloud is implemented vertically; between application layer and the hardware layer on which it is implemented **Saini A (2011)**. In this dimension loose coupling helps in delivery of various services like scaling, virtualization, and provisioning as required by the network traffic. **Mulholland A et al (2008), Juneja G et al (2009).** A highly flexible infrastructure can be achieved by combining these two dimensions of loose-coupling. The benefits of this infrastructure are

- Horizontal scaling by increasing the nodes.
- Vertical scaling by separation of different components of the application to distributed networked instances.
- Cloud to Cloud movement
- Well-defined APIs that can be replaced incrementally
- Support add-ons, new customers and new partnership ventures.

Hence it is evident that SOA and Cloud can be used in combination to build the model for complex flexible and scalable enterprise applications, this is also applicable for health care applications which are already SOA-enabled. This comparison is shown in the figure 4.5. The Cloud computing paradigm has transformed computing components like software, storage, platform hardware, presentation components to commodities that can be purchased whenever it is required. In order to commoditize the web services SOA potential was utilized so that the components are integrated. The dependency on the underlying network standards is common to both SOA and Cloud another aspect for both of them contracts of trust and relations between the service providers and seekers are of great significance. This gives a strong foot hold for the integration of SOA's capabilities with cloud in order to bring about exchange of information between systems that is effective and also help in cutting down costs and also maintain the security that is part of requirements for health care services **Axendia N (2010)**. There are many EMR, EHR open source solutions which are offered as a service in the Cloud. These services can

be integrated by the SOA interface, this way we can be assured that the health care service standards are maintained. The additional services can be developed add-on modules.
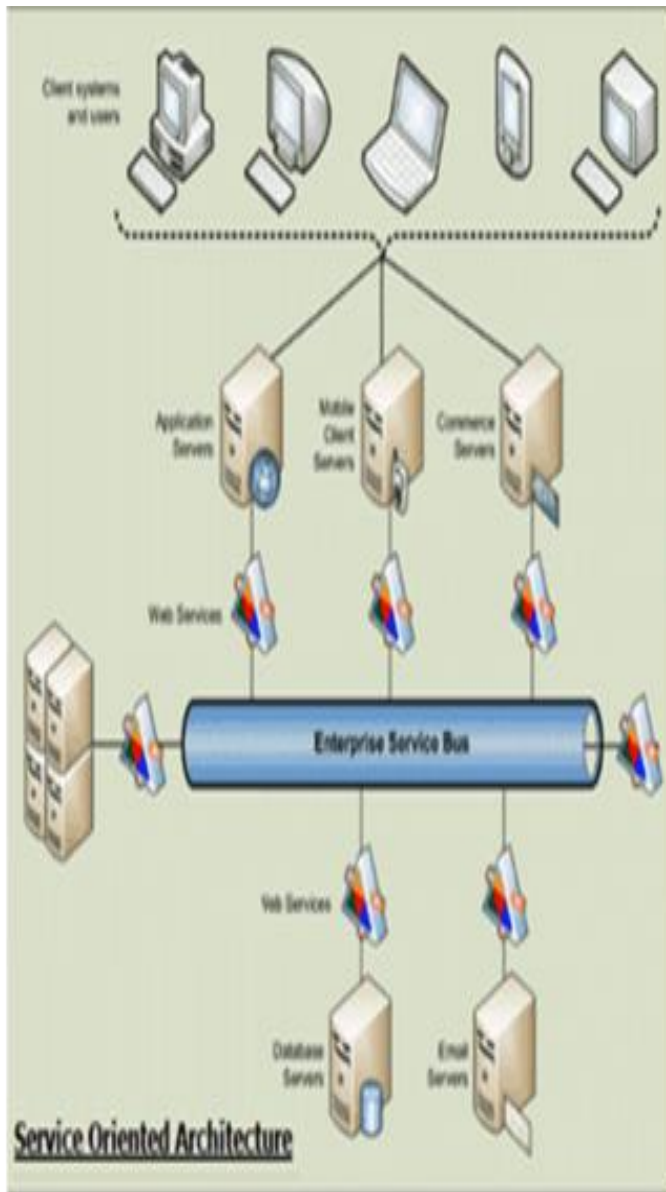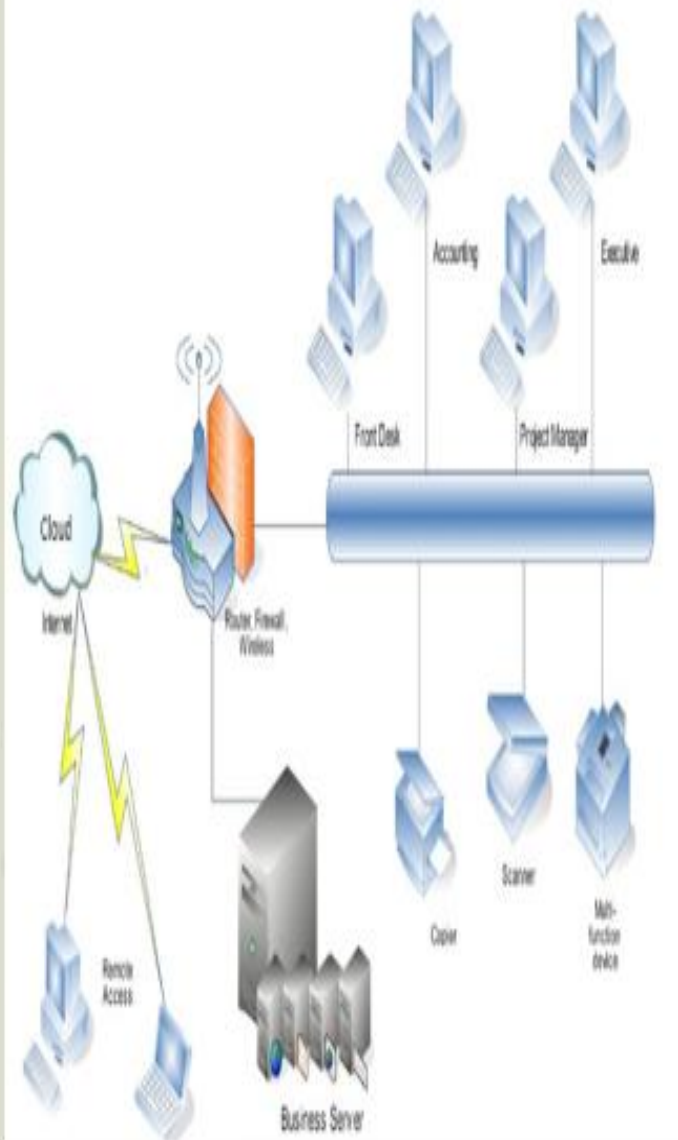
Figure Error! No text of specified style in document.**.5 Cloud Computing and SOA comparison of Horizontal and Vertical Coupling**[5]

[5]https://www.ibm.com/developerworks/community/blogs/mts_on_soa/resource/presentations/TrendsinSOAIntegration.pdf?lang=en

4.8   Module Services Design

In the previous chapter the modules were proposed to be developed as independent entities and offered as services so that it is easy to manage the billing and utility of the module. The modules would be developed as web applications and then published as services with the help of web services.

Web Services

There are many software applications that run on different platforms, or frameworks on the web. The job of interoperability between these applications is achieved by standards implanted by the Web services. Web Services are self-contained, modular applications. In order to make these services available to the users so that they can be used the services have to be enlisted first. In this process the services are stored with a name that helps to publish them and they are known with that name, then a description about that service is captured and then the keywords or tags that can identify and be associated with that services is also stored. This way web services can be provided access to the users over a network, in the World Wide Web. There are three roles in the Web Services architecture; the roles are to achieve three different objectives: As a first step Service providers communicate about their services to a service broker this process is called **publish**. The next step the services has to be locatable, to enable the Service requesters to locate the services through the service broker, this is the process of **find.** The find process can be made possible by the coupling that is done to **bind** them. Everything on the web is considered a service and an API for using the web service by others is published. With the help of Web APIs we can combine resources from multiple web sites and integrate them into a completely different application which is termed as **mashup**. Integration of multiple web applications using web services, revolves more on semantics of services and focuses less semantics of network protocol, this gives a loose coupling of business applications. This model enables the application integration within the enterprise and outside, over a common infrastructure. Web services could be implemented following the service oriented approach, as Network infrastructure is now pervasive, and it enables cost-effective computer-to-computer communication web services.

Web services communicate using a set of open protocols, they are self-contained, self-describing and can be discovered using a UDDI (Universal Description Discovery and Integration), can also be used by other applications. Communication of Web services is by a set of protocols based on

a Simple Object Access Protocol (SOAP). The services are described using the WSDL (Web Services Description Language). Every service is a functional unit, and SOA provides the endpoint and the protocol for integration of the services.

Type of Web Services

RPC Web services

Remote Procedure Call popularly known as RPC, there are three type of services under this category the XML-RPC, JSON-RPC and SOAP. These services typically have a single endpoint, method name, method parameters, a return value and most of them are all POST requests.

SOAP- is a special case of XML-RPC, it can be used with WSDL. The prime benefit of SOAP is that it gives a ground structure for the description of services to the clients, in order to give the visibility of the services. Yet many times programmers find it difficult to debug, it is very popular in .NET and Java and WSDL is itself very complicated as it is written in XML, and very verbose. SOAP uses strict data typing which is an unknown concept some programming languages like PHP.

RESTful Services

REST stands for Representational State Transfer.

- REST gives the benefit of a code rule for design in order to create services that are stateless and they are termed as resources that are identifiable by their unique URLs. This gives a basis to conclude that every URL uniquely represents an object.
- REST defines an interface that is simple and enables the transmission of data over an interface like HTTP that is standard in nature. It utilizes HTTP that stands for verbs that indicate which operation should be performed.
- The routing depends on the URL and the verb.
- REST is an architecture and SOAP is a protocol.

Approaches to build cloud based web services

A. **The classical two-tier - Client-server model**
   - Server – a single machine or an application that serves multiple clients.
   - Clients –software applications that provide user interface or front-end that provides access to the services at the server.

This approach would not be suited for this application as it is based on tight coupling so we cannot implement SOA using this approach.

B. The three-tier/multi-tier model

Client software – provides the User Interface to the system

Middle tier also termed as business layer

- The Middle tier usually has components related to front end, business logic and back end.
- The functions of the middle tier would be implementation of the UI of the application, services of the application and data access functionality.

Back-end -data layer- Manages the data of the system this could be a database or cloud.

4.9 Modules as Web Services

The modules will be developed as independent web applications and then published as web services. Web services are applications that are usable in the form of independent modules that have a mechanism to describe, publish and locate them. Their interface also provides facility for them to be invoked over a network, generally, the World Wide Web. Everything on the web is considered a service. The services are made available by publishing them using API **Writers (2000)**. Web APIs allow the combination of multiple web resources into new applications known as mashup. Figure 4.6 shows the characteristics of web services and also shows the method to publish, bind and find them. Figure 4.7 shows the characteristics of web services.
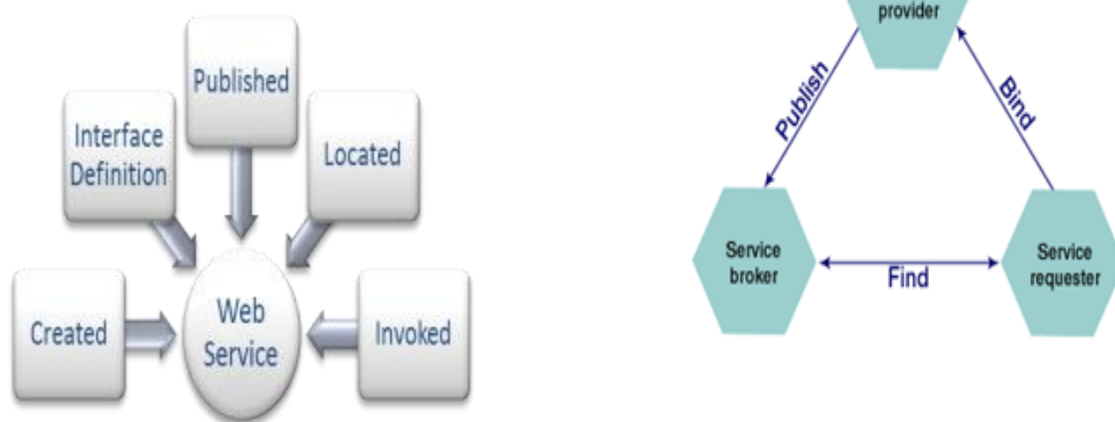
Figure Error! No text of specified style in document.**.6 Modules as Web Services**

Characteristics of Web Services
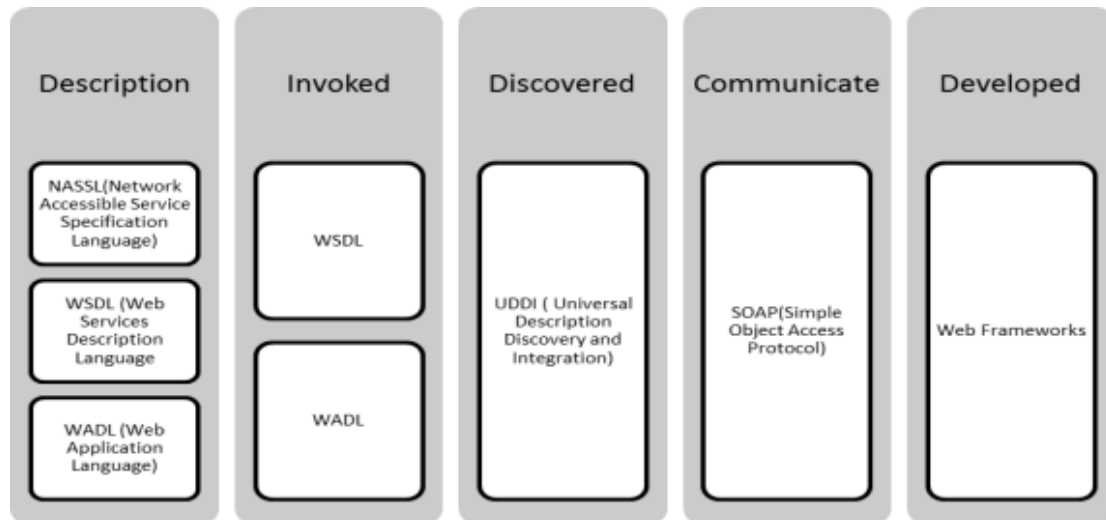
Figure Error! No text of specified style in document.**.7 Characteristics of Web Services**

Category of Web Services

The classic Web applications were modeled on the client-server architecture, with a server catering to multiple clients. When applications evolved into Web Services they were developed on the three tiered architecture **Writers** (**2000**). The layers here are the client layer, middle layer for business logic and data layer. The MVC design is an evolution of this traditional architecture **Manolescu I et al** (**2005**). The figure 4.8 shows the MVC architecture.
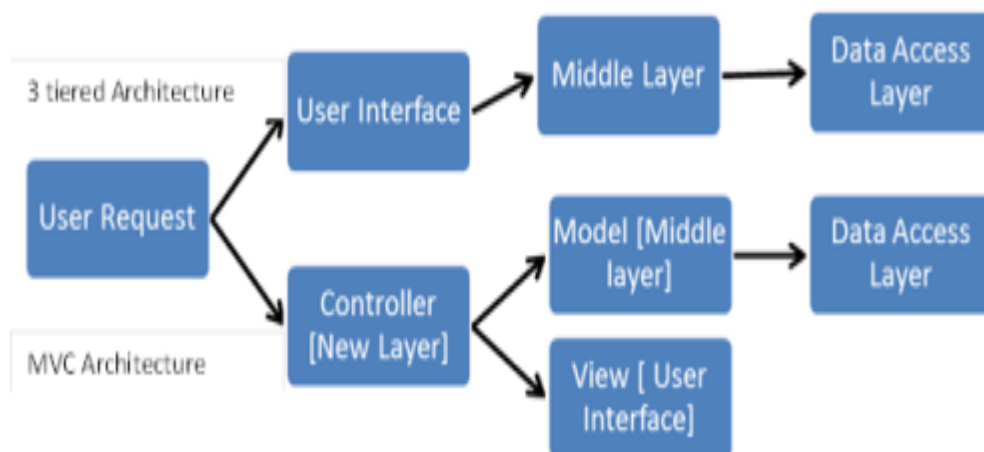
Figure Error! No text of specified style in document.**.8 MVC Architecture**

Model view controller (MVC)

MVC is architectural pattern which separates the business logic and the user interaction. It divides the application into three layers: *Model*, *View* and *Controller*.

View controls the look and feel of the interface. It displays the data, never allows data modification, but only presents it. There can be multiple views for the same data.

Model represents the real world object and supplies the data to the "View". It keeps the application state or the data, notifies the view so that it can be refreshed. It represents the business logic of the application. It provides the interface for manipulation of objects and also encapsulates all data base connections.

Controller handles the interaction with the user, is responsible to take the end user request and load the appropriate **Model** and **View**.

Benefits of MVC

Table Error! No text of specified style in document.**-2 Benefits of MVC**
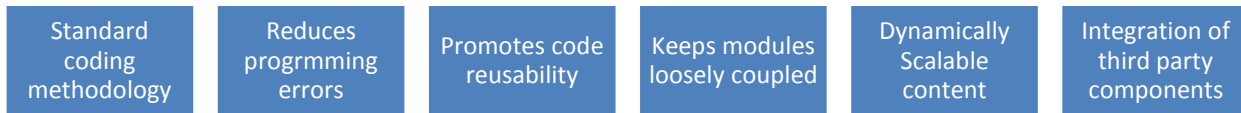
Separation of Components	Data Access
	Manipulation
	Business Logic
	Flow Control
Modularity	Different Controllers for each Function
Flexibility to incorporate	New Add-ons
	New Technology

4.10 Software Requirement Analysis

Web Application Frameworks

The MVC design is implemented by choosing a web application framework **Kreger H (2001)**. Framework is a set of code that is organized into an architecture which can be used for RAD. The framework implementation would give us the following benefits.

Open Source PHP Based MVC Frameworks

Standard coding methodology	Reduces progrmming errors	Promotes code reusability	Keeps modules loosely coupled	Dynamically Scalable content	Integration of third party components

Figure Error! No text of specified style in document.**.9 Open Source PHP based MVC Frameworks**

PHP is the most popular scripting language for web based development. There are many open source PHP based MVC frameworks available **Porebski B et al (2011)**. Symfony, CakePHP, and Zend Framework are the most popular frameworks in the web developers community. Open source web tools are popular only if they adhere to standards of quality. All the three of them are free of cost, and public interest in these frameworks show that they are way ahead of their competitors. The benefits of open source PHP based MVC frameworks is summarized in figure 4.9

4.11 Approaches for Cost Effective Cloud Based Design

There are different delivery models for Cloud computing.

Table Error! No text of specified style in document.**-3 Cloud based Delivery Models**

Level	Delivery model	Description	Example
End user level	Software –as-a-Service SaaS	Complete applications hosted in the Cloud that can be availed by end users through internet.	Google Docs, Zoho, salesforce.com
Programmer level	Platform-as-a-Service PaaS	Complete development environment for the programmers to design, develop, test and deploy the application on the Cloud infrastructure and deliver to the end users	Azure services, Google App engine.
IT level	Infrastructure-as-a-Service IaaS	Utility computing, the resources like processing, storage can be used through the internet and it is pay-as-you-go model.	Amazon Web services, Gogrid.

The Cloud based model for SCWM can be designed using either the PaaS and IaaS delivery models. This is summarized in table 4.3. Both the approaches are discussed below.

Approach I: Development on Platform as a Service (PaaS)

The first approach for the development of the modules could be done using PaaS. The development environment is available as a service on the Cloud. Some of the frameworks offered on the Cloud as a PaaS are shown in the table. After developing the modules, they can be hosted on any Cloud service infrastructure using the IaaS.

Symfony Web Frame Work

Symfony is an Open Source PHP Web applications development framework. Today it is among the leading frameworks available for PHP development.

CakePHP

CakePHP is an open source web application framework. Modeled on the lines of Ruby on rails that adapts the Rapid application framework, the CakePHP implements the Model-View-Controller (MVC) approach its utility is completely written in PHP. If web development has been made to lose all its monotonous coding then the credit goes to CakePHP. The programmers are given a portfolio of all the necessary tools required for getting started on the job of development and it also provides assistance on the logic specific to the application. Compatible with versions PHP 5.2.8 provide methods for Email, cookie, security, session, AJAX and request handling Components

Zend Framework

Zend Framework is an open source framework for developing web applications and services using PHP 5.3 Zend Framework is based on object-oriented code. Features of PHP 5.3, available for development like closures, late static binding, namespaces, and lambda functions are usable with the Zend framework. The framework of Zend has a structure that is designed with the intention so that it is compartmentalized and it is not tightly dependent on the other components. Its loosely coupled architecture allows developers to use the components as per the needs of the project. Zend also incorporates MVC implementation. This way it brings about the abstraction in the database layer that is very simple for usability for developers to develop forms that

implements HTML5 forms for interface, data capture, validation and evaluation. This makes it easy for the programmers to integrate the entire operations by the easy interface of object oriented approach. Zend Framework applications also have the flexibility to run on any PHP stack that fulfills the technical requirements. Zend is available on Zend Studio is a package that is a completed integrated development environment that has all the configuration parameter required to integrate with Zend Framework. But the Zend Studio has to be purchased and it not free. But, the Zend Framework and Zend Server Community Edition are free. The advantage of Zend Server is its compatibility with different environments and tools like Netbeans, Eclipse which are free of cost.

Netbeans IDE

NetBeans IDE enables us to develop Java desktop, mobile, and web applications. It also provides an excellent development environment for HTML5 applications with HTML, JavaScript, and CSS. The IDE also provides a great set of tools for PHP and C/C++ developers. It is free and open source application. It also has a large community of users and developers around the world. With its editors, code analyzers, and converters, you can quickly and smoothly upgrade your applications to use new Java 8 language constructs, such as lambdas, functional operations, and method references. It also provides code templates, coding tips, and refactoring tools. NetBeans IDE keeps the folders and files of the application organized and structured, it provides different data depictions from different source window projects with assistance and many utility tools for configuring the programs and applications and efficiently manage them. It has facilities for versioning by different methods like Subversion, Mercurial, and Git integration. New developers when they take over the project development or maintenance, they can easily understand the structure of the application because the code is well-organized. It also provides cross platform support as it can be installed on all operating systems that support Java right from Windows, Linux to Mas OS X System. WORA is true for Netbeans IDE as it itself written in JAVA. It also provides a rich set of plugins. It provides a powerful PHP Source Code Editor with code templates and code generation tools. It also provides facilities for highlighting of syntax and semantic errors in the code. It also has the property to indent and format the code, give sufficient pop-up documentation. There are also provisions to mark the occurrence of entrance and exit points. The try/catch code combination is cleverly completed, with additional selection of rectangular sections and smart parameter pre-filling option.

Table 4.4 shows the comparison of the web frameworks.

Parameter	Symfony	CakePhp	Zend Framework
PaaS	✓	✓	✓
Free	✓	✓	✓
IDE	Netbeans [free]	NA	Zend Studio [license] Netbeans [free]
Front End CMS	X	Croogo	X

Approach II: Develop System, Make Cloud Ready and Host on Cloud IaaS

Applications can be developed locally and hosted on the Cloud, using the IaaS of Cloud. The development approach should follow the same approach using MVC framework, this way the code can be clean, reusable and it ensure a clear separation of logic and presentation. The PHP based frameworks discussed are free and they can be downloaded. The development can be done in a suitable IDE and then hosted onto the Cloud IaaS. Zend or Symfony framework are compatible with IDE Netbeans. The development can be done on Netbeans, and then this application can be hosted on any Cloud. Alternatively, a content management system like Joomla can also be used. This is the front end for the Joomla's underlying MVC framework. PHP components can be developed and added to the framework. The resulting Joomla application can be hosted on the Cloud. Since Joomla provides good support and training documentation, many Clouds offer the hosting for Joomla free or for a very nominal charge. Google AppScale also offers hosting of PHP Apps on the Cloud for free. The free option can be used for testing and the initial stage and later when the number of users increases, suitable pricing models can be chosen **Drusinsky D (2011).**

4.12 Solution Strategy for Senior Citizens Wellness Management

- Information technology with the power of the Cloud has enabled the delivery of quality and cost effective services to even remote locations.

- Collection and sharing of information via the Cloud is very efficient and it thus promotes collaboration. It is critical for the NGOs and other agencies to effectively collaborate specially in times of emergency.

- The social networking promoted by the Cloud also enhances the capability of the NGOs to remain connected to others in the community and also extend and mobilize support to a social cause.

- As the community needs and number of uses grow globally the Cloud also enables to deliver scalable IT solutions.

- The Cloud computing is a good option for the NGOs to optimize their operations more effectively, and deliver a broader array of services at much lower costs and thus make a greater impact on the communities they serve.

- Cloud computing technology should be leveraged so that it can help to serve the senior citizens community better.

- Existing health care components available off the shelf can be leveraged by introduction of loose coupling horizontally and vertically which can be accomplished by integration of SOA with Cloud.

- Loose coupling at the module level also can be retained if the non-health care modules can be developed using suitable MVC framework so that the components can be integrated and hosted on the Cloud.

- Development of a cost effective solution can be achieved by two approaches, first one involves using php based MVC frameworks available as a PaaS on the Cloud and then hosting it on the Cloud IaaS. The second one involves, developing on the framework locally and hosting it on the Cloud IaaS.

4.13 Software Requirement Specifications for SCWM

The final software requirements are given in table 4.5

Table Error! No text of specified style in document.**-5 Software Requirement Specifications for SCWM**

Parameter	Value
Platform	Web Based hosted on Cloud IaaS
Architecture/Design	MVC with SOA
Database	MySQL
Scripting Language	PHP ver 5.2 with Javascript and AJAX
Web Server	Apache
Framework	Zend Framework
IDE/Development Platform	Netbeans 7.2

4.14 Summary of Technical Feasibility Study

- The Cloud computing technology is a good option to consider for building the SCWM as it is based on utility computing. The capital investment required upfront is less and the expenses are mainly the operational expenses which are billed based on the utility. Apart from this it has the additional merits of processing based on the demand, easy deployment and effectiveness of cost for service delivery. Hence Cloud computing is a good option for designing the SCWM.
- Health care services are part of the user requirements, regulations for health care need to be adhered to. The main factors for the hindrance of cloud adoption arise out of the concerns for security reasons and factors related to compliance with standards.
- The concerns can be alleviated by using SOA. A number of Open source and legacy health care options that are available off-the self can be re-used if they fulfil the demands for

requirements of security and standards in health care. Hence, it is best to reuse and make use of the technologies that have been invested for currently by the use of SOA.

- The benefit of SOA Integration with Cloud will provide us the flexibility of bringing horizontal and vertical loose coupling.

- The system will be a primary storehouse for the senior citizens data on the Cloud so that data could be accessed ubiquitously.

- The scalable infrastructure of the Cloud will help to accommodating the rising numbers of customers and also the rise in the number of health records for every user in the forthcoming years.

- The multi-tier architecture based MVC model, is best suited to develop SOA based services as this way loose coupling can be retained among the components.