"Implementation of VistA radiology at a Multi specialty Hospital: Analyzing the business requirements of the client with respect to VistA radiology /HIS"

A dissertation submitted in partial fulfillment of the requirements

for the award of

Post-Graduate Diploma in Health and Hospital Management with Specialization in Healthcare Information Technology

by

TANVIR ALAM

International Institute of Health Management Research

New Delhi -110075

January, 2011

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New Delhi -110075

January, 2011

Certificate of Internship Completion

Date:

TO WHOM IT MAY CONCERN

This is to certify that Mr. Tanvir Alam has successfully completed his 3 months internship in our organization from August 9, 2010 to November 9, 2010. During this intern he has worked on "**Analyzing the business requirements of the client with respect to VistA and HIS"** under the guidance of me and my team at DELL Services.

We wish him/her good luck for his/her future assignments.

(Signature)

_____ (Name)

_____Designation

Certificate of Approval

The following dissertation titled "**Analyzing the business requirements of the client with respect to VistA and HIS**" is hereby approved as a certified study in management carried out and presented in a manner satisfactory to warrant its acceptance as a prerequisite for the award of **Post-Graduate Diploma in Health and Hospital Management** for which it has been submitted.

It is understood that by this approval the undersigned do not necessarily endorse or approve any statement made, opinion expressed or conclusion drawn therein but approve the dissertation only for the purpose it is submitted.

Dissertation Examination Committee for evaluation of dissertation

Name	Signature
_____	_____
_____	_____
_____	_____

Certificate from Dissertation Advisory Committee

This is to certify that **Mr. Tanvir Alam**, a participant of the **Post- Graduate Diploma in Health and Hospital Management**, has worked under our guidance and supervision. He is submitting this dissertation titled "**Analyzing the business requirements of the client with respect to VistA and HIS**" in partial fulfillment of the requirements for the award of the **Post- Graduate Diploma in Health and Hospital Management**.

This dissertation has the requisite standard and to the best of our knowledge no part of it has been reproduced from any other dissertation, monograph, report or book.

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I owe my deep sense of gratitude to **Dr. Sharin Gupta** for giving me an opportunity to learn various aspects of Healthcare Information Technology with special emphasis on VistA radiology.

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ABSTRACT

Implementation of VistA radiology at a Multi specialty Hospital: Analyzing the Business Requirements of the client with respect to VistA and HIS.

By

Tanvir Alam

Implementation of Software in a Hospital requires a complete process of Requirement Gathering from all the stakeholders followed by a thorough analysis and matching of these requirements with the features that the software product offers. The Client Hospital talked about in this study already has HIS in place but the features of the existing HIS do not support all the client requirements, therefore in order to fulfill these requirements; VistA Software is to be implemented in the Hospital by Dell Services. The study focuses on the Radiology Module of VistA Software including all the features it offers and the complete suitability of these features with the requirements of the Client Hospital's Radiology Department.

This project on VistA Radiology Implementation will cover all the features of the module and the features of the existing HIS followed by the documentation of all the requirements of the Radiology Department, the division of these requirements into Priority 1 and Priority 2 requirements and finally, analysis of those that are fulfilled and those left unfulfilled by the Implementation of the Software.

The major findings are:

1. There are in total 62 user requirements (client requirements), out of which 52 requirements are fulfilled by VistA i.e. leaving only 10 unfulfilled by VistA. Existing HIS fulfills 20 requirements out of 62.

2. 32 requirements are Priority 1 i.e. essential in nature while 30 are Priority 2 out of which 31 Priority 1 Requirements are successfully fulfilled by Implementing VistA; only 18 are satisfied through HIS.

3. Some of the requirements left unfulfilled by both VistA and HIS are Payment refund on Order cancellation, recording of adverse reaction on Contrast Media, Order Modification, Bulk signing of patient orders etc.

4. The results from the study also depict that almost all the basic requirements of the client are fulfilled by VistA so client can easily go for the implementation of the VistA.

5. It is assumed that Turnaround Time (TAT) for the X-ray can be reduced to 60%, 30% for CT and 25% for MRI.

The Methodology adopted for the project was:

- Collection of Primary Data.
- Examining the current scenario of the Radiology department of the client hospital.
- Secondary Data Sources.

The primary data sources include the Requirement Gathering process and analysis of these requirements. Secondary Data Sources include the review of the features of HIS and VistA software, VistA Manual and VistA Radiology Software Document.

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ABBREVIATIONS

1. EHR- Electronic Health Record
2. EMR- Electronic Medical Record
3. VistA- Veterans Health Information System and Technology Architecture
4. CPRS- Computerized Patient Record System
5. PIMS- Patient Information Management System
6. HIS- Hospital Information System
7. CPOE- Computerized Patient Order Entry
8. CPT- Current Procedural Terminology
9. HL7- Health Level 7
10. MRI- Magnetic Resonance Imaging
11. CT Scan- Computed Tomography Scan
12. PCE- Patient Care Encounter

Part I: Internship Report

1. Organizational Profile

Dell Services (formerly Perot Systems) is an information technology services provider based in Plano, Texas, USA. Peter Altabef has served as president and chief executive officer since 2004. On September 21, 2009[13], Perot Systems agreed to be acquired by Dell for $3.9 billion.

1.1History:

H. Ross Perot and eight associates founded Perot Systems in June 1988 after having sold EDS to General Motors. Before its acquisition by Dell Inc., Perot Systems was a Fortune 1000 corporation with more than 23,000 associates and 2008 revenues of $2.8 billion [13]. The company maintains offices in more than 25 countries around the world, including the United States, Europe, India, China and Mexico.

1.2Acquisition:

The acquisition resulted in a compelling combination of two iconic information-technology brands. As a top-five finisher for the third consecutive year, Perot Systems was named to the Fortune magazine "Most Admired Companies in America" list for IT Services in 2008. [13] Company ratings are based on eight criteria, including everything from investment value and quality of products/services to innovation and quality of management.

The expanded Dell is better positioned for immediate and long-term growth and efficiency driven by:

- Providing a broader range of IT services and solutions and optimizing how they're delivered.
- Extending the reach of DELL Services' capabilities, including in the most dynamic customer segments, around the world [13].

1.3Location:

Express Way, Noida

Perot Systems TSI (India) Ltd [13]

Corporate Office Plot No. 3, Sector-125, Noida- 201301, U.P

Vision:

Dell services will be the most trusted industry leader in global information technology and business process services [13].

Mission:

- Dell services will be a vital contributor to the overall success of dell.
- Through our expertise execution and professional integrity we will develop and maintain lasting relationships with our customer.
- We will develop and deploy advanced and differentiated
- Support and next generation services, deepen our industry domain expertise, and expand our geographic depth and presence.
- We will always deliver real and measurable results for our customers.
- We will invest in training and development for our team, value and respect one another, focus maniacally on serving our customers and have fun doing it.
- The CIO organization will be recognized for technical excellence and industry, leading efficiency, planning and execution

1.4Industries:

- Consumer Products and Services
- Federal Government
- Financial Services
- Logistics & Distribution
- Healthcare
- Insurance
- Manufacturing
- Telecommunications
- Travel and Transportation

1.5Services:

Dell Services is a worldwide provider of information technology

- Application services like Application Modernization.
- Business process services like Finance and Accounting Solutions.
- Consulting services like Finance and Accounting Solutions.
- Infrastructure services like End-User Computing.
- Virtual services like Cloud Integration Services.

Background of client hospital:

Founded in 1985, ABC India Ltd. is a Public Limited company listed on the NSE and BSE of India with over 30,000 shareholders [14]. ABC India Limited is a multi-business corporate entity driven by the spirit of enterprise with a focus on people and service oriented businesses.

Prominent shareholders of the company are Mr Analjit Singh and a leading private equity firm, Warburg Pincus. The balance shareholding is held by the public and Institutional Investors.

The company´s vision is "to be one of India´s most admired corporate for Service Excellence [14]." Towards this end, it has established businesses that are today recognized as being at the fore front of service excellence, in each of the industry sectors where it operates. Performance, Trust and Service Excellence are enshrined in ABC India Group´s Vision, Mission and Values.

Client Hospitals:

ABC Super Speciality Hospital(DD Foundation), Saket
ABC Super Speciality Hospital, Saket
ABC Super Speciality Hospital, Patparganj
ABC Hospital - Pitampura
ABC Hospital - Noida
ABC Medcentre - Panchsheel Park
ABC Speciality Centre - Panchsheel Park
ABC Hospital - Gurgaon [14]

In 2009 the client hospital signed a contract with the DELL Services for **Electronic Health Record (EHR)-VistA implementation** and support and services for 10 years [3].

Healthcare IT vertical of Dell Services

In Healthcare IT, DELL Services provides various solutions to the healthcare provider's; one of the solutions is EHR (Electronic Health Record) [3].

Electronic Health Record (EHR)

An Electronic Health Record is an evolving concept defined as a systematic collection of electronic health information about individual patients [18]. It is a record in digital format that is capable of being shared across different healthcare settings by being embedded in network-connected enterprise wide information systems.

Advantages of an Electronic Health Record [4]:

- Easy access to information
- Comprehensive and standardized documentation
- Improved quality of patient care
- Increased efficiency of healthcare professionals
- Improved process communication
- Reduced medication errors
- Meet various accreditation requirements

- Reduced TPA denials
- Better control of Management
- Reduced pilferages

Number of Departments allotted for EHR implementation:

EHR Implementation:

- Clinical Transformation
- EHR
- Training
- Infrastructure and Application
- Integrating HIS System

For implementing EHR in Client Hospital, DELL Services is using VistA software: Veterans Health Information Systems and Technology Architecture (VistA) [3]:

VistA- Introduction [11]

- Complete EMR Solution - **V**eterans Health **I**nformation **S**ystems **T**echnology & **A**rchitecture
- Electronic Medical Record
- Over 130 clinical modules to select from (VistA Monograph)
- Thousands of man years of code development along with an evolving architecture
- Thousands of application programs (business logic) wrote in Mumps.
- Infrastructure provided by many platforms and architectures

WorldVistA is an open source implementation of the Veteran Administration's Electronic Health Record system intended for use in health care facilities outside the VA [15].

Background

The US Veterans Administration developed the most widely distributed Electronic Health Record used in the US, the Veterans Health Information Systems and Technology Architecture (VistA) [15]. In an effort to make the system widely available to institutions outside the Veterans Administration health system, the software code was placed in the Public Domain under the Freedom of Information Act.

The foundation for the WorldVistA EHR was formed to extend and collaboratively improve the VistA electronic health record and health information system for use outside of its original setting [11]. It was originally developed as part of the VistA-Office project, a collaborative effort funded by the United States Centers for Medicare and Medicaid Services (CMS), an agency of the US Department of Health and Human Services (DHHS).

WorldVistA EHR VOE/ 1.0 is based on and compatible with the U.S. Department of Veterans Affairs (VA) world renowned EHR, Veterans Health Information Systems and Technology Architecture (VistA) [15]. A fully open-source (GPL v2 licensed) project,

WorldVistA has also developed software modules (such as pediatrics, obstetrics, and other functions) not used in the veterans' healthcare setting.

In 2006, WorldVistA EHR VOE/ 1.0 was the only open source EHR that met Certification Commission for Healthcare Information Technology (CCHITSM) ambulatory electronic health record (EHR) criteria, and in January 2008, it was released with full CCHITSM EHR [11].

As a free product developed in co-operation with the US government, WorldVistA is not marketed in a similar fashion to commercial EHRs [11].

Core VistA functions

- Patient registration
- Clinical reminders for chronic disease management
- Clinical order entry
- Progress note templates
- Results reporting

Customizable functions

The structure of WorldVistA is modular, and a wide variety of customization is possible [15]. Because it is fully open source, this can be done without restriction (although CCHIT certification is granted only to the officially maintained package).

- ability to interface to existing practice management / billing systems, lab services and other applications
- scanning and inclusion of scanned documents into the medical record
- prescription finishing and faxing
- clinical quality measure reporting capabilities
- support for disease management, using clinical reminders
- templates for all the specialties

BUSINESS OBJECTIVES OF VistA:

1. Create an integrated platform to drive the capture of complete patient diagnosis and to help improve quality of Healthcare by reducing wrong medication [11]
2. Implement VistA EHR for the clinical requirements of client hospital.
3. Integrate VistA with the Client hospital HIS through HL7 based integration
4. Use Dell Services Clinical Transformation methodology ADOPTS [15] (Access, Define, Optimize, Prepare, Transform and Sustain) to drive user adoption of VistA and help client hospital derive the expected return on investment on VistA.

Features:

The VistA system is public domain software, available through the Freedom of Information Act directly from the VA website, or through a growing network of distributors. The VistA software alliance is a non-profit trade organization that both promote the widespread adoption of versions of VistA for a variety of provider environments [15]. VistA is a collection of about 100 integrated software modules.

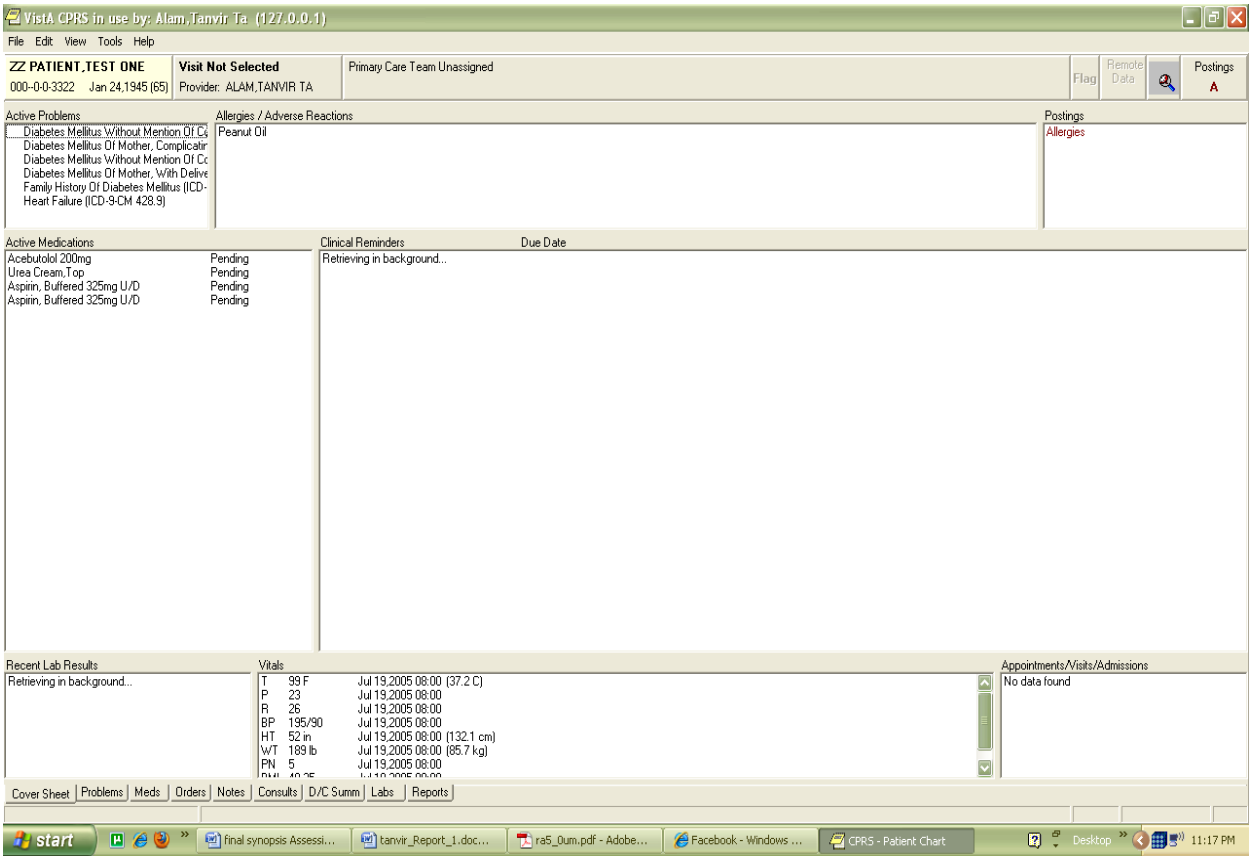
VistA functionality for the EHR solution for end users can be divided into the following modules.

- CPRS – Computerized Patient Record System
- Radiology – Roll and Scroll
- VistA Lab – Roll and Scroll
- VistA Imaging – This is a GUI and linked to CPRS
- Pharmacy – Roll and Scroll
- Surgery
- Dietetics
- PIMS- Patient Information Management System

Computerized Patient Record System (CPRS) Module:

The most significant is a graphical user interface for clinicians known as the Computerized Patient Record System (CPRS), which was released in 1997. In addition, VistA includes computerized order entry, bar code medication administration, electronic prescribing and clinical guidelines. CPRS provides a client–server interface that allows health care providers to review and update a patient's electronic medical record. This includes the ability to place orders, including those for medications, special procedures, X-rays, nursing interventions, diets, and laboratory tests. CPRS provides flexibility in a wide variety of settings so that a consistent, event-driven, Windows-style interface is presented to a broad spectrum of health care workers. CPRS provides electronic data entry, editing, and electronic signatures for provider-patient encounters as well as provider orders [15]. Its computer-based provider order entry (CPOE) capability is an important enabler in the migration from paper-based charting to electronic medical records (EMRs).

Figure 1: Features of VistA-CPRS



Laboratory Module:

Laboratory module enables the user with Ordering of tests and procedures on both patient and non-patient specimens, Collection and Accessioning of specimens into the Laboratory database, Processing and analysis in appropriate department or work areas, review and verification of results [11], Reporting of results and/or diagnoses for clinical health care treatment, Analysis and reporting of quality control data used in generating results and Providing management statistical data as well as requirements for accreditation by regulating bodies and agencies

Radiology module:

The Veterans Health Information Systems and Technology Architecture (VistA) Radiology / Nuclear Medicine package is a comprehensive software package, designed to assist with the functions related to processing patients for imaging examinations [11]. The Radiology / Nuclear Medicine package automates the entire range of diagnostic functions performed in imaging departments.

PIMS module:

The heart of the EMR module is the **Patient information management system** (PIMS). Patient Information Management System (PIMS) is a suite of software which is one of the modules in VistA [11]. It allows professionals in the medical field to organize, schedule, and analyze patient information.

IT enhances the patient flow from admission to discharge by developing a shared electronic record that contains all of the required information on a patient's progress

It enables clinicians to view the demographics, making tracking a patients a far easier and quicker process.

2. Managerial tasks assigned:

The department allotted to me was Healthcare IT and I was allotted a managerial task by my mentor. The task was to analyze the business requirements of the client hospital with respect to VistA and HIS. The VistA radiology software is going to be implemented in the client hospital as a part of EHR implementation. I worked with Dr. Sharin Gupta who is Business analyst and working in VistA Radiology team.

She provided me the documents needed for the study, told me why this study is needed and how the results of this study can help in the project.

3. Reflective learning:

In my dissertation along with my project, I worked in different teams like:

- Created Clinical templates of case sheets like Diabetes, Surgery, Inpatient department etc for CPRS (Computerized Patient Record System) team, where I learned to develop templates in SOAP (Subjective Objective Assessment Plan) format.
- Assisted Laboratory team where I mapped the data for VistA Lab and HIS Laboratory module. Also mapped the CPT (current procedural terminology) codes with Radiology procedures of the Radiology department.
- Also worked with PIMS (Patient Information Management System) team and helped them in configuration. Learned all the configuration of PIMS department.
- Worked with technical team and come to know how integration was done for the project.
- During this, I study the workflow of different departments of a hospital and learned how to make new workflows which will be used in the implementation of the VistA-EHR.

PART II

Dissertation on- "Implementation of VistA radiology at Client hospital: Analyzing the business requirements of the client with respect to VistA and HIS".

Part A. Dissertation Overview

1. Nature of the Problem:

This study highlights the procedures adopted for analyzing the business requirements for the Radiology department for VistA-EHR implementation in the client hospital. As client is already using an in built HIS for his radiology department, but not able to track the patient information throughout the study of the patient. So, now client is going to implement VistA-EHR in their hospital and VistA Radiology is going to be implemented in the Radiology department.

So client asked the Dell Services, to come up with a document which shows that, how much radiology requirements are fulfilled by the VistA- Radiology module, what are the unfulfilled requirements and what will be the final solution for the radiology department.

2. General Objective of the Study:

Analyzing the business requirements for the Radiology department of the Client Hospital with respect to VistA and HIS and recommending the best solution.

Specific Objectives:

1. Enlisting the features of current HIS for Radiology department and VistA Radiology.
2. Mapping of features of HIS and VistA Radiology with clients requirements.
3. What are the features that VistA Radiology can provide as per the client requirements?
4. What all cannot be provided to the client both from VistA Radiology and HIS Radiology module?
5. Why cannot Vista provide all the requirements?
6. What can be the final solution for the client?

3. Scope of the study:

The study mainly analyzes the radiology requirements of the client with respect to VistA and HIS. The results of this study will give us the requirements which are not fulfilled by VistA and HIS, what all can be provided to the client from VistA and what would be the best

solution for the client. Overall this study helps in understanding the basic requirements of any radiology department; the features supported by VistA Radiology module and hence can help IT companies to build software based on VistA radiology module.

4. Need of the Study

The need of this project is to study the implementation of VistA Radiology Module in accordance with the requirements of the users in the Radiology Department and concluding what all requirements are fulfilled by the existing HIS, what all will be fulfilled by implementing VistA Radiology Module and what all requirements will be left unfulfilled. The project also aims to study the features of Radiology Module offered by VistA and what all features support the user requirements.

The study will help to analyze the extent to which the reduction in Manual work and paper based work will lead to decrease in Turnaround Time (TAT) [5]. Thus, the project aims to study the need of a appropriate implementation of VistA automated system which fulfills requirements and hence improves the workflow of the Radiology Department, provides quality care to the patients, good management of the staff, increases efficiency of the staff etc.

5. Benefits of the study:

- A final solution to the client can be suggested if the requirements are not fulfilled completely and if it is unacceptable for the client to compromise with those requirements.
- This study will be helpful to design new software which will include features for those requirements which are not fulfilled for the client.
- Requirement analysis can be beneficial to any organization whether it is a hospital, clinic or a diagnostic center.
- So this study on whole helps both the Service provider and the client.

6. Assumptions of the Study:

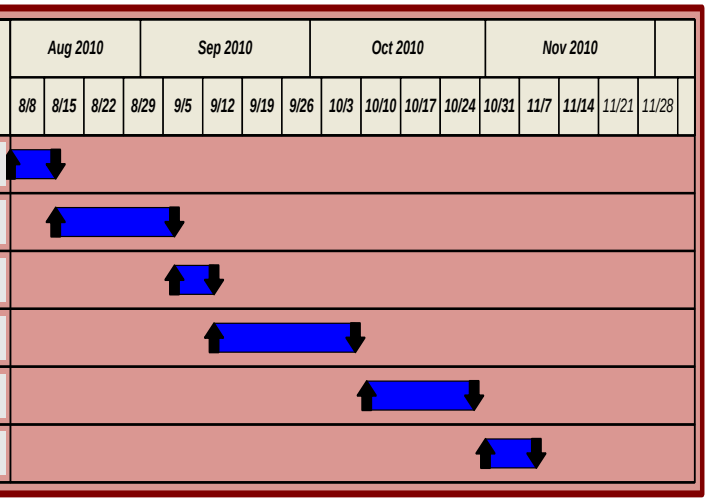
- The requirements given by the client are really feasible and related to the radiology department only.
- Make sure that all the requirements are frozen from both the sides i.e. client and the vendor, and no more additional requirements are added as per the policies of the vendor contract.
- It is assumed that all the past and current relevant data should be provided to the vendor.
- From the service provider's side it is assumed that they not only analyze the existing workflow of the client they also analyze future workflows that may result due to implementation of VistA in consultation with the client.

7. Sources of Data:

- HIS Radiology manual (Client Hospital)
- VistA Manual (http://www.vista.gov)
- Radiology Workflow (Client Hospital)
- Radiology Workflow (VistA Radiology)
- Radiology sample reports (Client Hospital)
- Radiology Department Schedule (Client Hospital)
- Requirement Document of VistA-EHR Radiology Module v1.0 (Dell)

8. Work plan of the Dissertation:

ID	Task Name	Start	Finish	Duration
1	Defining the problem	8/9/2010	8/16/2010	1.2w
2	Literature Survey	8/17/2010	9/6/2010	3w
3	Methodology Adopted	9/7/2010	9/13/2010	1w
4	Data Collection	9/14/2010	10/8/2010	3.8w
5	Compilation & Analysis	10/11/2010	10/29/2010	3w
6	Documentation	11/1/2010	11/9/2010	1.4w



9. Limitations:

The requirements were analyzed based on the requirement document (Annexure) developed earlier by DELL. There is a probable chance of change in the need of requirements by the user during this study which has not been taken into consideration.

Part B. Dissertation:

1. Introduction:

This dissertation work is based on the project "Electronic Health Record (EHR-VistA) implementation" being carried out by DELL Services for its client, a multi-specialty hospital. Currently, the client hospital is using HIS which is built by the in house IT (Information Technology) team of the Hospital and the IT team of IBM. The project has been undertaken by DELL to automate the hospital with VistA-EHR and to integrate the existing HIS.

In the present study the client is proposing to implement the VistA Radiology module for its Hospital. It already has an in house HIS running for the Radiology department. Before the VistA could be implemented it is imperative that an analysis be made regarding the requirements of the radiology department and maps it with the features of VistA for a successful implementation. This study will help in this process to complete automation of the Radiology department.

2.1 Radiology department:

Radiology is the branch of science where scientists use x-rays to see the inside of the human body from different rays [17]. Radiologists utilize an array of imaging technologies (such as ultrasound, computed tomography (CT), nuclear medicine, positron emission tomography (PET) and magnetic resonance imaging (MRI)) to diagnose or treat diseases.

Interventional radiology is the performance of (usually minimally invasive) medical procedures with the guidance of imaging technologies [17]. The acquisition of medical imaging is usually carried out by the radiographer or radiologic technologist.

For automation first we have to look what are the different types of requirements for the radiology department and according to the requirements the vendor has to be selected.

2.1.1 Requirements for a fully functioning electronic radiology department:

Networking Requirements:

- The operating system (e.g., MacOS [Apple Computer], Windows [Microsoft], Intranet Ware [Novell, San Jose, Calif], and UNIX) should be in its most current release with all of the required networking support [10].
- The heart of a Web server is the HTTP service, which receives a page request from a remote client's browser and transmits the page back to the correct client.
- Individual applications are required to run the HTTP server, to author Web content, to create and maintain databases, and to create graphics [10].

Hardware requirements:

Following hardware requirements are captured with discussion with the Radiology staff:

- Modalities: X-Ray Machine, CT-Scan machine, MRI Machine, Ultrasound, Fluoroscopy machine, Mammography machine, image viewers, etc [2].
- Third party software: PACS, PACS Monitors [10].
- IT: Computers, Printers, CPU etc.

Software requirements:

Based on the existing workflow of Max (Annexure 2) the following are the software requirements of the radiology department.

- Order of the investigation of the patient should reach the department as soon as possible [10].
- Registration of the patient in the radiology department [6].
- Completion of the procedures and provision of the films to the Radiologists as soon as possible.
- Generation of reports and given to patients and concerned physician as soon as possible [5].

- Films should be viewed from any area of the Hospital.
- Films also incorporated into the patient EMR.

Human Resource requirements:

Radiologists, radiographers

2.2 HIS:

A **hospital information system** (**HIS**), variously also called **clinical information system** (**CIS**) is a comprehensive, integrated information system designed to manage the administrative [12], financial and clinical aspects of a hospital [2]. This encompasses paper-based information processing as well as data processing machines.

It can be composed of one or a few software components with specialty-specific extensions as well as of a large variety of sub-systems in medical specialties (e.g. Laboratory Information System, Radiology Information System) [8].

Benefits of HIS:

- Easy Access to Patient Data to generate varied records, including classification based on demographic, gender, age, and so on. It is especially beneficial at ambulatory (out-patient) point, hence enhancing continuity of care [12]. As well as, Internet-based access improves the ability to remotely access such data.
- It helps as a decision support system for the hospital authorities for developing comprehensive health care policies.
- Efficient and accurate administration of finance, diet of patient, engineering, and distribution of medical aid.
- Improved monitoring of drug usage, and study of effectiveness. This leads to the reduction of adverse drug interactions while promoting more appropriate pharmaceutical utilization.
- Enhances information integrity, reduces transcription errors, and reduces duplication of information entries

2.3 Requirement analysis:

Requirements analysis encompasses those tasks that go into determining the needs or conditions to meet for a new or altered product, taking account of the possibly conflicting requirements of the various stakeholders, such as users [1].

Requirements analysis is critical to the success of a development project. Requirements must be documented, actionable, measurable, testable, related to identified business needs or opportunities, and defined to a level of detail sufficient for system design [16].

Requirements can be functional, non-functional [7]

Functional Requirements - These define how a product/service/solution should function from the end-user's perspective. They describe the features and functions with which the end-user will interact directly [1].

Table 1: Difference between functional requirements and non functional requirements:

Category	**Example**	**Representative Requirements To Be Captured**
Functional Requirements -Impacts the Business Process	-Common Functions -GUI Functions -Reporting Functions -Interface Functions -Batch Functions -Security Functions	-Common features and functions -Screen layout, report characteristics, and navigational requirements. -Data exchange between this system and others -Off-hours processing requirements -Authorizations, roles, and access privileges -Business Processes

Here all the requirements provided by the client are functional requirements.

Non-functional requirements - are requirements that specify criteria that can be used to judge the operation of a system, rather than specific behaviors [16].

Steps for requirement gathering:

The following standardized steps are followed as suggested by earlier studies [16]

Step 1: Identify Key Stakeholders

Identify the key people who will be affected by the project. Start by clarifying exactly who the project's sponsor is [16]. This may be an internal or external client. Either way, it is essential that you know who has the final say on what will be included in the project's scope, and what won't.

Then, identify who will use the solution, product, or service. These are your end-users. Your project is intended to meet their needs, so you must consider their inputs.

Step 2: Capture Stakeholder Requirements [7]

Ask each of these key stakeholders, or groups of stakeholders, for their requirements from the new product or service. What do they want and expect from this project?

There are several methods to understand and capture the client requirements:

Technique 1: Using stakeholder interviews
Interact with each stakeholder or end-user individually. This allows you to understand each person's specific views and needs [1].

Technique 2: Using joint interviews or focus groups
Conduct group workshops. This helps you understand how information flows between different divisions or departments, and ensure that hand-over's will be managed smoothly.

Technique 3: Building Prototypes

Build a mock-up or model of the system or product to give users an idea of what the final product will look like [7]. Using this, users can address feasibility issues, and they can help identify any inconsistencies and problems.

Step 3: Interpret and Record Requirements

Once you have gathered and categorized all of the requirements, determine which requirements are achievable, and how the system or product can deliver them [16].

Steps to interpret the requirements:

Define requirements precisely - Ensure that the requirements are:

- Not ambiguous or vague.
- Clearly worded.
- Sufficiently detailed so that everything is known. (Project over-runs and problems usually come from unknowns that were not identified, or sufficiently well-analyzed.)
- Related to the business needs.

Categorization of the requirements:

Even for a relatively small project, you are likely to end up with scores of requirements. To understand how they relate to each other, and to effectively deal with them later on in the process, it is necessary to separate them into categories, logically grouping the requirements according to related business functions or organizational boundaries [16].

Prioritize requirements: Although many requirements are important, some are more important than others, and budgets are usually limited. Therefore, identify which requirements are the most critical, and which are "nice-to-haves" [7].

Stakeholder issues:

- Users do not understand what they want or users don't have a clear idea of their requirements
- Users will not commit to a set of written requirements
- Users insist on new requirements after the cost and schedule have been fixed

- Communication with users is slow
- Users often do not participate in reviews or are incapable of doing so
- Users are technically unsophisticated
- Users do not understand the development process
- Users do not know about present technology

2. LITERATURE SURVEY:

I) The linux-based pacs project at the german cancer research center[10]

Uwe Engelmanna, Andre Schrötera, Markus Schwaba, Urs Eisenmannb, Malte L. Bahnerc, Stefan Delormec, Hanna Hahned, Hans-Peter Meinzera

Functional Requirements

The radiology department decided in early 1999 to replace the film based image archive by Reprint of: Lemke HU, Inamura K, Farman AG, Doi K (Eds). CARS 2000: Proceedings of the 14th International Congress and Exhibition. Amsterdam: Elsevier (2000) 41 9-424. 2/6 a long term PACS archive. All existing digital modalities (CT, MRI, US, and PET) should beintegrated (classical x-ray is not performed).

Image reading should be done at the diagnostic workstations. Additionally, the workstations should be able to support printing, work list management, and image transfers to external referring providers and other medical partners including synchronized teleconferencing.

Organisational Requirements

An important requirement was that the PACS should be based on the existing central archive system (ADSM, Tivoli) of the Cancer Center, which is professionally managed by the central data processing division since 1994.

It was planned to start with the implementation of four diagnostic workstations (CT, MRI), two workstations at the CT and MRI consoles and one for the radiation therapy planning group. All workstations should be able to perform teleconferences between each other and with external partners. Furthermore, all PCs on the doctors desks should be able to access the image archive with web technology.

Data Requirements

An investigation of the generated amount of data has been performed by the radiologists at the end of 1998. The result was that about 0.5 TB of data are produced per year. An image cache (RAID) should hold the images of the last 1 to 2 month on-line.

SYSTEM SPECIFICATION

Hardware Architecture

The core of the PACS is the existing ADSM backup/archive system hosted on 2 dedicated AIX servers. This is a black box for long term archiving. The system is in production since 1994 and serves currently 360 backup and 130 archive clients. The total storage capacity of 27 TB is provided by 3 tape libraries (ATL Products, StorageTek); storage media is DLT4000 and DLT7000. One library, an ATL 4/52 (4 DLT4000 drives, 52 tapes) with 1 TB storage capacity, is currently used by PACS exclusively.All other hardware components are based on PC technology running the Linux operating system (SuSE Distribution 6.3).

One central server is providing the disk space for the PACS database and the latest on-line images. The processors of the server are two Intel Pentium III with 500 MHz The data disks (5 x 36 GB) are organized as a RAID system, running raid level 5. Two redundant system disks (9 GB each) are running raid level 1. An uninterruptible power supply (UPS) can supply enoughpower for a period of 10 minutes.

All workstations are based on Intel Pentium III 600 MHz processors with a 18 GB disk each. The diagnostic workstations are equipped with two gray scale, high contrast monitors 3/6 (SIEMENS 2183L). The systems at the CT and MRI console are equipped with one color flatpanel with a resolution of 1600 by 1024 pixels (SGI 1600SW).

The local area network is a 100 Mbit/sec Ethernet.

Software Architecture

The software of all CHILI components is running under the Linux operating system.Important criteria for that choice have been performance, reliability, costs and

security. An expert at the British government's computer security headquarters, CESG (Communications-Electronics Security Group) has endorsed Linux along with the open source model for software development as the most secure computer architecture available. CESG is the sister organization of the GCHQ (Government Communications Headquarters), which is roughly the British equivalent of the American NSA (National Security Agency). There is also a warning against a competing commercial product with hidden source code.

II) Introduction to Requirements Gathering[9]

St. Edwards University Analysis, Modeling and Design MCIS6310 – Dr. David Franke 6 June 2006 Copyright ©2005-2006 Tyner Blain LLC

It provides an overview of the initial parts of the requirements engineering process. It touches on requirements gathering, a framework for managing requirements, and some of the key requirements management areas.

III) The White Paper on China's Hospital Information Systems, May 2008 China Hospital Information Management Association (CHIMA)[8]

Li Bao Luo, Ma Lian, **Accenture Greater China**, Kher Tean Chen, Robert Ball, Anne O'Riordan

Hospitals have entered the digital and information era as the Chinese economy rapidly progresses toward globalization. Large scale digital medical equipment is now being widely used in hospitals across China. Various Hospital Information Systems (HIS) and some Clinical Information Systems (CIS) or modules are deployed and being used in hospitals. Hospital computerization makes many changes and innovation in business practice workflow and hospital management, enabling the overall development of hospitals.

Hospital Computerization Concepts:
Hospital computerization is not simply a matter of computerizing existing hospital procedures; rather, it focuses on sharing of patient information (inter-departmental and inter-

hospital) between hospitals and the community, medical insurers, health administration authorities, etc. The aim is to provide patients with the best care and service, provide doctors and nurses with the best support and provide management with accurate and timely information for analysis and decision making.

HIS Supporting Environment:
A suitable software and hardware environment is the foundation of a successful implementation and operation of an HIS. The hardware environment mainly consists of the back-end hardware, terminals around the hospital and network. The back-end system may include high quality servers, large storage devices, backup capability and high capacity UPS, etc; terminals include desktops, laptops, tablets, palm, card readers and printers. System software includes the operating system, middleware and databases.

Key HIS Components:
In general at HIS can be divided into two parts – the management information system that satisfies administrative requirements and the clinical information system that satisfies clinical requirements. Management information systems include sub-systems such as outpatient registration, outpatient billing, inpatient registration, inpatient billing, equipment management, medical statistics, reporting,
Computer-assisted clinical decision-support etc. Clinical information systems includes the outpatient physician workstations, inpatient physician workstations, nurse workstations, drug-drug interaction reminders , laboratory information, PACS, surgery, anesthesia and intensive care management information systems.

IV) Requirement Analysis[7]

Andr_e Merzky, Florian Schintke and Thorsten Sch• utt

Document Filename: GridLab-08-RA-0001-RequirementAnalysis

It describes the requirements for WP8 of the GridLab project - \Data Management and Visualization". It is based on user scenarios as provided by the application work packages and on the requirements of WP1 - \Grid Application Toolkit.
This document will derive the requirements to the GridLab WP8 {Data Management and Visualization. For that, we first review the user requirements, application developer

requirements and requirements of all work packages depending on WP8. From these, we derive our own set of requirements.

Requirements in the sense of this document include:

Functionality requirements,
Design requirements,
Architectural requirements

V) Enhancing Radiology Workflow [6]

By Robert L. Bard Article from the customer magazine Medical Solutions, December 2007

This solution includes *syngo* Workflow (radiology information system – RIS), *syngo* Imaging (picture archiving and communication system – PACS) and *syngo* Portal Radiologist, the role-based interface that helps streamline radiologists‘ tasks in a simple, organized way. The comprehensive solution proved to be extremely beneficial in all aspects of radiology.

VI) Design, Implementation, and Assessment of a Radiology Workflow Management System[5]

Mark J. Halsted and Craig M. Froehle

Department of Radiology, Cincinnati Children's Hospital, 3333 Burnet Ave., M.L. 5031, Cincinnati, OH 45229-3039.
College of Business, University of Cincinnati, Cincinnati, OH

Received September 7, 2007; accepted after revision February 4, 2008.
The objective of this article is to describe the development, launch, and outcomes studies of a paperless workflow management system (WMS) that improves radiology workflow in a filmless and speech-recognition environment.

RESULTS

Despite an increase in caseload volume after the launch of the WMS, case turnaround times, defined as the time between case availability on PACS and signing of the final radiology staff interpretation, decreased for all case types. Median case turnaround time decreased by 33

minutes (22%) for emergency department, 47 minutes (37%) for inpatient, and 22 minutes (38%) for outpatient radiology cases. All reductions were significant at a p value of < 0.05. Interruptions were reduced, consuming an estimated 28% less radiology staff time, after implementation. Patient perceptions of radiology service timeliness showed modest improvement after the WMS was implemented. Staff satisfaction showed no significant change.

VII) Electronic Health Records Overview[4]

April 2006

The NIH National Center for Research Resources has contracted the MITRE Corporation to track developments and to inform the research community in the area of clinical research information technology through a series of targeted research reports.

This report provides an overview of the features and functions of major commercial Electronic Health Records (EHR) and reviews how they are being used in academic medical centers (AMC).

Electronic Health Records

This report uses the Health Information Management Systems Society's (HIMSS) definition of EHRs.

It reads:

"The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a

complete record of a clinical patient encounter, as well as supporting other care-related activities directly or indirectly via interface—including evidence-based decision support, quality management, and outcomes reporting.

VIII) Electronic Medical Records vs. Electronic Health Records: Yes, There Is a Difference[4]

A HIMSS AnalyticsTM White Paper By Dave Garets and Mike Davis**,**
Updated January 26, 2006

Electronic Medical Record:
An application environment composed of the clinical data repository, clinical decision support, controlled medical vocabulary, order entry, computerized provider order entry, pharmacy, and clinical documentation applications. This environment supports the patient s electronic medical record across inpatient and outpatient environments, and is used by healthcare practitioners to document, monitor, and manage health care delivery within a care delivery organization (CDO). The data in the EMR is the legal record of what happened to the patient during their encounter at the CDO and is owned by the CDO.

Electronic Health Record: A subset of each care delivery organization s EMR, presently assumed to be summaries like ASTM s Continuity of Care Record (CCR) or HL7 s Continuity of Care Document (CCD), is owned by the patient and has patient input and access that spans Episodes of care across multiple CDOs within a community, region, or state.

3. METHODS OF DATA COLLECTION:

METHODOLOGY ADOPTED:

The study involves the analysis of the primary as well as secondary data. Study also involves examining the current scenario of the Radiology department of the client hospital. For this study all the features of the VistA radiology and HIS are studied carefully and mapped with the requirements of the client.

TYPE OF DATA:

Primary and Secondary data collection

DATA COLLECTION TOOLS:

- Review of the requirement document for Radiology department given by the DELL.
- Observation of features in HIS.
- Review of VistA Radiology Manual.
- Observation of the features VistA Radiology software CPRS.
- Interaction with the Radiology staff of the client hospital.

PRIMARY DATA COLLECTION:

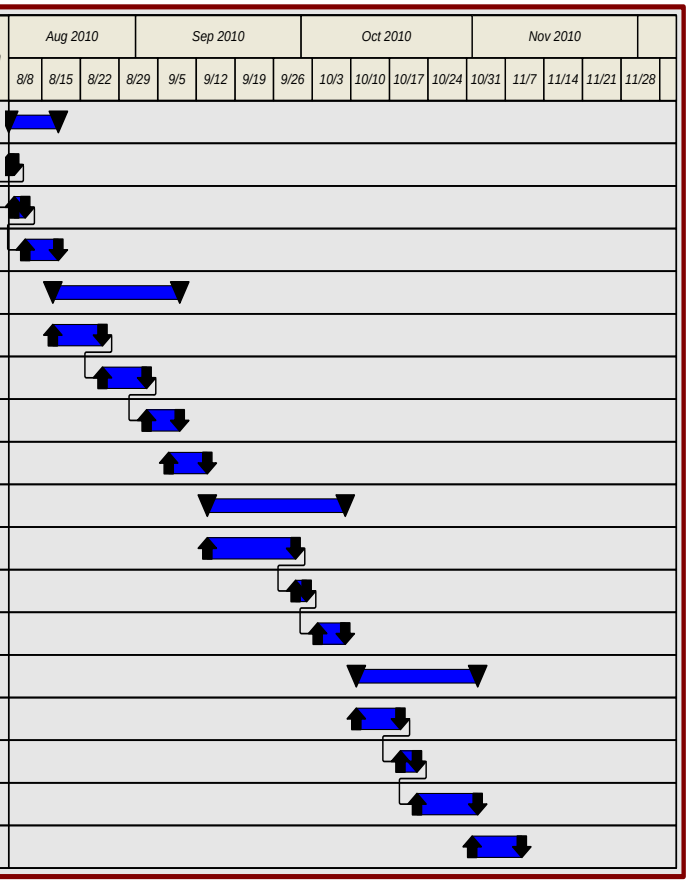
- Discussions with the Radiology staff of the hospital who will be the users of the new product.
- Discussion with the administration and top management of the client hospital.
- Observation and review of the features of HIS (Hospital information System) and VistA Radiology Module.
- Direct Observation of the work processes using exiting HIS.

SECONDARY DATA COLLECTION:

- Review of HIS Radiology Manual.
- Review of current workflow of Radiology department.
- Daily reports collected from the HIS
- VistA Radiology user Manual

4. Project Plan:

ID	Task Name	Start	Finish	Duration
1	**Defining the problem**	**8/9/2010**	**8/17/2010**	**1.4w**
2	Objective	8/9/2010	8/9/2010	.2w
3	Need	8/10/2010	8/11/2010	.4w
4	Scope	8/12/2010	8/17/2010	.8w
5	**Literature Survey**	**8/17/2010**	**9/8/2010**	**3.4w**
6	Papers	8/17/2010	8/25/2010	1.4w
7	Books	8/26/2010	9/2/2010	1.2w
8	Sites	9/3/2010	9/8/2010	.8w
9	**Methodology Adopted**	9/7/2010	9/13/2010	1w
10	**Data collection**	**9/14/2010**	**10/8/2010**	**3.8w**
11	Interviews	9/14/2010	9/29/2010	2.4w
12	Secondary Data Collection	9/30/2010	10/1/2010	.4w
13	Manual Observation	10/4/2010	10/8/2010	1w
14	**Compilation & Analysis**	**10/11/2010**	**11/1/2010**	**3.2w**
15	Categorization of the Requirements	10/11/2010	10/18/2010	1.2w
16	Prioritization of the Requirements	10/19/2010	10/21/2010	.6w
17	Validation of the Requirements	10/22/2010	11/1/2010	1.4w
18	**Documentation**	11/1/2010	11/9/2010	1.4w



Review of the requirement document:

List of the functional requirements

1. Alert on duplication of order before and after completion.
2. Manual entry of order in modality
3. Signing of addendum to report(s).
4. Verification of report.
5. Recording of time and resources during/after investigation.
6. Radiology reports from outside ABC incorporated into EMR
7. Radiology prescriptions from outside ABC scanned into EMR
8. Report will also be visible in Client HIS.
9. Radiology images from outside ABC must be incorporated into the EMR
10. Payment refund on Order cancellation
11. Recording of adverse reaction to contrast media
12. Signing of report.
13. Optional review for CT and MRI reports
14. Placing of Order.
15. Radiology order placed is reflected in concerned modality.
16. Notification of abnormal/significant findings.
17. Order modification
18. Order modification justification
19. Order cancellation.

20. Patient record must be available during CT, MRI and US.
21. Transcription of report.
22. A radiologist must be able to record his/her findings
23. Radiologist signature to be in ink on the report.
24. All images must be acquired before radiologist starts reporting.
25. Scheduling in advance
26. A unique identifier must be used across EMR, HIS and PACS.
27. Acknowledgement of report dispatch to patient.
28. When a procedure is started/ completed in the modality, a status update must be sent to HIS and EMR
29. Duplicate order placement justification
30. Advance payment at the time of order scheduling as per the hospital policy
31. Single sign on for HIS, EMR and PACS
32. Mandatory fields of an order
33. Alert on ordering CECT/MRI for serum creatinine and blood urea
34. Allergy alert on order placement.
35. Signing of order.
36. Bulk signing of patient order
37. Rescheduling or cancellation of scheduled order.
38. Order cancellation justification
39. Report Templates

40. Impression can be a part of the radiology reporting template

41. Notification on order completion.

42. Addendum to released report

43. MIS Reports.
44. Images acquired at any ABC location must be available in patient EMR

45. There must be storage for PACS images for duration to be decided by the hospital policy.

46. Non-DICOM images should be stored and viewed in PACS

47. Order scheduling.

48. Lossless compression of images during primary archival

49. Redundancy on archived media and location

50. DICOM images must be stored in PACS.

51. Reports must be formatted as per Client Hospital standards.

52. The system must make provisions for teleradiology

53. Report access restriction to the attending physicians

54. There must be a provision to provide soft copies of diagnostic study to the patients.

55. Diagnostic images must be made accessible to all the authorized clinicians immediately after acquisition.

56. In case of report dispatch to inpatients, acknowledgement must be entered by the recipient in the system

57. Remote access to patient EMR should be made available

58. Radiologist must be able to classify report as normal or abnormal/significant finding.

59. The radiologist must be able to restrict access to confidential reports

60. Billing of the Orders.

61. Release of interim report in case of emergency.

62. There must be a unique order ID from order stage to reporting stage.

Categorization of the Requirements:

After discussion with the client, requirements are divided into 3 categories, which are:

- **Essential**: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
- **Optional**: Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present
- **Conditional**: Implies a function that may or may not be worthwhile

These requirements were coded appropriately as ER, OR, CR

Conditional requirements are:

1. The system must make provisions for teleradiology (CR01)
2. Allergy alert on order placement(CR02)
3. Scheduling in advance(CR03)

Optional requirements are:

1. Order cancellation justification (OR 01)
2. Impression can be a part of the radiology reporting template (OR02)
3. Advance payment at the time of order scheduling as per the hospital policy (OR03)

Expect these 6 requirements all the other remaining 56 requirements are **Essential**

Prioritization of the Requirements:

Priority 1: Highly required by the client.

1. Placing of Order
2. Billing of the Orders
3. Alert on duplication of order before and after completion
4. Signing of addendum to report(s)
5. Verification of report.
6. Recording of time and resources during/after investigation
7. Report will also be visible in Client HIS
8. Signing of report
9. Radiology order placed is reflected in concerned modality
10. Notification of abnormal/significant findings
11. Order cancellation
12. Patient record must be available during CT, MRI and US
13. Transcription of report
14. Radiologist signature to be in ink on the report
15. All images must be acquired before radiologist starts reporting
16. A unique identifier must be used across EMR, HIS and PACS
17. Acknowledgement of report dispatch to patient
18. Allergy alert on order placement
19. Signing of order
20. There must be storage for PACS images for duration to be decided by the hospital policy
21. DICOM images must be stored in PACS
22. Reports must be formatted as per Client Hospital standards
23. There must be a provision to provide soft copies of diagnostic study to the patients
24. Diagnostic images must be made accessible to all the authorized clinicians immediately after acquisition
25. Radiologist must be able to classify report as normal or abnormal/significant finding
26. The radiologist must be able to restrict access to confidential reports
27. Release of interim report in case of emergency

28. There must be a unique order ID from order stage to reporting stage
29. MIS Reports
30. Order scheduling
31. Notification on order completion
32. Rescheduling or cancellation of scheduled order

Priority 2: Requirements which are needed after fulfilment of priority 1 requirement.

1. The radiologist must be able to restrict access to confidential reports
2. Remote access to patient EMR should be made available
3. In case of report dispatch to inpatients, acknowledgement must be entered by the recipient in the system
4. Report access restriction to the attending physicians
5. The system must make provisions for teleradiology
6. Redundancy on archived media and location
7. Lossless compression of images during primary archival
8. Non-DICOM images should be stored and viewed in PACS
9. Images acquired at any ABC location must be available in patient EMR
10. Addendum to released report
11. Impression can be a part of the radiology reporting template
12. Report Templates
13. Order cancellation justification
14. Bulk signing of patient order
15. Alert on ordering CECT/MRI for serum creatinine and blood urea
16. Mandatory fields of an order
17. Single sign on for HIS, EMR and PACS
18. Advance payment at the time of order scheduling as per the hospital policy
19. Duplicate order placement justification
20. When a procedure is started/ completed in the modality, a status update must be sent to HIS and EMR
21. Scheduling in advance
22. A radiologist must be able to record his/her findings

23. Order modification justification
24. Order modification
25. Optional review for CT and MRI reports
26. Recording of adverse reaction to contrast media
27. Radiology images from outside ABC must be incorporated into the EMR
28. Payment refund on Order cancellation
29. Radiology reports from outside ABC incorporated into EMR
30. Manual entry of order in modality

Review of Features of current HIS for the Radiology department:

Current HIS in the client hospital is having billing as a separate module which provides billing for all type of OPD and IPD investigations, procedures etc. Radiology department is also integrated with the billing module and provides billing for the radiological procedures like for MRI scan, CT scan, X-ray, Ultrasound etc.

Features of the OPD billing section of Radiology department:

- On the main window there is an option of Services which include Consultations, Investigations, health checkups and others where user can select any of the option.

- It is also having an option for advance search where we can directly write the name of the procedure or investigation.

- Than by double clicking the particular procedure it is get selected and it is shown in the space for the selected investigation. More than one procedure can also be selected.

Figure 2: Features of HIS:

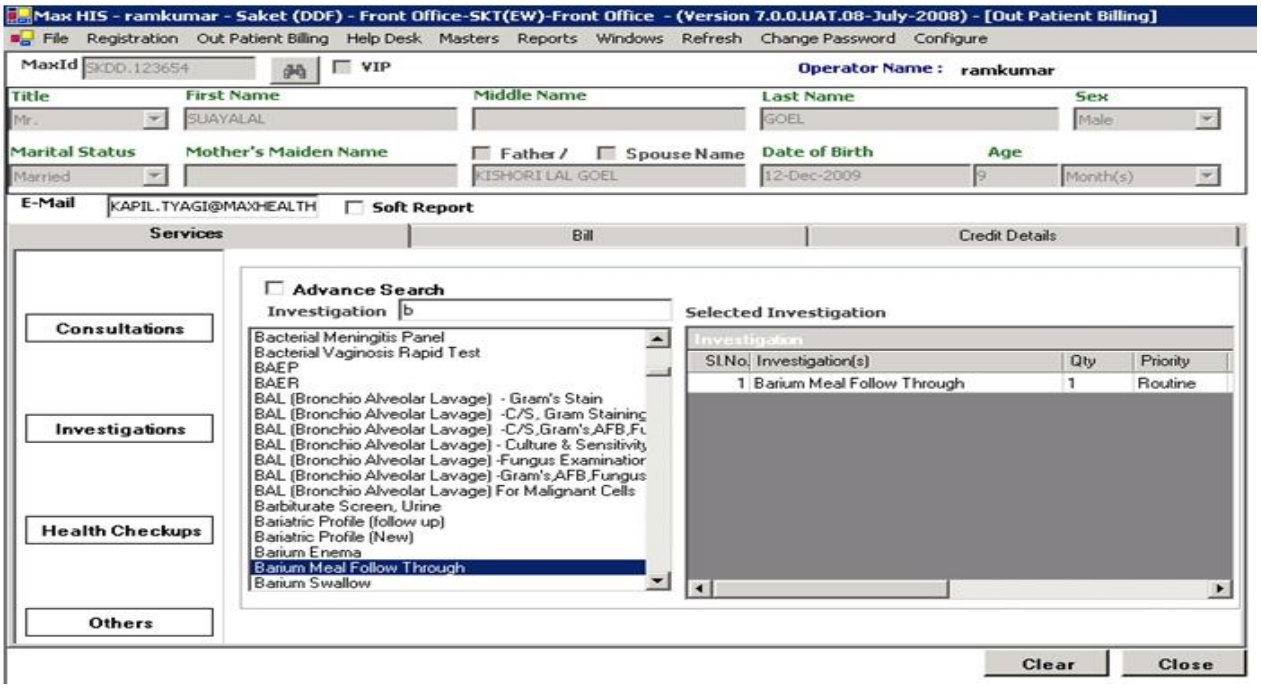
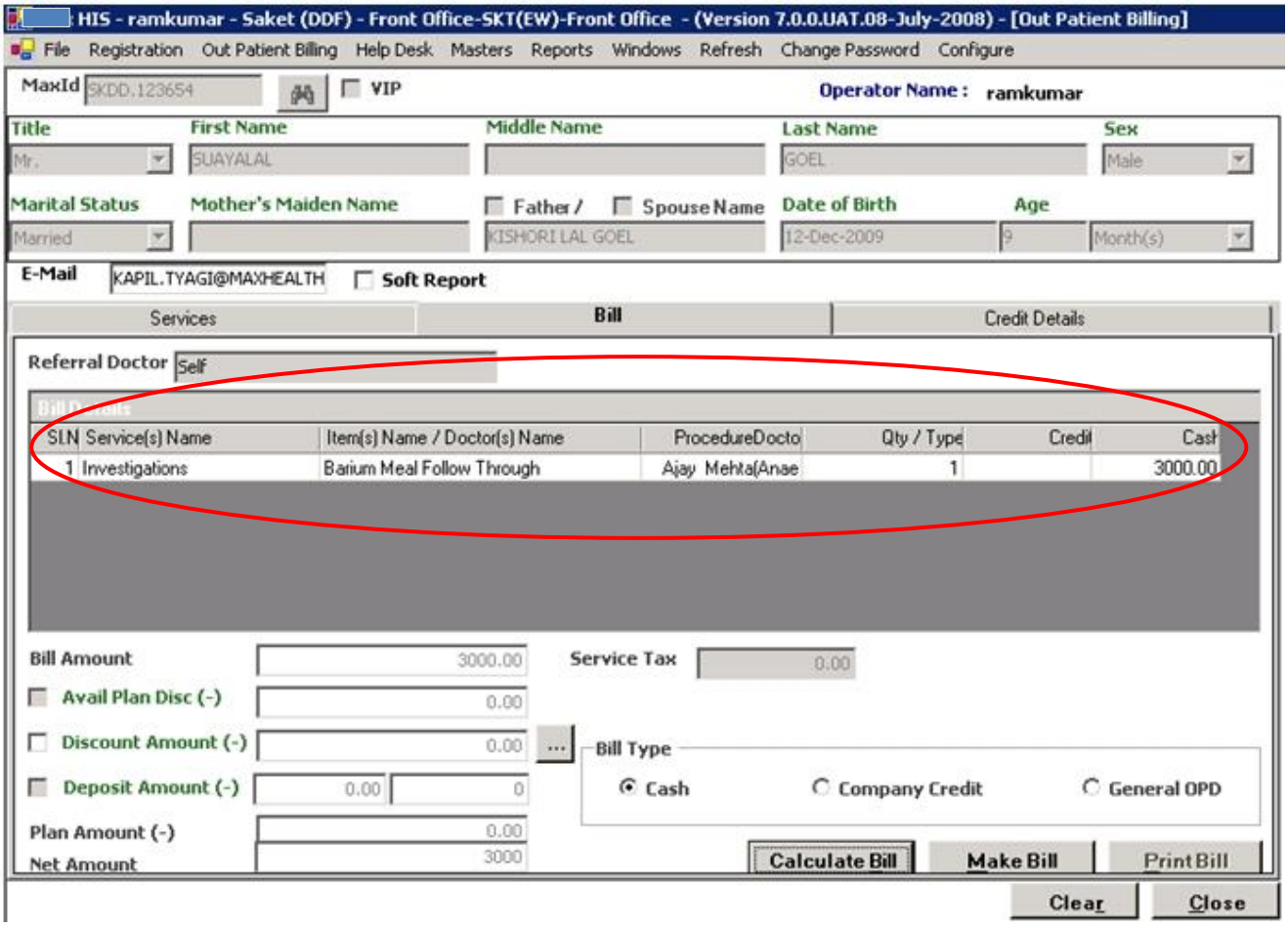
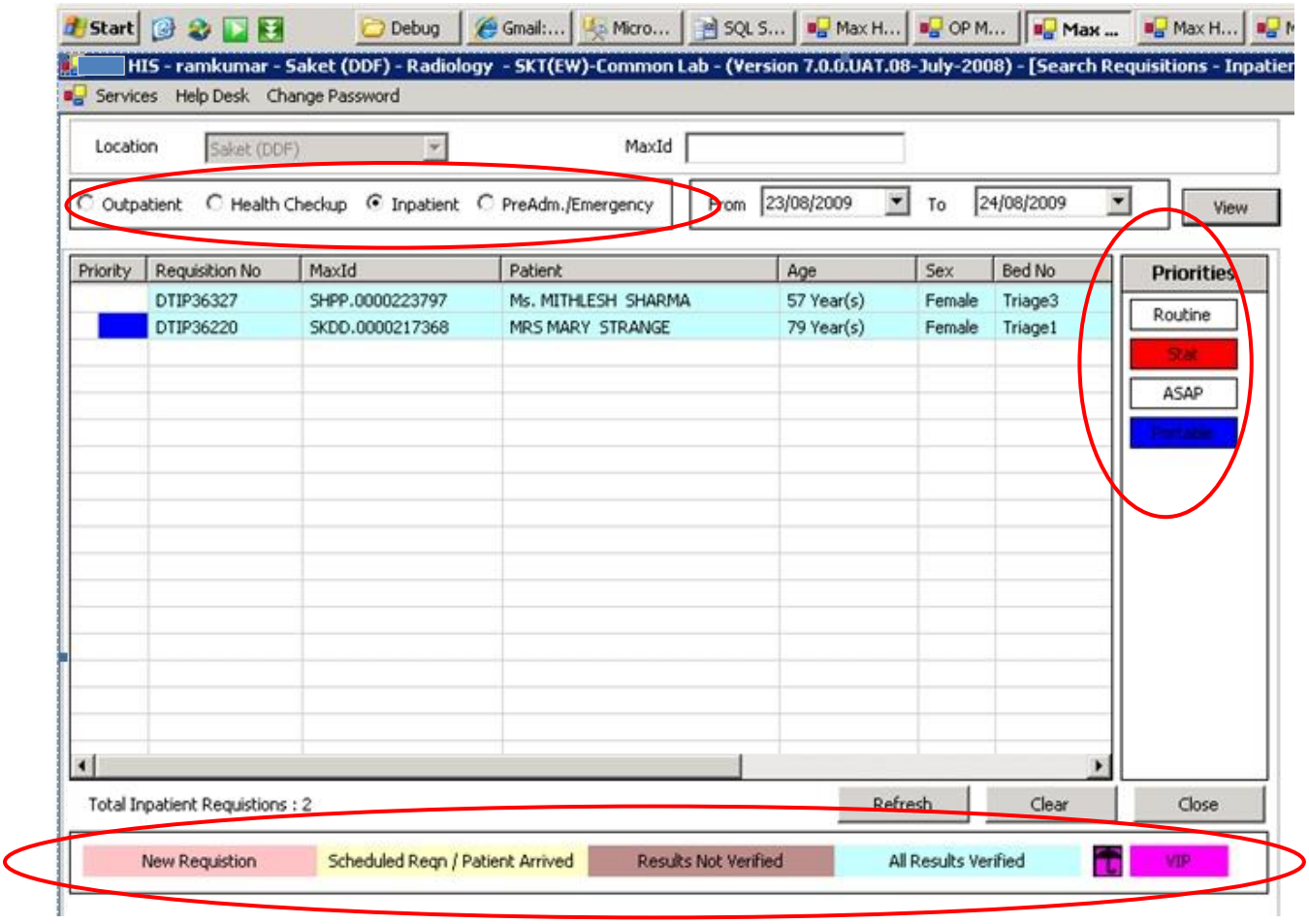


Figure 3: Features of HIS:



Features of HIS-Radiology:

Figure 4: Features of HIS:



- When operator logs in the Radiology lab the window shows option likes the hospital location and operators ID.
- There is an option for outpatient, inpatient, health checkup, and emergency on the screen.
- To see IPD patients there is an option from where we can select the desired period and we can see the requests from the IPD for that particular period.
- Priority is denoted by a colour which shows that how critical the case is: There are four priorities set in the HIS-radiology:

Table 2: Features of HIS:

ROUTINE	
STAT	
ASAP	
PORTABLE	

- Routine and ASAP is denoted by white colour, Stat is denoted by red colour, and Portable is denoted by blue colour.

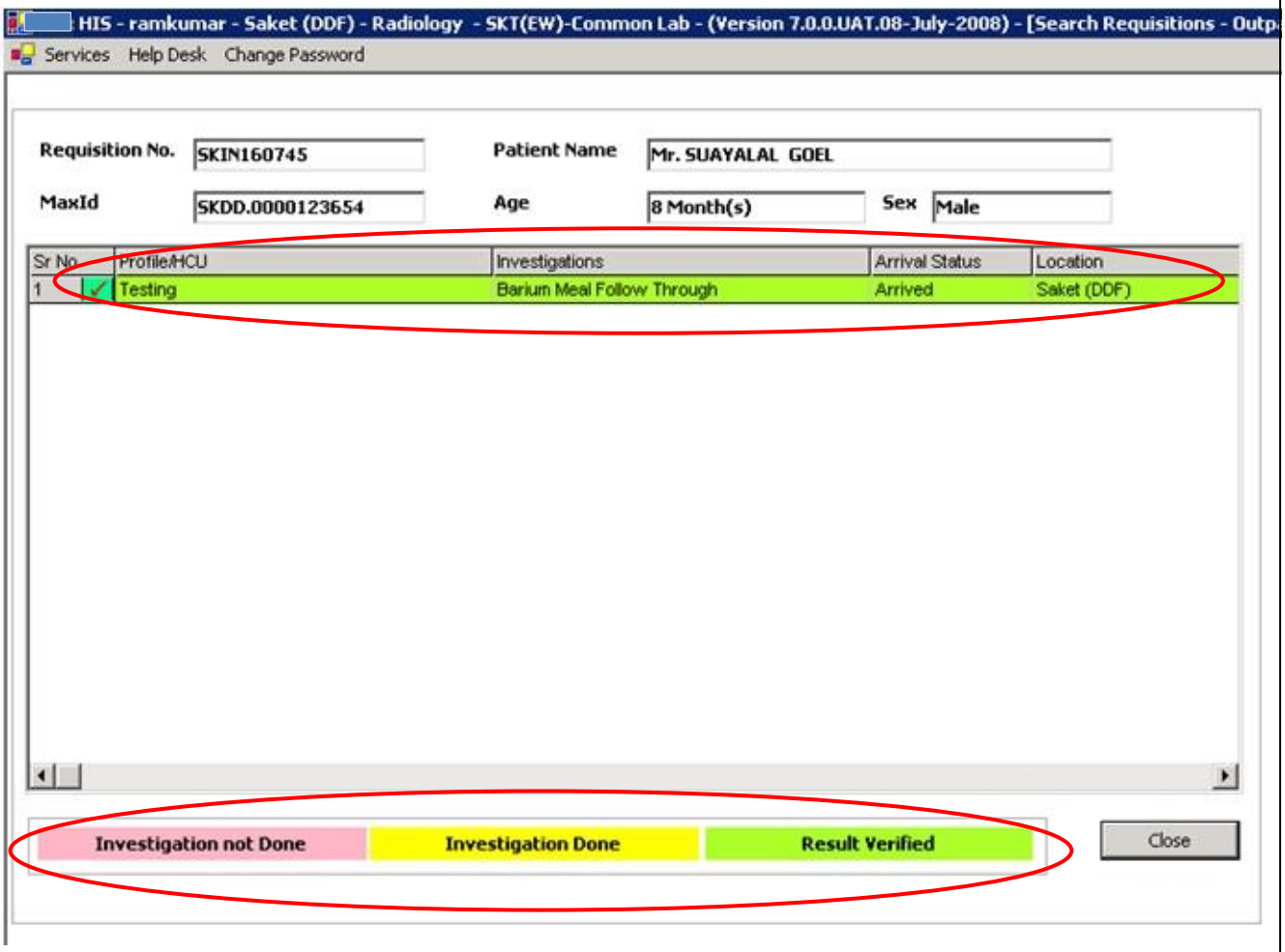
- There are four colours by which the particular requisition is shown:

Table 3: Features of HIS:

NEW REQUISITION	
PATIENT ARRIVED	
RESULTS NOT VERIFIED	
ALL RESULTS VERIFIED	

- New requisition is shown by light pink colour, Patient arrived in the department is shown by light yellow colour, Results not verified are shown by brown colour, and all results of the patient verified are shown by light blue colour. These colour quotations helps the user to easily identify the particular requisition.
- There is an also option for Total outpatient requisition in a day. For e.g. 55
- There is an option for refreshing the requisition or clearing any requisition from the list.
- It also includes an option for denoting any VIP patient in the list; it is shown by a dark pink colour.

Figure 5: Features of HIS:



- After selecting the particular requisition from the list then it shows the investigations related to that person only, it can also have more than one investigation.
- Regarding the patient information it includes-Requisition number, Patient name, age, sex and Hospital ID.
- Regarding information about investigations it includes Profile, Number of investigations, arrived status and location.
- In this screen particular investigation is shown by 3 different colours.

Investigation not done	
Investigation done	
Result verified	

Table-4- Features of HIS

- Pink colour denotes that investigation is not completed
- Yellow colour denotes that investigation is completed
- And green colour denotes that result of the investigation is verified by the Radiologist.
- After clicking on “investigation done” than it will ask to type the report.
- After typing the report it has options like- verify, review, save, delete, clear the text, exit and on the right hand side it will have the option for selecting reporting Doctor (here we can select up to 3 Doctors).
- If we clicked on “verify” than we cannot change the report but before verifying we can preview the report and can make required changes.
- After saving the report we can give the print command.

Benefits of HIS:

Current HIS is user-friendly and Radiology staff is very much familiar with the GUI of the HIS.

Colour coding of the investigations helps staff to identify the status of the investigations which enhance their efficiency.

It fulfills all the basic requirements of the radiology department.

Bottlenecks of HIS:

Current HIS is not integrated with radiology modalities, so patient information and investigation related information will not go to modalities automatically.

All the information related to the investigations done on patient is not included in the EHR of the patient.

The current HIS is not integrated with PACS so we cannot track the patient's visit in the Radiology Department and we cannot make out that the films reach the the current Radiologist or not.

Review of Features of VistA Radiology Module:

The Veterans Health Information Systems and Technology Architecture (VistA) Radiology / Nuclear Medicine package is a comprehensive software package, designed to assist with the functions related to processing patients for imaging examinations. The Radiology / Nuclear Medicine package automates the entire range of diagnostic functions performed in imaging departments.

The package is interfaced with VistA Record Tracking software for the purpose of tracking radiology and nuclear medicine records and creating pull lists for those records needed for scheduled clinic appointments. The VistA Radiology / Nuclear Medicine package is fully integrated with VA FileMan and provides certain patient demographic information supplied by the Patient Information Management System (PIMS).

It also interacts with other VistA packages to allow personnel to see patient medication histories, contrast media reactions, and laboratory test results which may influence the nature of an examination. Request entry has been incorporated in two ways: functionality within this package and an interface with the CPRS package, allowing on-line requesting of exams and viewing of reports. Information regarding each examination is stored by the system and may be compiled to produce a variety of reports necessary in carrying out daily business and for use by management in analyzing the workload. Information required to generate a variety of workload reports and resource allocation reports is also collected.

The VistA Radiology / Nuclear Medicine package supports the HL7 protocol. This allows the exchange of information concerning exam registration, cancellation, completion, and results (specifically reports and impressions) between the VistA system and clients within or outside of VistA.

The Radiology Med Total System menu is broken down into each of its sub-menus, and sometimes menus within the sub-menu, with a discussion of each option and examples of user/program interaction. This portion should be thought of and used as a reference guide to the options within the software.

Exam Entry/Edit Menu...

Films Reporting Menu...

Management Reports Menu...

Outside Films Registry Menu

Patient Profile Menu...

Radiology/Nuclear Medicine Order Entry Menu...

Supervisor Menu...

Switch Locations

Update Patient Record

Functional Description of VistA Radiology Module:

The Radiology/Nuclear Medicine package is designed to assist with the functions related to processing patients for imaging examinations. The types of imaging exams supported are General Radiology, Nuclear Medicine, CT scan, Magnetic Resonance Imaging (MRI), Angio/Neuro/Interventional, Ultrasound, Cardiology Studies, and Mammography.

Another important feature of this module is the ability to enter and edit information specific to radiopharmaceuticals for Nuclear Medicine. A new menu, Nuclear Medicine Setup Menu, under the Utility Files Maintenance Menu, allows the site to define parameters for radiopharmaceuticals concerning lot number, route, and site of administration, and source/vendor. The addition of radiopharmaceutical fields has a major affect on case and status edits for Nuclear Medicine and Cardiology Studies Imaging Types.

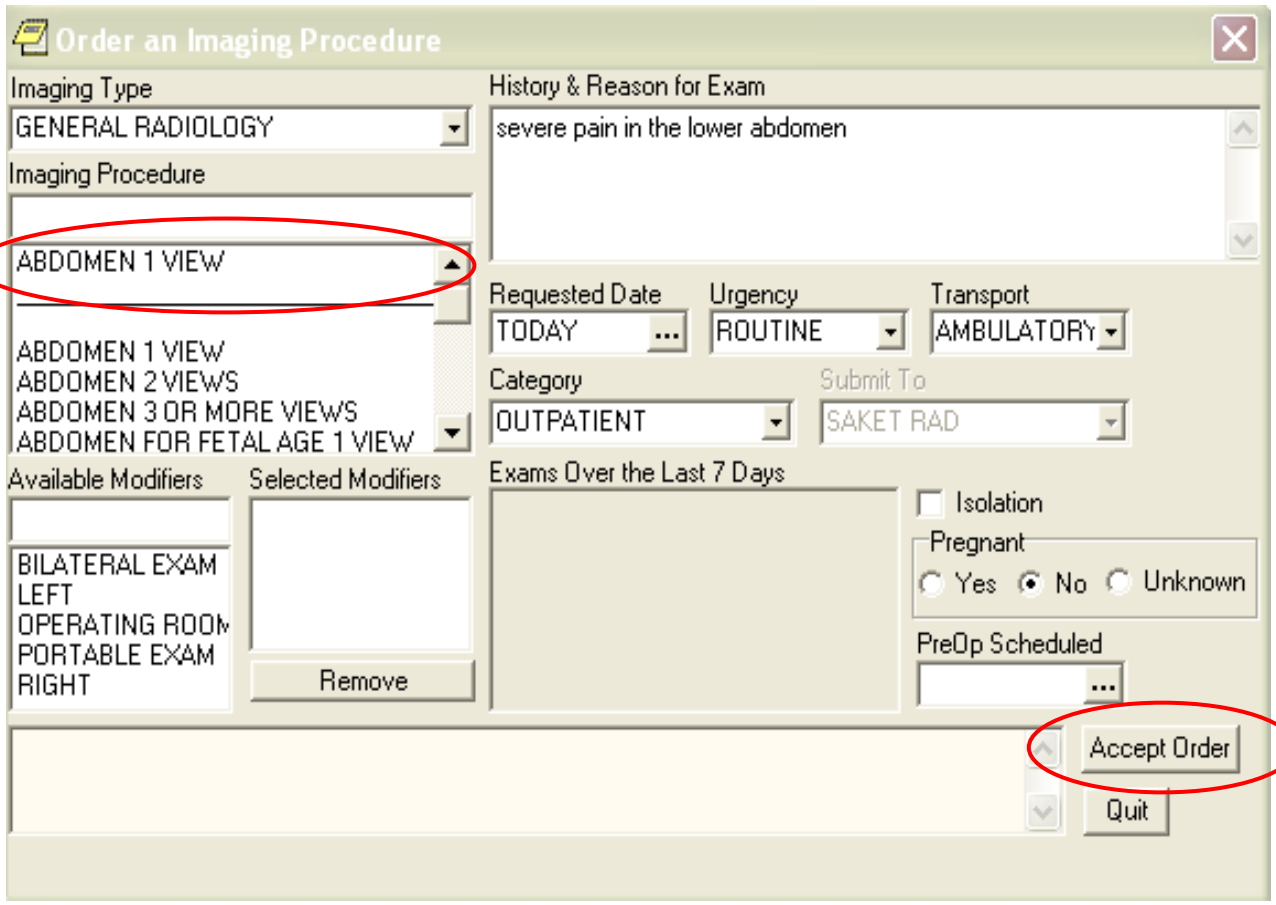
- On-line verification of "STAT" category requests
- Ability to select and print multiple reports
- Allows users to enter and edit examinations, and view patient demographic and examination data.
- Allows users to establish site-specific division, imaging location, and examination status parameters.
- Allows users to complete on-line verification of transcribed reports. Residents may also pre-verify transcribed reports on-line.
- Allows users to generate a variety of management statistics, including daily reports, functional and personnel workload reports, timeliness reports, and other special reports.
- Allows the grouping of results reports into distribution/routing queues which electronically distribute reports to hospital locations.
- Allows users to track registration and return of outside films.
- Allows users to print jacket labels, worksheets and flash cards.
- Allows users to initialize and maintain device specifications, timeout parameters and other IRM functions.
- Integrates with VA FileMan and captures certain patient demographic information supplied by the PIMS package.
- Interfaces with Computerized Patient Record System (CPRS) for entry of radiology/nuclear medicine requests, and display of results to clinical staff.
- Interfaces with the Record Tracking package for the purpose of tracking records and creating pull lists for those records needed for scheduled clinic appointments.
- Interfaces with the Patient Care Encounter (PCE) package for the purpose of crediting outpatient imaging workload.
- Interfaces with the Adverse Reaction Tracking package for the purpose of capturing and displaying contrast media allergies and reactions.
- Interfaces with the Health Summary package to print and display relevant medical history.

- Interfaces with the Imaging package to store Image IDs on reports, display 'i' in front of procedures for which Image IDs have been collected, provide HL7-formatted data upon exam registration, cancellation, completion, and report verification.

Allows the exchange of information concerning results (specifically reports and impressions) between the VistA and clinicians

Features of CPRS related to Radiology module:

Figure 6: Features of VistA-CPRS



- When a physician selects a particular patient in CPRS then for ordering an exam he have to click on orders and then have to select imaging order from there.
- Then a window will open named as "order an imaging procedure" here will be an option for imaging type where the physician will select General radiology.

- There will be many more options like imaging procedure, history and reason for exam, requested date, urgency, transport, category, submit to, option of “pregnant” for female patients, pre op schedule, accept order and quit.

- In imaging procedure physician can select procedures, in history and reason for exam he can write what is the reason for the exam, can select a date for that procedure.

- In urgency there are many options like ASAP, routine and STAT, in transport whether the patient is ambulatory, on stretcher, portable, or on wheelchair.

- In category physician may select whether the patient is employee of the hospital, inpatient, outpatient, contractor, sharing or research.

- In submit physician can select different location of the hospitals.

- At last physician will accept the order or he can quit.

- Then physician will sign the order for which he is assigned with a electronic signature, until and unless physician don’t sign the order the order will not go to the respective location.

Validation of the requirements:

Table 5: Validation of the requirements:

Client requirement	Alert on duplication of order before and after completion
Description	If a new order is placed before previously placed identical order is complete, the system must alert the ordering clinician of the same. The ordering clinician may choose to proceed with the new order or cancel it.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential** (Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes fulfilled by VistA**
Feasibility	Yes this requirement is feasible in VistA for this project.

Table 6:

Client requirement	Manual entry of order in modality
Description	A technician or a radiologist must be able to enter order details for a patient into the CT, MRI, Fluoroscopy, X-Ray and Ultrasound modalities.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes fulfilled by both HIS and VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 7:

Client requirement	Signing of addendum to report(s)
Description	A released report is made available to the patient, and is viewable in the patient EMR. Any changes to such a report is ideally prohibited, but must be tracked if inevitable. Therefore, all addendums to a report must be verified and signed by the concerned radiologist
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 8:

Client requirement	Verification of report
Description	Once a report has been prepared, it must be verified by the radiologist who reported on the particular procedure. If any correction has to be made, the report is edited accordingly. Once the report is verified for accuracy, it is signed by the radiologist and released to the patient and EMR.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 9:

Client requirement	Recording of time and resources during/after investigation
Description	A technologist or radiologist conducting the investigation must be able to record the following information: Contrast media used, Quantity of contrast media used, Film sizes used, Number of films used, Comments, Category. In addition to the above, the system must automatically include the following patient information: Name, Age, Sex, Date, Time in, Time out, Referring doctor, Performing Technician/radiologist, Registration Number.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 10:

Client requirement	Radiology reports from outside ABC incorporated into EMR
Description	A walk-in patient who wishes to avail consultation in ABC, and has radiology reports provided outside any of the ABC network hospitals, must have the report scanned into the patient EMR This is done to ensure the completeness of the patient EMR. The consultation is provided based on the reports and the radiology images, if any. The report must be handed back to the patient after use.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 11:

Client requirement	Radiology prescriptions from outside ABC scanned into EMR
Description	A walk-in patient who wishes to have radiology procedures performed at ABC, according to consultation and prescription provided outside any of the ABC network hospitals, must have his prescription scanned into the patient EMR
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 12:

Client requirement	Report will also be visible in Client HIS
Description	Once investigation is completed for an order, and report is created and verified by radiologist, it must be visible in ABC HIS for printing and dispatching purpose. The print of the report along with the reporting radiologist signature is dispatched to the report collection room for patients
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 13:

Client requirement	Radiology images from outside ABC must be incorporated into the EMR
Description	Any patient, who arrives at ABC network hospitals for consultation on diagnostic images acquired outside the ABC network facilities, must have the images incorporated into the EMR.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes fulfilled by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 14:

Client requirement	Payment refund on Order cancellation
Description	When an order has been cancelled, the patient must be provided full/partial refund, as per the policy, of the amount paid.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 15:

Client requirement	There must be a unique order ID from order stage to reporting stage
Description	When an order is placed in HIS/EMR, it must be uniquely identified by an order ID. An order must be easily tracked using this order ID as it proceeds from billing to acknowledgement to processing to reporting and finally to the completed stage.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both HIS and VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 16:

Client requirement	Recording of adverse reaction to contrast media
Description	Any adverse reaction to contrast media must be recorded in the patient EMR so that when an order requiring the administration of the same contrast media is placed for the patient, the order physician can be alerted.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 17:

Client requirement	Signing of report
Description	Once a report has been transcribed, it is verified by the radiologist for correction. Any changes suggested are incorporated and the corrected report is signed by the radiologist. Only a signed report is released. This report is then viewable in the patient EMR.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 18:

Client requirement	Optional review for CT and MRI reports
Description	Since CT and MRI procedures are expensive and critical, it may require a second opinion, especially when a junior or a new radiologist is conducting the procedure. In such cases a reporting radiologist performs reporting and signs the report and may assign a senior radiologist for review and signature.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 19:

Client requirement	Placing of Order
Description	An inpatient order is placed from a ward or an operation theatre by a nurse or physician. An outpatient order is placed from the emergency room or physician's clinic by a physician or a nurse. A walk-in order is placed from the radiology reception by a receptionist.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 20:

Client requirement	Radiology order placed is reflected in concerned modality.
Description	All orders placed from any of the entry points in the hospital (OP, IP, ER, walk-in) should automatically be reflected in the respective modality of the concerned imaging location pan ABC
Does HIS fulfill this requirement	**Yes, but for this the modality should be integrated with the HIS.**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by both VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 21:

Client requirement	Notification of abnormal/significant findings
Description	During the course of the investigation, if any significant finding is observed, an alert should be sent to the ordering/consulting physician in case of inpatient and outpatients. In case of walk-in patients referred from network hospitals, alert must be sent to the referring physician. The concerned clinicians can thereby plan the required treatment.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 22:

Client requirement	Order modification
Description	Order modification can be due to: 1. Complication during investigation (for example, patient having significant findings in lower abdomen while carrying out the USG for upper abdomen) 2. Some change in priority. 3. Change in modifier. 4. Change in date of investigation. 5. Change in contrast media.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 23:

Client requirement	Order modification justification
Description	Any order which requires any kind of modification (refer RAD-RAD-018) should be justified. A plain text field should be given where in the justification can be entered by the radiologist or the technician. This will confirm the actual requirement of modification.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 24:

Client requirement	Order cancellation
Description	Placed orders should be cancelled for the following reasons: 1. Patient non-cooperation because of physical discomfort 2. Error in order placement 3. Service is not rendered for any justified reason. 4. Change in imaging type, e.g.: If a radiologist recommends CT to a USG case.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 25:

Client requirement	Patient record must be available during CT, MRI and US
Description	For procedures like CT, MRI and USG radiologists or technicians require certain clinical details of the patient to proceed and relate to the findings. This can be achieved when the performer is given a provision to view the patient clinical history.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 26:

Client requirement	Transcription of report
Description	Once the images are ready, the radiologist should be able to report on image findings, which will be subsequently transcribed in the standard report template by the transcriptionist.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes both by VistA an HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 27:

Client requirement	A radiologist must be able to record his/her findings
Description	A patient undergoing any investigation in radiology will have images as an output. Subsequent to which a radiologist should be able to record his/ her findings so that a detailed study is available for the clinician to refer to and plan is further treatment plan, once the report is released by the radiology department.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 28:

Client requirement	Radiologist signature to be in ink on the report.
Description	All the reports that are handed over to the patients should be signed by the reporting radiologist. This ensures accuracy of the report and accountability in cases of legal issues. Therefore, all radiologists ensure precision while reporting and signing it.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 29:

Client requirement	All images must be acquired before radiologist starts reporting.
Description	Any procedure being performed in radiology will produce a series of images. All images of all series should be complete and sent to PACS before the radiologist sits for reporting. This will avoid any kind of discrepancies in reporting results. Also, it will curb the work duplication due to incomplete process.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 30:

Client requirement	Scheduling in advance
Description	The system should allow the scheduling to be done well in advance. This will help the patients in planning their procedures according to their convenience, and the radiology department in gearing up for the workload. Proper planning will lead to better patient turn up and avoid cancellations and rescheduling.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Conditional:** Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 31:

Client requirement	A unique identifier must be used across EMR, HIS and PACS
Description	Following through the path of order cycle: registration > order placement > order acknowledgement> processing> reporting> dispatch of report and image, a unique patient identifier should be used so that there is perfect management of each order and corresponding result.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 32:

Client requirement	Acknowledgement of report dispatch to patient.
Description	Once the report is verified and is ready for dispatch to the patient, it should be acknowledged in the system that the report has been handed over to the patient
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 33:

Client requirement	When a procedure is started/ completed in the modality, a status update must be sent to HIS and EMR.
Description	As and when any investigation proceeds in the concerned modality, it should correspondingly be reflected in the HIS and EMR. This will keep the professionals informed of the current status of the order procedure.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 34:

Client requirement	Duplicate order placement justification.
Description	There are certain investigations which require multiple ordering to keep a check on the trend of the results obtained. This helps the clinicians to be aware of the most recent results and proceed as per the requirement. So, any time the clinician reorders the same investigation, the concerned has to write in the justification for it, which will be maintained in the patient record.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 35:

Client requirement	Advance payment at the time of order scheduling as per the hospital policy
Description	During scheduling through the call centre/front office/radiology reception, an advance payment must be charged from the patients so that they do not miss on their schedules or compensation in case of no-show. This ensures efficient management of scheduled and walk-in patients. Also, the amount to be charged will be decided by the hospital policy.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Optional:** Implies a function that may or may not be worthwhile
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 36:

Client requirement	Single sign on for HIS, EMR and PACS
Description	Single sign-on enables users such as physicians, nurses and radiologists to use single login credentials for any of the systems. Subsequent navigation to any of the other two systems will not require the user to provide login credentials again.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 37:

Client requirement	Mandatory fields of an order
Description	Any order which is placed for the processing should have some mandatory data like: Name of the patient , Age, Sex, Unique-ID, Procedure name , Date and time of placement of order , Referring consultant, Imaging location(like CT-Scan, X ray etc), History and reason for exam, Pregnancy in case of female patient. Necessary inpatient information like: Admission Date, name of the ward , Bed number, Attending physician Orders having the above data make the order complete which helps in proceeding with investigations with minimum ambiguity..
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 38:

Client requirement	Alert on ordering CECT/MRI for serum creatinine and blood urea
Description	Blood urea and Serum creatinine level should be known to a radiology technician to perform CECT/MRI. To avoid unnecessary rescheduling and cancellation, the department will be well informed of the patient's laboratory and clinical details, thereby leading to efficient performance of procedure..
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential (**Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.)
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 39:

Client requirement	Allergy alert on order placement
Description	Patient allergy should be recorded in EMR. On order placement the clinician is alerted of any associated allergic reactions to the order
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Conditional:** Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 40:

Client requirement	Signing of order
Description	Nurse or Physician placing an order need to sign the order before order goes into processing stage. Signing an order will help to keep a track on who has placed a particular order..
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 41:

Client requirement	Bulk signing of patient order
Description	There should be an option where doctor can order all the required investigations for a patient. After ordering he selects all the placed orders and signs them. This will help in saving time and increasing the productivity of the system and professionals involved.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Essential**: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 42:

Client requirement	Rescheduling or cancellation of scheduled order
Description	Rescheduling or cancellation of an order can be done due to any of the below mentioned reasons: Patient seeking rescheduling due to personal reason. In case of CECT/MRI pre requisite lab test result not done or not within limit. Availability of associated clinician like paediatrician
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 43:

Client requirement	Order cancellation justification
Description	There are some times when a placed order needs to be cancelled by the physician or nurse. The placed orders are cancelled due to many reasons like wrong interpretation by the clinician, wrong procedure selection, unavailability of some required pre-requisite test etc. In any of the above condition clinician need to cancel the order. While cancelling he needs to justify by giving reason.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Optional**: Implies a function that may or may not be worthwhile
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 44:

Client requirement	Report Templates
Description	Radiology report template contains result and impression. This report template can be selected as per the investigation, while reporting, and necessary editions can be done. For an example when reporting for a case say "CT Scan Head" a standard report with name "CT Scan Head" can be selected and edited.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 45:

Client requirement	Impression can be a part of the radiology reporting template
Description	Impression on report gives quick conclusion to physician or nurse. For example, a report which contains impression like "normal finding" helps the clinician to conclude on the case easily without going through the entire report. This helps in saving time and increasing the productivity of the system and professional involved.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Optional:** Implies a function that may or may not be worthwhile
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 46:

Client requirement	Notification on order completion
Description	The ordering physician must be notified of a completed order so that he may proceed with a focused treatment plan accordingly
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 47:

Client requirement	Addendum to released report
Description	Any report released by the radiology department must have the facility to make an addendum to it. There are many a time when a report released is not complete ,correct or some new findings has been observed .In order to incorporate these findings in the report a facility of amendment of reports is required.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 48:

Client requirement	MIS Reports
Description	To know the statistics of the radiology department MIS report for example 1. Number of inpatient and outpatient --Date wise. 2. Number of investigation done - Date wise. 3. Number of investigation done –modality wise. 4. Number of investigation done -location wise. 5. Reports on number of reporting done and verified by a particular radiologist .-Date wise 6. List of Reports Pending for verification. 7. List of reports verified.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential**: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 49:

Client requirement	Images acquired at any ABClocation must be available in patient EMR
Description	A patient must have one EMR pan-ABC. Images acquired during the course of treatment in any of the ABC network hospitals, should be available pan-ABC as a part of patient EMR for consultation , reporting and clinical reference
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 50:

Client requirement	There must be storage for PACS images for duration to be decided by the hospital policy.
Description	All images acquired during the investigation must be stored in PACS for a duration defined by the hospital. The storing of images is done to achieve the medical requirement of the hospital and for future study and analysis. This will help in treatment plan for other similar cases, and the trend analysis of the same case.
Does HIS fulfill this requirement	**Yes**
NOTE	**PACS to be implemented**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 51:

Client requirement	Non-DICOM images should be stored and viewed in PACS
Description	PACS should store all the Non-DICOM images such as JPEG/AVI/MPEG, acquired during patient investigation .For example; ECG graphs are stored as binary data. This must also be incorporated into EMR to ensure completeness of the patient record.
Does HIS fulfill this requirement	**Yes**
NOTE	**PACS to be implemented**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 52:

Client requirement	Order scheduling
Description	Once an order is placed, it is scheduled for investigation. Scheduling involves a specific slot booking for a particular patient. This enables planning of radiology work load for a day. Partial payment is made at the time of order scheduling
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 53:

Client requirement	Lossless compression of images during primary archival
Description	Loss less compression of images to be employed to preserve the quality of images for the primary archival.
Does HIS fulfill this requirement	**No**
NOTE	**PACS should be implemented**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**YES**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 54:

Client requirement	Redundancy on archived media and location
Description	Redundant archiving will comprise of two long-term archives. In case the cost is prohibitive, one of the following two approaches(instead of deleting data) will be considered: (a) Use loss compression in the redundant copy (b) Use tape-archive for the redundant copy
Does HIS fulfill this requirement	
NOTE	**PACS to be implemented**
Does VistA fulfill this requirement	
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 55:

Client requirement	DICOM images must be stored in PACS
Description	PACS should store all the DICOM images such as CT, MRI etc acquired during patient investigation.
Does HIS fulfill this requirement	**Integration with PACS**
NOTE	**PACS should be implemented**
Does VistA fulfill this requirement	**Integration with PACS**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 56:

Client requirement	Reports must be formatted as per Client Hospital standards.
Description	The reports from radiology department should have a standard layout, where in the formatting and sequencing will be as per the decision made by the hospital policy.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 57:

Client requirement	The system must make provisions for teleradiology
Description	The system should be able to handle outsourcing if required byABC. A radiologist should be able to report on images irrespective of his location.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**No**
Priority	**Conditional:** Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present
Requirement fulfilled or not	**No**
Feasibility	**No this requirement is not feasible in VistA for this project.**

Table 58:

Client requirement	Report access restriction to the attending physicians
Description	The reports must first be made available to the attending physician. Depending on the hospital policy the report will then be accessible to other physicians after it has been viewed by the attending physician, or after a defined time limit.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 59:

Client requirement	Release of interim report in case of emergency
Description	In routine cases the image and verified report release takes a period of time. In cases of emergency, where the clinicians need to plan their line of treatment as soon as possible, an interim report should be released form the radiology department so that any kind of delay is avoided and patient care is not hampered.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 60:

Client requirement	There must be a provision to provide soft copies of diagnostic study to the patients
Description	There must be a provision to provide diagnostic images to the patients as CDs/ emails. Single system should be in place in the radiology department and authorized person must be allowed to do it.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 61:

Client requirement	Diagnostic images must be made accessible to all the authorized clinicians immediately after acquisition
Description	The reports from radiology department should have a standard layout, where in the formatting and sequencing will be as per the decision made by the hospital policy.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 62:

Client requirement	In case of report dispatch to inpatients, acknowledgement must be entered by the recipient in the system.
Description	In case of inpatients the recipient should acknowledge the receipt of the report in the system. This will help in streamlining dispatch process, and will help in minimizing loss of reports and enable better handling of transferred patients.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 63:

Client requirement	Remote access to patient EMR should be made available
Description	There are times, when clinicians are not present at the desired hospital location. For clinicians to view the patient record even from remote locations should be possible so that they can enter the required subsequent orders for the patients and avoid any delay in treatment action for patients.
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 64:

Client requirement	Radiologist must be able to classify report as normal or abnormal/significant finding.
Description	At the time of reporting the radiologist must be able to classify report as normal or abnormal/significant findings. This classification will help highlighting the need of immediate care if required to the attending clinician.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes both by VistA and HIS**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 65:

Client requirement	The radiologist must be able to restrict access to confidential reports.
Description	A radiologist must be able to restrict access to reports that he feels must be kept confidential, such as VIP patient, medico-legal cases etc
Does HIS fulfill this requirement	**No**
Does VistA fulfill this requirement	**Yes**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by VistA**
Feasibility	**Yes this requirement is feasible in VistA for this project.**

Table 66:

Client requirement	Billing of the Orders
Description	Billing for the orders placed by the physician should be possible.
Does HIS fulfill this requirement	**Yes**
Does VistA fulfill this requirement	**No**
Priority	**Essential:** Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner.
Requirement fulfilled or not	**Yes by HIS**
Feasibility	**No this requirement is not feasible in VistA for this project.**

5. RESULTS:

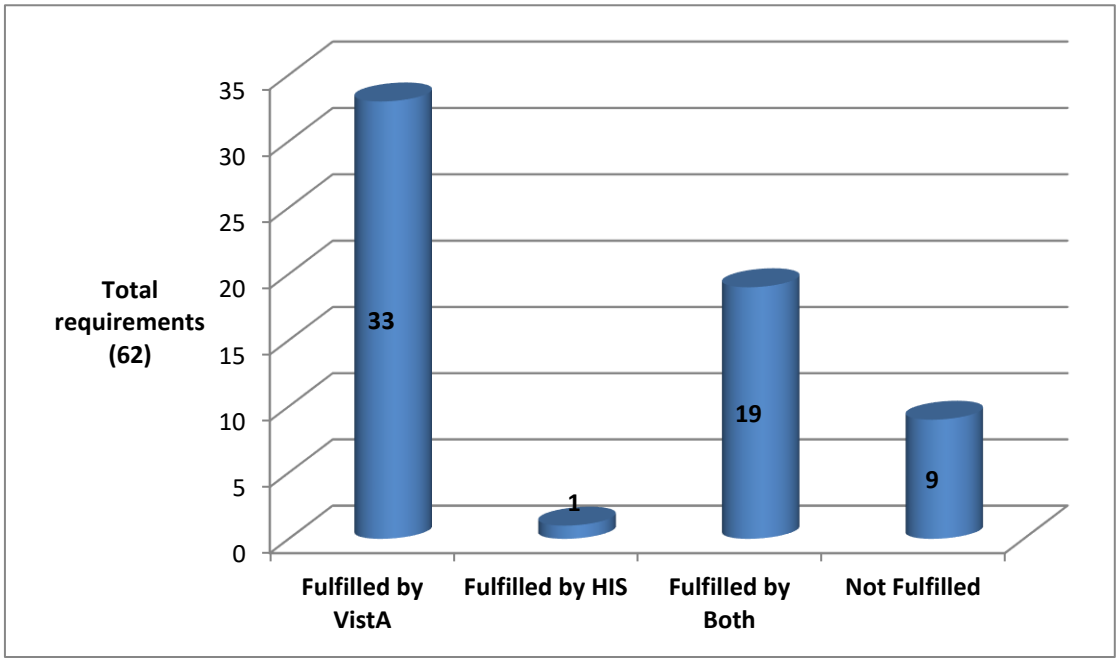


Figure-7 Results of the requirements

The above graph shows the total requirements of client that are 62 in number.

Out of 62 requirements, 33 are fulfilled by VistA, 1 is fulfilled by HIS and 19 are fulfilled by both the software's. 9 are not fulfilled by either.

Therefore it means that out of the total 62 requirements, 52 requirements (84%) are fulfilled by VistA and 20 are fulfilled by HIS. Which means only 10 requirements are not fulfilled by VistA.

Results on the basis of the priority of the requirements:

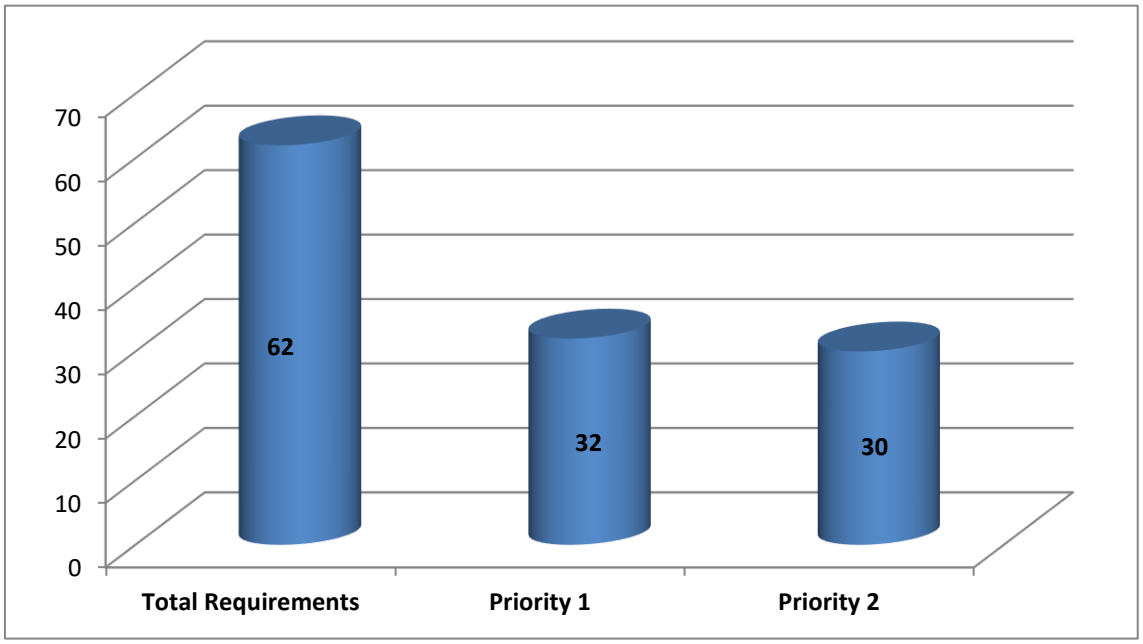


Figure-8 Results of the requirements

Total requirements of the client are 62 out of which 32 requirements are **Priority 1** and 30 requirements are **Priority 2**.

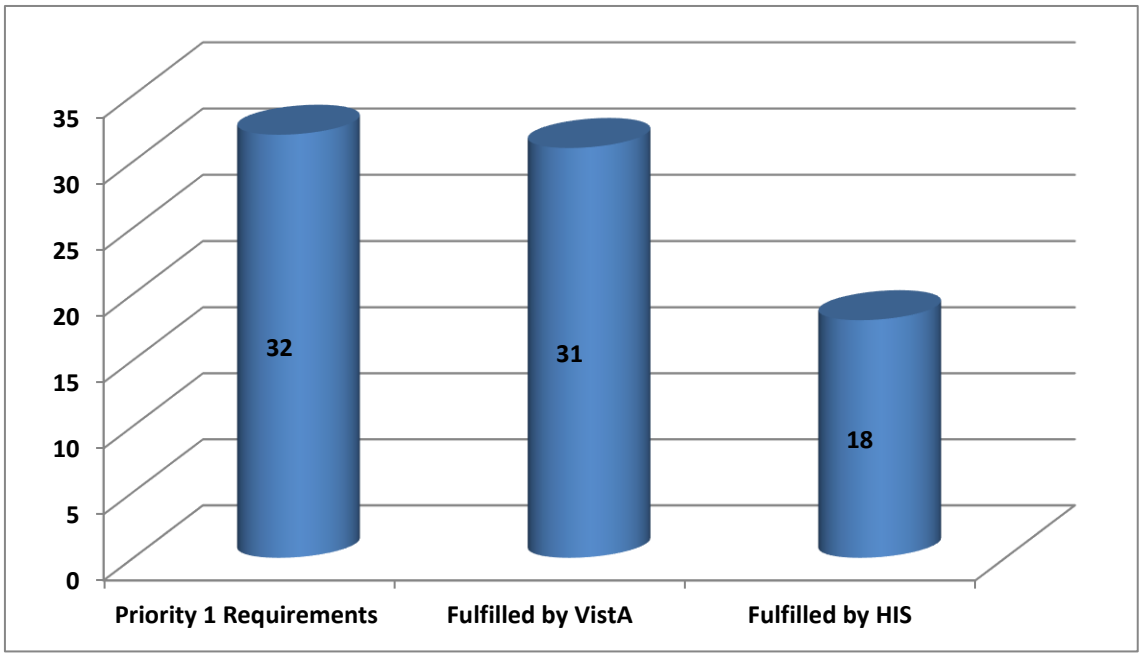


Figure-9 Results of the Requirements

The above graph shows the total number of **Priority 1** requirements of clients that are 32 in number, out of which 31 are fulfilled by VistA, leaving just 1 requirement unfulfilled. HIS fulfills 18 out of 32 requirements.

BOTTLENECKS

Requirements which are not fulfilled by both the software are:

- Radiology reports from outside the Hospital incorporated into EMR.
  -This feature is not present in both the software, to incorporate patient images from outside the Hospital needs to be scanned first and then to be attached with the patient EHR but this option is not present in VistA.

- Radiology prescriptions from outside the Hospital scanned into EMR
  -As mentioned above this option is also not present in both the software.

- Payment refund on Order cancellation.
  -This is possible but you have to do it manually, there is no option for this which means that data related to this requirement can't be recorded in the system.

- Recording of adverse reaction to contrast media.
  Only type of contrast media can be recorded in VistA and there no such option in HIS.

- Order modification
  Once the order is placed it is not possible to modify that, if modification is needed than physician has to give another order.

- Order modification justification.
  Not possible without order modification

- Advance payment at the time of order scheduling as per the hospital policy.

It can be done but the record for this have to be maintained manually

- Single sign on for HIS, EMR and PACS.

  The user has to sign differently on all the different modalities

- The system must make provisions for teleradiology.

  There is no option for teleradiology in the system.

Results which can be used for negotiation of the unfulfilled requirements with the client:

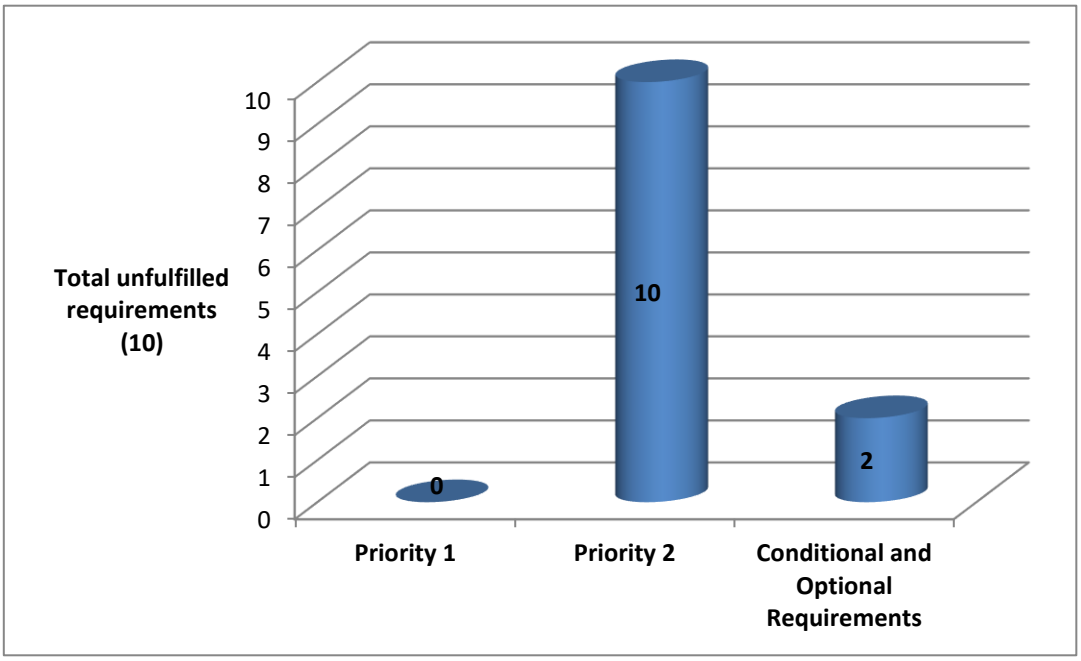


Figure-10 Results of the requirements

Above graph shows the total unfulfilled requirements which are **essential** in nature and are 10 in number. All of these requirements that are not fulfilled by VistA are **Priority 2** requirements (least required by the client). 2 out of 10 requirements are **Conditional** and **Optional**. Therefore, the vendor only needs to negotiate for the 8 essential requirements that are left unfulfilled.

What can be the Challenges in VistA radiology implementation?

1. Client's requirements are not matching with features of VistA Radiology completely.
2. Integration of both HIS and VistA Radiology and with other 3rd party software's like billing, PACS etc.
3. The present staff is proficient with HIS so it is a challenge to change the mindset of the end-users for using GUI/Roll and Scroll for VistA radiology module.
4. Customization in VistA Radiology according to client's requirements is not possible because VistA is open source software, so if any changes will be done in coding than it will affect the whole software.

6. CONCLUSION:

Requirement analysis is one of the most important steps for implementing any software. A thorough analysis of each and every requirement helps us to know whether the software that is going to be implemented fulfills all the requirements or not. Service provider has to ensure that sufficient time is spent at the beginning of the project on understanding the objectives, deliverables and scope of the project.

Based on Requirement Analysis, the above study helped in deciding whether to implement the VistA software in the Radiology Department of the Super specialty Hospital or not.

The results of the study show that all the requirements are not fulfilled by this software completely, so the client has the right to choose the possible solution for the unfulfilled requirements and as a vendor we need to suggest the client that all the requirements can never be fulfilled by any software and one has to compromise for some of the requirements.

The results from the study also depict that almost all the basic requirements of the client are fulfilled by VistA so client can easily go for the implementation of the VistA.

And it is also assumed that Turnaround Time (TAT) for the X-ray can be reduced to 60%, 30% for CT and 25% for MRI.

7. RECOMMENDATIONS:

As the results show that all the requirements are not fulfilled by the software, so it is necessary to give a better possible solution to the client. Possible solutions can be:

- The service provider can ask the client whether the unfulfilled requirements are negotiable or not, if not than what will be the impact of these requirements on the radiology department and the hospital.
- It is also suggested that, if it is possible by the client to customize the current HIS for the requirements which are not fulfilled.
- As billing is not provided by the VistA so it is suggested that, client can use the current HIS for billing purposes.
- We also noticed that some of the requirements need advanced modalities like MRI, CT- SCAN, DIGITAL X-RAY, and PACS, so client has to make sure that he is using all the updated modalities.

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D. Annexures

1. Radiology Requirements:

RAD-RAD-003	Alert on duplication of order before completion	
Aim	A check must be imposed on replicating an order placed.	
Description	If a new order is placed before previously placed identical order is complete, the system must alert the ordering clinician of the same. The ordering clinician may choose to proceed with the new order or cancel it.	
Users	Radiologist, Physician, Nurse	
Frequency	3	1. Once only 2. Once per pt. only/Low 3. Every Visit/Moderate 4. Multiple/High
Remarks	**Customer Remarks**	**Analysts' remarks**
	[MJ:020210] There should also be an alert on duplication of order after completion.	
Integration touch points	No integration point if there is master data sync up. Gap added for it.	
Priority	E	* E- Essential: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner. * C-Conditional: Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present * O-Optional: Implies a function that may or may not be worthwhile

Sign (Team Lead, DELL)	Sign (Head of the dept., Max Group of Hospitals)
For Internal Use only	
Is the requirement clear?	
HIS Input	
VistA Input	

Is it is feasible to provide this req		Y: Yes, without any additional effort E: Possible to provide with extra effort in coding or config N: Not feasible NR: Not recommended
Give reasons for above		

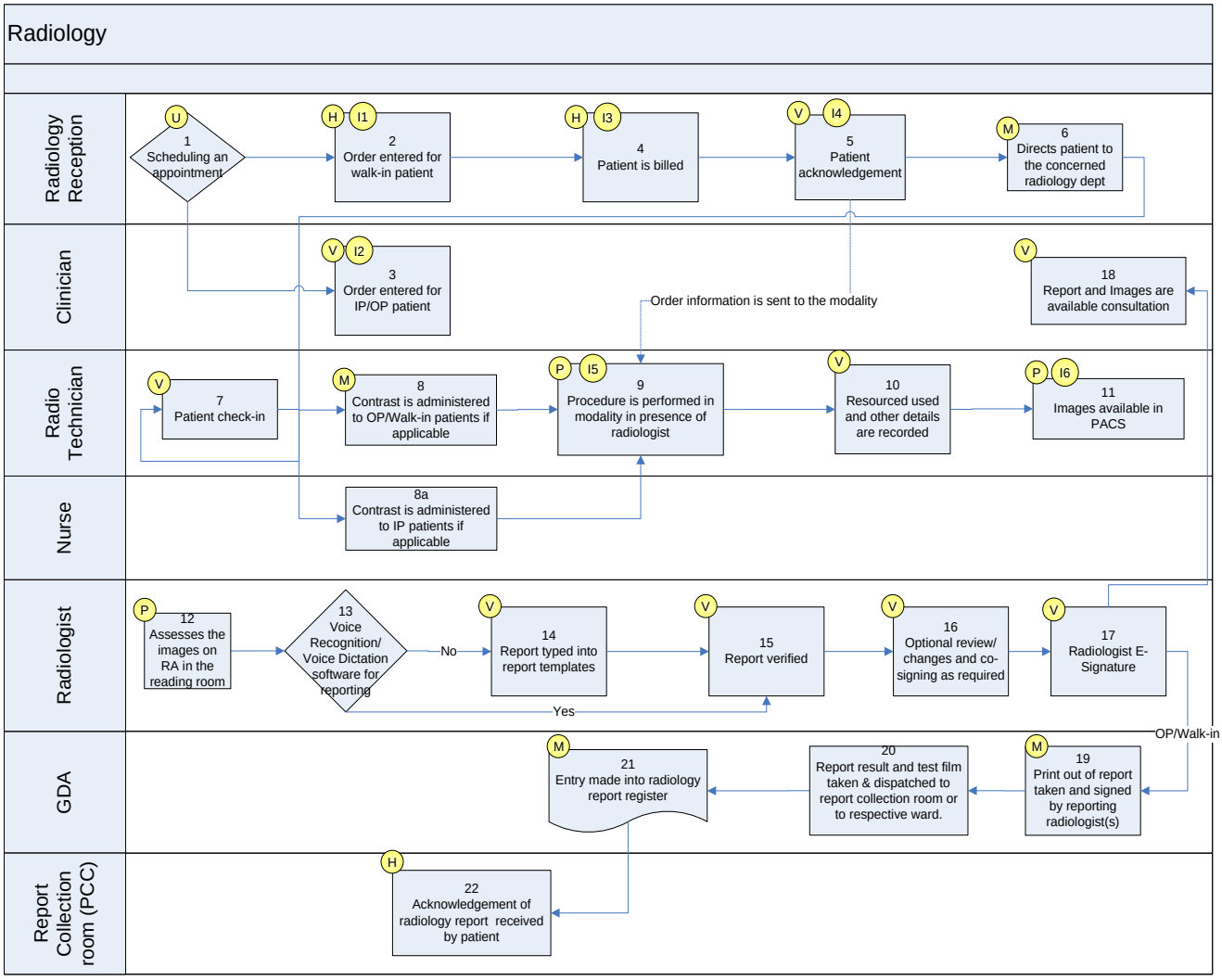
RAD-RAD-008	Billing of Order	
Aim	An order must be billed prior to order processing.	
Description	An outpatient, inpatient or walk-in order must be billed before it can be processed. An exceptional case is an order that is modified at the time of investigation and performed immediately. Billing of such an order is done after the procedure is completed. [Refer RAD-RAD-018]	
Users	Front office assistant, radiology receptionist, ward nurse	
Frequency	4	1. Once only 2. Once per pt. only/Low 3. Every Visit/Moderate 4. Multiple/High
Remarks	**Customer Remarks**	**Analysts' remarks**
Integration touch points	A Radiology order will be placed from HIS or VistA. In each case, a message has to be sent from one system to another. If placed in VistA, should be sent to HIS for billing. If the order is placed in HIS, should be sent to billing and VistA in parallel. Integration point identified.	
Priority	E	* E- Essential: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner. * C-Conditional: Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present * O-Optional: Implies a function that may or may not be worthwhile
Sign (Team Lead, DELL)		Sign (Head of the dept., Max Group of Hospitals)
For Internal Use only		
Is the requirement clear?		

HIS Input		
VistA Input		
Is it is feasible to provide this req		Y: Yes, without any additional effort E: Possible to provide with extra effort in coding or config N: Not feasible NR: Not recommended
Give reasons for above		

RAD-RAD-008	Billing of Order	
Aim	An order must be billed prior to order processing.	
Description	An outpatient, inpatient or walk-in order must be billed before it can be processed. An exceptional case is an order that is modified at the time of investigation and performed immediately. Billing of such an order is done after the procedure is completed. [Refer RAD-RAD-018]	
Users	Front office assistant, radiology receptionist, ward nurse	
Frequency	4	1. Once only 2. Once per pt. only/Low 3. Every Visit/Moderate 4. Multiple/High
Remarks	**Customer Remarks**	**Analysts' remarks**
Integration touch points	A Radiology order will be placed from HIS or VistA. In each case, a message has to be sent from one system to another. If placed in VistA, should be sent to HIS for billing. If the order is placed in HIS, should be sent to billing and VistA in parallel. Integration point identified.	
Priority	E	* E- Essential: Implies that software will not be acceptable unless the requirements are provided in an agreed upon manner. * C-Conditional: Implies these are requirements that would enhance the software product; would not make the product unacceptable if they are not present * O-Optional: Implies a function that may or may not be worthwhile
Sign (Team Lead, DELL)		Sign (Head of the dept., Max Group of Hospitals)

For Internal Use only		
Is the requirement clear?		
HIS Input		
VistA Input		
Is it is feasible to provide this req		Y: Yes, without any additional effort E: Possible to provide with extra effort in coding or config N: Not feasible NR: Not recommended
Give reasons for above		

2. Radiology workflow (VistA-EHR)



3. Evaluation of Medical Record use in Radiology Department: Questionnaire

In this questionnaire, we would like to know about your use of and perception of the electronic medical record in your hospital with special focus on the stakeholders of the radiology department. By electronic medical record, we mean one of the computer software systems that are used by the hospital to record patient information.

This questionnaire is meant only for a survey to be conducted for the evaluation of EMR and to evaluate the satisfaction level of the hospitals using EMR. We hereby assure you that your replies are strictly confidential and will not cause harm to you or your hospital/healthcare organization in any way.

Name of Audit Lead:

Date:

1. Are you a:

(a) Radiology staff (b) Administrative Staff (c) Medical Professionals

2. Are you of aware of computerization in your healthcare organization/hospital?

YES NO

3. Is your Hospital / Healthcare centre computerized?

YES NO

4. Is your Radiology Department equipped by latest modalities like X-Ray, MRI and CT-Scan?

YES NO

5. Is your hospital/healthcare centre having HIS/HMIS?

YES NO

6. Is your hospital/healthcare centre having EMR/EHR?

YES NO

If yes, please specify?

7. Is your hospital/healthcare center using PACS?

YES NO

8. Is PACS integrated with HIS or RIS?

YES NO

9. How often do you use the electronic medical record (EMR) to assist you with the following tasks? Please answer by checking one of the alternatives in column 1-5.

		1	2	3	4	5
S No.	**Statement**	**Never/ Almost never**	**Seldom**	**About half of the occasions**	**Most of the occasions**	**Always/ Almost always**
1	Review the patient's problems					
2	Seek out specific information from patient records					
3	Obtain an order for new test or investigations					
4	Enter the results of a particular test or investigation over time					
5	Follow the results of a particular test or investigation over time					
6	Enter daily radiology notes					
7	Obtain Order of X-ray, ultrasound or CT investigations					
8	Enter the results from X-ray, ultrasound or CT investigations					
9	Order modification/ cancellation					

10	Scheduling in advance					
11	Signing of order					
12	Classify report as normal or abnormal/significant finding.					
13	Restrict access to confidential reports					
14	Billing of orders					
	CONTENT					
1	How often does the system provide the precise information you need?					
2	How often does the information content meet your needs?					
3	How often does the system provide reports that seem to be just about exactly what you need?					
4	How often does the system provide sufficient information?					
	EASE OF USE					
1	How often is the system user-friendly?					
2	How often is the system easy to use?					

	TIMELINESS					
1	How often do you get the information you need in time?					
2	How often does the system provide up-to-date information?					

10. Your opinion about the electronic medical record in radiology department, all considered.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
1. How much do you agree with the following statement: EMR is worth the time and effort required to use it					
	Significantly decreased	**Decreased**	**No change**	**Increased**	**Significantly increased**
2. All considered, the quality of our department's work has become					
	Non-existent	**Poor**	**Fair**	**Good**	**Excellent**
3. All considered, how would you rate the success of the EMR system installed in your department?					

11. COMMENTS: