An operational analysis of a new medical imaging department

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M.Sc. Health Services Management
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Dissertation in part fulfilment of the Masters in Health Sciences – Health Services Management.
Declaration of authenticity

I, the undersigned, hereby declare that this dissertation is my own original work, gathered and utilised for the purposes and objectives of the study, and has not been submitted for any other degree. I also declare that the literature cited in this work has been personally consulted and that unless otherwise stated all conclusions are mine.

CHRISTIAN AXIAK

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[Supervisor's Signature]

H. AGIUS MUSCAT

Supervisor
Abstract

The aim of this study was to establish what is already known within current work practices of the Medical Imaging Department of Mater Dei Hospital, consolidate and formalise practices such that they are transparent enough to be analysed critically, assess options for improvement or change and propose improvements in workflow.

The approach taken for data collection was a one-to-one interview approach that enabled the researcher to retrieve as much information as possible from every contributor. Interviewees included radiologists, radiographers, clerks, transcriptionists, sectional administrators, managers and last but not least patients.

Data gathered was compiled to assess effectiveness and efficiency of current practices and suggestions for improvement, all based on experience of the various stakeholders. It was found that processes and requirements varied with the different sections within the Medical Imaging Department. Operations were analysed on the basis of effectiveness, efficiency, patient satisfaction, responsiveness, accessibility and waiting lists in scheduling, synchronisation of appointments to reduce waiting room congestion, quick reporting and effective notification. The researcher used an approach which included process, organizational, information and operation perspectives, and also an integration of all approaches. The researcher also introduced a socio-cultural perspective to put the study into context.

The service provided is effective overall and patients' complaints are low. With regards to efficiency, suggestions for added staff were made particularly in the number of radiologists and also to a lesser extent radiographers in many areas. Further improvements are suggested in the scheduling lists and opening times for service outlets. The waiting lists for elective investigations, in theory, can be reduced in many areas, however increased resources are required. It was also suggested that economic evaluation will benefit the Medical Imaging Department, in the long term and it was suggested that to reduce demand on services, there should be meticulous screening of requests.
...to all my family for their love, and patience. Thanks primarily to Sonia for her support and encouragement, and to my children Nathan, Lauren and my late daughter Juliet who I am sure has a say in the miracle of life and my family. Juliet, you are loved very much by all!

&

...to my late grandparents Nanna Tessie and Nannu Frans who I miss very much. Thanks to them for my strong principles and a great love for music.
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Chapter 1: Introduction

1.1 Title:
An operational analysis of a new medical imaging department.

1.2 Statement of the problem
St Luke’s Hospital, a national hospital that served the Maltese population to meet its health requirement, was going to be migrated to a new location. A new hospital was constructed and equipped with state-of-the-art technology to meet developments in medicine that were not feasible within the previous hospital setup. The new hospital was called Mater Dei Hospital. A major development within the new hospital was the implementation of a completely digital medical imaging department.

Mater Dei Hospital started receiving patients on the 12th of November 2007. St Luke’s Hospital was equipped to meet all patients’ needs but with a technical infrastructure in which there was little investment for a decade in expectation of the migration to the new hospital. The new hospital is equipped with digital systems which are interfaced among themselves. The staff that previously worked in the old hospital was trained and used to working in an environment where records were kept on paper, medical images were printed on X-ray films and developed in a dark room, messages were sent in writing and by hand, and so on.

Previously, staff used old equipment, protocols, workflows and professional competencies. These changes required staff to learn and acquire new skills. These skills were acquired just prior to the migration and while services were still running in the old hospital. The training was basic and short (200 employees were trained within 55 calendar days, i.e. around 8 working weeks) due to limited timeframes imposed for the migration process; it covered basic operational skills to start operations in the new hospital without depriving the old one from the necessary staff.
This study will explore the operational processes which were established at Mater Dei hospital following this training and migration process and suggest how these may be optimised. It will also look at staff awareness and the adequacy of staff training.

1.3 Research questions:
1. How can operations in a new medical imaging department be optimised?
2. Are staff members aware of the workflow pattern in the new medical imaging department?
3. Is the staff trained adequately for the new operational system?
1.4 Aims:
1. To explore strengths and weaknesses in the daily operations of the new medical imaging department.
2. To suggest improvements based on current literature and findings from this study.

1.5 Objectives:
1. To document workflow pathways in the new medical imaging department.
2. To record strengths and weaknesses as perceived by staff within the department.
3. To explore training and competencies of staff in digital medical imaging.
4. To propose areas of improvement in workflow and operations based on this study's findings and current literature.

1.6 Literature Review outline
The literature review will outline some definitions of workflow. This will then be discussed within the context of a medical imaging department. The change from an analogue to a digital department will be discussed together with their advantages and disadvantages. This will then be followed by relevant frameworks used to analyse workflows pathways, patterns and practices within any department.

1.7 Methodology
The methodology chapter will outline the type of study being carried out. It will also account for the people who will be involved in this study and what tools will be used to collect data from them. Justification for the use of these tools will also be given and rational for the selection of the methods of data collection explained. Issues regarding permissions and data protection will be accounted for.

1.8 Presentation of results
- Operational workflow charts were compiled by the researcher to show the sequences of processes followed in the medical imaging department.
• Tables were retrieved from the software package accompanying the RIS PACS system in operation. From these tables, graphs were plotted to show the following:
  i. Workload distribution over a year;
  ii. Request-to-report times;
  iii. Waiting lists;
  iv. Referral rates.

1.9 Data Analysis
All data collected were structured around the predetermined workflow pathway flowcharts that were built for the scope of this study. These flowcharts represented the full operational process of the Medical Imaging Department and were built specifically to increase the understanding of the processes involved in the department's operational workflow. In this way, the researcher could address the various sections of the workflow in a more comprehensive way.

A questionnaire was given to the patients and the responses of this questionnaire were recorded on a Likert scale (1=not at all, 2=very little, 3=satisfactory, 4=quite a lot, 5=very much). The questionnaire that was used was used previously in another study (Axiak 2006) that was carried out within the same department and addressed patient satisfaction with a paediatric radiography service. The tool could be used within this study since the environment and scope for it were similar. Pearson's correlation coefficient was calculated to measure the significance of patient satisfaction resulting from the determinants that were questioned in the form. The responses to the questionnaires were presented as percentages since, the sample number was of 100 patients and secondly it only measured one the many aspects of operational processes, patient satisfaction with the delivery of the service.

1.10 Discussion
Following a discussion of findings, recommendations were made for possible improvements in the department. Conclusions were drawn according to the findings. Further studies were recommended accordingly.
1.11 Justification

The Medical Imaging Department has been in operation in a conventional analogue format for a number of years. The medical imaging and radiography professions have established themselves over the years in the conventional scenario. The changeover process from a conventional to a digital system may have brought insecurities since previous experience in daily operations needs to be unlearnt and new processes adopted. This also involves new skills and competencies.
Chapter 2: Literature Review
2.1 Introduction

This chapter will account for the literature that has been sought for this study. These articles will be used to define and explain terms used in the dissertation and also to explore other research that were carried out in other locations, their findings, scientific value and finally their relevance to the local scenario.

2.2 Definitions of workflow

“Workflow is the automation of a business process, in whole or part, during which documents, information or work items are passed from one participant to another for action, according to a set of procedural rules.”

(Wendler and Loef, 2001).

The definition of workflow as stated by the ZDNet dictionary (http://dictionary.zdnet.com/definition/Workflow.html; accessed November 2008) states that it involves the automatic routing of documents to users responsible for working on them. This implies that it defines pathways followed so that relevant information is supplied in advance to support each step of the business process. The information can be moved either physically or via electronic databases. In the latter case, users are given exclusive privileges to access the required information, thus limiting users from accessing data that is not relevant to the scope of their job.

ZDNet dictionary also admits that the manual movement of documents to support workflow is prone to errors; documents can get lost, or shuffled. In automated workflows, data moves according to a prescribed pace and chronology. The inclusion of software in an integrated workflow may require a lot of programming to accommodate various routines. Suppliers have to team up with workflow experts to provide appropriate interfaces that accommodate required routines.

The definition given by Yahoo’s (http://www.answers.com/topic/workflow?cat=biz-fin; accessed November 2008) answers online service states that:
1. "The flow or progress of work done by a company, industry, department, or person",
2. "The rate at which such flow or progress takes place"

The first definition relates to operational processes whereas the second definition refers to turnover time, which is more related to how long it takes a beneficiary (patient) to get served. The first definition of workflow will be adhered to for the scope of this study.

A workflow (Employers' Resource Centre, 2009) consists of a sequence of connected steps. It is a description of a sequence of operations, declared as work of a person, a group of persons, an organization of staff, or one or more simple or complex mechanisms. Workflow may be seen as any abstract of real work, as part of an more complex group of processes, division of jobs or other sequences of procedures. For control purposes, workflow may be a view on real work under a chosen aspect, thus serving as a virtual representation of actual work. The flow being described often refers to a document that is being transferred from one step to another.

A workflow (Employers' Resource Centre, 2009) is a model to represent real work for further assessment, e.g., for describing a reliably repeatable sequence of operations. More abstractly, a workflow is a pattern of activity enabled by a systematic organization of resources, defined roles and mass, energy and information flows, into a work process that can be documented and learned. Workflows are designed to achieve processing intents of some sort, such as physical change, service provision, or information processing.

Workflow concepts (Employers' Resource Centre, 2009) are closely related to other concepts used to describe organizational structure, such as silos, functions, teams, projects, policies and hierarchies. Workflows may be viewed as one primitive building block of organizations. The relationships among these concepts are described later in this entry.

The term workflow (Employers' Resource Centre, 2009) is used in computer programming to capture and develop human-to-machine interaction. Workflow (management) software aims to provide end users with an easier way to orchestrate
2.3 Overview of workflow within a digital radiology department

Mack, Holstein, Kleber and Gronemeyer (2000) state that workflow has to change when a conventional medical imaging institution changes to a digital one. They also state that this change has to be followed by regular quality assurance throughout the referral-to-result process. Reiner, Siegel, Carrino and Goldburgh (2004) reported that on the introduction of a new Picture Archiving and Communications System (PACS), workflow rate decreased by 10.8% in the first year and after that it increased yearly by 27.8%. These findings show that quality does not exclusively depend on the operating system. Quality also depends on the knowledge of the operators and their learning curve (Reiner et al., 2004).

Langen, Bielmeier, Wittenberg, Selbach and Feustel (2003) performed a study comparing a conventional medical imaging department that operated in 1999 with the same department that changed to digital in 2001. Their findings showed that in the long term, turnover time improved with the introduction of digitally automated work flows. However, according to Morgan, Branstetter, Mates and Chang (2006), this improvement increased the supplier-induced demand. Consequently radiologists were pressured to provide an efficient, quality service in less time (Morgan et al., 2006). This implies that the expected throughput augmented with increasing pressure on the radiologists, who in turn were expected to deliver an increasing number of reports without reduction in quality of reporting. This also implied that there was an increasing number of requests for investigations, some of which constitute the delivery of a radiation dose to patients.

The implications of this phenomenon are that the increased rates of referrals constitute a higher exposure for patients to ionizing radiation. Furthermore, the increase in referral is not being caused by or related to morbidity changes but simply by increased accessibility to services. This implies that there is increased use of the limited resources and one could argue that these are being utilised in a wasteful way.
since there was no expressed need for such utility before it was actually available. In operational management particularly within health the patient centred service does not only imply the highest accessibility to investigations, but also the rational selection of investigations that are required such that the health of the patient is not compromised without benefit. There is no scope for examination of the justification of numbers of requests within this study, however, it is logical to query what repercussions over-utilisation of such a service has on patient safety.

Craig, Morioka, El-Sladen, Duckwiler, Zou, Ying, Bui, Johnson and Kangarloo (2001) commented that in their opinion, workflow can be enhanced by the introduction of digital systems such as Hospital Information System (HIS), Radiology Information System (RIS) and PACS. However, when these systems are integrated, interface design may need customisation. This enables compilation and assimilation of images and report data with the rest of the patient medical data information. This improves overall quality. The authors also commented on a disadvantage of providing both image and report data at the ordering end. This large amount of data may overwhelm the clinician.

Furthermore, the software package and the automation that it allows improves efficiency. Moise and Atkins (2002) suggested that to enhance the efficiency of a PACS, this has to be adaptive and sensitive to change. Routine tasks can be maximised by creating shortcuts and embedded macros in various stages of the workflow pathway.

Wendler and Loef (2001) concluded that workflow-enabled application systems do not support the processes that an institution wants to follow. Until this study was carried out, workflow management systems proved to be more useful outside the medical scenario. However, they also commented that in medical imaging such systems are apparently promising. Most workflow application systems are data oriented. Workflow architectures with compatibility among multiple vendors may constitute a solution to accommodating a desired workflow pathway. This implies that unless there are various solutions provided by different supplying companies and these solutions can be integrated among themselves, a system would tend to dictate a pathway rather than follow one. This does not imply that quality and
efficiency are compromised. On the contrary, these are enhanced and the workflow pathways that are dictated by the radiological application increase both quality and efficiency (Wendler and Loef, 2001).

Chesson (2007) reported that with the introduction of PACS in 2004, eleven radiologists read 200,000 images from eleven practices throughout Tennessee and Georgia. They issued reports within 24 hours. They used integrated RIS–PACS with digital dictation and an enterprise practice management system. The workload increased by 15% even though one radiologist left. In any case, the workflow rate increased by 27% per radiologist.

“One of the goals of medical imaging management should be to encompass the development of a robust practice environment that emphasizes workflow enhancements with seamless integration of decision support and task automation tools.”

(Vaccari & Saccavini, 2006, p.93).

2.4 Workflow within operational processes

The radiologists' role in operational processes of a radiology department is to produce an accurate diagnostic result in as efficient a way as possible. Suppliers of radiology digital software should be versatile and flexible enough to incorporate new features within the software (Moise & Athkins, 2002; Ralston et al, 2004). The aim of their study was to provide a smooth, efficient and automatic display for interpretation of medical images by using a new generation of hanging protocols (HPs). This seemed to focus principally on the requirements of radiologists within their imaging department.

Lang et al. (2005) who approached workflow from a more business like perspective, highlighted the importance of workflow modelling and optimisation to address efficient use of finite resources. They also mentioned that there is an increasing commercial pressure particularly where a hospital reimbursement system is utilised. There is also an increasing requirement for quality management in medicine. In this statement there is an underlying reference to the changing definition of a quality
service from total quality management to the more achievable delivery of clinical governance whereby services with higher urgency and increased feasibility are given a higher priority on a policy agenda.

2.5 Analysing Workflow Operations

Lang et al. (2005) divided workflow into three approaches: (1) data flow oriented – following the trail of data retrieved, compiled and added and resent; (2) control flow – the processes that are followed within the institution driven by a sequence of events and (3) object flow oriented. These were not clearly defined in the quoted paper however; the tools that were used for each approach were noted:

- Data flow oriented – Flow charts were displayed (even though they were not referred to in the text);
- Control flow oriented – Petri nets (Workflow nets (Wf-nets)), Event-driven Process Chains (EPC) and Business Process Modeling Notation (BPMN);
- Object flow oriented – UML 2.0 activity diagrams (UML AD).

Lang et al., (2005) excluded the influence of the organisational structure on the workflow. They also excluded completely the influence of socio-cultural factors on operational processes.

Van der Aalst and Jablonskit (2000) gave an overview of basic workflow terms. These included the process perspective, the organisation perspective, the information perspective, the operation perspective and the integration perspective. These will be described and discussed individually in the next few paragraphs.

- Process perspective – this includes the documentation of workflow patterns with regards to what processes have to be carried out and in what order. This perspective is characterised by a sequence of tasks (atomic pieces of work). This is similar to the control flow in Lang et al., (2005).

This approach is useful in project planning particularly in implementation of new systems. It excludes completely the human element and assumes that every user is capable of fitting into his role with very little room to improve. When the migration to
Mater Dei Hospital was implemented, this type of workflow was documented and demonstrated to the suppliers to install, configure and organise relevant training. These pathways were intended to inform personnel who were not familiar with the workflow and who were required to accommodate this by the software that was being introduced.

The process perspective is important in delineating what actually happens in the process of delivering a service to a patient. When this is documented it can be critically analysed and amended to increase effectiveness and response to the needs of the client, be it the referring doctor or the patient. These workflow pathways will be demonstrated in the results chapter.

- **Organisation perspective** – this focuses on the organisational structure. This is more of a vertical structure delineating hierarchal levels. The authors state that this perspective describes the relationship between roles showing responsibilities and availability of resources.

This perspective was extracted from a departmental report that I myself had compiled for clarification of roles within the department. This operational report was instrumental in explaining to outsiders the roles and ranks within the department. This perspective does not really say anything about operational processes within a department. It exposes liabilities and responsibilities of different staff groups. This perspective even includes listing of resources available for the use of the various levels of staff. This is useful in expressing what tools are available to accommodate staff operations. Lack of availability, obviously stunts the workflow, however, on the other hand, over-resourcing is more commonly known as waste of resources. Objectively speaking if one had to ask every employee what is required, they would probably request all equipment at the disposal of every individual. However this is not practical.

The organisation hierarchy reflects the amount of bureaucracy that is present in an institution. It also reflects the divisions in responsibilities and the level to which an
issue is carried before change can be implemented. This too will be shown in the results chapter.

- **Information** perspective – this perspective deals with the production and control of data. **Control** data is data that is introduced exclusively for workflow management (routing purposes). **Production** data includes forms that are filled and other information objects which do not depend on the workflow. Some examples are patient demographic database, order forms for requesting investigations etc. This is similar to the data flow explained in Lang et al, (2005).

The information perspective describes the way in which people communicate without actually meeting. These aspects of communication are important since they relay hidden information. For example, if an order form is being filled, the spaces that are required to be filled are telling the person who fills the form what the receiver of the form wants to know. Once again this is not related directly to workflow however, it is another way to streamline the flow by having the required information at hand when required. A negative aspect of this perspective is that is frequently acts as part of more than one workflow. For example, the requestor has to dedicate time to fill in all the data that is required by the receiver within his own working time. The more information is given by the requestor the more time he requires to fill the form; however, this translates to a shorter processing time by the receiver. Consequently, analysing information received and given within one workflow excludes completely repercussions on other sections of the institution.

- **Operation** perspective – the operation perspective describes the simple operations that are carried out at shop floor. Typically, these operations are used in the process perspective to create, read, or modify control and production data in the information perspective. Most operations are (partially) implemented by applications (software in digital systems).

Digital systems constitute speed and high availability of data. However, since a product is programmed and configured to meet demands and workflows within different institutions, they are never fully comprehensive in answering to a workflow
that changed from an analogue one. In other words, software may facilitate and streamline a workflow pathway; however, the human being is so complex that the program will never be able to respond in the same rational way as a person. This implies that to some extent the human has to adapt to the digital system. An analysis of operations involves studying specific stages within the process flow individually to improve single operations in isolation of other and also in combination with others. For example speeding up the process of scheduling appointments can be one operation to study, but actually combining them such that a patient attends the department once for more than one investigation on a single day, whether the services being rendered are both within the same modality or in two different sections, Furthermore, there may be areas which are not completely met by the system and these areas have to be solved by human intervention and control.

Integration perspective – this involves the integration of the other four perspectives. In other words the process perspective is linked to (1) the resources identified by the organisational perspective; (2) data elements in the information perspective and (3) operations in the operation perspective. Operations are also linked to data elements.

The structure proposed by Van der Aalst and Jablonskit (2000) is a very comprehensive structure that includes various aspects of the workflow. These different perspectives constitute a very objective review of the functions and operations that identify a workplace and its workflow.
These perspectives exclude culture traits and environment in which people operate. The cultural perspective, in my opinion, is an important aspect because the moral attitudes, influences, demands and many other aspects affect many aspects of operations. For example, the influence that managerial staff has on his employees influences attitudes and operational performance. Competitiveness and academic preparation also influence performance. I would have added a socio-cultural perspective to the ones mentioned previously, to ensure that all aspects are factored in and that no confounders are excluded from an operational study.

Vaccari and Saccavini (2006) delve into the socio-cultural perspective when they describe how the human-computer interface could be overcome. They stated that computers offer the possibility of breaking down complex processes into a series of well-defined tasks. Unfortunately, when these authors refer to staff they mean exclusively radiologists, however their reasoning can be generalised to other staff members too. They also add that computers can help to reduce bias, fatigue or inconsistency. Human-computer interaction in the radiology practice is affected by
factors belonging to four distinct areas: psychology, sociology, input device characteristics and hardware visualisation capabilities (Carrino, 2005).

Vaccari and Saccavini (2006) state that there is a paradigm shift to overcome when changing from an analogue to a digital system. The digital system is oriented in a fully electrical environment which requires alterations in human resources infrastructure. An interesting incentive suggested by Vaccari and Saccavini (2006) is the provision of an internet service to radiologists so that they can surf and look for assistance in their diagnoses of patients. This almost sounds like a perverse incentive since this facility is just another substitute for books; however, the concept behind fast access to internet data, in itself is a positive incentive to improve quality. From my experience in digital radiology, internet access is an asset which however, has to be highly and actively controlled. Data is so accessible via internet that unless adequate policies are pushed by the server to block unnecessary links, invasion of a virus can cause havoc over a network that hosts vital medical information which cannot afford to get corrupted.
Chapter 3: Methodology
3.1 Introduction

This chapter will describe the modes of data collection and will justify the methods used. Data was collected from all parties in the Medical Imaging Department in Mater Dei Hospital. These included radiographers from the different sections of the department, radiologists, schedulers (clerks that issue appointments), transcriptionists (secretaries that assist in the typing of patient reports), other administrative staff (e.g. supervisor and manager) and last but not least patients attending for the different modalities (MRI, CT, Nuclear Medicine etc.).

3.2 The study’s design

This study included a combination of qualitative and quantitative data. A cross-sectional study was carried out to include all stakeholders (administrators, radiologists, radiographers, support staff & patients) within the Medical Imaging Department. The list of stakeholders includes all parties that operate or can criticise the quality of the service that is being provided.

The mixture of quantitative and qualitative data aimed at achieving comprehensive results. Patients who constitute the effected party filled in a questionnaire. This questionnaire provided quantitative data expressing their satisfaction with the service received. This questionnaire did not actually give more information on the workflow and efficiency but simply took the opinions of patients on services rendered in various areas. This was important to outline areas where the service provided was not effective.

Written permission was sought to carry out the study from: (a) the Chairperson of the Medical Imaging Department, and (b) the ethical committee that approves dissertations for the Institute of Health Care, University of Malta. Data collection was started only after this permission was granted.

- The questionnaire was adapted from a previous questionnaire that was used to assess whether patients were satisfied with radiography services to paediatric patients (Axiak, 2006)(see Appendix A). As previously illustrated, the
questionnaire was aimed at assessing patient satisfaction of the service that they receive. The questionnaire asked patients if overall they were satisfied with the service they received at every stage of their visit to the hospital. These stages included receiving an appointment, whether this wait was satisfactory for the patient, attending for an appointment at main waiting area, in the imaging room, impressions of radiographic professionals, impressions of time in room, overall satisfaction.

i. Inclusion criteria will comprise the following:
   1. Inpatients and out patients (analysed separately) attending the hospital;
   2. Male or female;
   3. Any age groups;
   4. Patients living in all geographic areas;
   5. The sample will be selected by cluster random sampling.
      - Clusters will be taken by investigation. This will be done to receive data on as many services as possible.
      - The actual number of participants in the sample will be discussed with a statistician. This will be necessary to ensure validity.

ii. Exclusion criteria include:
   1. Patients with intellectual disabilities;
   2. Patients with mental disorders;
   3. Patients who refuse to participate (reason for refusal will be documented for non-response justification);
   4. Patients who are hospital staff or whose relatives work at the hospital (they might otherwise be given preferential treatment or may be biased in their responses);
   5. VIP patients (since such patients receive preferential treatment).

This questionnaire was introduced to identify areas which are satisfactory to the operators but unsatisfactory to the beneficiaries of the service. On the other hand operators' experience was be required to suggest improvements to the system.
The study aimed at exploring current operational practices and procedures and find areas where there is room for improvement. It is also intended to propose ways of improvement. This was investigated through a detailed documentation of current operations and enquiry on opinions and satisfaction of operators within the radiology department and even patients. It was hypothesised that there was room for improvement in operational performance in various areas of the Medical Imaging Department.

Different types of information were collated. Information on current practices was compiled to be able to analyse accurately the framework of current operations and to be able to have a basis on which to scrutinise every step within the operational flow. A SWOT analysis was also carried out on the information gathered; operators were expected to highlight strengths, weaknesses, opportunities and threats within their areas of practice. In this way needs were identified in areas where there was room for improvement. Comparison of these needs with strengths rendered possible prioritisation. Brooks and Brooks (1996) stated that needs may be elicited from a random survey of individual members in the target group.

The literature review analysed the impact of changes that occurred in other imaging departments on the environment, workflow and people. It also presented models for analysing an operational workflow in a comprehensive way. In this way I could select a model for analysis of the operational workflow in the Medical Imaging Department.
The study design was mainly a qualitative cross-sectional study that included participants from all the different areas and strata within the hierarchy of authorities. It also included some quantitative input from patients who used services. The cross-section of participants was taken in both the vertical and horizontal dimensions. The vertical cross-section included people from the hierarchy (chairperson down) whereas the horizontal cross-section included people from all areas within the Medical Imaging Department; namely all the different modalities of imaging service delivery outlets (e.g. MRI, CT, etc).

Qualitative data regarding current operations and practices was collected via a number of interviews with a number of operators from all skills or specialties and levels within the hierarchy. The original idea of organising focus groups was moved away from since, from previous experience, only few of group participants contribute actively whereas other that may valuable information to offer will sit back and listen. Opting for interviews gave opportunity to every participant to contribute on an individual basis. Furthermore, the author could dedicate as much time as was required to probe each contributor to obtain the maximum amount of information that was possible. All results, criticism and proposals were recorded. Quantitative data regarding patient satisfaction was collected using a questionnaire that was distributed to patients receiving services.
The following were the main stages in the study:
- Obtaining permission;
- Qualitative data collection;
- Quantitative data collection.

In the sections on quantitative and qualitative data, the following are described:
- Selecting participants;
- Preparation of data collection tools;
- Data collection, and
- Data analyses.

These stages will be discussed in further detail below.

- Various interviews were carried out with:
  i. All schedulers;
  ii. All receptionists;
  iii. Selected radiographers;
     1. A cross-section of radiographers chosen by cluster sampling from each of these groups:
        - Chest and skeletal radiography;
        - Fluoroscopy;
        - Computed tomography (CT);
        - Magnetic resonance imaging (MRI);
        - Mammography;
        - Ultrasound;
        - Angiography and interventional medical imaging;
        - Nuclear medicine;
        - Accident and emergency radiography.

Group leaders were given subject guidelines to discuss with their relative employees. A meeting was held for team leaders to give their suggestions.

iv. All radiologists – these were divided into smaller groups within their work shifts with the aim of achieving better response.

v. All transcriptionists.
The interviewees were all asked the same questions:

- Did they work at St Luke's Hospital (SLH)?
- What was their work at SLH?
- What is their work at MDH?
- Are they satisfied with their present job?
- What would they like to change in their job?

- Interview with the Chairman of the Medical Imaging Department about the various stages within the workflow. The following questions were asked:
  - What improvements do you see at MDH's Medical Imaging Department?
  - In your opinion, are there any areas that have regressed?
  - What is your impression of the integrated system that has been adopted for operational processes in the department?
  - Are there any improvements that you would like to see in the system?
  - What quality improvements do you see in the current practice?

This approach allowed triangulation of information to be performed, with information being retrieved from all stakeholders involved. The provisions of data protection law were complied with at all times. Anonymity and confidentiality was guaranteed by coding patients with numerical codes, e.g. P1, P2. Focus group participants were coded similarly. Data was used exclusively for the study and destroyed soon after it was analysed.

Since the researcher holds an administrative post within the department, blinding for data recording was used, with the aim of decreasing the risk of response effect.

The data collected was to meet the study objectives. Consequently the research questions could be answered.
3.2.1 Obtaining permission

Permission to carry out this study was obtained from the Chairman of the Medical Imaging Department. The Ethics Committee of the Health Division was also approached and they granted their permission to carry out the study, using an approved questionnaire and tools.

3.3 Modes of data collection

3.3.1 Qualitative data collection

It was originally intended to hold focus groups of radiographers and clerks. However, this intention was moved away from for various reasons. Primarily, staff members were approached during working hours and it was logistically difficult to group them up since this would result in temporary cessation in service delivery. Secondly, from a previous dissertation I had noted that some focus group members speak out their mind without inhibitions whereas others require more time and probing. Addressing these people in a group would result in data from the more reserved to be lost. Thirdly, there is a sense of competition in the different groups and I would not have liked information given to be biased simply because people are trying to impress. I thought that data retrieved from the less forthcoming members might be more useful to probe since this may include needs that are not being addressed. More outgoing members of staff may have already escalated their concerns without inhibition whereas the more reserved staff may be more reluctant to take personal initiative. Hence losing data from the latter group would constitute a bias in the results. This variation decreased the non-response of the population.

Finally, knowing the different team leaders, I noted that they had different academic backgrounds: some were more clinically oriented and others were more business oriented. If all were equally ready to contribute to the group, it would still be problematic to place them in a discussion. Some of them would be discussing business management and process organisation whereas others would be discussing clinical management.
These different approaches were both important to me and so to be able to highlight both aspects, they were discussed separately and with individual team leaders. Placing all the team leaders in a group would have probably resulted in data (probably from the clinical aspect) to be lost due to the lack of understanding of business process organisation.

3.3.1.1 Selecting participants for interviews

Participants were selected on the basis of:

- Their position within the hierarchy of authorities
- Their experience in their job.

This implied that:

- Radiologists were selected randomly from the pool of radiologists employed.
- Radiographers had to have an assistant principal radiographer rank or higher and had to be actively practicing in administration of different sections.
- Scheduling clerks were all interviewed.
- Transcriptionists were also all interviewed.
- The Chairman of radiology and Manager of Radiography Services were also interviewed separately.

3.3.1.2 Radiographers’ interviews

Eight interviews were carried out to radiographers from seven different sections of the Medical Imaging Department. Selected radiographers were all in administrative posts (Assistant Principals or higher) and were all in charge of the running of operations in the respective sections.

The sections included were:

1. Casualty;
2. Theatre and mobile radiography;
3. Mammography;
4. Computed tomography;
5. Magnetic Resonance Imaging;
6. Angiography and interventional radiography;
7. Chest and Skeletal radiography and Fluoroscopy;
8. Nuclear medicine.

The interviews were divided into three sections.

- Section A probed the level of experience and job satisfaction of the employees. This data was required to expose respondents’ personal attitudes towards their work. This section was included to identify confounding factors that could have biased responses. Furthermore, Section A was also necessary to make the respondent him/herself aware of his/her own attitudes towards their work. This would help to reduce response biases.

- Section B was directed more towards the opinions of staff towards of the current operational system, areas of noted improvement within the department, areas that regressed, the general feeling of the staff etc. Section B aimed to launch open questions to probe respondents’ experience on daily operations and workflow.

- Section C was more of a question and answer section which suggested different aspects and factors that affect workflow to respondents’ who were expected to comment on each topic. In Section C, I specifically asked staff to comment on issues like staff complement, training, performance, environment etc. This section was necessary to make sure that respondents commented on most factors that affect workflow. Some respondents, particularly ones who were qualified and experienced in management touched on the topics without the need for suggestion, however some required the prompting that was provided in Section C. Consequently, Section C was required to obtain more comprehensive responses rather than just leave it up to the staff member to respond to the open questions in Section B, without omitting any aspects of the workflow by running through a checklist by mentioning aspects of the workflow that may not have been touched in Sections A and B. Probing section (C) was left to the end deliberately; had this been taken up earlier, interviews may have been shorter but
I would have missed out on the *first things that come to mind* when a question is addressed and the responses would have been biased.

The findings of the interviews will be discussed in the results chapter.

### 3.3.1.3 Interviews with scheduling clerks

Scheduling clerks were approached individually and their feelings and attitudes enquired. Questions regarding the difficulties they encounter when scheduling various investigations. These varied with different modalities and workflows. Furthermore, the schedulers' degree of ownership of the processes that they support was enquired by probing on what image is projected outside the hospital regarding the scheduling responsibility.

Clerks were interviewed individually to provide them with a more secure opportunity of conveying their sincere opinion with the guarantee that the data that was being communicated would not be disclosed by the two of us or any other third party who may be present during the discussion. This secure environment enabled them to speak out as clearly as they could their opinions.

I used the technique of repeating whatever they were suggesting prior to taking note of it for two reasons: primarily, to make sure that what they were saying verbally was exactly what they wanted to express by intention since this clarity varied by interviewee, secondly they were sure that they knew precisely what notes I was taking and that they were not being misquoted or misinterpreted.

### 3.3.1.4 Interviews with transcriptionists

Transcriptionists were asked to describe how they were contributing to the workflow. Their role was to support radiologists in their reports however; they mentioned other roles that they had other than that of a transcriptionist. Interestingly enough, these were the last group of people to support the changing environment from the analogue department to the digital one.
Whilst other sectors had already settled into daily routines that were fixed and edged in the long-term workflow pathways, transcriptionists had to support the patients' reports, radiologists who were not confident with speech-recognition, backing up patients' online reports with printed reports to make sure that change has no impact on the patient care pathways.

The role of the transcriptionists practically represents a support role for reporting, report communication systems, report issuing and distribution. To some extent their role is vaguely defined, variable and continuously changing with department needs and requirements. This made it difficult to obtain focussed replies to define scientifically the workflow of this group of people. Their patchwork role seems to constitute the solution for gaps in operations within the whole department. Hence, their contribution was important for the scope of this study.

3.3.1.5 Interviews with radiologists

Radiologists varied in age, competencies, skills, language skills (different nationalities) and attitudes. Some of these variances originated from the different backgrounds of the physicians. Foreign radiologists had varying levels of command of the English language. Radiologists also had many reporting options. They could report by (1) simply typing in a report, (2) dictating a report digitally; this had to be typed in by the transcriptionists and finally (2) speech recognition, which implies that the dictation of the radiologist is transcribed automatically onto a report by the software.

Radiologists were asked to comment on the various aspects of the workflow that affected them and that they could influence. They were asked to describe the referrer demand for their reporting. They were also asked to comment on their appointment systems and whether they were given enough time to perform their clinical investigations and report on the images that were acquired. They were asked to express their opinions on the reporting systems and to recommend any improvements that they deemed necessary.
3.3.1.6 Meeting with Parliamentary Secretary

The parliamentary secretary was asked to state strategic plans in which the Medical Imaging Department was participating. This aim of this interview was to list the ultimate scopes for any changes that were being made. The strategic goals were important to match with the corporate goals of the Chairperson of Medical Imaging and also to be able to focus operational processes that were running on a daily basis.

3.3.1.7 Interview with the chairperson

The chairperson was asked to comment on different aspects of workflow within the various sections within the Medical Imaging Department. He was also asked to suggest possible improvements in any of the sections discussed and whether there are any plans for future developments. All data gathered was recorded together with any additional points that were deemed important by chairperson himself.

3.3.1.8 Interview with the Manager Radiography Services

The Manager of Radiography Services was also approached in a similar way to the chairperson. He was asked the same questions and was also asked to comment more in detail on the operational difficulties that are encountered on a daily basis within the operational workflow. Once again all the data was recorded for documentation and recommendations for improvement.

3.3.1.9 Data documentation and processing

All data was recorded and inputted into a Microsoft Office Excel sheet so that levels of satisfaction, both personal and operational, staff complement and other quantifiable data was recorded. All quantities were retrieved from the interviewees; I did not score their responses but asked them to score them themselves on a scale of one through ten. For example, on a scale of one to ten, how satisfied do you feel with you present job in your present position? If the response was eight, I recorded eighty percent.
Suggestions for potential improvement were also recorded for reference. Experience and qualification was also noted to be able to compare responses and background of academic and experiential knowledge of the interviewees. Academic qualification also reflected on the terms of expression of the interviewee and so this data was also used to compare responses with employees of similar experiences and exposures.

3.3.2 Quantitative data collection

The questionnaire used was an adaptation of another questionnaire that was used previously for another study that assessed needs for the implementation of a specialised paediatric radiography service within the same department. This template was designed by myself, piloted and tested and proved to be effective in the previous study. This questionnaire could be used as a template for the current study since it was designed to accommodate a similar scenario within the same department. It was also intended to assess the same aspects of satisfaction of patients towards the different areas within the workflow of the department. Furthermore, the original questionnaire was aimed at the guardians of the children and so was designed to meet intelligibility of adults rather than children. The current study was also targeting adult patients who were utilising services provided by the Medical Imaging Department.

Since the quantitative data formed only part of the data collection that addressed only one of the many stakeholders within the department, the researcher aimed at collected about one hundred questionnaires from patients who were asked to comment on the service they received. The data collected was recorded in a Microsoft Windows Excel format to be able to analyse and represent graphically. Patient satisfaction with explanation and allotted time for examination where also correlated to the adequacy of explanation to both patients and any relative accompanying patients for calculation of validity of answers.
3.3.2.1 Distribution of the questionnaire

Questionnaire reliability was tested by giving the tool to three people to check and to criticize in advance of the distribution. The tool was given to a radiologist, principal radiographer and the student supervisor. It was even presented in the dissertation proposal and approved by the Ethical Committee for use in this study.

One hundred questionnaires were distributed to the patients in the reception area by reception staff. Patients were given the option to choose a questionnaire that was in Maltese or in English. Each questionnaire had attached to it a covering letter that explained the purpose of data collection and my contact details. They were given the option to refuse participation and were assured that data protection was going to be respected. In fact patients were asked to put all sheets back into an envelope and seal the envelope. All these envelopes were opened by me for the purpose of data documentation. In this way there was blinding of information. This was necessary to reduce bias in a patient who may not want to disclose his identity to the researcher.

3.3.3 Other data collation

Flowcharts prepared for the documentation of a sequential process flow were quoted in this study. These flow charts were originally designed as an internal marketing exercise to improve the understanding of the workflow of the department. These flow charts were also necessary to formalise procedures that were carried out on a daily basis within the Medical Imaging Department.

The Medical Imaging Department operational report (2008) was also cited. This document was compiled with various contributions from different areas within the Medical Imaging Department and gave a snapshot of the situation of within the department. The operational report was also compiled to standardise practices and share information with employees to disseminate a common understanding among people on what the practices and procedures were followed.
3.4 Conclusion

This chapter gave a detailed description of the methodology used for data collection and processing. The following chapter will be discussing relevant literature that was
Chapter 4: Results
4.1 Introduction

This chapter will display all the data collected and the results inferred from the information. The layout used will be a modified version of the one suggested by Van der Aalst and Jablonskit (2000) since the researcher thought this was very comprehensive. Hence results will be displayed under the following subtitles: the process perspective, the organisation perspective, the information perspective, the operation perspective and the integration perspective. The data collected from the interviews with the heads of sections was used to form these flow charts. These flow charts were also rechecked with the sectional administrators when they were ready. After this another subtitle relating to socio-cultural perspective will be introduced. The latter includes issues related to motivation of employees and its relationship to workflow.

4.2 The process perspective

Figure 4.2.1 Work flow flow-chart from referral to attendance of patient.
The figure above explains how the referrer (doctor or designated professional) requests an investigation from a modality to assist in his diagnosis or treatment. The decision diamond expresses the decisions that the requestor is required to make. There are presently two modes of requesting in operation, running in parallel: (1) online requesting and (2) filling a request form in writing. At present the vast majority of requests are made in writing since online requesting has not yet been implemented to any great degree. However, the government of Malta is projecting to eliminate the written request completely and replace it with the online mode. This study recommends that there are advantages in the implementation of online requests. This will be explained in the next section.

4.2.1 Requesting an investigation

The change from written requests to online requests is expected to have a ripple effect on the workflow. In the current practice Principal Radiographers are sorting received requests by priority. This is an informally delegated task to enhance turnover times within the process chain.

The priority sorting and accepting or refusing of requests is a designated job for which qualified radiologists are accountable. However, the lack of availability of radiologists, in the past, brought business process changes whereby highly experienced Principal Radiographers with an interest in a particular area were allowed to stand in for the radiologist role in vetting and sorting. Since this process was never formalised, radiographers who carried out the latter tasks were not held directly accountable for their decisions; particularly because it was an unwritten rule that they sort routine requests using fixed policies in the name of radiologists. Radiologists were consulted only if any difficulty was encountered or if exceptional requests varied from what the radiographers were used to processing routinely.

The change to online requesting will result in user authentication at every step of the process chain by the user logged onto the system. Hence, this will expose radiographers who are sorting and vetting and they will have to formally shoulder their share of the responsibility when requesters query why their requests were refused or not given the priority they expected. For this reason radiologists have to
take over all the vetting unless formal rules, policies or laws allow radiographers to perform such duties.

The Medical Imaging Department sustains that the present complement of radiologists is inadequate and insufficient to cope with the high demand of requests received. One possible way of tackling this challenge is that the Chairman of the department concedes some skill mix from radiologists to radiographers in skeletal and chest radiology modalities where selected Senior Radiographers may be delegated the task to vet and prioritise exams within their section. Consequently, radiographers on emergency duties will also be required to perform vetting tasks.

In Accident and Emergency, there is a throughput of between 200 and 240 patients per day requiring medical imaging. Hence, another action that may be considered is that in selected areas the default option for acceptance of online requests is set to accepted; so that operational staff members are required to vet only those requests that are deemed unjustified. This would not imply that requests are left unchecked but rather that an intervention is required only in cases of unjustified requests; which in Accident and Emergency are in small numbers.

Another area where vetting could be set to “accepted by default” could be Ultrasound. This action could be justified by the fact that there is no known administration of ionising radiation. Furthermore, after peak working hours (after 2:30pm) all ultrasound investigations would have to be vetted by a single radiologist who is covering for Accident and Emergency, Ultrasound and CT scanning. At present no vetting is carried out. This implies that all requests would be accepted automatically and placed in order according to the priority requested by the referring doctor. A consequence of the introduction of obligatory vetting for all, justified or unjustified investigations, in both Accident and Emergency and Ultrasound would create a higher workload on staff that are coping with an exceptionally high number of patients that are referred to the imaging rooms with different degrees of urgency.

The main advantages of online requesting include:

1. Legible requests, without the problems associated with illegible handwriting;
2. Completeness of information, as result of the filling of mandatory fields on on­
line request forms;
3. Clarity of automated user authentication transmitted electronically and taken
from user logins;
4. Consequently, as a result of point 3, a increased probability that requests are
placed by the actual person whose signature appears on the form (unless a
requestor discloses his personal password to another user);
5. As a consequence of point 2, the amount of data entry in front desk processes
(scheduling and registration) is reduced; since more demographic and clinical
data comes into the RIS software through the interface when a request is
present on the system, than is presently being detailed on the written form;
6. In summary and more holistically, the introduction of online requests enables
better accountability, reduces the potential abuse, increases the information
received on request and speeds up the general workflow within the Medical
Imaging Department.

When a request is accepted, the patient may follow two routes. He/she may be
served immediately to meet his demand or he may be required to book an
appointment for a scheduled examination. Booking of appointments happens in six
different groups. Six schedulers book in appointments for different sections within
the Medical Imaging Department.

One of the schedulers schedules appointments for Mammography and Magnetic
Resonance Imaging (MRI). In the case of MRIs, consultant radiologists are required
to vet all requests, even in the present workflow. The Senior Principal in charge then
sets the appointments’ dates and times the scheduler feeds the data onto the
network as advised. In the case of mammography, at present routine sorting is
being carried out by an Assistant Principal in charge who consults with consultant
radiologists if any query arises.

The Assistant Principal then sorts orders by priority, leaving some vacancies for
emergency requests. These, as in MRI are handed to the scheduling clerk who
inputs the data onto the network. With the introduction of online requests this vetting
process for mammography investigations is expected to change. Consultant
radiologists will be required to vet all mammography requests before they are scheduled. This, consequently increases the demand on radiologists will be required to add to mammography vetting to their daily duties.

Another scheduler sorts and appoints all fluoroscopic investigations after the checking of requests by radiologists. With the onset of online requesting these investigations will start being checked and vetted by radiologists through RIS. Once again this process will alter slightly the current workflow. It was suggested that there is increased pressure to negotiate justification and accept requests less liberally than is being done at present. At present most requests are accepted without any weighting of reasons for requests; it is being recommended by this study that justification and adequate vetting should reduce the numbers of requests being placed.

CT scans are presently being vetted by an Assistant Principal Radiographer in charge of CT, who asks radiologists for assistance when he is in doubt or has received an unusual request. These requests are then given to a scheduler who sets the appointments according to the priority requested by the Assistant Principal radiographer. This process is expected to change with the onset of online requesting. The vetting process is expected to be carried out exclusively by radiologists. This constitutes a process reorganisation that is not expected to change the incoming workload but to shift this load from the Assistant Principal Radiographer onto the radiologist.

When an appointment is given, the patient is notified of his appointment and is expected to present at the reception area on the required date. A patient is also expected to have prepared himself adequately particularly if any fasting is required, if any preparatory drugs need to be taken or if any preliminary tests are required. All these instructions are given to patients in advance. When the patient presents at reception he may be asked to wait for a few minutes until he can be ushered to the room where the required investigation will be undertaken.

Unfortunately, a number of patients do not turn up for their investigations. Some reasons that were given by patients who have been contacted were that the patient
forgot to attend, or that the patient had undertaken the investigation at another private clinic or even, in some cases, that the patient refused to attend for the investigation, either because a problem seemed to have resolved without intervention or because they were not willing to undertake the exam. The Medical Imaging Department should look into ways of mitigating this problem. One option would be to ask volunteers from VOLSERV (an organisation providing voluntary services to Mater Dei Hospital) to assist with patient handling within Mater Dei Hospital to call patients by phone beforehand to confirm their attendance. This will have two advantages: (1) make sure patients do not forget their appointments and (2) cancel appointments of patients who are not willing to attend and fill these appointment slots by other patients who are still waiting to be appointed. Consequently, this would help to reduce waiting lists within the Medical Imaging Department. The next section will describe what happens when the patient attends for the investigation.

4.2.2 Patient imaging process

![Diagram]

Figure 4.2.2.1 The process followed to serve patients by imaging.

Figure 4.2.2.1 depicts the process followed to serve patients. When the patients arrive at reception they are registered into RIS. At this stage they are assigned to a
specific imaging room. The patient’s demographic details are transferred automatically from the reception computer, not only to computer within the rooms, but even directly to the modality computer; so that the radiographer can proceed with the investigation without the need for repeated inputting of same data and duplication of jobs.

Radiographers are expected to set the modality equipment to take the required images and continue the digital workflow. At this stage the patient’s status is changed to “started”; detailing that the patient is in the imaging area. It is then changed to “examined” which implies that the investigation was executed within the imaging area. At this stage images are transferred to the PACS. In this way there is constant logging of where a patient has reached in the process and constant monitoring and auditing of the time elapsed between each different status, which can be traced and reported.

The process mentioned is followed in all imaging rooms except one Casualty imaging room. In this room the equipment is constantly updated with the catalogue of skeletal radiography processes so that when patient demographics are transferred from the reception registering computer to the imaging modality, the imaging modality also retrieves a code that inputs the required examination into the modality. As soon as the patient is selected from the work-list, the X-ray equipment automatically changes orientation and moves to a position required to serve the patient. For example, when a selected patient is registered as requiring a chest X-ray, the X-ray tube will move and align itself with the standing (erect) digital detector automatically to perform the required investigation. In the meantime the radiographer can instruct and assist the patient to change into the gown and focus his undivided attention on the patient.

Some areas make use of CR radiography. This implies that the equipment itself that is used to create the medical image is not digital equipment; phosphor plates are used in place of conventional imaging cassettes. The phosphor plates are scanned by the CR reader. In this way the image stored on the plates is digitised. The digital image can be transferred to PACS and stored. After the phosphor plates are scanned, the image is removed from the plates, which can then be reused. Areas
that use this system of digitisation of images include a second X-ray room in casualty, the mammography suite, ward portable radiography and radiography of patients that are imaged in operating theatres. A disadvantage of the CR radiography areas is that an image is not sent instantly after it has been taken, but there is a time lag between the taking of the image and the time when the phosphor plate is scanned by the reader. This is dependent on the circumstances; for example when a radiographer visits a number of wards before going back to the CR reader then the waiting time for viewing of images varies.

4.2.3 Receiving a result

![Flowchart](Figure 4.2.3.1 Patient receiving result.)

When patients leave the imaging room, they are instructed on how to receive their result (Figure 4.2.3.1). Patients are given an out-patient follow-up appointment during which the result will be communicated to them. The result is published by the Medical Imaging Department within hours of the investigation. The Chairman of Radiology Services stated that the turnaround time to issue a report was between an hour and a maximum of three days over the weekend. This result is available to the referring doctor through software applications interfaced to the PACS. The referrer
collates the findings with those of other tests that were requested and plans the relevant treatment or intervention as required.

The patient is notified of the findings and any other required investigations when they attend for their next scheduled visit to the out patients’ clinic and notified by the referring doctors. This implies that even though the result is issued within hours of the investigation, the patient may still receive the result days or weeks later when the out-patients appointment is scheduled. It is understood that when the prognosis arising from an investigation is poor, a patient is called to attend earlier than the scheduled outpatient appointment. The effectiveness of this practice goes beyond the scope of this study. In the time period between the issuing of the result and the out patient visit, the referrer has the option to plan treatment, communication or add any necessary requests to clarify symptoms and signs and perform a more accurate diagnosis that is based more on the evidence of various clinical findings.

This delay in the delivery of result may be a perceived cause of lower health care quality since the patient’s condition may deteriorate further if intervention is not early enough and patients’ anxiety is higher when they are less informed; hence, the earlier a patient is informed the less probability there is of undue anxiety.

One of the findings from the interviews with the radiologists was that, as a result of the introduction of digital systems, there is less face-to-face communication between doctors from different specialties. During the interviews, it was suggested that an email service should be introduced for radiologists to inform referrers of the requirement for urgent intervention on patients with poor prognosis.

Consequently, the referrers have to check recorded results of their patients routinely. Urgent, unexpected findings may fall between other results and take some time to be received. The risks involved in this case may be mitigated through the implementation of an electronic mail function which enables radiologists reporting on diagnostic images to notify referrers via email that a patient’s result contains urgent information. The implementation of this function involves listing and updating of referring doctors, ensuring that lists are comprehensive. The idea of the added email function reduces the clinical risk to patients who require early intervention.
The implementation of such functionality in the RIS context would need to be tested for and accepted by the Medical Imaging Department.

The implementation of digital systems brought with it various changes within the clinical field. Furthermore, the strategy for implementation of these systems was carefully planned; however, none of the local administrators had experience since this was the first local implementation of its kind. In such a situation, the concept of a learning environment should be promoted and lessons learnt from daily experience be used to offer incentives for improvement. It was also suggested from the interviews that to encourage this learning environment, MID management should react promptly to suggestions and complaints. This would help encourage this common interest in learning from experience.

4.3 The organisation perspective

Figure 4.3.1 Organisational structure of MID Mater Dei Hospital

Figure 4.3.1 describes the hierarchy of responsibilities of staff within the MID. This organizational chart was obtained from the interview with the Manager of
Radiography Services who explained the different strata of authorities. The horizontal structure shows five columns of authorities under the Chairman of Medical Imaging: (1) the Manager of Radiography Services; (2) the Radiology Nursing Officer; (3) the hierarchy or radiologists with consultants at the top; (4) the RIS PACS Manager and (5) the Medical Physicist (scientific officer in charge of quality assurance). Human Resources lie under the responsibility of the Manager Radiography Services; in fact, even the other two managers keep him updated with their use of personnel related benefits such as leave, sick leave etc.

The consultant radiologists are administered directly by the Chairman of MID since there are 4 consultant firms in the MID. Senior House Officers are not assigned to specific consultants since the staff complement is so small that this would limit the service. Each doctor performs duties related to his rank in the hierarchy. For example MRIs, Mammography investigations and Angiographic investigations are reported exclusively by consultants. CT scans and all other investigations except Nuclear Medicine are reported by Senior House Officers and house officers report only on images taken within chest and skeletal radiography. Nuclear Medicine, on the other hand is reported only by one Nuclear Medicine Consultant who happens to be also the Chairman of Medical Imaging.

At present, Senior Principal Radiographers, Principal Radiographers and Assistant Principal Radiographers are in charge of operations in different sections of the MID. They are also in charge of radiography personnel operating in their respective section, leave scheduling, sick leave logging and staff rosters. The responsibilities in different sections varied only slightly. In Ultrasound for example the administrator in charge hardly involved herself in the scheduling of patients at all; this was taken care of by the respective scheduler. In MRI all scheduling was done by the administrator and simply inputted into the computer by the scheduler whereas in CT the administrator set the clinical waiting period and the scheduler set the appointment to meet that period. Quality of service was totally based on the level of initiative of the administrators; standard setting, standardization of protocols, quality testing, trawling data for errors etc is completely up to the administrators with little control.
A repeated comment encountered in the interviews was the poor vertical communication present in MID. 50% of the radiographers interviewed who are in charge of various sections remarked that they felt that there was little notion, at operational level, of the corporate strategy in the MID. It was also noted that this comment was typically raised by radiographers who held a management qualification. Furthermore, team leaders also experienced some difficulty communicating suggestions upwards, to top managers since they felt that this participation is not encouraged and incentivated from the top.

25% of administrators suggested a more formal management structure to ensure that operational procedures lead towards common strategic goals and relevant corporate strategies. To follow up these suggestions the researcher met the Parliamentary Secretary for Health; the governmental strategic goals were obtained. These included the digitisation of government information systems, with the health care information system being specifically mentioned.

The administrative radiographers interviewed expressed a need to be informed on the corporate goals to feel part of the process and to participate actively in the progress of the MID. They wanted to follow a structured plan towards achieving common goals in a universal and comprehensive way. Notion of these milestones would have given a more clear indication of what the organisation, on an operational level should be working towards.

On the other hand when departmental meetings were set up to discuss policies and procedures, the level of attendance was low and the level of cooperation was poor, in spite of the expressed need to set up formal management and enhance vertical communication. It was suggested that this could be caused by a lack of willingness of management to receive and react to bottom-up expressed suggestions and requirements or perhaps an unstructured approach that did not give equal chance to all to express themselves within these meetings. It was also suggested that this low attendance for MID meetings was because meetings were stretched over a long time period and not conducted in a structured way were turning out to be merely a waste of time.
4.4 The information perspective

This flowchart was based on the digital workflow that the automated digital software follows. The fact that it is a simplification of the previous workflows demonstrates that this was designed to streamline and speed up the process flow by condensing all processes into one automated system.

![Flowchart showing data movement within MID.](image)

4.4.1 Requesting an investigation

When an investigation is requested, an amount of information is required for various reasons:

1. Primarily, patient identification and demographic data is important for assurance that the right patient is attending for the right exam. This data includes:
   a. patient identification number,
   b. patient name
   c. patient surname
   d. patient address
   e. contact numbers

This data is obtained directly from a Patient Administration System (PAS) that is populated with a list of all Maltese nationals and their details and other persons who have come in contact with the health services. This system is interfaced with the Radiology Information System (RIS) and is updated...
automatically with almost all details except changes in the patient identification numbers. At present patients who for any reason change their identification numbers are identified by the RIS as new patients and hence need to be merged individually. This is a process that is lengthy and inefficient and for this reason, it is being recommended that this should change in the future and that identification number changes on PAS should translate to an update to the original patient on RIS or merge the old patient profile with the new one on RIS when this is rectified on the PAS. Consequently, from this study it will be suggested that changes on the RIS are carried out in an automated way through interfacing software (through what is called the iSoft Interface Engine).

2. Secondly, there should be clear information regarding what investigation is required and a clear detailed explanation of the reason for requesting the particular investigation. This is required for two reasons; (1) the acceptance or refusal of the request by MID vetting staff who may or may not agree that the investigation will yield results that are of benefit to the patient - this staff may recommend alternative investigations or simply indicate that the required results will not be achieved from the request, and (2) scheduling the investigation according to its priority, urgency, demand and availability of resources. The suggestion to implement online requests could also resolve this issue, since the required data could be included in mandatory fields that have to be filled in by the referrer.

3. In this respect a limitation of the automated online request vetting system is that it does not allow vetting staff to access selective workists of requests; if a user has the privilege to vet, then he/she has access to all requested investigations. Since, for example radiographers will only be required to vet skeletal requests, they should filter out MRI and other investigations to ensure that these are not selected by mistake. This error could be reduced by assigning predetermined configured searches on RIS to specific users; for example a radiographer is assigned a default search which pops up onto his screen automatically when opening the visitation page, and on this list he can only see the exams that he is required to vet.
4. Certain investigations require that a patient is medically eligible since he/she may be allergic to contrast or prone to asthmatic attacks, allergic to particular drugs or perhaps not healthy enough to be able to fast over a required period of time. All these factors need to be pointed out when the request is placed. With the introduction of online requests, these, so called "Questions that have to be answered" have to be filled and a request cannot arrive unless particular questions are answered. These questions vary according to the investigation that is being requested.

4.4.2 Examining a patient

Patient identification number and name and requested investigation are uploaded automatically on the modality computer as soon as a patient is registered in the reception area. For a patient to be able to attend for his investigation, the latter has to be approved by both the requestor and MID staff. There has to be an agreement on the investigation that is requested and on the priority assigned for scheduling purposes.

As soon as the patient is admitted into the imaging room, he is identifiable from all networks within the health care system as a patient that is being imaged at that very instant. As soon as the acquired images are sent to the PACS these are attached to the episode registered on RIS. The radiographer then records on the RIS that the patient has been examined.

4.4.3 Reporting an investigation

At this stage the radiologist can issue his report on the attached acquired images, however this report will not be published to other systems before it has been checked and approved on RIS. Before this stage it can only be seen on RIS. When a report is approved it can be seen on two systems. One of these systems, iSoft Clinical Manager, is accessible to all medical and nursing staff and patient management can be planned according to the radiological findings together with other clinical findings. The other system (GE Centricity Web Enterprise) provides access to all medical staff to both images and report. The latter network is a web-
based network that can be accessed anywhere over the intranet that is used by all the public sector.

This network has also been extended to some consultants' homes through Virtual Private Networks (VPN). This was done to be able to consult with the required consultants without their needing to leave their homes. This may be considered to be a form of telemedicine (teleconsultation). The advantage of the web-based system is that images can be seen as soon as they reach PACS and even before an approved result is issued, so consultants can express their opinions on images before the results are published.

A feature of iSoft Clinical Manager that is sometimes perceived as a disadvantage is that deletions are not carried out. It is so transparent to hospital staff, that if a report needs to be deleted or changed even minimally, the original report is not removed, it is just marked as corrected and a new corrected report is sent. This is done to account for any decisions that could have been taken while the erroneous report was the only report that could be accessed. This implies that any reporting errors will remain visible and radiologists who issued the erroneous report will continue to be visible and held accountable for any possible clinical repercussions on the patient. On the other hand any changes, deletions or alterations to reports are altered on Centricity Wob Enterprise.

4.5 The operation perspective

All respondents were familiar with the sequence of events defined within the operational flow. MID operations are divided into six stages:

1. Requesting and investigation;
2. Vetting a request;
3. Scheduling an elective accepted request;
4. Registering a patient on presentation at the MID reception;
5. Starting and examining a patient in the imaging rooms;
6. Reporting on and approving acquired images.
All these stages are incorporated in the RIS software (Centricity RIS4.1, Centricity RIS User and Centricity RIS Reporting) and set in separate pages for the different assigned stages in the operational workflow.

4.5.1 Receiving a request
At present a request is received in writing, even though a facility for online requesting exists. Paper requests result in deficiencies of information in many senses:

1. The request may be illegible and may be misinterpreted;
2. The signature of the requesting doctor is frequently illegible – this means that the receiver of the request is at a loss as to with whom to discuss any conflicting opinions;
3. Requests may be duplicated without notice (unlike a digital system which has an in built duplicate order policy that informs both the requestor and the receiver that the patient has received multiple requests for the same investigation);
4. It is easier to misplace paper requests that if not yet scheduled or registered into the digital system are lost.

The proposed introduction of online requests will improve the amount of information that is received from a request by default. There was a general consensus among respondents in favour of the introduction of online requests. The information received includes information related to contraindications for a patient to undertake an investigation; such as allergies, asthma, pregnancy, inabilitys to comply with diets or receive specific drugs. With the introduction of an online request, a referrer will be required to fill in information within mandatory fields to be able to send the request. This implies that the amount of information included in the request is expected to be complete and consistently present.

This complete information will ensure that only patients that will benefit from an investigation are referred and that patients are not taking unnecessary risks that may compromise their health.
4.6 The integration perspective

This point of view unites the organisational perspective that highlights the available resources, the data handling within the information perspective and the operational perspective that delineates the sequential workflow. The process perspective is also included since this explains in detail individual operations within the integrated perspective.

From the data collected various administrative radiographers that are in charge of the sections state that they are understaffed. The only two sections that admitted that they do not require additional staff were Mammography and Angiography & Interventional radiography.

<table>
<thead>
<tr>
<th>Modality / Area</th>
<th>Staff complement (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammography</td>
<td>100</td>
</tr>
<tr>
<td>CT Scan</td>
<td>60</td>
</tr>
<tr>
<td>Skeletal and Fluoroscopy</td>
<td>90</td>
</tr>
<tr>
<td>MRI</td>
<td>99</td>
</tr>
<tr>
<td>Theatre and Mobile radiography</td>
<td>25</td>
</tr>
<tr>
<td>Angio. &amp; Interventional radiography</td>
<td>100</td>
</tr>
<tr>
<td>Ultrasound</td>
<td>75</td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td>83</td>
</tr>
</tbody>
</table>

Mammography is used exclusively for secondary care of patients and for this purpose the present staff complement satisfies the current demand. Furthermore, there is only one mammography machine which may be a reason why more staff is not required. This may imply that the present waiting list of mammography is not related to the lack of staff complement but rather to the lack of equipment resources. With the current practices mammography operates only in the mornings and it was suggested that the hours of operations in mammography are increased to cope better with the workload demand.
The government is planning on introducing a national screening setup for breast screening. For this service to be manned more personnel will be required and the current staff complement will not be adequate to meet the demand. However, it must also be noted that this project is still being analysed for technical feasibility and eventual policies will be established only after a scientific needs assessment is carried out. This needs assessment will need to look into the incidence and prevalence of attendees for screening and whether the populations concerned are large enough to deserve meeting the opportunity cost and hence be economically feasible.

The MID has two CT scanners, a 16-slice spiral CT scanner and a 2-slice spiral CT scanner. During the interviews with the radiographers it was suggested that to increase the versatility of operations the 2-slice CT should be changed into a 64-slice scanner that can also perform cardiac CT scans. Unfortunately these scanners are not being used to their full capacity since only one patient at a time is presently being scheduled whereas the CT scanning suite was designed to perform within two rooms simultaneously.

There is duplication of resources without duplication of services. Utilising both scanners simultaneously would also duplicate the throughput of patients and reduce waiting lists. It was also stated that more staff is required for the current practice to run more efficiently and that the simultaneous utilization of both CT scanners would require an even stronger staff complement.

There is one 1.5 Tesla MRI machine in the MID. The Senior Principal in charge commented that his staff complement is almost enough, however he still does not find enough time to perform administrative jobs. This implies that an addition of one member of staff could relieve him from the clinical area so that he can dedicate himself exclusively to administration. MRI administrators also recommended that there should be better top down communication of strategic and corporate plans for administrative planning.

Furthermore it was also pointed out that there are too many steps within the RIS sequence of processes, that they are not sequentially streamlined and that there are
little deficiencies in the software related to automated authentication of operators. This was referring to the fact that, for example, when a scheduler attempts to give an appointment to a patient against whom a request was placed, the only way that a scheduler knows that this request has been vetted is when the software blocks the scheduler from giving an appointment. It would have been much easier if an unvetted request did not show up in the first place on the schedulers’ page.

It was also noted that rescheduling of an appointment could be easily done by dragging an appointment from one day to another on a calendar-like agenda; however, when this was done by a different person from the original scheduler, the new appointment will still be shown on the original appointer’s name. This means that if user A gives an appointment and user B changes it to a different date by dragging it as explained previously, the second appointment will still show on user A. This issue is sorted automatically when an appointment is changed from the patient details page that is associated with the RIS scheduling.

Similarly, radiologists pointed out that when a patient report is issued and approved, it may be amended by adding an addendum. However, when the addendum has been written this requires a signature and, by default, the signature of the original reporter comes up with his code. This code has to be changed manually by the second user but if not changed will show up as a change done by the original reporter, possibly without his knowledge.

It was proposed that when someone other than the original radiologist who approved the report creates an addendum, there is identification that shows the person typing the addendum, even if the correction is still approved by the original radiologist. This is important since only radiologists are given the privilege to approve reports but sometimes addenda are created for administrative purposes. For example a radiologist refers to a previous result that was issued prior to the introduction of the digital system within a report; administrative staff copies the old result into the addendum so ensure that the comparative reference can be appreciated without unnecessary delay and efforts to trace old reports.
Theatre and Mobile staff requested that MID administrators consult more with the operators before any decisions are taken. These remarks may suggest that vertical communication within MID is deficient. MID needs to enhance bottom up communication by consultation with users and also better top down communication of plans, be they strategic or corporate.

The theatre and mobile team is made up of a small amount of staff (25%) that are unable to cover a 24-hour service are required. Furthermore there are presently more theatres in which these radiographers need to operate than there are radiographers in any shift. This results in theatres having to wait for a radiographer to be available before they start an operation. This situation is similar to the one in CT scanning where the equipment resources are higher than the human resources. It was also pointed out that this pressure on few radiographers to perform in many operating theatres increases stress on radiographers which in turn are expected to perform accurately and safely.

Another operational issue that is present within the theatres and mobile team is an unwritten policy among employees that same radiographers operate in same theatres. This was described as a sort of sub-specialisation of radiographers within a specialised team. This is evident even from the surgeons' comments that state that they prefer to be assisted by particular radiographers rather than others. An example of this is particular orthopaedic surgeons who comment positively on individual radiographers who are frequently present in their theatres and who know the sequence of surgical operations so well that they are very efficient and precise in their performance. The effects of this sub-specialisation is that other radiographers who work in such areas only in the absence of the "good performer" may not perform as efficiently since they are not as used to working in the particular operating team.

This issue may be met in two ways: either rotating staff so that they receive equal, but reduced, exposure to the surgical operations that are carried out; or else increasing staff complement to the extent that staff is rotated within every theatre as a separate specialised team. It was suggested that additional staff is required anyway for the theatre and mobiles team to be able to cover surgical interventions that are done after 7:30pm. The frequency of interventions at night under
emergency conditions may not be high; however, performance levels have to be equally high and efficient during these times as during the peak hours.

In Angiography and interventional radiography there were no complaints on staff complement within the team. The operational workflow was described as unremarkable. The only issues raised were related to top-down and bottom-up communication of administrative issues. The administrator of Angiography and interventional radiography was more concerned about fixed frameworks of operation built within a corporate plan and directed towards a strategic goal. This administrator was recommending a more scientific approach to management to contrast the present practical administration of addressing crises in retrospect. With the introduction of CT Angiography and MRI Angiography the demand on the Angiography and Interventional Radiography team was reduced and hence there were no issues related to waiting lists or staff complement in this area.

Within ultrasound various communication issues were mentioned. The first problem that was pointed out was communication between the front-line staff and the radiographers that resulted in daily coordination difficulties. There seemed to be an overcrowding problem within the ultrasound sub-waiting area. The MID has a large waiting area and various sub-waits situated close to the different sections within the department. Each of these sub-waits is designed to seat a limited number of patients who are awaiting their investigation that is imminently going to start. Overcrowding of this waiting area implies that front-line staff were not taking note of the patients that left the investigation room before they send in other patients.

Another issue that was mentioned by the Ultrasound administrator was the uncontrolled and uncoordinated arrangements with nursing staff from wards. Patients were not being whaled to the Ultrasound room in time according the pre-booked schedule of appointments. The administrator commented that on a daily basis patients should be ushered down from wards when they are called and that they should cooperate with this very busy section of the MID and stick to their schedule. Furthermore, if there are specific times when ward staff are unable to escort patients to the MID, then this should be noted and catered for in the
scheduling of these patients. This constitutes a problem of horizontal communication between staff from different professions.

In the Gamma Camera Unit there seems to be good cooperation between the staff on the operational level. There also seems to be an adequate level of training and specialty in the area. Some difficulties mentioned were related to the fact that only one specialised radiologist reports on all the patients that undergo a nuclear medicine investigation. This implies that this one radiologist is not replaced when on vacation leave or sick leave. This issue is worked around by the sending of diagnostic images to this doctor who expresses his opinion from a remote location; if the prognosis requires immediate attention, this is communicated to the referring doctor. This puts a lot of strain on the one doctor who may be required to perform jobs even when on vacation or in poor health.

4.6.1 Waiting lists

In the case of ultrasound, emergency cases are imaged when they are sent from Casualty. Urgent appointments have a week’s waiting time, whereas non-urgent, elective appointments are being scheduled for ten months time. That is if a patient request presents today for a life threatening undiagnosed ailment, the ultrasound is probably done today; if the patient can wait but is uncomfortable, his appointment is given for the two weeks later; but if the patient requires monitoring and hence has no hurry, the patient is imaged in ten months time.

In the case of CT scanning, as in ultrasound, urgent cases are imaged on the day when they present at Casualty, urgent appointments are given in two weeks time and non-urgent elective appointments are given in five months time. Consequently, the elective waiting list is half that of ultrasound. MRI follows the same pattern whereby urgent appointments are scheduled for the period of time as requested by the referrer. This means that if the investigation is required on the day or within two days or a week, this request is met. Waiting for elective appointments depends on the investigation. For example, the waiting list for patients requiring MRIs of the spine is four months, for MRI of the brain its five months whereas for MRI of peripheral extremities such as arms and legs the waiting list is of six months.
In nuclear medicine, there are practically no waiting lists. Appointments are given according to the request of the referring physician. Waiting lists are only present in the case of Methoxyisobutylisonitrile (MIBI) cardiac gamma scans. These waiting lists are of eight months and the Chairman of Medical Imaging reported that he is presently exploring ways of reducing this wait.

Mammography waiting lists, as in other sections, depend on the requirements of the patients according to the referring doctor. Mammograms are scheduled such that there is room for insertion of urgent cases or patients that require imminent intervention, however, non-urgent elective appointments are scheduled for six months time. It was reported that this waiting time for mammography scheduling has been reduced since the digital system was introduced, however, is still long and reduction of this waiting list was recommended by the interviewees. The prospective introduction of a screening facility will also impact this waiting list in the long term and its effect on the current practice still has to be assessed.

Angiography and interventional radiography have no waiting lists since they operate on a daily basis as a backup for other modalities such as CT and MRI that perform their share of relatively un-invasive angiographic procedures. They presently have elective appointments that stretch up to two months; however, this is due to the lack of urgency of the scheduled procedures.

Patients requiring skeletal imaging are served on the same day when the request is placed; hence there is no waiting list. When patients are required to come from home appointments are given within a week which is the time that needs to be allowed for the appointment sheet to reach the patient by post. As in other sections urgent fluoroscopy investigations are done on demand, however elective appointments are given within six to eight weeks from the request in most cases and in the case of barium enemas and sialograms within five to six weeks.

Waiting lists, in general, are not impacting on the prognosis of a patient. In all sections of the Medical Imaging Department, the waiting is dictated by the negotiated urgency between the referring physician and the radiologist. It is for this reason that
radiologists are required to vet requests that are received within the imaging department. Radiologists are required to check that the request is justified, that the exam requested answers the required clinical questions and that the urgency for the request is justified. For example, an investigation that is required to screen a patient for mammography, for example is not required within days, hence if it is requested urgently, this priority is transformed to one which is relevant within that situation.

4.7 The socio-cultural perspective

The Maltese population has a Mediterranean culture which may have influenced their feelings and attitude during the implementation of a digital workflow.

The interviewees commented that before the change-over to the digital system was such that there were hardly any changes occurring in workflow and this had instilled in employees a sense of security; they were very familiar with processes and procedures. The simultaneous move from one hospital location to another and from an analogue system to a digital one breached all these intrinsic securities.

The operational strategy required to tackle the mentioned insecurities was discussed with the employees during the interviews and they agreed that this change had to be accompanied by strong support, both from administrative staff and knowledgeable technical staff. Administrative staff had to be prompt to react to complaints; they were expected to solve difficulties and rise to the occasion in problem solving in real time, without disrupting operations, and while they themselves were in the process of learning.

This approach of continuous hand holding was required at every stage of the changes that were being implemented. When the employees were asked to comment on this issue they all stated that technical support they received was adequate and prompt and that the response that was given was timely. The researcher was aware that this positive response could have been biased since the researcher was the person who took charge of hand holding during the implementation of the digital systems.
The researcher probed interviewees by referring to the administration as the department to detach him completely from the picture. Interviewees were also encouraged to mention both issues that they recall that were solved and others that were not. Responses could have been influenced by recall bias. This should not be too significant since the data was being collected only few months after the changes to the digital system were being carried out.

Users showed that they were aware that the changes being made were part of a corporate strategy that was aimed at meeting the strategic goals of the health service. These strategic goals were listed in a meeting with the Parliamentary Secretary for Health within the Ministry of Health and Social Policy, Dr, Joseph Cassar MP; these included digitisation of government information systems to enhance communication with foreign organisations and increase internal efficiency.

The Parliamentary Secretary stated that the Maltese government aspires to work towards the implementation of an electronic government (e-government) policy whereby the small size of the Maltese archipelago is exploited to convert all national records into digital records that are protected and shared with definite regulation and as efficiently as possible by exploiting the inherent benefits of digital information systems. This is expected to market Malta as a pilot for other bigger countries to follow this digitisation policy. This is also expected to market Malta as a country that is advanced in computer technology.

The digitisation of medical records is only part of the move towards this e-government policy. Other similar processes are being implemented in other sectors such as the Value Added Tax section and national electronic identification (e-ID) system. The complexity of medical information demands the interfacing of various systems that are dedicated to the needs and workflows of different healthcare professions and clinical areas. These are interfaced to communicate using international standards such as Health Language seven (HL7) and Digital Imaging and Communications in Medicine (DICOM) standards. Systems that fail to comply with such standards are not compatible for interfacing and cannot efficiently exchange data with other systems.
The contract established with Mater Dei Hospital for the implementation of RIS and PACS networks binds suppliers to provide solutions to similar imaging systems in the Maltese archipelago and additions or further changes in equipment from conventional to digital systems will be added to the present networks which are expected to provide for communication of images and data.

Consequently, the Mater Dei Hospital project is only the start of a nation-wide project for which increased resources (including human) will be required with growth. Furthermore, workflow enhancement within Mater Dei Hospital Medical Imaging Department will serve to provide for a more efficient flow on a national platform. This scenario was reported to be a major incentive for employees of MID to accept the major changes that they were being put through.

4.8 Human resources

4.8.1 Radiographic human resources

There is a consensus among all interviewees that there is an adequate staff complement in MRI, mammography, angiography and interventional radiology and skeletal and chest radiography sections. However, there is also a need for an increase in Casualty and Theatre and Mobile radiography staff since these sections are being run on roster and on a twenty-four hour, seven day week basis. The Theatre and Mobile section administrator claims that the staff complement within his section needs to be quadrupled to be able to provide a fully dedicated and specialised round the clock service.

There is also a need for a marginal increase in staff complement in the Fluoroscopy area; however a move to control the demand by emphasising adequate justification vetting on requested investigations is expected to reduce the need for added staff in this area. Responses to the needs in radiographic human resource complements seemed to be subjective and inconsistent; there was a difference in the responses of the sectional administrators and the Manager of Radiography Services on the needs and priorities of the sections. The requirements of each section varied with
interviewee and there seemed to be no scientific analysis as to how many people were required to run sections adequately, effectively and efficiently.

4.8.2 Radiology human resources

With regards to radiologists, there seemed to be a more clear definition of what is required and what needs are actually not being met. It was clearly defined by the Chairman of the Medical Imaging Department that the number of consultants required had to double; from four to eight. Another consultant is required to report on nuclear medicine. The number of senior registrars also had to increase by another four. Specialised radiologists were also required to be able to report adequately on paediatric imaging, gastroenterology and oncology.

The researcher was informed that the vacancy for a paediatric imaging radiology consultant could be filled within the year, however, the prospective specialist was still undecided on whether to come to Mater Dei Hospital or not. There were another two consultants and one senior registrar who expressed some interest in coming to work in Malta. In the eventuality that these radiologists actually come to work at Mater Dei Hospital the number of radiologists required would decrease from twelve to nine.

4.8.3 Support staff human resources

No numerical shortages were reported in this staff complement that is required to support the MID. There were some concerns expressed by the Manager of Radiography Services on the quality of the output service. Workflow can be enhanced by training this group of staff to relate more effectively with patients. For example, patients may be instructed routinely on whom to contact if they are not comfortable with the waiting period for their investigation or if they are unable to attend for a given appointment. An effect of this is that a number of patients simply do not turn up for their appointed investigation and when some were contacted, they stated that they attended elsewhere (generally private clinics) for the investigation.

This factor is particularly present in the scheduling staff members who were described as needing to be more flexible in the services they provide. Each scheduler has a personal telephone line which he/she uses for the appointments
made in the particular area, when one scheduler is absent, there is nobody to answer patients' calls in his/her absence. Furthermore, when a scheduler is absent, nobody replaces the scheduler in booking of appointments and the workload of pending scheduling simply builds up until the absent employee returns to his/her desk.

This obviously slows down the provision of scheduling service and limits the availability of scheduling facilities to few hours within a day. The services stop when the schedulers are on break time and off duty. In critical situations this process is taken over by the radiographer heads of sections who schedule investigations that are urgent and cannot afford to wait for scheduling staff to return to their desks.

The researcher also noted that there was little concern for administrative staff; there was absolutely no mention of what staff is required to support, manage and regulate clinical practices. This support staff may be useful in maintaining and supporting a system, ensuring quality and patient safety within clinical practice.

4.9 Current situation and related prospective corporate strategy

At present the major limiting factor within the Medical Imaging Department work flow is the radiologist complement. The present complement has difficulty reporting investigations with the fast rate that they are receiving them from all the sections within the department. To compensate for this deficiency in radiologist staff complement, radiographers are taking over some radiologist duties to cope with the increased number of performed investigations and increased population of patients. Radiographers were considered by some interviewees not to be adequately qualified to be held accountable or legally liable for the duties that were delegated to them.

Numbers of investigations are increase both in type and numbers. This is due to the progress in medical procedures and even to the increasing demand from referring doctors. Another factor affecting the numbers is the fact that the efficiency increase related to the decreased turnover time for issuing a radiological report has increased the interest in radiological investigations. Whereas previously, in a conventional
system, a report would have been issued within a week from the investigation, now within the digital workflow reports are issued practically across the board on a same day service.

This increase in MID operational efficiency is a major contributor to the increase in demand for radiological investigations. Various future changes in service delivery that will also have an impact radiological staff. The service outlets for radiological investigations are increasing to meet the needs of people in various sectors of the population.

Increases in services include:
- The upgrade of the Gozo General Hospital from a single X-ray room to a suite of five modalities that supply various services;
- The creation of a reception centre for irregular immigrants with its screening facilities;
- The upgrade of regional health centres to be able to meet the required demands more efficiently, and to comply with the main hospital and point of service outlet, Mater Dei Hospital.

The prospective introduction of online requesting, also proposed as an improvement in this dissertation, will also oblige radiology staff to vet every single entry and accept or reject as required. At present, with written requests, radiologists are required to intervene only when a request is not adequately justified and no intervention is required on accepted requests. This obviously does not imply that any requests could be overlooked but that vetting required no intervention on RIS software when the justification was founded. In the past, routine vetting was being delegated to senior radiographers within the different sections who were expected to consult with radiology staff when the request was not already known to them.

In MRI, Angiography and Nuclear Medicine all investigations were being vetted by radiologists, so the workflow in these areas is not expected to change with the prospective introduction of online digital requesting. However, in CT, US, chest and skeletal radiography, fluoroscopic investigations and Mammography, first line vetting
was being carried out by radiographers who were operating as delegates of radiologists and consulting with radiologists only in the case of a query as mentioned previously. Hence, in all these sections, with the prospective introduction of digital online requests, all the vetting has to be carried out by radiologists since they are legally liable for this process and automated digital authentication does not cater for delegation of responsibilities. To attempt to reduce this factor, the Medical Imaging Department administration has options proposed by interviewees for this dissertation.

Primarily, ultrasound investigations may not require vetting since there is no known harm to a patient undertaking an ultrasound investigation. This was debated by different interviewees since vetting is not only carried out to protect the patient but even to reduce unnecessary costs of the institution.

Another proposal put forward by the interviewees was for skeletal and chest investigations to be vetted by radiographers, who were expected to refer unjustified requests only to radiologists when required and accept justified requests as they arrive. This suggestion was disputed and there were even an administrator specifying that vetting does not fall under the professional capacity of a radiographer and that this would constitute a clinical risk. Others, on the other hand, were confident that radiographers can perform this job adequately and even that they were capable of justifying requests without the intervention of the radiologists.

The second proposed solution may seem to be a partial solution for the reduction of workload to radiologists; however it impacts heavily on radiography staff within the Accident and Emergency department. This section serves between two hundred and two hundred and thirty patients a day and is manned exclusively by radiographers who operate within two X-ray rooms that are imaging patients twenty-four hours a day, seven days a week. This implies that this prospective introduction of vetting duties will increase the workload on these radiographers who well in addition to their normal duties need to vet between two hundred and two hundred and thirty requests every day without additional human resources to support the service. The present human resources have to be reorganised to meet this requirement. Furthermore, it also should be noted that the Accident and Emergency
staff also support theatre and mobile radiography, CT scanning and ultrasound services in after hours.

The Medical Imaging Department long term corporate strategy is to increase the complement of radiology staff to an adequate level. This will be followed by increasing the hours of service delivery; thus decreasing the after hours support from Accident and Emergency staff and decreasing waiting lists. Finally, when the adequate staff complement is reached, new equipment may be purchased and installed to eradicate waiting lists completely and meet the demand completely.

In reality the prospect of meeting the demand completely is a very ambitious one however, the corporate strategy of the Medical Imaging Department as stated by the Chairman of Radiology is working in that direction. This strategy has other implications, of course, primarily costs incurred in recruiting additional staff, purchasing additional equipment, adding fixed costs of wages to people who operate for longer hours. Hence, in reality the solution shifts the demand from a clinical perspective to an economic one and to assess the overall feasibility all factors have to be included, even the clinical implications and possible increased patient wellness.

The following figure gives a graphic representation of the workload within different areas of the Medical Imaging Department as from the 12th of November 2007, the date when the digital systems that are currently in place started serving patients, to the 12th of November 2008, exactly a year later.
4.10 Patients’ attitudes towards imaging service delivery

The patients’ attitudes survey was introduced to assess the effectiveness of the clinical service. The target of the services provided by the Medical Imaging Department is to meet the needs of the patient; hence patient satisfaction was selected as a determinant of clinical effectiveness.

Patients were found to be generally satisfied with the service that is being provided (71%). There were no specific complaints with regards to the work flow or waiting time within the Medical Imaging Department itself and scores on questions asked were never less than 65% satisfactory. Patients were asked whether they waited too long in waiting areas and whether the service time was adequate since this constitutes a quality factor related to hasty or adequate time allocation giving to patients. In both areas the score was high. Out of one hundred questionnaires waiting time scored an average of 66% satisfaction whereas adequate time and explanation scored 84%.
Responses were assessed for correlation and comparisons between adequate time and adequate explanation gave a correlation coefficient of 0.61, between adequate time and overall satisfaction 0.64, between adequate explanation and total satisfaction 0.83. Hence there was an average correlation between responses of 0.69 with a standard deviation of 0.11. These results showed that the responses to the questionnaire were understood and consistent.

![Graph: Patients' attitudes towards service provided](image)

**Figure 4.10.1** Patients' responses to main themes in questionnaire.

![Graph: Patient Satisfaction](image)

**Figure 4.10.2** Percent overall patient satisfaction.

Satisfaction with waiting lists for scheduled appointments was not enquired within this questionnaire. This could have constituted a source of dissatisfaction that was
not accounted for, however, I was assured from the administration staff that appointments were scheduled according to urgency and priority in an equitable way and that patients who required appointments to be scheduled within a restricted period of time for medical reasons which were justified by the referring doctor or consultant, were always accommodated within any of the sections within the medical imaging department. Requesting patient expectations on waiting times for elective appointments would probably have demonstrated dissatisfaction since most patients are not objective regarding the gravity of their personal situation and expect to be served as soon as possible with little concern for the global needs of the Maltese population served within MID.

Patients who were very emotional due to past medical experience or family related distress were, in most cases, given additional priority in scheduling of appointments and communication of results. Furthermore, the Medical Imaging Department is presently in the process of implementing an email automated message system that is triggered by a simple process when a patient has a result that gives a poor prognosis or required immediate attention from the referrer.

This message would arrive in the form of electronic mail (email) that notified the referring consultant that the patient in question has a result that required urgent intervention. This system is paralleled by a flagging system that is present in the software that doctors within the hospital use to request an investigation; however, this flagging system does not discriminate between good, bad or urgent results and assumes that the referrer reads all the results of the patients that were referred by him/her.

In conclusion to the effect of the present work flow on patients, it was noted that the patient’s needs detailed by the referring physician, are given absolute priority and that waiting lists are not set sequentially and indiscriminately but allowances are made to accommodate any patients that require, for medical, legal or emotional reasons, as early an intervention as required. Furthermore, all sections within the Medical Imaging Department accommodate justified requests placed by the requesting doctors and appoint patients to attend for the imaging investigations on
request of the referring doctor who is held responsible as a legally and competent professional on the needs of the patient.

The referrer acts as gate keeper and operates as an agent of the patient, hence, priority is not set on a patient request but on a referring doctor’s advice and justification for accommodation of patients with their specific needs is accepted exclusively from the referring doctor. Consequently the opinion of the patient in the case of waiting lists was not going to affect the policies and practices within the Medical Imaging Department. For future studies it would have been useful to question the satisfaction of the referring physician too who is the agent of the patient and consequently the direct client to the Medical Imaging Department.
Chapter 5: Discussion
5.1 Introduction

This chapter will discuss critically the findings documented in the results chapter. The data collected is principally of a qualitative nature with little quantitative input particularly from the questionnaire distributed to patients. All staff members were interviewed individually and the research data was documented without prejudice and as accurately as possible.

5.2 Critical evaluation

The performance indicators used to determine whether the operational processes are adequate or deficient with regards to effectiveness and efficiency include patient satisfaction, clinical effectiveness, response to clinical requirements, degree of specialisation of staff in delivery of particular services, consistency and conformity to administrative processes.

5.2.1 Patient satisfaction

Patients have shown adequate satisfaction with the services they receive. This shows that the expectations of the public are being met. This in itself is a positive aspect which however has to be taken in perspective of the local culture of the people. The hospital has just changed from an old fashioned, unattractive building to a new hospital which in itself is not only an architectural project but also a work of art. This new hospital is fully air-conditioned and fully equipped with the latest technology equipment which operates in digital format. This does not imply that the previous hospital was not meeting clinical needs of patients.

The previous hospital actually met clinical needs adequately and for most people in the Maltese population this was an adequate service. Patients were satisfied with the services provided in the previous old fashioned hospital due to many factors. Primarily we have only one national hospital and hence there is no market competition to this hospital. This could only be contrasted with private clinics and hospitals that in reality are not able to compete with the national hospital due to the economies of scale of the national hospital.
Furthermore, another factor that could have affected patients' responses is the lack of their inclination to criticise the services that they receive. This factor is also reflected in other issues related to patients' and their relationships with health care professionals. For example it is a known fact that up to now very few patients seek legal compensation from health care professionals whose actions have a negative impact on the state of the patient or his/her relatives.

This seems to be changing gradually; however, the expectations of a patient are frequently not very high. On the contrary, patients do not expect to receive perfection and they frequently express themselves in a fashion that demonstrates that they want to receive more than they are getting to make sure they receive the utmost of what is possible. This factor puts pressure on service providers who frequently feel pressured by patients in spite of the fact that they are doing their utmost efforts.

Hence, in conclusion, patients do not expect any more than they are presently receiving and hence express themselves positively to what they experience in the real scenario. The non-respondent group could constitute a number of patients who were not willing to participate due to some negative factor that affected their attitude; this could be dissatisfaction with the something that left an impression on their temper when they received the service. However, the rate of non response was very low (3.1%). Questionnaires were distributed by reception staff to safeguard anonymity and use blinding techniques to reduce biases. These were then collected in sealed envelopes which were opened by me.

5.2.2 Clinical effectiveness
The results obtained in the patient questionnaire demonstrate that the clinical requirements of the patients are being met in all sections with few exceptions. For example MIBI scans in gamma camera are still lagging behind the demand for this investigation, in view of the fact that patients who require such a scan are classified as critical patients. In MRI all elective investigations are being treated within the
waiting lists of the section without discrimination. Hence, it is up to the discretion of the referring doctor who is acting gatekeeper and agent in the name of the patient to negotiate with radiologist staff the required urgency. The request is then prioritised according to the mutual agreement of the referrer and the radiologist. For further studies it would have been useful to include a sample of referrers in the data collection since the requests of the referrers may not tally with the expectations of the patient and the results may have varied.

On the whole, the operational processes within the Medical Imaging Department seem to meet the requirements of the referrers and hence can be classified as clinically effective. However, this study does not query the opinion of the referrers and hence these conclusions may require further insight. One of the limitations of this study is definitely the exclusion of the referrer group from the data collection.

The response time for reporting on investigations is very high; reports are practically issued on the same day that the investigation is performed across the board. Consequently, the speed of the workflow is very high and turnover time documented between investigation date and time and reporting time is very short.

There was some anomalous data regarding the scheduled appointment date and time and the registration of patient attending for the investigation; registration time was actually ahead of the scheduled time, consequently, in various modalities this shows that patients were being admitted to the waiting rooms earlier than scheduled. Of course, this could also imply that the scheduling pattern could be revised to increase the numbers of appointed patients within a given time frame. This is an exercise that should be undertaken by the Medical Imaging Department.

5.2.3 Response to clinical requirements
As mentioned in the previous section, the clinical requirements are expressed in the request of the referring doctor and negotiated in the vetting process. What is normally, primarily negotiated is the justification for the requested imaging procedure. Secondly, the referrer and radiologists discuss the value of the
prescribed investigation and its contribution to the prognosis of the patient. Finally, the urgency by which the investigation is required is negotiated.

With regards to justification of requested investigations, the radiology staff in the medical imaging department feels that it is being quite lenient with its referrers. This is because radiologists claim that they feel pressured by the referring parties who request investigations to ensure that they do not miss any occasional findings that may be present in the patient that can be related to his health status. Furthermore, issues of liability may also bias all medical towards over investigating.

Radiologists expressed clearly in the interviews that if an ailment is missed liability falls on the medical staff that may have refused to perform an investigation. Hence if the referrer would have not requested it, liability falls on the referrer, whereas if the radiologist would have refused the investigation, liability falls on the radiologist. Consequently, the tendency is to be over investigative from the referrer’s side and over lenient from the radiologist side in accepting to perform an investigation. The reason for this over-use of service is merely the shouldering of liability for diagnosis or misdiagnosis.

Some radiographers commented that when considering issues of quality, at face value over investigation may seem to be an asset to the benefit of the patient; however, many investigations related to medical imaging are related to the administration of a radiation dose. Consequently, if an investigation is not adequately justified, but performed anyway to make sure that no ailment is missed; the patient may be receiving a radiation dose that may even be a contributing factor to the causation of an ailment. Research on the effects of radiation on the human body is being carried out to assess the stochastic and non-stochastic repercussions on different organs within the body.

Hence, there is a conflict of interest in this issue. Over protection of the patient who may seemingly not require the administration of a radiation dose may lead to under-requesting of imaging investigations, whereas, over protection of liability to professionals who do not want to be held responsible, in the short term, of a missed ailment may lead to over-requesting. The Medical Imaging Department is trying to
move towards the reduction of unjustified requests in two ways. Primarily, strict justification of requests is being encouraged by MID administration and radiologists are in favour of strict protocols for the referral of patients. Secondly, if online requests suggested by the interviewees are implemented, there are two levels of control; the first is the control on the reasons for requesting particular investigations. That is reasons for requests are automatically screened to filter out justifications such as trauma that in itself says nothing that is directly related to the state of the patients.

Administrators and radiologists commented that these measures have a double effect on the current practices. They will increase the quality of service delivery to the patient who will not be examined without adequate justification and secondly the workload is expected to decrease thus allowing for shorter waiting lists and shorter response time to elective patient referrals who are waiting their turn for an appointment. Another advantage stated by the Chairman of Radiology is the reduction of load on radiologists whose staff compliment that is low in comparison to the current demands of the institution (Mater Dei Hospital).

It is true schedulers stated that in most areas waiting lists are related to the elective investigations, however, patients on these waiting lists still require shorter waiting times since the cause of their discomfort may, in some situations be identified exclusively by imaging. Hence patients may require the imaging investigation to start improving; either by conservative treatment or surgical intervention and as the radiographers stated any wait is too long if the patient’s quality of life is compromised. Imaging investigations frequently determine whether there is a chance for a patient to improve his health status or not by any intervention and undue procrastination may also be a cause of aggravation of a patient's prognosis.

5.2.4 Staff specialisation

The Manager of Radiography Services stated that staff specialisation is required on two levels within the Medical Imaging Department. Specialisation of radiographers is required to increase the quality of the services delivered to the patient. At present there are a number of courses running for radiographers to specialise in various
areas such as MRI, mammography, ultrasound, CT scanning, accident and emergency etc.

This does not impact the speed of workflow directly however, radiographers expressed that an increased quality output of images may result in a reduction in number of images that are required for adequate imaging diagnosis by radiologists. Hence, better radiography may also result in a reduction of the quantity of request investigations. This has two effects: primarily it will impact the workflow by increasing the numbers of scheduling slots available for booking investigations; secondly it will result in a reduction of administered dose to a patient and hence an increase in the quality of clinical practice.

The Chairman of Radiology expressed that with regards to radiologist specialisation, at present, there are many gaps. There is a need for specialised radiologists in paediatric imaging, gastroenterology and oncology imaging. This implies that quality in the named areas would be enhanced if the required specialisations are present. At present all skeletal imaging being reported by radiologists and senior housing officers in radiology. MRI, Angiography, Mammography are being reported by consultants and nuclear medicine investigations are being reported by a consultant in the area. Even in nuclear medicine, an additional consultant is required since at present a single consultant is required to report on investigations and this single consultant is the only source of consultation in the area even when away from the place of work.

Radiologists expressed that at present they have to consult with each other to double check before approving reports prior to sending off the result. This constitutes a source of delay since there is an element of duplication of procedures which can be avoided if specialised staff is introduced. Even though the present work flow is efficient and has a fast turnover time there is a need to adopt specialised resources for the issuing of more concise reports as required in the mentioned areas.

Furthermore radiologists commented that, in neurology, neurosurgeons frequently prefer to use the images taken directly since at present when a neuroradiologist is
required for consultation images are sent to a remote location overseas. Hence, there is an unexpressed need for neuroradiology consultants since at present neurosurgeons are covering for this role. It will only increase the demand on the department since additional reporting will be required. On the other hand the present workflow decreases the workload on the department making more efficient. This may be the reason for the unexpressed need for a consultant in neuroradiology.

5.2.5 Administration

The hierarchy of administration of the Medical Imaging Department is a complex, vertical hierarchy. Radiologists are managed directly by the Chairman of Radiology, radiographers are administered by the Manager of Radiography Services who, in turn, answers directly to the Chairman of Radiology. The Medical Physicist, RIS and PACS Manager and the Nursing Officer answer directly to the Chairman of Radiology too and all nurses are managed by the Nursing Officer in charge.

There is also an informal arrangement that the Manager of Radiography Services acts as human resources manager and keeps track of leave, sick leave and other benefits of all staff except radiologists and other doctors. The Nursing Officer, on the other hand, takes care of the stocks related to angiography and interventional radiography. All stocks in other sections are administered by a Senior Principal Radiographer who answers directly to the Manager of Radiography Services. Since the two mentioned people are performing similar jobs in different areas, there is duplication of jobs within the same department. Consequently, there is also discontinuity in the global picture of what stocks are being consumed throughout the department.

Furthermore, at present, the role of Nursing Officer also includes the administration of the angiography suite as a whole, since this operates similarly to other operating theatres. In the angiography suite there is also a dedicated Senior Principal Radiographer who administers radiographic procedures, patient appointment scheduling and operation of digital systems related both to the network and the imaging equipment. The presence of two administrators within the same area results in conflicting roles that frequently overlap. There is lack agreement on
limitations of each other's administrative role and frequently the Senior Principal Radiographer checks blood results that are normally a nurse's job and the Nursing Officer attempts to change scheduling patterns and compute statistics related to the numbers of investigations carried out within a given period of time to manage stocks. This results in the radiographic administrator requesting rights to utilise the nursing software and vice versa.

Human resource benefits of radiologists are administered by the Chairman of Radiology himself. Apart from administrative duties, the Chairman of Radiology also operates as the only Consultant in Nuclear Medicine. The function of the only Consultant in Nuclear Medicine is an operation which requires long hours of duty and for which, as mentioned in section 4.8.2, a replacement for the only consultant is required.

The Senior Principal Radiographer in charge of Gamma Camera stated that the addition of administrative roles, particularly that of Chairperson of Radiology, to the role of clinical consultant puts a lot of pressure and dependence on one person, who is required to cope and sustain all processes in the Gamma Camera workflow and administrative processes. As a consequence of this the Chairman of Radiology has limited time for meetings and administrative initiatives other than the bare minimum required for the daily operations. This does not imply that the Chairman, at present does not perform his duties adequately, however, if operations were to be divided among more flexible people more time could be dedicated to administrative processes.

A frequent issue that was raised within the interviews with people who were not in top administration (radiographers, schedulers, transcriptionists etc.) was not related to deficient administration but more related to lack of vertical, top-down communication. The departmental goals were not being communicated down to the employees at operational level. Furthermore, there was little notion, at the operational level, of the goals and plans of the department for the future of the different sections within the department. Consequently, sectional administrators feel that they are not being involved in decisions that affect their daily operations. As a result of this, sectional administrators are not participating in prospective planning
and corporate management of their areas but simply administering, sustaining and maintaining on a daily basis and frequently reacting to some unforeseen crisis.

These administrators suggest that they should be involved more actively in department corporate planning. This will yield better performance since the dedicated administrators are in touch with realities and difficulties that are being encountered in their respective sections, in real time. Greater involvement of sectional administrators enhances the sense of belonging of employees at operational level. This increases employee motivation and performance levels. It was also suggested that better top-down communication will help sectional administrators to be aware of what goals and achievements they are working towards and consequently participate actively in progress to achieve common goals. This improvement in communication will then catalyse processes of change and development of the whole Medical Imaging Department.

5.3 Limitations of the study

There is always a danger of bias creeping into interviews since the human intervention of the interrogator may influence responses or may be influenced by personal prejudices (Bell, 1993). However, if only one interviewer conducts all interviews this bias is reduced since it is consistent throughout all the data collection. Borg 1981 (in Bell, 1993) states that some factors that may influence responses may be (1) the eagerness of the respondent to please the interviewer, (2) a vague antagonism that may arise between responder and interviewer and (3) a tendency of an interviewer who attempts to extract already preconceived notions. These factors are called response effect.

Primarily, my impression was that the communication between interviewees and me was transparent since, in my job I am used to receiving all sorts of requests and criticism and try to react very constructively. However, being rationally objective, I cannot exclude that nobody was trying to please the interviewer (myself). For this reason during the interviews I attempted to react to the different personalities that were interviewed in different ways. I gave them the option of where to sit at table
and sat down before them to ensure that they kept a distance that was comfortable for them.

I also avoided direct eye contact with responders who were naturally reserved or reluctant to contribute particular negative comments. I also encouraged responders to avoid being diplomatic and attach me directly with what they had in mind. I also repeated after interviewers the notes that I was taking to ensure that what I understood and noted was exclusively what they wanted to say. In spite of all the mentioned measures, one must not exclude that response effect bias did not influence results.

It would have added value to the results to distribute a questionnaire to some referrers, enquiring whether they were satisfied with the waiting times for elective investigations, or with the prioritisation of scheduling within the Medical Imaging Department, since these issues are frequently negotiated between radiologists and referrers. However, this did not fall within the scope of the study since client satisfaction, clients being both referring doctors and patients, was not defined as an objective of this research. It would only indicate effectiveness of the service as would other related issues such as clinical outcomes from the investigations that were carried out. Furthermore, this type of outcome study would have required that the researcher adopts another style of research a prospective cohort study which in itself requires a much longer time span which was not feasible within the limited timeframe of this study.
Chapter 6: Conclusions
6.1 How conclusions were drawn

Conclusions were drawn up on the basis of the information collected within the interviews. These conclusions will reflect progress from the past to the current situation and possible solutions for future further progress.

6.2 Past to present

This study shows that the migration of the Medical Imaging Department from the analogue conventional system that was being operated within St Luke’s Hospital to the completely digital system that is being operated within Mater Dei Hospital brought with it an increased efficiency in the speed of issuing of reports for patients. We have already mentioned that reports that were being issued within a week of an investigation are now being issued within one or two days from the investigation.

Radiologists stated that the increased throughput results in an increased demand on the radiologists since these are expected to keep up with the high influx of investigations (see Fig. 8 pg 57). Some areas did not increase their throughput since the migration either because the same equipment was transported (e.g. MRI) to the new hospital or because operational processes were not changed to accommodate the new setup. The latter are areas of concern for improvement.

6.2.1 Magnetic Resonance Imaging (MRI)

There is a logical justification of the workload in MRI not increasing; the resources have not changed. What has changed is the way in which patients are registered in the modality when they present at the Medical Imaging Department for their investigation. Previously they had to be keyed in at the imaging area (MRI suite) and now they appear on the modality as soon as they are registered at reception. However, in reality this does not impact MRI since patients are checked so meticulously as soon as they arrive to ensure that they are adequately prepared and are not wearing any metal objects, that even previously there was ample time for a second radiographer to key in the patient details.
6.2.2 Mammography

On the other hand one should look more closely at why Mammography investigations did not increase. There was no reported change in the scheduling patterns for Mammography investigations after the migration from St Luke’s Hospital. It is true that as in Mammography the equipment was transported from one hospital to the other and the same equipment is presently being utilised to carry out investigations, however, there seems to be irregular scheduling patterns on different days that leaves a lot of room for insertion of urgent investigations.

The sectional administrator of Mammography reported that numbers of urgent requests in mammography is not really very high since mammography investigations are routinely scheduled either to screen for breast cancer, monitoring of known cases of breast cancer or biopsy of a lump. In reality none of the referrals are sent directly from casualty. Sometimes the equipment is utilised to take images of spontaneously aborted foeti. Interviewees gave the impression that more appointments can be scheduled per week. The scheduling pattern demonstrated that the numbers of scheduled patients per day decreased after Wednesday of every week. This implies that on Monday and Tuesday more patients are scheduled than the other four days of the week.

When approaching the Mammography scheduler, another topic that has was reported as not having changed in Mammography with respect to the previous hospital is the high number of requests that are pending to be processed. It was noted that there is a large catalogue of requests even placed a year ahead that are still not appointed. This discussion disclosed incidents of requests that were placed a year ago are still not given an appointment. This shows that in reality most of the waiting time to receive an appointment is not caused by the lack of space to fit in more appointments but due to the backlog of requests that have not yet been booked in.
6.2.3 Theatres and Mobile radiography

6.2.3.1 Theatre radiography

In this area workflow is much related to the area in which an investigation is carried out. The sectional administrator for theatre radiography commented that the radiographer has to accommodate the theatre schedules. In this area one cannot really discuss scheduling of patients because, in reality, it is the radiographer that is booked to be available for an operation. In St Luke’s Hospital radiographers were covering three theatre areas, one of which rarely required imaging services. The areas that were covered were main operating theatre, orthopaedic operating theatre and gynaecology and paediatrics theatres. The last theatre used the medical imaging services minimally, hence two radiographers in every shift was adequate to meet the demands of the other two theatres.

Within Mater Dei Hospital, there are more theatres and even though they are presently not all being utilised due to the shortage of staff within the area, the numbers of concurrent operations has increased and the two radiographers per shift that met the demand in St Luke’s Hospital is not enough to meet the demand in Mater Dei Hospital.

6.2.3.2 Mobile radiography

Mobile or ward radiography falls under the next section as theatre radiography. It is known that the numbers of beds within the hospital is more or less the same as in St Luke’s Hospital, however the added demands mentioned within operating theatres has an impact on the service provided to wards.

In fact it was reported in the data collection that the staff compliment for Theatre and Mobile Radiography need to be quadrupled to meet demands and even to cover for theatre requirements and wards between 7:30pm and 7:30am. This period of time is covered by staff working in the accident and emergency area. The quality of the service provided at night falls short of the requirements and standards requested by the Principal in charge of the section. For example, radiographers within the team are required to register dose related parameters within the RIS software. When
accident and emergency staff stand in for the members of this team this data is frequently omitted.

6.2.4 Computed Tomography (CT Scanning)

CT was not reported to have changed much of its workflow with the migration to the new hospital. The new hospital is equipped with an additional CT scanner; however, lists were not changed radically. This implies that, as reported by the a Senior Principal who represented CT that at present, there is still one list of appointments being scheduled daily and that hours of service provision that were provided in St Luke’s Hospital are very similar to those in Mater Dei Hospital.

Given an adequate staff compliment (increase by 40% over current staff), CT scan can afford to double its appointments to perform CT investigations on two scanners concurrently. The introduction of digital systems has reduced the work since patients’ details do not have to be keyed in with every patient that arrives. The data is uploaded automatically with patient registration in reception.

It is true that the variety of performed exams has increased with the introduction of the new CT scanner which has much better functionality due to its much higher capacity to scan in detail. However, the waiting lists, in theory, can be halved if appointments are doubled on a daily basis (recommended by interviewee). The present waiting lists are already adequate with urgent appointments scheduled for a maximum period of two weeks and elective appointments scheduled for a maximum period of five months; these timeframes can practically be halved with an increase in staff compliment.

6.2.5 Nuclear Medicine

Nuclear medicine was declared by the sectional administrator to be operating smoothly with the efforts of few people. Staff compliment requires an increase. Primarily, the presence of a single consultant reporting on all the nuclear medicine investigations marks a need for employment of another consultant. The nuclear medicine is the only one of its kind that serves the nation and the suite is equipped
with two nuclear scanners that function concurrently to scan patients, many of which have a poor prognosis. The single consultant that reports on Nuclear Medicine is frequently asked to intervene on particular cases involving patient when he is away, either on leave, sick leave or for any other reason.

Radiography staff was described as being almost adequate in quantity and performs adequately to meet the requirements of the service. Hence, the service is running effectively and, against all odds, efficiently. However, relying on a single consultant constitutes a risk that is marked with putting too much pressure on a single individual who is irreplaceable within a critical area.

### 6.2.6 Skeletal and Chest Radiography

Skeletal and Chest Radiography sections are functioning adequately and effectively with respect to meeting the influx demand of patients. The sectional administrator declared that quality issues related to documentation of doses administered to patients need to be implemented to ensure that the service provided is not effective but a quality service with controlled administration of radiation to patients.

Furthermore, there is an identified need for more meticulous screening of requests for imaging. It is was suggested that the introduction of comprehensive vetting reduces the influx of requests; the demand on the service should decrease in quantity. However, there is a concern in that the introduction of online vetting for online requests will also increase the workload since staff will have to vet all requests, even the acceptable ones; at present staff intervened only when an unjustified request require discussion or rejection. It is also expected to impact the workflow of medical imaging services provided by accident and emergency service outlets since those rooms meet the highest workload. Furthermore, accident and emergency staff are expected to be effective, proficient and fast. Actual vetting of all requests whether acceptable or not is expected to reduce the process speed.
6.2.7 Angiography and Interventional Radiography

The Angiography administrator had very little to remark about the change to the digital workflow since this did not change with the migration from St Luke's Hospital to Mater Dei Hospital. Furthermore, the demand on the Angiography Suite has decreased. This is because emergency angiography interventions are being carried out in CT which can perform CT Angiograms. Only few situations require the intervention of Angio Suite in emergency situations.

There is practically no waiting list in this area in fact the same sectional administrator himself schedules the appointments. Appointments are given according to the requests of the referrer received; if a requestor asks for an angiogram to be performed next week this request is given as asked, if the request specifies that the angiogram is required within a month or two the appointment is given as such. Consequently the waiting time is not related to a waiting list but accommodates other waiting lists (e.g. in operating theatres).

6.2.8 Ultrasound Imaging

In this area the sectional administrator has practically no control over incoming requests. The requests are scheduled by a scheduling clerk who admitted to appoint all requests as they are received. If incoming requests had to be vetted the demand would probably decrease. Vetting in the case of ultrasound may be required for economic purposes rather than radiation risks. The economic considerations of workflow are frequently not given too much importance within a clinical setup; considerations of reduced workload on radiologists seem to be taking priority over controlled provision of an efficient service.

However, this aspect has also to be taken into perspective of the present scenario; the number of radiologists covering a service is not high enough to cope with added duties of checking all requests. Radiologists complained that at present, are required to register patients, examine them, set patients as examined, report on patients and approve reports. Perhaps, it would help radiologists to be accompanied by a radiographer when they are performing ultrasound investigations after 2:30pm. The sectional administrator commented that ultrasound vetting could be introduced
to limit the numbers of requests that are being received. This solution could be an option to reduce the workload on ultrasound investigations in the longer term. However, radiologists commented that this would cause logistical problems particularly in urgent ultrasound requests in after hours where the radiologist compliment is at its bare minimum.

6.3 Recommendations

6.3.1 Summary of operational recommendations

Addition of staff is required primarily in the number of radiologists that serve in the Medical Imaging Department. There are also requirements for further specialised radiologists who, apart from dividing the workflow over an increased number, will bring about an increase in quality of the reports being issued. An increase in the number of radiographers would enable an extension of working times in some areas such as Theatre and Mobile radiography, Mammography and CT Scanning; this would render possible the provision of a twenty-four hour service without requiring backup from casualty radiographers after 7:30pm.

An additional number of radiographers supporting radiologists in ultrasound after 2:30pm may help radiologists have more time for vetting requests that, in the long term, may reduce demand on the service; particularly in areas such as ultrasound. Further changes that may reduce waiting times and lists may include the scheduling of lists for CT scanning such that both CT Scanners are operated simultaneously.

It is also recommended that the implementation of digital requests will reduce the time and increase the volume of patient data captured electronically. It will also help to solve legibility issues and reduce liability issues arising from the use of handwritten signatures. These changes may help to increase quality, economic efficiency and consequently increase the goodwill value of the services provided. This would be welcome in the present day situation where the health financing that the country can afford has to cope with all the needs and demands being made on the health service. Moreover, this benefit can be exploited in issues like medical tourism; a
Christian Axiak  MSc Health Services Management

prospect for future implementation listed in the health strategic goals for the local public health sector.

The main problem that was highlighted from the data collection of this dissertation is a communication problem that exists in the vertical administrative structure of the Medical Imaging Department. This issue was further reinforced in the number of suggestions that the interviewees expressed for workflow streamlining. There were suggestions that were aimed at improving quality of the service delivered such as increase in service provision, and others that addressed the efficiency of the workflow; this included screening demand to have more time for the more needy and effective prioritisation from meticulous vetting.

6.3.2 Recommendations for further studies

A study that could relate and give another perspective to the vetting of requests within the Medical Imaging Department could be an analysis of the perception of referring doctors of the cooperation they find from the Medical Imaging Department when they place their request. This is obviously more of a clinical perspective rather than managerial, as is the scope of this study.

Another study that could be undertaken is the actual economic evaluation of the Medical Imaging Department, in such a way that every exam can be costed and that economic efficiency can, as a result, be calculated in economic terms. This type of study would be an exercise for the financial and accounting professions since it really delves into direct and indirect costings, accurate apportioning of fixed costs, precise documentation of use of consumables, service package grouping, and so on.

A further development over this study would be an analysis of human resource management and its relation to staff motivation. This study would help to document aspects of work that actually motivate the existing employees (intrinsic or extrinsic motivators), what demotivates them, and recommendations on what approach can actually be used to increase staff motivation at the Medical Imaging Department. This study could also delve into documenting the frequency and causes of burnout in
employees. From an administrative point of view this data would be very useful for the adoption of correct internal marketing approaches.

Another study that was recommended by the interviewees themselves is a similar study as this by carried out within individual sections. The aim of such a study would be to be able to delve more deeply into the individual needs of every section. Such a study would also include more people on any area that is being researched. For example, if this is done in MRI all staff members may be included in the data collection. The inclusion of all members of staff would also give a more representative account of staff opinions and reduces possible biases of subjectivity.

The mentioned studies could give more specific and detailed insight on what can actually enhance productivity of the Medical Imaging Department. While the present study has discussed policies, processes, resources etc. incorporated in an operational analysis, there are other hidden factors that affect productivity. One can argue that what you can do with one person you should not assign to two to increase the efficiency; what if the person is being over pressured and in the long term will end up being less productive or perhaps move to another job or even in tangible terms be working so hard that end up with problems in his personal life? The benefits of preventing social difficulties would be high. Definitely not least important, from a humanitarian approach, respect and care for the present human and material resources is a moral duty and an economic asset. All factors have to be included for an adequate, economically efficient compromise to be reached.
References


Appendix A
Dear Sir/Madam,

I, Christian Axiak, am carrying out a questionnaire as part of my dissertation project regarding “A qualitative operational analysis of a new medical imaging department”. This study aims at improving the work patterns of the Medical Imaging Department in Mater Dei Hospital. I am currently reading for a Masters in Health Services Management and this project is being carried out in part fulfillment of this qualification.

All compiled data will be kept strictly confidential, will be used just by me and solely for the purpose of this study. The data will be destroyed after completion of the study, however participants are free to withdraw from their participation at any time. No information that may disclose one’s identity will be listed.

I thank you in advance,

Participant’s signature

Christian Axiak
Email: christian.axiak@gov.mt
**Questionnaire covering letter in Maltese**

Sinjur/a,

Jiena, Christian Axiak, qiegħed inqassam kwestjonarju biex inkun nista’ nistħareġ b’liema mod is-servizz tal-*Medical Imaging Department* ta’ I-Isptar Mater Dei jista’ jaqdi aħjar lill-isptar u b’hekk lill-ċlienti. Dan il-proġett huwa parti mill-kors tieghi tal-universita’ ta’ Masters fil-management tas-servizzi tas-saħħa.

Din l-informazzjoni ser tibqa’ bejnietna, nużaha jien biss u m’hiex ser niprova nitkixxef ta min huma r-risposti. L-informazzjoni li ttuna kollha ser tiġi mqatta’ wara li l-istudju jkun lest u kull min iрид jista’ jitlobna biex ma nużawx l-informazzjoni għall-istudju, meta jrid.

Grazzi bil-quddiem,

_____________________________
Firma tal-partecipant.

Christian Axiak
Email: christian.axiak@gov.mt
Questionnaire English version

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<th>Investigation:</th>
<th>Town of origin:</th>
<th>Accompanying relative:</th>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>Very little</td>
<td>Satisfactory</td>
<td>Quite a lot</td>
<td>Very much</td>
</tr>
</tbody>
</table>

1. Was the patient calm before the investigation?  
2. Was the patient afraid of the examination?  
3. Did the patient like the receptionist’s attitude towards him/her?  
4. Did the patient wait for long before getting examined?  
5. Was the waiting area adequate?  
6. Did the patient and/or guardian get an adequate explanation of procedures before the examination?  
7. Was the patient reassured of protection against unnecessary radiation?  
8. Did the patient like the radiographer’s attitude towards him/her?  
9. Did the patient like the X-ray room where he/she was being examined?  
10. Did the patient get an adequate explanation of how to receive the result of the investigation?  
11. Was the overall impression of the service, adequate?  
12. General comments:  

100
### Kwestjonarju bil-Malti

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<td>2</td>
<td>Il-pazjent kien imbeżżgħa qabel l-eżami?</td>
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<td>3</td>
<td>Għoġbitu l-pazjent, l-attitudni li biha mexa’ miegħu ir-receptionist?</td>
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<td>Il-pazjent dam jistenna’ hafna qabel ġie eżaminat?</td>
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<td>5</td>
<td>Il-waiting area kienet accettabbli ghall-pazjent?</td>
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<td>6</td>
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<td>Hadt impressjoni tajba tas-servizz?</td>
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<td>Kummenti ohra:</td>
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Appendix B
**Interview with Manager Radiography Services**

<table>
<thead>
<tr>
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<tbody>
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<td>Mammography</td>
<td></td>
</tr>
<tr>
<td>Ultrasound</td>
<td></td>
</tr>
</tbody>
</table>

- Training received in the area
- Potential areas in which present service may require improvements (to be discussed)
  1. training
  2. equipment
  3. interior design
  4. appointments
  5. allotted time per patient
  6. allotted staff (number)
  7. allotted staff (quality)
  8. other

*Thank you.*
Appendix C
Interview with Chairman of Radiography Services

Overall impression
1. How would you describe the service that patients are presently receiving?

2. Do you feel that the staff of the MID are performing according to your expectations?

Workflow operational process
3. Are you satisfied with the

   a. Scheduling section of the MID
      1. Strong points?
      2. Suggestions for improvement?

   b. Reception staff (receptionists and facilitators)
      1. Strong points?
      2. Suggestions for improvement?

   c. Radiographers
      1. Strong points?
      2. Suggestions for improvement?

   d. Radiologists
      1. Strong points?
      2. Suggestions for improvement?

   e. Other workflow issues?

   f. What corporate strategy does the department follow to meet the strategic goals?
Appendix D
Discussion with Parliamentary Secretary for Health

What are the strategic goals of the Health Sector for the Medical Imaging Department?