CRANFIELD UNIVERSITY

Department of Enterprise Integration
School of Industrial & Manufacturing Science

MRes Individual Project

Academic Year 2000/2001

Martin J. Wickes

Process Mapping for BPR at Torbay Hospital

Supervisor: Mr K Sehdev

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This thesis is submitted in partial fulfillment for the degree of
MRes in Innovative Manufacturing (Enterprise Integration Option)

Abstract

This report documents a process mapping exercise conducted at Torbay Hospital and subsequent process improvement exercise, forming the initial stage of a Business Process Re-engineering programme.

The report reviews pertinent research, concluding that whilst BPR exercises continue to be a popular method of facilitating efficiency gains, few hospitals seem to report the success of their programme or methodologies. As such, every hospital starts the programme from square one.

The report therefore documents the methodology employed for data collection, as well as the options for representing the data, once collected; IDEF 3 is recommended as the most appropriate means. The thesis then discusses the tactics involved in running a BPR exercise in the Endoscopy Unit of Torbay Hospital and details subsequent recommendations for improvement.

Executive Summary

This report documents a process mapping exercise conducted at Torbay Hospital and subsequent process improvement exercise, forming the initial stage of a Business Process Re-engineering programme. The government has set a target of 2004 for the implementation of Booked Admissions scheduling. This means that patients will be provided with a virtually guaranteed date for their appointment, which will be booked at the time the decision is made (instead of the patient being put on a waiting list). The very first stage in this process is to document and understand the existing processes, so that they can be brought into line with industry best practice before implementing the new system.

The report reviews pertinent research, concluding that whilst BPR exercises continue to be a popular method of facilitating efficiency gains, few hospitals seem to report the success of their programme or methodologies. As such, every hospital starts the programme from square one. The report therefore documents the methodology employed for data collection, as well as the options for representing the data, once collected. The literature review also includes a review of BPR: what it is, how do it and what not to do.

Semi-structured interviewing proved to be the most appropriate means of collecting data. Other methods employed included group interviews, telephone interviews and participant observation, though these proved to be somewhat unwieldy in a healthcare environment. This was due to the logistical problems of taking several members of a department away from their duties, the transfer of content rich data via the telephone and shadowing staff in a hectic, sometimes cramped environments, respectively. Semi-structured interviews were effective because they facilitate participation on both sides. It this way it was acknowledged that the data collection exercise was a highly collaborative activity.

IDEF 3 is recommended as the most effective method of representing the data collected because it allows decomposition, resulting in a number of levels of detail being represented. In addition is a highly structured approach, which means there is less room for subjectivity than with some other methods, such as flow charts and Data Flow Diagrams (DFDs). This also means that the maps have longevity; their value will not degrade over time.

Quantitative data was also collated as a means of complimenting the process maps. Though collected, data was only available for a limited period of time due to some reporting inaccuracies in the database system. As such the sample period of the data was considered to be too small to base reliable decisions on. Some recommendations are therefore made for when a sufficient sample has accrued.

A Business Process Re-engineering day was conducted in the Endoscopy Unit, chosen because it is considered representative of a number of other systems in the hospital. Members of staff from all grades and job types were invited and helped to map the existing processes, using rolls of brown paper and 3M Post-It Notes. The maps were then used to stimulate a debate on potential methods of process improvement.

Selected recommendations arising from this day and in general include:

- Re-engineered administrative processes in the appointment allocation process in the Endoscopy Department.
- Improved patient log-in processes for Endoscopy.
- Re-defined patient categories for Endoscopy.
- Improved information flows for patients.
- Recommendations for inter-departmental collaboration.
- The revision of referral forms.

Acknowledgements

The author would like to take this opportunity to thank all the members of staff at Torbay Hospital who have contributed to the success of this research. In particular, I would like to thank the following people:

Sasha Karakusevic for commissioning the research
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Di Campbell for allowing me to become involved in the BPR exercise

In addition, I would like to thank my project supervisor, Kamal Sedhev.

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Glossary

The following glossary is adapted from Mosby's Medical, Nursing & Allied Health Dictionary[i].

Barium Enema: a rectal infusion of barium sulphate, a radiopaque contrast medium, which is retained in the lower intestinal tract during roentgenographic studies for diagnosis of obstruction, tumors, or other abnormalities.

Barium Meal: the ingestion of barium sulphate, a radiopaque contrast medium, for radiographic examination of esophagus, stomach and intestinal tract.

Barium Swallow: the oral administration of radiopaque barium sulphate suspension to demonstrate possible defects in the esophagus.

Colonoscopy: the examination of the mucosal lining of the colon using a colonoscope, an elongated endoscope.

Coloractal Cancer: a malignant neoplastic disease of the large intestine.

CT (scan): a radiographic technique that produces a film that represents a detailed cross-section of tissue structure.

Endoscopy: the visualisation of the interior of organs using an endoscope.

Gastroenterology: the study of diseases affecting the GI tract, including stomach, intestines, gall-bladder and bile duct.

OGD: the examination of the interior of the upper GI, using an endoscope.

1.0 Introduction

1.1 General

The Department of Enterprise Integration at Cranfield University offers Masters qualifications in the field of manufacturing. As part of the course, students are required to complete an industrially based individual project.

The sponsoring organisation for this project is the National Health Service. This project is part of on-going work in the Continuous Improvement of Booked Admissions - Capacity and Resource Environment Scheduling (CIBA-CARES) by Cranfield University, which aims to improve the experience of patients using the NHS hospitals by applying traditional manufacturing techniques to the healthcare industry.

Specifically, this research aims to process map patient routes for gastroenterology using scientific manufacturing methodologies. The process maps will then be used to understand the current system and its processes and then as a basis for process improvement.

1.2 Organisation Background

1.2.1 NHS

The NHS was set-up after World War II and is one of the largest organisations in the world. It is acknowledged as one of the best public health services by the World Health Organisation (WHO)[ii].

The National Health Service was set up to provide healthcare for all citizens, based on need, not the ability to pay. The NHS is funded through tax revenue, which means that it is accountable to Parliament. Around one million people work

for the NHS in England and it costs more than £50 billion a year to run[iii]. The NHS aims to bring about the highest level care for all citizens, within the resources available, by:

- promoting health and preventing ill-health
- diagnosing and treating injury and disease
- Caring for those with a long-term illness and disability, who require the services of the NHS

Sustained periods of under-investment and increasing demands placed upon the system have caused the system to become stressed.. In fact, demand for healthcare has increased every year since the creation of the NHS in 1948, and as a result of these two factors, the system requires efficiency gains to ensure the long-term provision of effective care. In order to tackle these problems, the Government has produced a ten-year action plan, called The NHS Plan[iv]. The plan promises:

- More power and information for patients
- More hospitals and beds
- More doctors and nurses
- Much shorter waiting times for hospital and doctor appointments
- Cleaner wards, better food and facilities in hospitals
- Improved care for older people
- Tougher standards for NHS organisations and better rewards for the best

Cranfield University, in particular The Department of Enterprise Integration has conducted significant research in this area. This explorative research aims to apply traditional manufacturing techniques and experiential knowledge gained from working with private sector companies over several decades. It is believed that these techniques will contribute to a reduction in waiting times and increase quality of care.

1.2.2 NBAP

The National Booked Admissions Programme was launched in 1998 as part of the Government's strategy for modernising the NHS. The programme is designed to use resources more efficiently and to improve the quality of patient care. The programme is co-ordinated by the National Patient's Access Team.

In the first wave of the programme 24 pilots were funded to establish booking directly from general practice for outpatient or day case surgery and hospital-based booking systems for day-case and in-patients.

The National Booked Admissions Programme aims to implement the Prime Minister's vision of a National Health Service[v], where the patient is in control of their medical appointments, rather than being placed on long waiting lists with little information as to their progression through the system:

> *"People are fed up with waiting. They wait for a GP appointment. They wait in the GP surgery. They wait for a prescription. They wait for outpatients. They have to wait for tests. They wait for an operation. They even wait sometimes to be discharged."*

Process Mapping is the very first stage in implementing a booked admissions scheduling system. Before the project can progress to deal with scheduling methodologies and IT issues, management must understand the current set of processes at the hospital. Process mapping will contribute to managers' comprehension of the system.

1.2.3 South Devon Healthcare NHS Trust

The Trust was established in 1991 in the first wave of Trusts. It runs hospital, community, mental health and learning disabilities across South Devon. Serving an area of over 300 square miles and a population of 260,000 which rises to about 360,000 at the peak of the holiday season, the Trust manages the district general hospital in Torquay (Torbay Hospital), 7 community hospitals and a number of in-patient and day care centres.

Torbay Hospital is the largest healthcare institution under the Trust's authority, servicing the whole catchment area. It is currently the focus of a modernisation programme receiving funding for Booked Admissions scheduling, a new critical care unit, a revamped children's ward and an improved A&E Department. Torbay Hospital is also working towards the implementation of an Electronic Patient Record (EPR) system. In the longer-term, a new hospital will be built to service the people in South Devon area.

Torbay Hospital have commissioned this piece of research to gain an understanding of the techniques and methodologies involved in process mapping with a view to setting up similar initiatives across the hospital. The processes mapped in this research are for gastroenterology. This specialism was chosen because patients with complaints relating to gastroenterology pass through several of the hospitals departments. As such it was one of the more complex areas to map and provided knowledge of many of the hospitals processes. The Edoscopy unit was selected for the focus of the process improvement or business process re-engineering exercise (BPR) because it is recognised as a pioneering institute and as such can be seen as a beacon for efficient systems by the other departments.

1.3 Problem Definition

1.3.1 Project Aim

The aim of project has been defined as:

"To comprehensively process map patient routes through the Gastroentorology Department".

In terms of scope, the maps start at the point when the patient walks through the hospital doors with a gut complaint, or if they've been referred by a GP or another member of medical staff, from the point at which the referral is received.

The maps finish at the point when the patient is discharged from the gastro department, whether they are discharged home, or to another specialty in the department.

The maps therefore cover departments such as Endoscopy, Radiology, Surgery and day surgery. They also include routes for out-patients, In-patients and Emergency patients.

1.3.2 Project Objectives

The specific objectives of this project have been defined as:

- Conduct a series of interviews with key personnel in order to extract process knowledge.

- Generate 'AS-IS' process maps of patient routings .

- Perform a series of validation exercises to ensure accuracy of 'AS-IS' process maps.

- Make recommendations for improvement, focussing on Endoscopy systems.

- Analyse quantitative data to determine units of treatment required at each stage of process.

1.4 Thesis Structure

Having stated the thesis objectives, it is necessary to briefly outline the structure and layout of the thesis. The following chapter analyses literature pertinent to this research including topics such as process mapping techniques at other hospitals, methodologies for representing the information collected and business process re-engineering (BPR). Chapter three details the methodology of the research: how the objectives were achieved. Chapter four analyses the maps, the results of the BPR exercise and makes recommendations for further improvement. Finally, conclusions will be drawn from the research. This section will also discuss the limitations of the research and recommendations for further research.

1.5 Overall Methodology

This report describes the research carried out as part of the project, and the recommendations made.

The overall methodology aims to achieve the primary objectives as discussed in the previous section. This can be summarised in five stages:

1. **Information generation**
   Data collection from which the process maps can be generated.

2. **Operationalisation**

   Using a format for the data, which is structured, has longevity and is accessible to appropriate members of staff.

3. **Information validation**

   Ensuring the accuracy of the data.

4. **Business Process Re-engineering**

   Highlighting suitable methods and working with hospital staff to improve current systems.

5. **Information dissemination**

   Ensuring that the research receives maximum exposure from the correct personnel at the hospital.

2.0 Literature Review

The purpose of a literature review is to surmise pertinent research in the same field and to discuss literature, which is referred to later in the thesis. This literature review covers three main topics:

1. Process mapping and BPR exercises in other healthcare organisations
2. Process Mapping Methodologies – for representing the data collected
3. Business Process Re-engineering – how to improve the processes once they have been mapped

The techniques utilised for data collection are discussed in Chapter 3, Methodology.

2.1 Process mapping and BPR exercises in other healthcare organisations

2.1.1 Research conducted at Cranfield University

Whilst many hospitals are currently undertaking programmes of process reform, there is little available literature on the subject. Many articles discuss the need for reform as a means of improving levels of patient care and increasing capacity, yet there appears to be a complete lack of literature reporting the success (or otherwise) of such process mapping and subsequent business process re-engineering activities, at least in Britain.

Previous research, conducted at Cranfield University, has mapped processes for a number of hospitals. The research mapped a series of processes for four hospitals. The report concluded "the IDEF 3 methodology proved itself to be a capable, instinctive and easy to use tool, which allowed the capture and elicitation of an extremely complex process". The report also provided a

migration strategy for future implementation by the hospitals as a means of continuing the process improvement exercise.

2.1.2 Other Research

Aside from this research, most other literature must be imported from America, where there are some publications that deal with the success of BPR initiatives in healthcare [vi] [vii]. Of the articles that are available, the degree of success appears to be linked to the level of coordination and integration of the strategy.

Ho *et al.* (1999[viii]) analysed 215 US and Canadian hospital executives. They concluded that improved quality of service to patients and enhanced financial performance are the main driving forces for hospitals to undertake a BPR programme. One in two executives indicated that their organisation had undertaken fewer than five BPR projects and less than 10 per cent had implemented more than 20. Clearly then, BPR initiatives are widespread in America and Canada, but are just as rarely reported on as in Britain. Ho *et al.* cited four factors as having important ramifications for unsuccessful BPR implementation:

1. Lack of cooperation from staff because BPR is viewed as job cutting
2. Lack of buy-in from medical staff
3. Insufficient staff training and skill development on BPR
4. Poor planning

In similar research Walston *et al.* (2000[ix]) analysed data from a 1996/1997 national survey of hospital restructuring and reengineering sponsored by the American Hospital Association and the Leonard Davis Institute for Health Economics. It was found that the use of steering committees, project team

codification of the change process and executive involvement in core changes were the main distinguishing drivers for success.

Savory and Olson (2001[x]) provide a guideline for process mapping, which details a five step strategy:

1. Define the purpose of developing a process map
2. Establish the team
3. Map the 'AS-IS' process
4. Establish measures for improvement
5. Propose changes

Luck and Peabody (2000[xi]) discuss re-engineering processes in a VA Medical Centre and promote the use of semi-structured and unstructured interviews and direct observation of clinic activities as the most effective means of data collection. They also discuss the need for benchmarking, something which British Hospitals must get from clinical directives such as produced by government agencies, rather than from each other which would foster integration and collaboration.

2.2 Process Mapping Methodologies

There are many different types of methodology for process mapping, depending on the purpose for which they are documented. These range from very individualistic, subjective methods to highly structured analytical means. The maps can be presented on anything from flip charts to dynamic computer software and can vary massively in terms of detail and accuracy. This research seeks to document gastroenterology patient routes in a scientific, objective manner to an appropriate level of detail, such that process improvement can subsequently follow.

2.2.1 Flow Charts

A flow chart is a pictorial representation of the steps in a given process. The steps are presented graphically in a sequence so that personnel can analyse and comprehend current processes. There are three main types of flow chart:

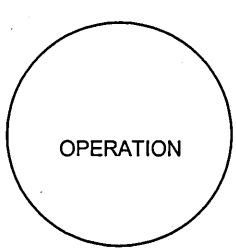
Functional Chart - A chart that is used to describe how activities interact with one another within an organization as well as with other organization and/or systems.

Process Flow Chart - A chart that is used to describe the sequence and relationship of the tasks that make up an activity.

Process Flow Description Chart – A detailed description of the tasks outlined in a Process Flow Chart. Typically used to show the kinds of tasks performed within a process; the number of operations, review, and transfers; and the amount of storage and time required to complete an activity.

2.1.1.1 Flow Charting Basic Symbols

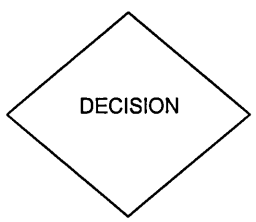
This popular method has existed for centuries and has developed in an *ad hoc* way to the extent that there is no effective standard. Some of the most common symbols are as follows:



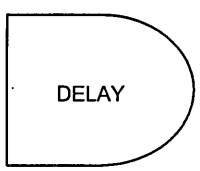
Operation - An operation occurs when an object (i.e. product, document, etc.) is intentionally changed in any of its physical or chemical characteristics, assembled or disassembled from another object, or staged for another operation, transportation, inspection or storage. Operations also occur when information is transmitted or received or when planning take place.

Manual Operation - Is sometimes used to denote operations that are done manually.

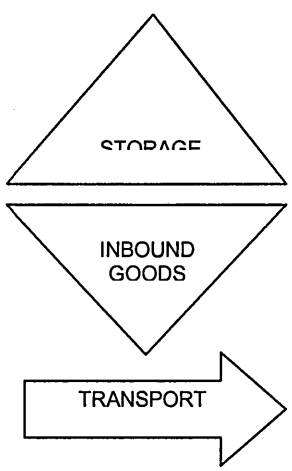
Inspection, Verification or Measurement - An inspection, verification or measurement happens when an object is examined for identification or is verified for quality or quantity in any of its characteristics. The symbol also indicates that a decision must be made.



Decision Making/Approval - The diamond, typically used for document or software processes, also represents a decision or an approval point. Typically, if yes, the task sequence flows to the right, if no, it flows to the left. Descriptions for the operation are sometimes simply Approved? or O.K.?



Delay - A delay is typically shown as a half circle or a capital D. A delay occurs to an object when conditions, except where intentional changes to the physical or chemical characteristics of the object do not require immediate performance of the next planned step.

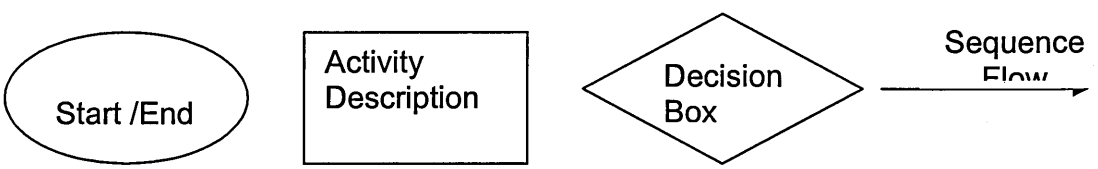


Storage - A storage occurs when an object is kept and protected from unauthorised removal. The symbol on the left typically indicates inbound goods. When the triangle is inverted, it typically represents storage or filing.

Transportation - A transportation occurs when an object is moved from one place to another with the exception where such

movements are a part of the operation or are caused by the operator at the work station during an operation and/or inspection / verification / approval.

Flow charts can be an effective method of documenting processes yet ironically its ubiquitous nature has resulted in a destandardised methodology, and therefore its subsequent loss of popularity. ISO9004.4 recognise only four symbols, which are very different to those suggested in literature:



2.2.2 Rich Pictures

Soft Systems Methodology (SSM) was developed by Professor Peter Checkland. The methodology is a way of dealing with problem situations in which there is a high social, political and human activity component. This distinguishes SSM from other methodologies which deal with hard problems which are more technologically oriented.

SSM is divided into seven distinct stages. These are;

2 Finding out about the problem situation. This is basic research into the problem area. Who are the key players? How does the process work now? etc.

3 Expressing the problem situation through Rich Pictures. As with any type of diagram, more knowledge can be communicated visually.

4 Selecting how to view the situation and producing root definitions. From what different perspectives can we look at this problem situation.

5 Buiiding conceptual models of what the system must do for each root definitions. The basic 'Whats' are defined in the root definitions. At this stage the 'Hows' should be defined.

6 Comparison of the conceptual models with the real world. Compare the results from steps 4 and 2 and see where they differ and are similar.

7 Identify feasible and desirable changes. Are there ways of improving the situation. Recommendations for taking action to improve the problem situation. How would you implement the changes from step 6.

It should be noted that the stages in this methodology are not necessarily sequential as the process is largely iterative. Rich pictures are used to express problem situations and as such can be categorised under part 2 of the methodology.

An example of a Rich Picture can be found in Figure 1. Shell's MF Rich Picture.

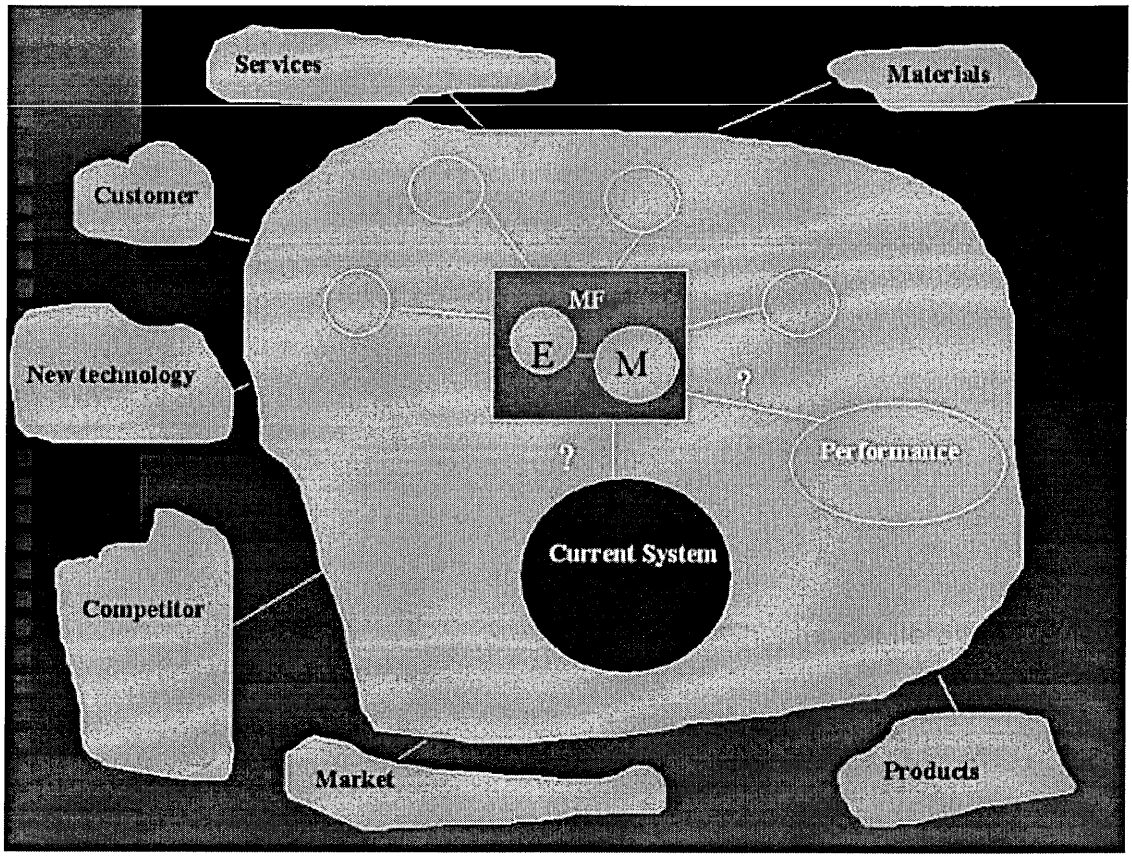


Figure 1. Shell's MF Rich Picture. Acknowledged source unknown.

A service group in Shell, manufacturing function (MF), it provides a lot of service for the other groups in Shell to help them to make decision for the future development. The MF has been running for a long time, and the people think it is about time for them to rethink their role in Shell and how to make their performance better. Thus, the problem situation for them will be how good is our current system? How can we evaluate our system performance? Can we do better?

Rich pictures vary hugely from person to person due to different artistic styles and interpretations of problems. As such they are in no way standardised, which means they can easily be misunderstood. However, they can be useful in

situations where the interviewee is nervous or overawed by the prospect of completing a more technical process map.

2.2.3 Data Flow Diagrams

Data Flow Diagramming is a means of representing a system at any level of detail with a graphic network of symbols showing data flows, data stores, data processes, and data sources/destinations. The diagrams are:

- graphical, eliminating thousands of words;
- logical representations, modeling what a system does, rather than physical models showing how it does it;
- hierarchical, showing systems at any level of detail; and
- jargonless, allowing user understanding and reviewing.

The goal of data flow diagramming is to have a commonly understood model of a system. The diagrams are the basis of Structured Systems Analysis and Design Method (SSADM). Data flow diagrams are supported by other techniques of structured systems analysis such as data structure diagrams, data dictionaries, and procedure-representing techniques such as decision tables, decision trees, and structured English.

The diagrams use four symbols to represent any system at any level of detail. They are:

- data flows - movement of data in the system
- data stores - data repositories for data that is not moving
- processes - transforms of incoming data flows to outgoing data flows
- external entities - sources or destinations outside the specified system boundary

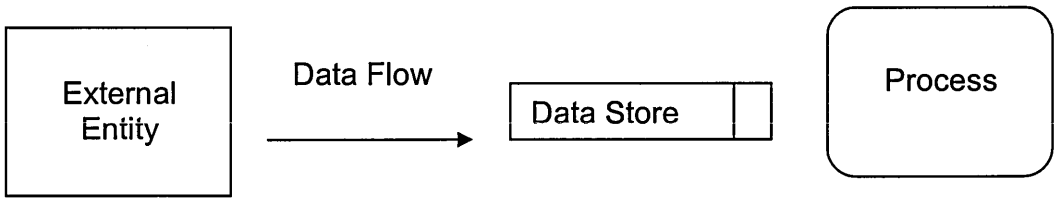


Figure 2. DFD Symbols.

Data flow diagrams do not show decisions or timing of events. Their function is to illustrate data sources, destinations, flows, stores, and transformations. The capabilities of data flow diagramming align directly with general definitions of systems. Data flow diagrams are an implementation of a method for representing systems concepts including boundaries, input/outputs, processes/subprocesses, etc. They can however depict levels of decomposition within a map, in a similar manner to other process mapping techniques.

The Following is an example of an SSADM DFD:

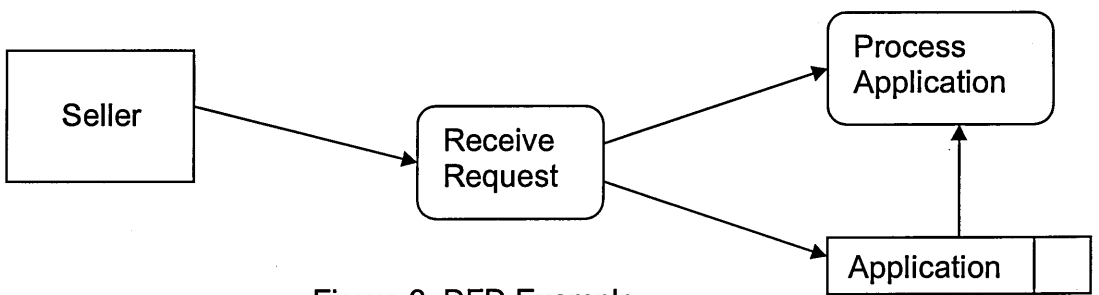


Figure 3. DFD Example

2.2.4 IDEF 0

IDEF 0 is a method designed to model the decisions, actions, and activities of an organization or system. IDEF 0 was derived from a well-established graphical language, the Structured Analysis and Design Technique (SADT). IDEF methodologies, in particular IDEF 0, is widely used in industry.

IDEF 0 is a highly standardised, structured approach to process mapping. It is activity based and uses a series of connecting boxes and arrows to represent processes. Each activity is described by its Inputs, Controls, Outputs and Mechanisms (ICOM). These terms can be defined as:

Inputs: the objects without which the activity could not proceed.
Controls: objects that will affect the output but will not prevent the activity from being completed.
Outputs: the result of the activity.
Mechanisms: the tools required to perform the activity.

The activity box and ICOM factors are represented as in Figure 4.

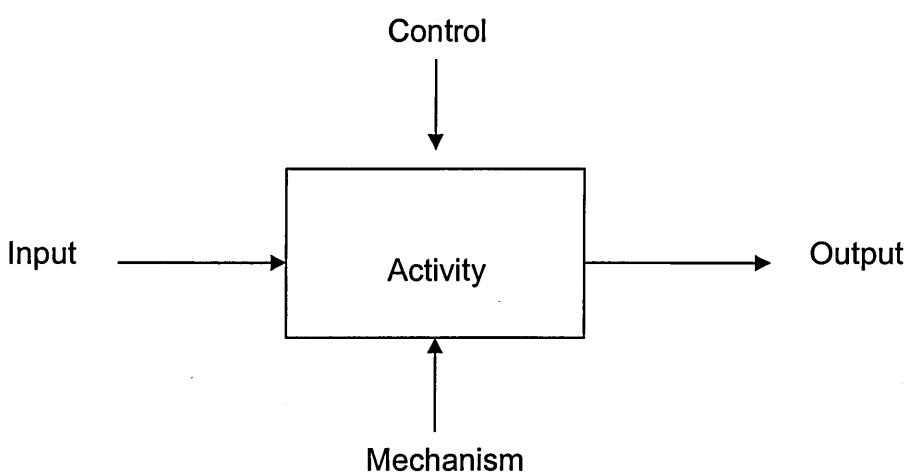


Figure 4. ICOM Structure

One problem with IDEF 0 is the tendency of IDEF 0 models to be interpreted as representing a sequence of activities. While IDEF 0 is not intended to be used for modeling activity sequences, it is easy to do so. The activities may be placed in a left to right sequence within a decomposition and connected with the flows. It is natural to order the activities left to right because, if one activity outputs a

concept that is used as input by another activity, drawing the activity boxes and concept connections is clearer. Thus, without intent, activity sequencing can be imbedded in the IDEF 0 model. In cases where activity sequences are not included in the model, readers of the model may be tempted to add such an interpretation.

2.2.5 IDEF 3

IDEF 3 is a relatively new mapping technique, not widely used in industry. It was designed to complement existing IDEF methodologies. IDEF3 provides a mechanism for collecting and documenting processes, capturing precedence and causality relations between situations and events.

IDEF 3 employs an ordered sequence approach, similar to a storyboard, to explain events and processes. The storyboard can be written from one of two differing perspectives:

- A process flow description; and
- An Object State Transition Network (OSTN)

The process flow description captures the flow of data, activities and objects within an organisation. THE OSTN approach depicts the changing states of objects, such as a patient as they move through various processes within a hospital. There are three main components to the IDEF 3 methodology:

- Units of Behaviour (UOB)
- Junction boxes
- Links, and

2.2.5.1 UOBs

A unit of behaviour can represent a function, a process, a scenario, an activity, an operation, a decision, an action, an event, a procedure, or even another part of the model. It represents a step in the process and is the equivalent of an activity box in IDEF 0.

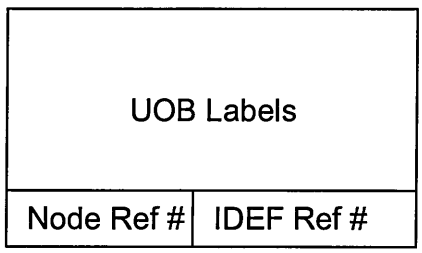


Figure 5. Example of a UOB in IDEF 3.

2.2.5.2 Junction boxes

IDEF 3 uses three types of junction box: AND, OR , EXCLUSIVE OR, as illustrated below:

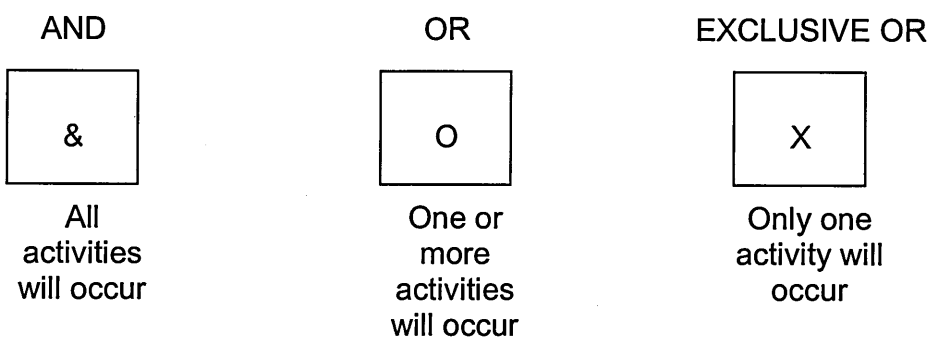


Figure 6. IDEF 3 Junctions

In addition to these junctions one of two conditions will apply, regarding the timing of the activities: synchronous and asynchronous. These are represented by parallel lines within the junction box, as illustrated below.

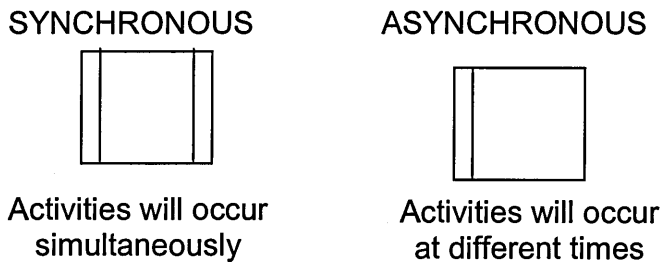


Figure 7. IDEF 3 Conditions

Junctions are used where processes converge or diverge. Where junctions diverge, the junction box is known as a 'fan-out' junction and where processes converge the junction is known as a 'fan-in' junction box. A short, thick black line illustrates whether a junction is a fan-in or fan-out, as depicted below:

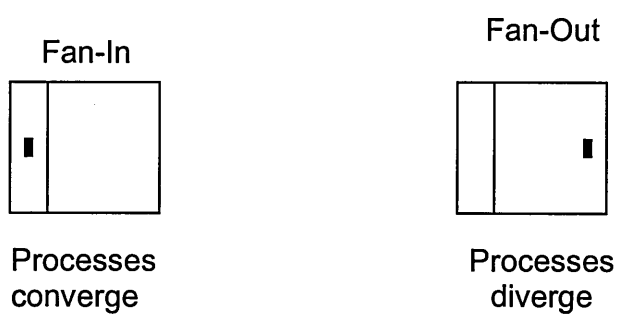
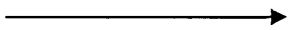


Figure 8. IDEF 3 Conditions (II)

2.2.5.3 Links

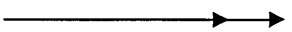
In addition, UOBs and junctions are connected by a series of links, as defined below:

Precedence Link



Precedence links are used to describe the sequence of execution in a process. The basic rule is that the preceeding process in a precedence link must be finished before the following process can be started.

Constrained Precedence Links

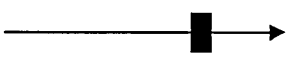


The succeeding process must occur, if the preceding one does. The succeeding process may occur without the preceding one.

The preceding process must occur. The preceding process may occur without the succeeding one.

The preceding process must occur when an instance of the succeeding process occurs. The succeeding process must occur when the preceding process occurs.

General Constrained Link



An additional constraint exists, such as time.

Relational Link

Relational or user-defined links have no predefined semantic. Their meaning is defined by the modeler for the purpose of his model.

The following is an example of a process map using the IDEF 3 methodology:

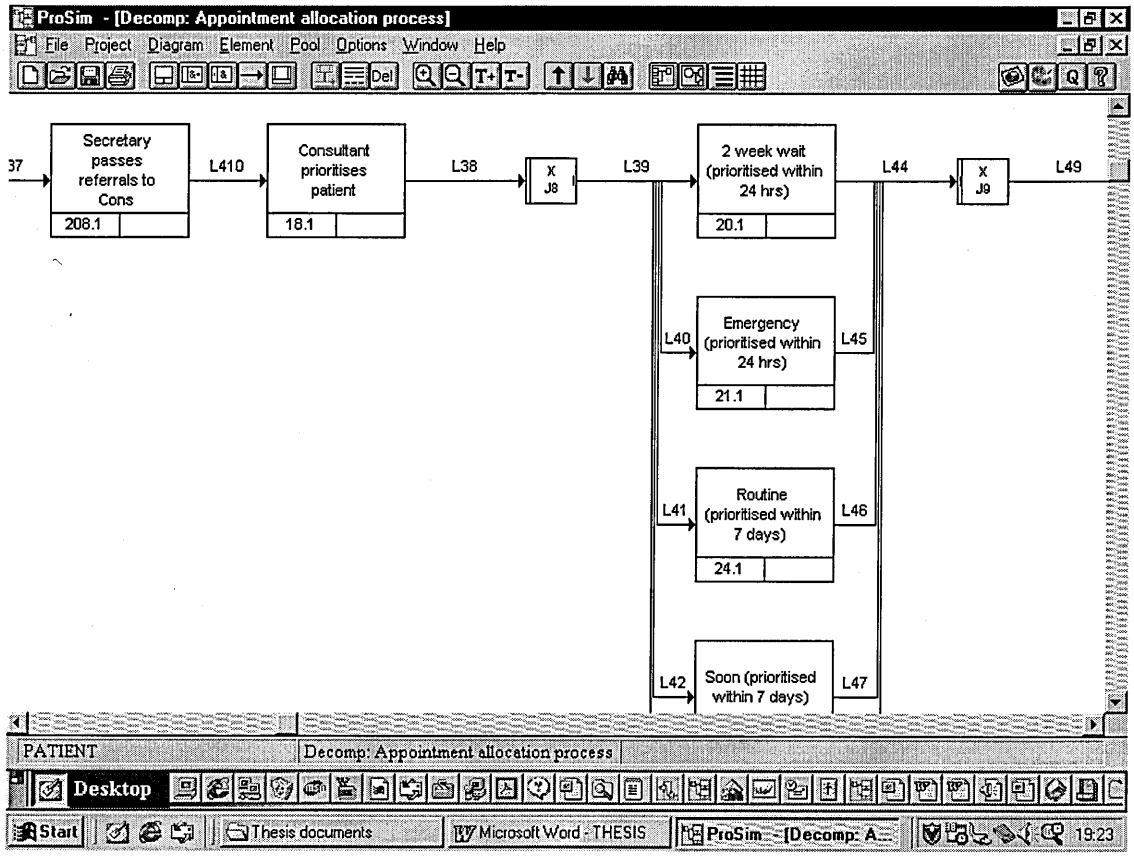


Figure 9. Screengrab of an IDEF 3 Process Map

2.2.6 Methodology Selection

IDEF 3 appears to be the most appropriate methodology: it has longevity, can map processes at both high and low levels of detail and is a highly standardised format. Non of the other methodologoes can combine these three crucial factors. However, the author has never mapped such complex processes before and this, coupled with the fact that this research is a fast track project, meant that there was no room for a change in methodologies part-way through. It seemed necessary therefore to examine the selection criteria and result from previous Cranfield research, also in the field of process mapping.

The team analysed the applicability of each of these techniques discussed to the healthcare environment[xii], using Kepner-Tregoe analysis[xiii]. The project team

used its experience of process mapping and modelling to derive ten key criteria to select the tool. These criteria recognised the unique nature of the project and of the hospital environment and from this. The criteria were:

1. Ease of diagram creation
2. Portability
3. Decision centres easily identifiable
4. Readily understood logic
5. Ease of validation of output
6. Sequence of actions/procedures obvious
7. Timing of actions/procedures
8. Interviewee/process owner commitment
9. Standardised format
10. International standard and recognition

The analysis resulted in the following table, Figure 10.

Weighting	Criterion	Rich Picture		Data Flow Diagram/ SSADM		Flow Chart		IDEF0		IDEF3	
		S	WS	S	WS	S	WS	S	WS	S	WS
0.9	Ease of Diagram Creation	10	9.0	6	5.4	10	9	7	6.3	8	7.2
1.0	Portability	2	2.0	6	6	3	3	10	10	10	10
0.6	Decision Centres	2	2.0	6	3.6	3	1.8	7	4.2	9	5.4
0.6	Logic	4	2.4	5	3	3	1.8	8	4.8	8	4.8
0.6	Output Validation	5	3.0	4	2.4	3	1.8	8	4.8	9	5.4
0.8	Sequence	2	1.6	7	5.6	2	1.6	7	5.6	10	8
0.7	Timing	0.5	0.35	4	2.8	2	1.4	4	2.8	10	7
0.5	Process Owner Commitment	8	4	4	2	3	1.5	7	3.5	8	4
0.7	Standardised	0.5	0.35	5	3.5	2	1.4	9	6.3	9	6.3
0.5	International Standard Ratified	0.0	0.0	5	2.5	5	2.5	10	5	10	5
	TOTAL	34	*24.7*	52	*36.8*	36	*25.8*	77	*53.3*	91	***63.1***

Figure 10. Kepner-Tregoe Analysis of Process Mapping Methodologies

The researchers considered IDEF 3 to be the most appropriate methodology and were satisfied with the outcome of its application. It seems right and proper that this research utilises the same methodology as well.

2.6 Business Process Re-engineering

Davenport and Short (1990[xiv]) defined BPR as "the analysis and design of work flows and processes within and between organisations".

2.6.1 BPR tools and techniques

The definition of BPR suggests that the radical improvement of processes is the goal of BPR. It does not, however, refer specifically to the tools and techniques used in reengineering business processes. The result of this void is that authors and consultants alike have pursued the use of many different tools in the search for the best reengineering application. These tools and techniques include the following:

Process visualisation. While many authors refer to the need to develop an ideal "end state" for processes to be re-engineered, Barrett (1994[xv]) suggests that the key to successful reengineering lies in the development of a vision of the process.

Process mapping. Cypress (1994[xvi]) suggests that the tools of operational method studies are ideally suited to the reengineering task, but that they are often neglected. Recent evidence suggests that these concepts have been incorporated into tools such as IDEF0 (Integrated Definition Method), DFD (Data Flow Diagrams), OOA (Object Oriented Analysis).

Change management. Several authors concentrate on the need to take account of the human side of reengineering, in particular the management of

organisational change. Some authors (e.g. Mumford and Beekma, 1994[xvii] and Bruss and Roos, 1993[xviii]) suggest that the management of change is the largest task in reengineering.

Benchmarking. Several authors suggest that benchmarking forms an integral part of reengineering, since it allows the visualisation and development of processes which are known to be in operation in other organisations (Chang, 1994[xix] and Furey, 1993[xx]).

Process and customer focus. The primary aim of BPR, according to some authors, is to redesign processes with regard to improving performance from the customer's perspective (Vantrappen, 1992[xxi]). This provides a strong link with the process improvement methodologies suggested by authors from the quality field, such as Harrington (1991[xxii]).

It should be noted that few authors refer to any single technique when discussing BPR. Most incorporate a mixture of tools, although the nature of the mix depends on the application, whether it be hard (technological) or soft (management of people). While the exact methodologies to be used are the source of some discussion, it can be seen that BPR, as a strategic, cross-functional activity, must be integrated with other aspects of management if it is to succeed.

In summary, therefore, BPR can be seen to represent a range of activities concerned with the improvement of processes. While some authors appear to suggest that tools and techniques are the key, most authors suggest that a strategic approach to BPR, and the development of a BPR strategy is the key to success. There seems little doubt in either the literature or in practice that efforts on the scale of BPR must be strategically driven and supported by senior management if they are to succeed.

2.6.2 Understanding organisational processes

Deming (1993)[xxiii] has written about the importance of systems thinking in understanding workflow, business processes, and the impact of feedback. In any system, events will occur that have an effect elsewhere in the system, and possibly on the event itself. In order to have a full understanding of the effects of what is being done, it is necessary to understand the whole process and how it fits into the organisational system.

IT has the capability of providing the means to achieve breakthrough performances in organisational systems. The vision, however, must come from understanding both the current and potential processes.

Some of the reengineering literature advises starting with a blank sheet of paper and redesigning the process anew. The problems inherent in this approach are:

- the danger of designing another inefficient system,
- ignoring the embedded system knowledge accumulated over many years, and
- not appreciating the scope of the problem

Therefore, many authorities (Grover and Malhotra, 1997[xxiv] and Stoddard and Jarvenpaa, 1995[xxv]) recommend a thorough understanding of current processes before embarking on a reengineering project. Current processes can be understood and documented by flowcharting and process mapping. As processes are documented, their interrelationships become clear and a map of the organisation emerges. The aim of BPR is to make discontinuous, major improvements. This invariably means organisational change, the extent of which depends on the scope of the process reengineered.

2.6.3 Organisational redesign using BPR

BPR is not intended to preserve the status quo, but to fundamentally and radically change what is done; it is dynamic. Therefore, it is essential for a BPR effort to focus on outcomes rather than tasks, and the required outcome will determine the scope of the BPR exercise.

Schaffer and Thomson (1992)[xxvi] highlighted how focusing on results rather than just activities makes the difference between success and failure in change programmes. The measures used, however, are crucial. At every level of reengineering, a focus on outcome gives direction and measurability; whether it be cost reduction, head count reduction, increase in efficiency, customer focus, identification of core processes and non-value-adding components, or strategic alignment of business processes. Benchmarking is a powerful tool for BPR and is the trigger for many BPR projects. But the value of benchmarking does not lie in what can be copied, but in its ability to identify goals (Earl and Khan, 1994[xxvii]). If used well, benchmarking can shape strategy and identify a potential competitive advantage.

2.6.4 The redesign process

Central to BPR is an objective overview of the processes to be redesigned. Whereas information needs to be obtained from the people directly involved in those processes, it is never initiated by them. Even at its lowest level, BPR has a top-down approach. As such, most BPR efforts take the form of a project, typically, in the form of several discrete phases.

People need to be equipped to assess, reengineer, and support — with the appropriate technology — the key processes that contribute to customer satisfaction and corporate objectives (Coulson-Thomas, 1993[xxviii]). Therefore, BPR efforts can involve substantial investment but they also require considerable top management support and commitment. Critical to the success of the redesign is the make-up of the reengineering team. Most authors suggest that the team should comprise the following:

- senior manager as sponsor
- steering committee of senior managers to oversee overall reengineering strategy
- process owner
- team leader
- redesign team

The project approach to BPR suggests a one-off approach. When the project is over, the team is disbanded and business returns to normal, albeit a radically different normal. It is generally recommended that an organisation does not attempt to reengineer more than one major process at a time, because of the disruption and stress caused. Therefore, in major reengineering efforts of more than one process, as one team is disbanded, another is formed to redesign yet another process.

Once a process has been redesigned, continuous improvement of the new process by the team of people working in the process should start. That is, organising work around people, which fosters interaction, understanding, and responsibility. The dissemination of information via IT further empowers the team to make decisions and inevitably results in a delayering of management structures.

3.0 Methodology

The purpose of the Methodology section of this report is to detail the methods employed to operationalise the project's objectives. The methodology should look at some of the more pragmatic aspects of the research and the way in which the transition from project specification to implementation occurred. Therefore, this chapter includes:

1. Analysis of the data collection and validation methodology
2. Details of a BPR exercise conducted at the Endoscopy Unit
3. Discussion about the role of the quantitative data collated
4. Information of the dissemination strategy

3.1 Data Collection Techniques

There are a plethora of data collection techniques available yet given the context in which they were to be used, only 5 proved appropriate. The techniques needed to allow for the exchange of content rich data, facilitate a high level of documentation in a short space of time and have minimal bias. The technique also needed to be practical given that the data collection would take place on hospital wards – if the method employed prevented staff from conducting their duties in the appropriate manner, it could not be used. The following is a summary of a range of techniques used and their applicability in a hospital context.

3.1.1 Semi-Structured Interviews

Semi-structured interviews are conducted with a fairly open framework, which allows for focused, conversational, two-way communication. They can be used to both give and receive advice. Not all questions are designed and phrased before the interview; the majority of questions are designed during the interview. This allows both the interviewer and interviewee the flexibility to probe for details or discuss issues. Semi-structured interviews then, are structured only in the sense that some form of interview guide provides a framework for the interview.

Importantly, semi-structured interviews promote two-way communication; reasons are often given by the interviewee rather than just answers. This would prove to be an important factor in the data collection process as staff had significant process knowledge and could support their arguments with sound clinical reasoning. The author, though having significant process mapping knowledge does not have any clinical experience. It was therefore important to acknowledge that the data collection process would be a collaborative exercise.

In addition to this 'partnership' approach, semi-structured interviews, when performed on a one to one basis allow for rapid dissemination of technical knowledge. However, by mapping a process with only one person there is an inherent danger of bias for one of three reasons:

- The interviewee may be nervous about the interview or may be ill-informed as to the purpose of the exercise. A common concern for many employees who take part in such exercises is that they might improve the process to the point that their services are surplus to requirements. As such, pertinent information may be withheld. This is less of a concern when process mapping in an NHS hospital as any subsequent increases in capacity will not result in redundant staff, simply increased throughput. It is of paramount importance that this is made clear at the start of each interview, however.

- The map will represent only one person's point of view: it cannot be an objective assessment of the current system. This was a genuine concern given that this research had a two month deadline - this represent one of the limitations of this research.

- The interviewee may be so intimate with the processes that they have become intuitive to them. In such a circumstance, the interviewee may genuinely forget parts of the process.

In addition there are the following disadvantages:

- The interviewer must be skilled
- Preparation must be carefully planned to ensure there are no leading questions

Semi-structured interviews were used more than any other type of data collection technique.

3.1.2 Structured Interviews

As the name implies, structured interviews are relatively inflexible, with the interviewer having a set of predetermined questions. Although this technique may sound constrictive, this rigidity helps to ensure that important information is covered and documented as there is little scope for both the interviewer and interviewee to be distracted by a seemingly more interesting topic.

This technique would be more appropriate where the interviewer requires little technical knowledge, or where the interviewer is simply looking for knowledge to be substantiated. This technique requires less interviewing skill and would therefore be appropriate for less experienced staff. However, more experience is

required in the design and analysis of the questions because there is little opportunity for the interviewee to support their answers by exploring alternative avenues of information. Less experienced staff should therefore coached through the design of the questions to ensure that biased is minimised.

The same dangers of bias exist as with semi-structured interviews, actions must therefore be taken to counteract the potential bias.

Structured interviews were not used in the data collection process. Although initially attractive, after acknowledging that the process would be collaborative, drawing on the technical skills of both the interviewer and interviewee, the technique became redundant.

3.1.3 Group Interviews

In order to build on the effective nature of one to one interviewing, whilst attempting to discount potential bias, an effective method of data collection may be interviewing on a one to many basis. Here the dangers associated with discussing the processes with only one person are not present, unless an over-bearing member takes over the group. In such a circumstance, it is down to the skill of the interviewer to involve the other members of the group in the discussion. In the main, subjective bias is discounted.

The group interview technique employed in part in this research allowed the group to work independently of the interviewer. Having provided the group with the problem (i.e. to map a certain part of the process) and necessary tools (a roll of brown paper and a packet of 3M Post-It Notes), the interviewer allowed the group to work largely unaided. The benefit of this tactic is that staff are able to discuss the precise nature of their role. So, if there is conflict about the sequence of activities for example, the group would be left to resolve the situation.

Though effective, this method can be difficult to implement in a healthcare environment. The author attempted to organise a series of these meetings, but was only successful on two occasions because to take several staff of a similar grade from a single department may effectively terminate that department's ability to provide a service. This was particularly true over the summer period when this research was conducted as many departments were stretched due to staff taking annual leave.

3.1.4 Participant Observation

Given that there are inherent problems with one to one interviews, one alternative is participant observation. It is a relatively straightforward technique: the data collector sits silently, near to the member of staff he is observing but without intruding into the observee's personal space. In this way the observer can document the processes as they occur in practice. The theory behind the effectiveness of this method is also relatively simple: by immersing himself in the subject being studied, the researcher will gain a deeper level of understanding than could otherwise be obtained.

However, whilst watching a person in their natural environment does not rely on the interviewee recalling their (often unconscious) routines, it does raise questions about the objectivity of the researcher: unsystematic gathering of data, reliance on subjective measurement and possible observer effects (observation may distort the observed behaviour).

This method of data collection is time consuming and on its own can include as much bias as any of the other techniques. In a healthcare environment it is not always appropriate to shadow members of staff because their jobs are extremely hectic and to observe is to follow that member of staff around, which may limit

their clinical effectiveness. Clearly this would present bias and would not be regarded as acceptable in any case.

Participant observation should therefore be regarded as a complimentary technique and it is effective as such.

3.1.5 Telephone Interviews

Telephone interviews are a cheap and immediate method of collecting data. Due to the high level of interaction required in process mapping, this technique was used rarely. It did however, prove to be effective on several occasions where there appeared to be inconsistencies in the data or a data set was incomplete. In such circumstances, telephone interviews can be an effective means of clarification.

3.2 Data Collection

Having defined the method for data collection, the plan was implemented. The author conducted approximately 25 interviews with around 35 members of staff between the 7th July and 10th August 2001. Typically this process would involve sitting down with the interviewee and jointly drawing a very basic process map. The map would simply be a series of boxes with arrows connecting them. In this way the interviewee can see the map develop and a degree of validation can occur during the interview. It also seemed that the interviewee gained insight into the purpose of the activity and became much more proactive as the discussions progressed. This, is turn, settled the interviewee increasing the quality of the interview further. It is therefore recommended that future process mappers book interviews for a period of one hour. This ensures that there is enough time for the

interviewee to be briefed about the purpose of the interview and become fully active in it before a degree of fatigue sets in.

The author found it difficult to arrange meetings with consultants due to the fast track nature of the project and the time of year – many consultants were on annual leave or covering for colleagues on leave. Therefore it was necessary to focus on interviews with administrative staff, nurses of all grades, directorate and support personnel such as IT and management support.

The vast majority of meetings were semi-structured and with one interviewee as quite often it was a case of collecting as much data before nurses were called to an emergency. Only two group interviews were held, both in the Radiology Department. In general it proved difficult to organise group interviews because to do so would leave the department short of staff in many instances. The observation technique was employed once in the A&E department, to map administrative processes, but it became clear that this technique was not appropriate in hospitals. This is because staff are continually on the move and the presence of an observer, openly following staff around would guarantee some change of behaviour in the observed. Further, staff need to focus when they perform their duties as they operate in pressured situation - an observer would clearly have become a hindrance.

Two types of techniques were used for recording the information. The first was to use small Post-It Notes and flip charts. This method has the benefit of allowing iterations whilst keeping a tidy page. In this way clarity of the record is ensured. However, after one or two interviews, it became clear that this method was somewhat unwieldy. Most of the interviews were conducted on wards, which meant that there wasn't room for flip charts and Post-It Notes. Although extremely effective, the technique employed in the main was to use A3 paper and pens. Although this resulted in some untidy records, providing the

information was entered into ProSim, the software used to represent the data, shortly after the interview, no information was lost.

As a means of validation, the maps were shown to most members of staff to ensure that the way in which the information was represented was accurate. Of course, this does not discount subjective bias, previously discussed, but it does remove misinterpretations between mapper and interviewee, which might otherwise have been present.

3.3 ProSim

Having collected the data and with a decision to use the IDEF methodology to represent the information, it was necessary to input the information into IDEF 3 software. The Department of Enterprise Integration at Cranfield University is most familiar with software published by Knowledge Based Systems Inc. (KBSI), who are specialists in producing software for IDEF methodologies. In addition to representing the information in a manner consistent with the IDEF 3 theory, ProSim alows the user to[xxix]:

- Create animated simulations and virtual reality visualisation of workflows in Witness. (Another piece of research is being conducted at the Hospital by The Department of Enterprise Integration using Witness as a discrete event simulator).
- Index into distributed corporate information sources with process knowledge map
- Publish the knowledge base on the Internet.
- Package and distribute standardised process knowledge with the ProSim Viewer

Further information about the company and its products can be found at http:www.kbsi.com.

3.4 Business Process Re-engineering at the Endoscopy Unit

Having mapped the processes and translated them into the IDEF 3 methodology, the next stage was to analyse the maps in order to uncover potential areas of improvement. Given that the project had only a two month life, there clearly was not enough time to oversee a full BPR programme. However, it was important to impart some lasting techniques. As such, the author became involved in the initial stages of a re-engineering programme at the hospital's Endoscopy unit. The department was chosen because it is a pioneering institute and represents best practice in many areas. It has been the subject of case studies in the past and has an equivalent status to a World Class Manufacturer. Given the department's previous successes it appeared appropriate because:

- As a pioneering department, staff must be keen to develop systems and improve practice.

- If process improvement could be found it may inspire other departments within the hospital: 'if Endoscopy can improve their systems, then we *must* be able to'.

3.4.1 BPR Exercise

The Endoscopy Department already had an afternoon booked off from clinical activity to look at ways of improving their systems. The author became involved in this day and provided for a more structured scientific approach toward process improvement.

42 people from all staff categories were invited to the session. Staff present therefore included consultants, administrative staff, nurses, Clinical Directors etc. As a part of the planning process, staff were split into 4 groups. This was undertaken as part of the planning process to ensure that each group was balanced, both in terms of medical experience and personality type. Each group also included 4 people with no medical experience whatsoever. The purpose of this was to have someone to ask the naïve questions that might have been overlooked by people more intimate with the process. In this way, methods such as the 5 Ys can be used. Why do we take patient details twice? Why is that important? Why can't we achieve the same results by doing it this way? Etc.

The groups were then asked to assemble at their team table. Groups were identified by colour (the Blue Team, the Red Team etc.) rather than by letter or number (Team 1 or the 'A' Team) as it was felt that this would cause less tension and friction within the staff. Samantha Jago, a representative of Cancer Collaborative Services, then gave a brief introduction to the day and to process mapping. Miss Jago has considerable expereince in process mapping at hospitals. The teams then practiced their mapping techniques by looking at the sequence of activities involved in getting to work. To do this, each team were given 3M Post-It Notes and a roll of brown paper. Post-It notes are useful for exercises such as these because they can be re-arranged on the brown paper, helping to promote discussion within the group as each member offers an alternative method or solution. Process mapping is an iterative process and in practice cannot be completed accurately at the first attempt, as such, this technique proved extremely effective.

Although a significant amount of data had been collected for the Endoscopy Department about their processes, the author felt that the exercise was an opportunity for staff to become involved in the mapping process and could get some 'hands on' experience. In this way the department would not just be given a set of process maps at the end of the project but would have been given the

tools to map and re-engineer their processes in the future. This experiential knowledge should also be rolled out to other departments who will inevitably have to document and re-engineer their processes in the near future. This also acted as a means of validation.

Each group was asked to map half the process, so after the exercise there were 2 complete versions of the process. The groups were then brought back together and the two versions of the map were merged, providing one definitive map. The group then debated possible areas for improvement. The result of this was an action list where people were given responsibility for conducting feasibility studies to determine whether the improvements could actually be implemented.

3.5 Quantitative Data

Having collected the relevant data and documented it in the form of a process map, the next stage in the process was to collect complimentary quantitative data.

The author requested records that contained either gatroenterology or colorectal codes. This would then pull any record of a patient that had been seen by a gatroenterology or colorectal consultant / surgeon. In addition it would identify any patients that had been to the Radiology Department for example, for imaging related to a gastroenterology complaint.

For each record the following data fields were requested:

- Patient Number (a unique reference)
- Date of the treatment
- Name of the treatment
- Department in which the treatment took place

By ordering this data by patient number and then by date it would be possible to see the types of treatment administered to each patient with a gastroenterology complaint and how quickly they moved through each stage of treatment. By requesting the date of treatment field it would become apparent whether the treatment was part of a current set treatment or an older set. This would ensure that, for example, if a patient had colorectal cancer, which was treated but then reappeared, distinctions between the two sets of treatment could be drawn.

Such data can be used to determine:

- **Units of treatment**. Which services do gastroenterology rely on? Are there any potential bottlenecks?
- **Typical Routes**. It is important to care for minority, but cater for the majority. That is, if 70% of patients follow the same or very similar route through Gastroenterology, are there ways of tailoring the service toward the majority whilst maintaining the same level of care for other patients?
- **Cost reduction**. If three cheaper diagnostic tests are used for the majority of patients with a suspected problem, is it more effective in terms of cost and throughput to use one more expensive, catch-all technique, such as a CT scan?
- **Improved care**. If most patients have care in a number of departments, are those departments aware of what the patient has been through? Can we prepare the patient once for two tests?

Clearly then, the quantitative data plays a complimentary role to the process maps and is of significant importance. There were however, problems with obtaining this data. The author's experience of Information Departments within NHS hospitals and trusts is that they are typically slow to respond and do so with inaccurate and invalidated data. This is not true of Torbay Hospital who have an excellent management team who have a clear vision of what information is

required to make credible decisions and analysis. However, the Information Department recently discovered that the data from the Radiology Department was inconsistent. Further investigation revealed that it was far from robust and could not be treated as a credible source. The problem was discovered some time ago and was remedied, but accurate Radiology data was only available for the first three months of the current financial year. As the primary purpose of the quantitative data was to determine units of treatment required at each stage of the process, having been restricted to three months of data for Radiology the author was necessarily restricted to data for the same period for the other departments involved in the gastroenterology process.

Anecdotal evidence from the process mapping data collection phase of this research had suggested that a significant number of patients flowed from the Endoscopy Department to the Radiology Department in order to develop a portfolio of diagnostic information. This still was not substantiated by the quantitative data. It appears that this is because the average length of treatment is longer than the three month period for which the data was collected. As such, it is not possible to collect complete patient routes for the majority of patients as the beginning, end or beginning and end of their treatment falls outside the period for which the data was collected. The effect of this is illustrated in Figure 11.

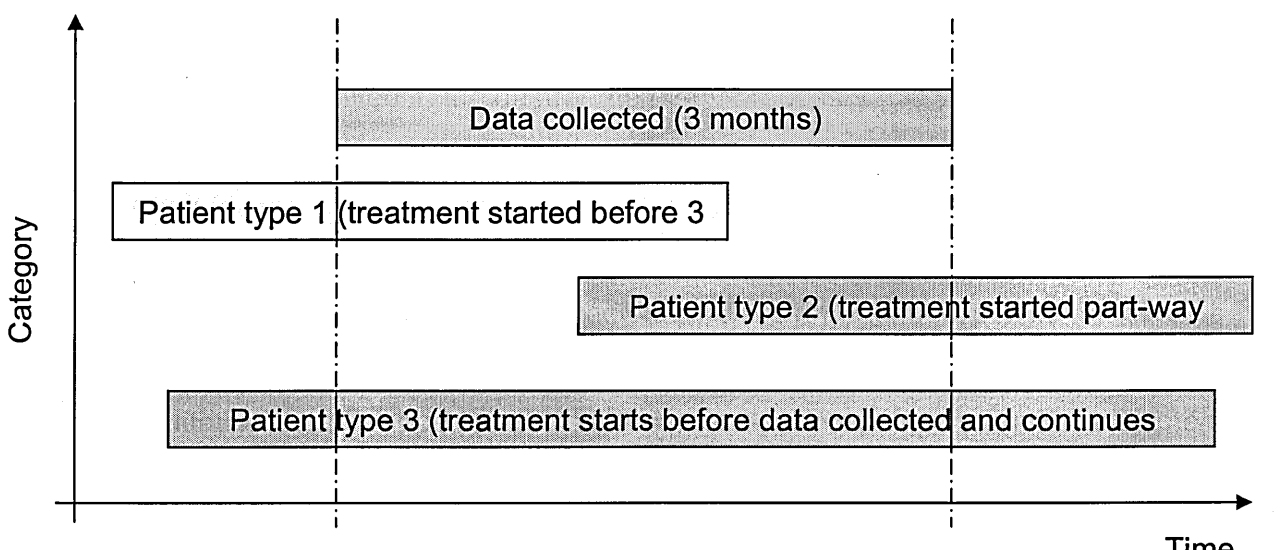


Figure 11. Quantitative Data Problems

Of course, regardless of the length of time that data is collected for, there will always be patients whose treatment isn't fully represented in the data; there will always be patients whose treatment starts before or towards the end of the period for which the data is collected. However, because of the short period of time for which the data is available, the situation is exasperated. There were two potential remedies to this situation:

- Conduct statistical analysis to determine the number of incomplete patient routes in the data set. The data could then be mitigated accordingly. This option is not available for this data as the time period for which the data was collected is too short.

- Search the medical records for each patient to ensure a full set of data for each patient. This type of investigation ensures accuracy of data and is more appropriate for small data sets because it is a labour intensive task. However, to allow the author access to this information would be to infringe on patients' privacy rights. It was deemed that the author did not have the appropriate level of authority.

As such, analysis of this data was not possible. However, an appropriate sample size should be available towards the end of the year. It is recommended that this analysis be conducted at that time.

3.6 Dissemination Strategy

Having conducted the research it is imperative that it be available to the appropriate people. As such it will be distributed in both paper format and on CD-ROM as Torbay Hospital intend to purchase licenses for the ProSim software. The report should also be made available to staff via the hospital intranet site.

The maps and report will be disseminated to a wide range of personnel, who will use the information in a number of different ways. For example:

Booked Admissions. According to current government policy, all NHS hospitals must have implemented a Booked Admissions Scheduling System by 2004. Process mapping is the very 1st stage of this process, because to schedule the right resources to the right place at the right time the system must be fully comprehended. Every department therefore will have to undertake process mapping exercises in the near future.

In addition, when the system is implemented it should represent best practice within the industry so that the system isn't antiquated before the 'go live' date. BPR exercises will also need to be conducted before the booked admissions system can be implemented. Departments are therefore urged to initiate the mapping process immediately.

Care Pathways. An accurate process map can act as the basis for a care pathway. One way of increasing capacity is to increase the use of protocol led nursing, which is currently being rolled out across many hospitals in the department.

Electronic Patient Records (EPR). The EPR system will amongst other things, electronically document patient progress through the system. Patient routes will therefore be required so that the system can track each patient.

BPR. The maps will be used as a basis for performance improvement. Once the current system (the AS-IS model) is mapped and understood, more effective processes should be developed, known as the TO-BE model and then implemented. The Endoscopy Department should therefore continue their process improvement initiative. Lessons learned from this exercise should be

disseminated across departments, both in terms of mapping techniques and improvements identified as a means of consolidating gains.

Inter-departmental. The maps can be used to develop an understanding of other department's processes. There appears to be a lack of integration at department level. As one nurse remarked "the left hand doesn't know what the right hand's doing". Inter-departmental collaboration will highlight areas where process improvements can be made, for example, preparing a patient once for two diagnostic tests (refer to Chapter 4 – Analysis).

Performance & Development. The maps will also be used by Performance & Development as part of their performance appraisal. They will also be involved in process improvement schemes.

4.0 Analysis & Recommendations

The purpose of this section is to highlight areas of the process maps that can be improved. These areas are identified, the nature of the problem is explained and where possible recommendations for immediate improvement are made. Where such recommendations cannot be made, further investigations have been initiated. These are also discussed.

Many of the recommendations do not relate directly to the process maps. This is because the maps were used to facilitate discussions about problems in the system and potential remedies. This approach acknowledges that staff involved in the process are aware of the problems and in many cases how to solve them. The author felt that building on staff enthusiasm would more beneficial in building momentum in the re-engineering process, rather than strictly using the maps as the only means of process improvement.

4.1 Recommendations from BPR Exercise

The primary objective of the research was to produce the AS-IS process map, which represents the current system. The secondary objective was to relate any observations for improvement that may have been highlighted during the data collection phase or subsequent analysis of the maps. Given that the plurality of the author's time was spent with the Endoscopy Department, most of the recommendations relate that department. However, many of these issues will be recognised as problems in other departments. Therefore in order that the gains from the research are consolidated, improvements, where appropriate, should be rolled out to other departments as well. After a series of recommendations pertaining to the Endoscopy unit a second set of more general suggestions follow.

1. Some of the administrative processes need to be re-engineered for maximum efficiency. One example was found in the Appointment Allocation Process for GP referrals.

   The inefficiency in this process lies in the speed at which referrals are dealt with. If a patient has suspected cancer or is considered to be a an Emergency case, the GP will fax over a referral form. In all other circumstances, the referral is posted. If the referral is faxed, it will be dealt with within 24 hour. If the referral is posted however, the process is much slower. It may take 1-2 days for the referral to leave the GPs surgery, by the time it has been passed through the internal post. It will the be with the Royal Mail for 1-2 days before spending a further 1-2 days in the internal post for the hospital. The referral then, may not reach the department for up to a week after it was initially written. After the referral is received it is passed to the consultant to which it was written, via Reception and the Consultant's secretary. Due to the work load placed on Consultants in the department, postal referrals are generally dealt with once a week, so that they can be treated in one instance. However, the result of this is that the referral may not be dealt with for up to two weeks after it was written and may not be received by the patient for up to three weeks (I week for the post processes, 1 week in the Endoscopy Unit before referral and then 1 week for the appropriate letters to be generated and posted to the patient). This causes two key problems:

   - Some patients' condition may be more serious than appreciated by the GP. Their referral may have been posted when it should have been faxed through as an emergency or two week wait. This does not happen very often, but anecdotal evidence would suggest that it does occur and that the system does need to be improved.
   - It could be up to three weeks before the patient is contacted by the hospital. This is clearly not the highest level of service that can be achieved.

The problem can be resolved by re-engineering the process. If each consultant within the department took responsibility for all of the referrals, regardless of who they were posted to, on a given day of the week, then all referrals could be dealt with within 24 hours.

This may not cause as much commotion as it would first appear. The consultants within the department operate a generic list. That is, there is not a separate waiting list for each Consultant, only one for the whole department. Therefore, under the current system, once the referral has been received, there is no distinction. Further, each Consultant would only be responsible for referrals once or twice a week, so overall workload should not be significantly affected.

One issue may be that not all mail posted to the Consultants are referrals. As such, there is a chance that the referring Consultant for the day may receive non-referral mail that should be opened by the addressee. However, internal private mail is marked as 'Confidential' and should therefore only ever be opened by the addressee and most other non-referral mail is for training courses and other work-related issues. As such it would be information that would probably be shared among the Consultants anyway.

It is therefore recommended that each Consultant should take responsibility for all referrals on a given day of the week.

2. The length of time that referred patients have to wait until they are seen by a Doctor. Typically as the day progresses the number of patients waiting increases. This suggests that the average length of time a doctor needs with a patient needs to be re-examined. In addition the times at which patients arrive and the numbers in which they arrive also need to be revised.

3. Upon closer analysis of the maps one of the other administrative processes appears to be relatively inefficient. When patients arrive, their personal details are checked against a print out of the patients expected for the day. This is to ensure that future correspondence is sent to the correct address. However, when the receptionist has time, the details are then checked against the PAS and Endoscribe systems. This represents a duplication of work and therefore an inefficiency. It is therefore recommended that details are checked against PAS and Endoscribe in the first instance.

4. Number of patient classifications. Again, this is represented in the decomposition of the Appointment Allocation Process for GP referrals. There are currently five main classifications of patient urgency: Emergency (E), Two Week Wait (2WW), Urgent (U), Soon (S) and Routine (R). Increasing numbers of patients are being referred as Urgent. Staff believe this is because GPs feel under pressure to get their patients an appointment as soon as possible. However, this causes further problems for the Endoscopy unit as every referral needs to be studied in detail to determine whether the patient's reported condition is suitable for the category which they have been referred under.

   Therefore, a review of this system and the number of classifications within it has been actioned.

5. Two Week Wait referral forms are often faxed through to the department incomplete, represented as one of the first stages in the Appointment Allocation Process for GP referrals. These referrals are supposed to used exclusively for patients with suspected cancer. This lack of information makes it extremely difficult for consultants to prioritise these most ill patients. The form cannot be amended however because it was produced by government and can only changed by them.

It is therefore recommended that GPs are contacted and the problems are relayed. The situation should then be reviewed in two months.

6. There appears to be a substantial amount of data colected that is entered into the PAS system, (which is hospital wide), the Endoscribe system, (which is Endoscopy specific) and into a third database run by one of the consultants' secretaries. This causes several potential problems:

   - Time and effort is duplicated when data is entered into three separate systems.
   - The likelihood of inconsistent data increases for two reasons:
     1. Data may be sourced from different locations.
     2. Increased probability of mistakes by the people who input the data

   Therefore people in the same department may be working from different figures.

   As the data collection process has developed on an *ad hoc* basis, it is likely that some of the data collected is now redundant and is not acted upon – in which case it is useless and should not be collected.

   Precise information requirements for the department, Directorate and Trust must be identified. They in turn must ensure that the data they require is still genuinely required.

   In addition, an action has been established to determine whether one or more of the databases can be combined.

7. The number of people on the waiting list and the length of time they have to wait is increasing. This situation is currently under review. A capacity Vs. Demand study has been undertaken by Dennis Balsdon, a representative

from Management Support Services. Findings will be presented at the next process improvement meeting. It is acknowledged however, that this is a long-term piece of research and will not be concluded in the near future.

8. Patients have their appointments cancelled at short notice. This is largely due to the unavailability of endoscopists and causes not only patient cancellations but urgent rescheduling and reorganisation of nursing rotas. The knock-on effect of this can be far-reaching.

   Action has therefore been undertaken to review the communications strategy within the department. Possible solutions include using electronic diaries and implementing a minimum period of notice before endoscopists can take leave.

   Analysis should also be initiated to determine whether more endoscopists are required or whether protocol-led nursing could free up sufficient existing endoscopists, allowing them to focus on their core skills.

9. An analysis of patients who Did Not Attend (DNA) their appointment has been actioned. Initial discussions seemed to suggest that DNA rates were much lower for patients who had been pre-assessed. This would appear to be logical because the greater the involvement of the patient, the more they feel part of the process and are therefore more likely to attend. This sense of involvement or ownership could be fostered in a number of ways:

   - All patients could be pre-assessed. This would appear to be the logical solution, however this would require additional nursing staff. There would also be a problem in terms of available space in which to conduct the pre-assessment.
   - Patients could be pre-assessed over the telephone. This would perhaps not be suitable for first time patients, but would almost certainly be acceptable for repeat patients.

- Allow the patients to choose their own appointment dates and times, wherever possible. This would increase the level of patient involvement in the process and may therefore reduce the DNA rate either by increasing attendance or through an increased number of valid cancellations.
- Minimise the length of time between contacting the patient to arrange an appointment and the actual appointment. This could be achieved by sending interim letters to the patient informing them of the current situation, to prevent irate telephone calls to the department from patients who think they have been forgotten, but without providing details of their appointment until nearer the time. This would increase the levels of communication with the patient increasing the feeling of responsibility to attend the appointment or to inform the hospital if it is cancelled. In addition, the smaller the period of time between being given the appointment and the actual appointment the lower the DNA rate. This is because the greater this length of time is the greater the chance that patients will simply forget about the appointment or feel as though they have recovered and do not need to attend the appointment.
- Telephone all patients one week before their appointment to remind them. This obviously would not need to be done if the patient was pre-assessed either physically or over the telephone before the appointment. It would however require additional administrative staff.
- Post letters with return slips or telling the patient to contact the department x days before the appointment to confirm attendance or they will lose the booking. This transfers responsibility on to the patient but in doing so increases the level of interaction between patient and department. The letters should not be posted more than two weeks before the appointment so that there is less chance the patient will forget or recover from complaint.

In the longer term, the Booked Admissions Scheduling system will have some impact on the DNA rates because the system will facilitate much shorter waiting times. This will combat many of the problems discused above. It will however be a number of years before the system is rolled out across the entire hospital. It is therefore recommended that one or more of the alternatives detailed above are employed.

10. There have been an increased number of complaints from patients who have misunderstood potential waiting times. An action has therefore been set to review all information sent to patients, including letters. It is very difficult to determine the precise length of time that a patient will have to wait, (unless they are an Emergency or Two Week Wait in which case they will be seen as soon as possible). This is because patients who are considered to be Urgent will jump the queue ahead of patients classified Soon and Routine. Therefore if an abnormal number of patients are classified as Urgent it is likely that all Soon and Routine patients will have to wait significantly longer than they expected as they effectively become relegated in lieu of more serious referrals.

    One potential solution would be to stop offering patients expected waiting times because the status quo is likely to change; one could argue that by offering a fixed date, the hospital makes a rod for its own back. An improvement may be found in simply explaining the system to the patient in a letter and to also detail maximum waiting times. Using this system, patients would not be given false hopes and would not telephone the Endoscopy Reception on a regular basis to find out if they've been given an appointment yet.

11. It was noted by administrative staff that patients became increasingly frustrated as appointments got further and further behind the schedule. Most of the time this frustration manifested itself in the patients asking the

Endoscopy Reception how much longer they would have to wait and occasionally complaining whilst they were there. When patients did complain, Reception staff would be tied up for a significant period of time, preventing them from conducting their routine duties. So that Reception staff can focus on more important matters, it is recommended that a display be installed in the waiting area, to show a +/- x minutes, depending on whether the department was running behind or ahead of schedule. By keeping the patient informed with up to date, pertinent information patients will be less inclined to complain.

12. The waiting area is often full. Of course, a percentage of these are patients, but the remainder are people accompanying patients. Some wait with the patient before the consultation, some wait to collect the patient afterwards and often patients bring more than one person with them. In addition, there are a number of cases each week where the patient cannot get home because the person collecting them cannot be contacted. As such, at any one time there may be a significant number of extra people in the waiting room who need not be there. Potential solutions include:

    - Limit the number of people accompanying the patient to one.
    - Find a different area, possibly away from the main Endoscopy building from which patients can be collected.
    - If this is a problem for other departments within the hospital as well, a shared service centre to deal with the collection of patients from a number of disparate departments may be appropriate.

It is recommended that a feasibility study be conducted to determine the most appropriate solution.

13. There appear to be a series of delays or bottlenecks within the system. These delays are:

- List start times
- Patients not arriving on time or are not ready on time
- Late arrival of doctors and nurses
- Clean endoscopes are not available
- Hospital transport at the end of the day
- Bed availability

Further research is required to determine the root causes of these delays. For example, is the main cause of late patient arrival due to the fact that:

- There are only a limited number of parking spaces at the hospital and the patient has to waste time finding a place to park, resulting in their late arrival
- The infrastructure around the hospital is poor and cannot handle traffic level at peak times during the day, causing the patients to arrive late
- Patients expect the schedule to be running late and so do not arrive on time
- Patients do not care whether they are late
- None of the above

With regard to the endoscopes, does the problem relate to:

- the process of cleaning them
- lack of staff to perform this job
- more endoscopes are needed

Analysis and subsequent costing of alternatives is required before a robust recommendation can be made.

14. Similarly there is a general lack of space in the department. Potential remedies for this situation must be investigated. Specifically, extra room is needed for the following activities:

- Waiting room for patients (already discussed)
- Admission space for nurse assessment
- Waiting space / room for post assessment
- Trolley space (currently stored in the corridor)
- Recovery space
- Storage space

A volunteer group has been assembled to investigate the problems cited in points 13 and 14. The group comprises nursing staff, technical, clerical and medical staff.

The Endoscopy Department have arranged for another afternoon of process improvement at the end of September. All persons actioned to analyse these issues will report to the rest of the department on this day.

4.2 General Recommendations

1. Most departments have more than system which patient data is entered into. This is represented in several areas of the maps. All departments use PAS and then a second system, specific to their needs. As previously discussed, Endoscopy use Endoscribe, Day Surgery use Daynamics and so on. The author accepts that these systems are repositories for different information. However, a significant percentage of the data stored in each system is the same, such as demographic data. The entry of this data into two systems

represents duplication of work and has the same negative connotations detailed in the previous section of this chapter.

Whilst it is not possible to replace these systems in the short-term, they could perhaps source key data from one data store by creating a link between the two systems. This would mitigate problems of repetition of work and inconsistency of data.

2. Greater Inter-departmental co-operation. The author noted comments on several occasions where staff felt frustrated at the lack information passed between departments. Integration of departments may facilitate improved patient care in some circumstances. For example, the patient preparation schedule for a Barium Enema, which is an imaging diagnostic tool conducted in the Radiology Department is virtually exactly the same as for an OGD, which is an endoscopy of the upper GI conducted in the Endoscopy Department. This information is represented in the decomposition of Patient Preparation in the appropriate place for Endoscopy and Radiology. The patient preparation is a restricted diet and series of laxatives, taken in a solution, called Piccolax. For both of these tests, the purpose of the preparation is to empty the patient's stomach and digestive system so that for the Barium Enema there are no food stuffs in the stomach that will impair the image taken and for the endoscopy so that the endoscope can pass through the patient's gut with relative ease.

   Currently, there is no communication between the two departments and so a patient may have to go through two preparation routines within a matter of weeks. Not only is this an unpleasant experience for the patient but results in a delayed diagnosis. In short, the quality of care that the patient receives could be improved.

It is therefore recommended that systems are installed to facilitate communication between the two departments on this and similar matters. A steering group with representatives from relevant departments should be formed. Initially the group should disseminate process maps between members, to identify possible areas for collaboration. The maps can then act as a basis for discussion, facilitating initial integration. Further integration thereafter will be determined by initial success.

3. Revised referral forms. Incomplete forms are not only a problem for the Endoscopy Department but more generally across the whole of the hospital, for external referrals such as from GPs and for internal referrals such as from a consultant in another department. This potentially causes scheduling problems. One example comes from a GP referral to the Radiology Department. The referral form was complete in the sense that all patient information that had to be legally included was included. However, the section entitled other comments was empty. This was nothing unusual and the referral was therefore processed as normal.

   However, when the patient arrived for the appointment it was found that she was massively obese and required a hoist to get her into her bed, so that the imaging procedure could be performed. By the time the hoist arrived and given the extra time and staff that were required to move the patient, more than two time allocations had been used, causing another appointment scheduled for later in the day to be cancelled.

   This type of situation is clearly unacceptable and can be remedied by revising the referral forms. Instead of having a section at the bottom entitled any other comments, pertinent information can be included on the form. For example a series of tick boxes, for obesity, diabetes etc. could be included. This would remove the subjectivity from the form and would ensure that important issues are detailed.

Staff interviewed were not angry about this development but saw it as a quite reasonable attempt for the GP to try to get their patient seen more quickly by failing to include important information. This is discussed in more detail under the title Recommendations for Further Research in the subsequent chapter.

4. Preparation for patients undergoing colorectal surgery as an in-patient will usually occur at the hospital. This is represented in the maps under Patient Preparation for colorectal in-patient procedures. This requires the patient to arrive at the hospital at least two days before the surgery. This preparation is similar to that for a Barium Enema or OGD (discussed earlier) where the patient has a restricted diet and a series of laxative treatments. As such, the preparation for some patients could be completed at their home. This would free up a number of beds for at least two days at a time.

   It would not be suitable for elderly or frail patients to self-prepare at home, but for the majority of patients it would be acceptable. From the patients' point of view this would represent an improved level of service, simply because it would require less time on the ward.

   It is therefore recommended that a series of investigations are initiated to determine the degree to which preparation of in-patients can occur at home. This should be rolled out to all specialties if initial research proves fruitful.

5.0 Conclusions

The purpose of this section is draw together any recommendations not detailed in the previous chapter and highlight any particularly relevant experiences that may be of benefit to the reader. In addition, limitations of the research are discussed as well as recommendations for further research.

5.1 Process Mapping

In terms of the data collection for the process mapping exercise, the use of group interviews is recommended where possible. These sessions proved to be the more effective of all the techniques employed in this research and involved a great deal of discussion between the members of staff, allowing them to gain a deeper level of understanding about existing and potential processes.

If this type of one to many exercise is not possible, the mapper must attempt to validate their findings with more than one person to try to discount any bias.

Regarding the use of IDEF 3 as a methodology for representing the information, the author would concur with the conclusions of Lee *et al.* (2000) who felt that IDEF 3 was an extremely robust and effective methodology.

However, the ProSim software was not as functional as expected. At times the lack of options in the software became quite frustrating. For example the lack of a copy and past function for moving blocks of processes meant that iteration was an extremely time consuming process. Having said this, Version 5 was used which has recently been superseded by Version 6. It is therefore recommended that Torbay Hospital determine the degree that the software will be used and make a decision based on that information. If significant process mapping is

expected to follow, it is recommended that a full software review be conducted to find appropriate software.

5.2 BPR

The overall structure of the BPR exercise proved to be effective, but more time was needed to complete the exercise. It is therefore recommended that full days be booked to conduct such exercises. Several other points arose from the day:

- Ownership of process. Involving the staff from the department at the start of the exercise, i.e. asking them to map the processes *then* asking their opinions for improvement was a very effective method of winning over an initially sceptical group.

- Importance of early milestones. A range of possible improvements have been identified, ranging from recommendations that can be implemented quickly to much longer term goals. These smaller milestones are effective at building early momentum. It is important to move with that momentum in order to build up a significant force for change.

- Progressive psyche. This momentum will, in time, help to foster a more positive mind set regarding process improvement. Staff will become more willing to make suggestions for improvement not only at BPR meetings but as a part of the work ethic of the department. In this way a culture that embraces change can be developed, which is the most effective way of developing a reputation as a pioneering department.

- Highly visible sponsor of programme. The experience of the author supports the literature promoting the support of senior managers. Unless such backing is present and visible, staff are provided with an instant excuse for not fully partaking in the exercise.

5.3 Limitations of the Research

There are two key limitations of this research, which are in part the result of this research being a fast track project. They are the lack of supporting quantitative data and an incomplete validation process.

5.3.1 Quantitative Data

The lack of robust quantitative data makes it difficult to develop more recommendations. This lack of data should resolve itself in due course as the corrupted processes in the Radiology Information System have been identified and the system now compiles accurate data. It should therefore be possible to produce complimentary data within the next few months. This situation could have been prevented to some extent if the research had been conducted over a longer period of time.

5.3.2 Validation Process

The validation process is complete in one sense. The author has in the main been able to arrange follow up meetings with staff to ensure the accuracy of the way in which the processes have been represented in ProSim. However, it would have been preferable to have conducted another set of data collection meetings in order to discount bias in the maps. Bias may have been incorporated into the maps as a result of not being able to map all the processes with more than one person. This could have been prevented if the project had had a longer life.

5.4 Recommendations for Further Research

The following recommendations are made:

- Continue validation process. The maps are a robust and detailed account of the processes that exist. If however, they are used as a basis for drawing care pathways, it is recommended that further validation meetings are arranged to rule out the presence of subjective bias.

- Continue collation of quantitative data. As previously discussed, sufficient data will be available over the forthcoming months to support some of the anecdotal evidence detailed in this report.

- Continue BPR exercise for Endoscopy Unit. It is important move with the momentum and build on early gains in the Endoscopy Unit.

- Develop inter-departmental collaboration scheme. As discussed in the main body of the report, there is scope for improving inter-departmental communication. In order to achieve this aim effectively, further research should be initiated. This will determine the potential depth of collaboration in the hospital.

Initiate programme for developing tighter alliances with GPs. Many of the problems associated with GPs, such as incomplete referral forms and mis-classification of the seriousness of the complaint may be due to poor GP understanding of the hospital's processes, and vice versa. It is therefore recommended that the scope of this problem is researched along with a roadmap for remedying the situation.

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