Can an Integration of Soft Systems Methodology & the ETHICS Framework enhance Socio-technical Systems Design in Large and Complex Organizations? :

An Action Research Study on Two NHS Pathways and their Design Strategies

Dicle Timurtas

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ABSTRACT

Finding solutions to Information System (IS) design problems requires attention to both technical and organisational matters. System designers frequently ignore the organisational design issues and instead they almost entirely focus on technical design. This frequently leads to unsatisfactory designs.'

This thesis is an account of an Action Research study which had three purposes. Initially, it investigated the compatibility of two Action Research techniques; Soft Systems Methodology (SSM), which gives importance to the definition of the organisational and technical purpose of the system, and the Effective Technical and Human Implementation of Computer-based Systems Framework (ETHICS), which gives importance to the co-optimisation of organisational and technical design. Secondly, the main purpose of the study investigated whether their complementation can enhance socio-technical design in IS problems. Lastly, it investigated the feasibility of applying this integrated methodology in the real world.To arrive at a conclusion, two NHS pathway cases provided by the EPICog team are used as practical examples to investigate this general research question.

The research question is answered with two main studies. A Design Strategy Analysis, which investigates a new design strategy to be applied in the NHS pathway designs including the integrated methodology. A Pathway Analysis, in which the integrated strategy applied on the provided pathway examples to generate socio-technical design alternatives to each pathway. Lastly interviews with EPICog team provided exploration and support of the findings of the two main studies and provided opinions for alteration of the integrated methodology into a simpler and possibly more feasible structure.

Through these two practical pathway studies, the integrated methodology is found to be very compatible and promising to enhance the socio-technical design of information systems. However the methodology is found to be over structured for the NHS and for practicality reasons a new simplified and much practicable version is introduced.

CONTENTS

CHAPTER 1. INTRODUCTION

This research began with the researcher's wish to perform an Action Research study to investigate whether Soft Systems Methodology could complement Socio-technical Systems approach to considerably enhance organisational and technical design strategies.

Initially I was introduced to Ken Eason who is an Emeritus Professor in Loughborough University working on a Socio-technical systems consultation project called EPICog and asked him to help me find a case study where I could apply Soft Systems analysis and a Socio-technical technique together. He suggested a project he is currently working on; EPICog, which gave me access to suitable data on the National Health Service (NHS) pathways.

In the 1st face-to-face meeting, Ken introduced several NHS pathway services he was socio-technically consulting on. A 'pathway' is a healthcare description of a procedure to perform a multi-disciplinary healthcare service that provides for a specific type of patient's needs through a sequence of interdependent tasks performed by the service agents, within a specific time period. (Kingdon, Gregoire, 2011) In this meeting he mentioned that he would like to have a secondary opinion about the pathways and their design processes and found it interesting to investigate whether socio-technical systems and soft systems approaches could add value to the NHS pathways with a view to improve healthcare services and IT systems.

In a 2nd phone meeting, the researcher selected two pathways to scope the context. Firstly, the Stroke Pathway aims to serve stroke patients with healthcare including diagnosis, treatment and monitoring for up-to three years. Secondly, the Retinopathy Diabetic Screening pathway aims to identify patients with diabetes, monitor their disease and provide clinical eye screening from age twelve. (Garvican, O'Leary, 2008) The EPICog team's ten interviews with the clinical teams and socio-technical summaries of the selected pathways were shared with the researcher.

These two pathways were selected from several options since they have different pathway patient handover structures and are designed by different IT teams. These are the NHS Walsall Informatics Stroke team and NHS Northampton Informatics Retinopathy team which have different sizes and embrace different participatory design strategies.

In light of these meetings with the EPICog Research Director and the shared resources, the researcher started looking for another action research tool that could be coherent with the initially selected action research tool (SSM) and the participatory perspectives of the NHS design strategies.

Argyris et al.(1982) described action research as a participative and collaborative process including critical inquiry, social practice and reflective learning between the researcher and the stakeholders, Considering these principles, the socio-technical participatory methodologies are investigated for second action research tool.

Initially the participatory and socio-technical scenario based evaluation technique is considered (Eason, 2007; Eason, 2009; Harker, Eason, 1999) as a possible method, however this technique is eliminated, as the researcher cannot have access to the NHS clinicians for a collaborative workshop study.

Secondly, the ETHICS framework (Mumford, 1983) is evaluated as a possible option and found to be a good contrast to SSM as it has been suggested by Mumford that methods with socio-technical philosophy such as ETHICS and SSM could be used for effective systems design. (Mumford, 2000) Moreover, SSM is found to improve the shortcomings of the steps one through three of ETHICS. (Singh, Wood, Wood-Harper, 2007) Furthermore, SSM and ETHICS are found to be providing linguistic practices in requirements analysis that deal with contingency and diversity in organisational problems (Atkinson, 2000b) and including both user participation and a structure of Information Systems Design. (Pekkola, Kaarilahti, Pohjola, 2006)

As a result, it is decided that Checkland's Soft Systems Methodology and Mumford's ETHICS framework can be integrated and the specific research question is defined as:

"Investigating the compatibility and application of an integrated structure of the Soft Systems Methodology (Checkland, 2006) and the ETHICS Framework (Mumford, 1983) to enhance the socio-technical design and practicality of the socio-technical approaches by applying two NHS pathways."

Four further chapters make up the rest of the thesis:

In *Chapter Two*, the literature review will define the background of the ETHICS and SSM, detail their application processes and provide their previous practical usage in the NHS.

In *Chapter Three*, a description of the conducted Action Research studies which used SSM, ETHICS and other Socio-technical System principles and their findings.

In *Chapter Four*, the conducted studies and findings are discussed and an alternative design strategy is proposed for the two pathway designs to be investigated in future practical studies.

In *Chapter Five*, the conclusion of the specific NHS pathway study and the general research question are discussed.

CHAPTER 2. LITERATURE REVIEW

2.1 Alternative Approaches to Information Systems Design

The information system design (ISD) is clearly problematic and main failures caused by the tendency to ignore the organisational aspects while designing the information systems. (Doherty, King, 2005) The reason for this neglect is generally due to the adoption of a 'hard' systems perspective (Madsen, Vidgen, 2009), which comes from a conventional systems engineering background. (Lewis, 1994)

A hard approach tries to solve the organisational problems with the same understanding as the technology is engineered with and as a result focuses more on the technical design. (Jackson, 1991) It discovers the optimal alternative solutions and selects the best solution for a defined and unquestioned purpose that can be fully translated into objectives.

There several other approaches that considers the 'social' and 'soft' side of the issue with a common understanding that there is a need for a humanistic and societal change in these conservative development perspectives which encounter the complex and ever-changing social and organisational issues (Klein, Hirschheim, 1987).

Soft systems and socio-technical systems are the main approaches that embrace this social perspective.

The soft systems approach is aroused by an understanding that follows Vickers's (1965) theory of 'appreciative systems', which distinctly describes each social entity and gives special importance to the definition of the purpose of systems by considering all the personal and social perspectives related to the world. The first and most popular technique, which aimed to structure 'soft' perspective for design, is evidently Checkland's (2006) Soft Systems Methodology. This prevalent approach later gave inspiration to many academics such as the SISTeM approach (Atkinson, 2000a) and PADM methodology (Wastell, White, Kawalek, 1994).

The socio-technical systems thinking originates from the design traditions of the Tavistock Institute, which favours not only investigation of the social system but also it's co-optimisation with the technical system. This co-optimisation principle requires finding compatible and closely merged social and technical objectives for a system that takes into account both the interdependencies of the social system and its interaction with the technical system. (Eason, 2010) Several techniques are introduced from this 'socio-technical systems' phenomenon such as Mumford's ETHICS (1983), Avison &Wood-Harper's Multiview (1991) which are placed between 'soft' and 'hard' approaches. They are much closer to 'soft' phenomenon with inclusion of 'hard' aspects. (Atkinson, 2000b)

These example frameworks are found to be bridging the gap between the ISD and user-centred design techniques by referring to ISD stages alongside defining where the users need to be involved in the design. (Pekkola, Kaarilahti, Pohjola, 2006) However such 'soft' / 'socio-technical' techniques are not generally accepted by systems designers and developers because they are found to be cumbersome and impractical. (Doherty, King, 2005) The main reason for this impracticality is the techniques' philosophical perspective and not having adequate instructions defining their processes. (Pekkola, Kaarilahti, Pohjola, 2006)

In this dissertation study, the hypothesis assumes that a combination of a pure 'soft' approach and a 'socio-technical' approach, which is between the 'soft' & 'hard' perspectives, can be fruitful to enhance the socio-technical design and reduce the practicality issue. Since the researcher selected to complement SSM and ETHICS Action Research methodologies they are described separately in the sections below.

The Soft Systems Methodology

The Definition

SSM is an Action Research tool for investigating organisational problems by going through classical action research steps; problem diagnosis (Mansell, 1991), action

intervention and reflective learning to interpret both persisting and changing social reality (Checkland, Holwell, 1998) and find a desirable and culturally feasible change for the situation. It doesn't attempt to deal with defined problems but instead focuses on 'messy' and 'ill-defined' problematic situations. (Checkland, 2006a)

SSM is not a method but a methodology, which provides a set of principles that can be adopted and adapted by the researcher. It regards the unique details of each context and every situation involving human beings (Checkland, 2006a), but leaves the usage to be specified and detailed by the practitioner and their mental model. It provides a structure for action research whilst preserving its process flexibility through its several approaches and purposes. It can have different approaches such as investigating the process of a study, SSM(p), or investigating a particular context, SSM(c). (Checkland, Winter, 2006b) Furthermore the purpose of using this methodology can be either evaluating an existing system or defining the purpose of a new one. (Checkland, 2006a)

As a Wittgensteinian approach (Gregory, 1993), it gives emphasise to the logical establishment of the purpose and actions of the information system via a detailed investigation of the social system's perceptions of the world and the problematic situation through interpreting the language of the social system and the meaning of their words. Therefore an SSM practitioner seeks interpretation and learning rather than optimisation or a solution to a problem.

The Process

The current structure of the methodology's 'Four Main Activities' (Checkland, Scholes, 1990) is described in the next four stages below.

1. Defining the Problematic Situation

In this initial stage, SSM uses 'Rich Pictures' which are informal, generally hand drawing pictures (Checkland, Scholes, 1990) to represent the practitioner's interpretation of the complexity of the human situation.

Rich pictures summarise the complex inquiry findings from interviews, reports, meetings and informal talks more efficiently than the traditional time-consuming documenting. There are no conventions in rich pictures; the figures and symbols are left to the researcher's imagination however small notes are necessary to avoid misinterpretations. (Flood, 1993) During the process of inquiry, these pictures start from smaller and simpler drawings to richer and more complex representations of the situation and can never be completed in an ultimate sense since the process of inquiry never finishes in a continuously changing social context. Therefore according to Checkland and Poulter (2006a), 'wise practitioners' continually reproduces rich pictures for a tool to brainstorm.

Apart from rich pictures, three levels of analysis are suggested for investigating the ill-defined situation in detail. These three levels includes 'Analysis One: Culture', 'Analysis Two: Context' and 'Analysis Three: Political Situation'.

Analysis One consists of contemplating about the situation itself. It should define the roles in the situation, such as a client who is the causes of the intervention to take place on an issue, a practitioner who performs the intervention on the issue, the issue owner who has the greatest interest in resolving issues. Furthermore it investigates these role's aspirations, perspectives and beliefs about the real world problematic situation, which are known as 'worldviews', and the issues between these worldviews, which are called 'conflicts'. Analysis One can be divided into two versions; *SSM(p)* and *SSM(c)*. (Checkland, Winter, 2006b) SSM(c) is the analysis that focuses on the content of the study which is the problematic situation, whereas SSM(p) focuses on the process of the investigation which is about how to perform the study.

Analysis Two consists of thinking about the social and cultural situation, which is dealing with finding not only a desirable but a culturally feasible change. This level of analysis takes the SSM approach a level beyond just investigating the worldviews of individuals

by also considering social organisations common history and worldviews. These social worldviews are identified with three important elements;

- *Roles* are the social positions of the members of a social group or organisation.
- *Norms* are the expected behaviours of particular roles in the defined society.
- *Values* are the standard criteria of a particular role that gets judged by the society.

Analysis Three consists of contemplating about the politics of the situation, which is highly entangled with, and effective on, the cultural analysis. This level of analysis tries to find out the sources and types of the power in the situation to improve the understanding of what is politically feasible to change. At this stage, the researcher might find it useful to look back to the cultural analysis to investigate the specific individual's roles and their influence in the organisation.

2. Making Purposeful Activity Models

In the second section, from the assumption that human beings with specific worldviews take purposeful actions to reach their individual or mutual goals in a social system. SSM offers two steps to investigate this purposeful action, definition of the purpose and conceptualisation of the action.

For definition of the purpose, the problematic situation is defined with possible worldviews of the stakeholders and their conflicts to form a purpose statement for improvement known as the 'Root Definition'. At this step, any transformation that could be fruitful to investigate for deriving the appropriate change to the problematic situation should be defined.

Checkland and Poulter(2006a) provide several guidelines to adequately define a root definition.

The initial principle is called; 'The PQR formula' which gives the structure for writing a root definition with the format of 'do P, by Q, in order to help achieve R.'

The second principle is called; 'CATWOE' which is useful to enrich the root definition by defining the elements that have to be in a purposeful activity as customers, actors, transformation, worldview, owners and environment, as defined in *Table 1*.

CATWOE	Definition
Customers	The stakeholders that affected by the transformation either in a bad or good way
Actors	The stakeholders that are performing the transformation
Transformation	The set of activities that is required to perform the purposeful act
Worldview	The main perspective of the actors while performing the transformation
Owners	The people who have right to alter or stop the process
Environment	The environmental situation while performing transformation.

Table 1. CATWOE elements

'Human Activity Models' are used in the conceptualisation of the purposeful action. For these models, the main transformation action of the root definition with the defined worldviews is decomposed into sub-activities, and then drawn in blocks with links highlighting meaningful sequence. Importantly these models provide only a starting point for discussion and not the perfect or the ideal case. After drawing these models, they should be reviewed considering the three criteria; efficacy, efficiency and effectiveness of the transformation.

3.Discussing the Activity Models:

In this third consultation / debate section, after defining several Human Activity Models these activities and the possibilities of related change should be discussed over models with all stakeholders. Although these models can be discussed within an informal debate, it can also be used to create an ideal scenario for performing walkthroughs to see the differences of new system. A 'chart matrix' approach is recommended for more structured discussions to help ask questions on each activity and writing down possible relevant changes for the activity. *Table 2* shows the set of example default questions given by Checkland and Poulter (2006a).

Does the activity exist in the current situation?	Related Questions for the activity
Yes	Who does it? When has it been done? How has it been done? Who else could do it? How else could it be done? Is there any dependency between activities? Does this dependency exist in the current situation?
No	Should it be added? How should it be added? Who should perform it? Will it have a dependency to activities? Does this dependency exist in the current situation?

Table 2. Default Discussion Questions

Discussion of these activities can trigger investigations of new activities, unconsidered worldviews or conflicts that needs detailed conceptualisation. This can result in an iterative creation of a network of conceptual models.

4.Taking action to perform improvement

In the final negotiation stage of SSM, all stakeholders' interests are considered and investigated to find a consensus or a compromise. (Rose, 2002) The process ends with defining the improved situation of new recommended changes and plan of action, which includes the details for managing the necessary changes.

The ETHICS Framework

The Definition

ETHICS is one of the most well-known and popular socio-technical and participatory design approaches. It stands for the Effective Technical and Human Implementation of Computer-based Systems. (Mumford, 1983)

It is an action research tool for solving organisational and technical problems by evaluating the existing system and designing an effective system.

ETHICS as a requirements specification tool tackles the definitions of human, technical and business needs and objectives of the social and technical systems to improve the job satisfaction and technical efficiency. (Mumford, 1995)

As a socio-technical approach, it aims to give equal importance to the organizational and the technical objectives of a system. The methodology emerged from the need to provide both compatibly and optimally merged, in other words; 'co-optimized' technical and organizational systems. Although it does not claim to solve all of the technical and social problems, it guarantees major improvements. (Mumford, 1983)

ETHICS encourages emancipatory design, which aspires organizational democracy and rejects authoritarian approaches to define socio-technical systems through user and client participation (Klein, Hirschheim, 1994). The design includes cooperative work of two teams; the Design Team and the Steering Committee. The design team includes users, clients and designers who participate throughout the process by open discussions. If the organization is complex, several design teams including different user groups can be preferred. A Steering Committee consisting of managers of departments and team leaders of user groups monitors and filters the design decisions of the design teams at each process stage. ETHICS embraces Vicker's (1973) perspective for obtaining successful participation and aims to achieve social learning. The participation of the clients and users are supported with the facilitation of designers whose role is to overcome the participation problems, guide design teams and assist progression through a collaborative learning process.

The process

This socio-technical Action Research tool includes six main analytical stages (Murphy, Stapleton, 2005) and several related steps.

Stage 1: Definition of needs

This stage is the one of the most detailed stages of ETHICS and includes nine steps. (Mumford, 1983)

Step One is about questioning the need for a change in the existing system. This stage consists of a discussion stage where the current main problems and possible technical or organizational improvements are looked over.

Step Two defines the system boundaries according to the design team's responsibilities. Decisions need to be made on what the design includes, e.g. work activities, technology activities, technical product and organizational boundaries such as companies, departments, units, agents etc.

Step Three investigates the existing system before interfering with it. This stage includes a two level analysis; a horizontal input-output analysis and Stafford Beer's (1984) Viable Systems Model. Horizontal input-output analysis requires a definition of input, output and the main responsibility definitions for each possible system department. This is similar to the process of defining a socio-technical input-output block diagram. The vertical analysis has five steps defined in *Table 3*:

Activity Type	Description
The operating activities	The day-to day tasks for each worker that provides the department to function.
The prevention/ solution activities	The activities performed to prevent work problems or solve the work problems
The coordinated activities	The coordinated activities within and between departments
The development activities	The activities that require development related with technologies, services, products
The control activities	The activities to control overall work to evaluate the efficiency and meeting the targets of department

Table 3. Viable Systems Model

Step Four explores the ideal system qualifications without considering if they currently exist in the system. The group defines the ideal business mission or key objectives of the system by considering the current business mission, which can be described as the primary functionalities and purposes of the current system.

Step 5 decomposes the key objectives into its key tasks. The design team defines the possible ideal sub-tasks while ignoring whether they existing in current socio-technical system.

Step 6 defines the key tasks relating to essential organizational and technical information needs.

Step 7 defines the overall job satisfaction by investigating the fit between the workers job expectations and the job definition set out by the authorities. In this stage ETHICS offers a job satisfaction framework, which is inspired by Parsons' (Parsons, Shils, 1951) analytical theory and explores this fit. The job satisfaction questionnaire created from this framework should be used anonymously. In situations where the questionnaire is not practical, the framework should be used. After the analysis of the questionnaires, the results are discussed in small groups to ensure anonymity of the job satisfaction information needs. The elements of the ETHICS job satisfaction framework are defined in *Table 4*. (Mumford, 1995)

Activity Type	Description
Knowledge FIT	The satisfaction of applying adequate usage of knowledge and skills during the job done.
Psychology FIT	The satisfaction of fulfilling personal interest's of the employee with the job done.
Efficiency FIT	The satisfaction coming from the fit between the effort that the employee paid and the reward that s/he gets.
Task FIT	The satisfaction coming from the fit between the job and the employee's expectancy from the job.
Ethical FIT	The satisfaction aroused from the fit between ethical values of worker and the company.

Table 4. ETHICS Job Satisfaction Model

Step 8 measures the efficiency needs of the system through 'Variance Analysis', which is a socio-technical term that requires a detailed analysis of problematic issues in the working system. Variances come in two types; key variances are the major problems in very important functions of the system whereas the secondary variances are the minor problems in operations of the system. (Mumford, 1995) After investigating the reasons of the variances, possible solutions should be discusses which entail the efficiency information needs.

Step 9 defines future information needs of the system by anticipating the future improvements in technology, prospective changes in organizational structure, economy of the system or client's views and needs.

Stage 2: Setting objectives

In this second stage, the needs definition process ends and the design process starts.

Step 10 starts with the design group listing to all previously defined information needs. The design group ranks each information design need from one to five with their user groups according to their benefits, limitations and necessity. The objectives are divided into lists according to their usefulness for all users or individual user groups. The conflicts between these grouped and prioritized objectives are established to provide reconciliations. With an overall discussion, the priority objectives are defined once accepted as essential by all user groups. The new design should aim to fulfill all these priority changes and most of the rest. The selected objectives should be discussed, and agreed with all design groups and the steering committee before moving to the next stage.

Stage 3: Identifying socio-technical solutions and making a design choice

Step 11, separates all of the technical objectives, which include hardware and software changes on the technical products, which are separated and evaluated over the efficiency objectives defined in *Step 8.*

Step 12, defines the possible organizational objectives in parallel, which include organizational hierarchy changes, merges, job redefinitions, work design changes. These are then defined and evaluated over the job satisfaction needs defined on *Step 7.*

A number of alternative socio-technical solutions are combined from merging these grouped and ranked technical and social objectives to form compatible socio-technical

solutions considering the priority objectives and conflicts. Then the design groups select the best solution from these alternatives for presenting to the Steering Committee.

Step 13 includes defining new socio-technical systems with detailed work designs, including organizational structure design, job design and workspace design where simple task analysis and flow-charting can be used. Furthermore, the new socio-technical system can be defined using Beer's (1984) Viable Model.

Stage 4: Implementation of solution

Step 14 relates with identifying the best implementation strategy considering possible implementation problems, duration of implementation, and the training needs of the staff in meetings with the Design Team and Steering Committee.

Stage 5: Follow-up evaluation

Step 15 uses variance analysis and job satisfaction analysis to evaluate the implemented system with the previously defined job satisfaction needs, key and secondary variances.

Stage 6: Reports for the company

Step 16 documents the design process and it's theoretical background to the company with reports and academic articles.

2.2 Related research on NHS

As this research study involves two NHS pathways, the literature on the use of SSM and ETHICS in the NHS context has been investigated. Although these techniques are found to be coherent and valuable to use together (Mansell, 1991; Avison, Lau, Myers, Nielsen,

1999; Singh, Wood, Wood-Harper, 2007), there is not any literature on a conducted study that applies SSM and ETHICS together and investigates whether this combination is advantageous or practical. Therefore separate studies of each technique on the NHS context are detailed below.

From the beginning of 90's, both SSM and ETHICS were frequently used in the NHS information systems projects. Several SSM studies are investigated not only by its founder Checkland but many other practitioners.

An SSM based participatory study has been performed for a clinical information system (CIS) project for an Acute hospital considering the problems between the purchaser and provider (Checkland, 1993). This participatory approach was extremely useful for defining and discussion rich pictures and conceptual models. (Checkland 2000) In another project, the existing resource management of a larger hospital was evaluated. (Checkland, 2006) SSM is also used in an organisational merger project called 'Merger's in the NHS' for considering issues caused by the merging process of different healthcare authorities, hospitals, community services etc. (Checkland, 2000) For the NHS National Initiative evaluation project an SSM(p) and SSM(c) approach was used. (Checkland, 2006)

Apart from Checkland's studies Gillies (2008) used SSM to consider the local factors operating in a local NHS Health Informatics Service. Wells (1995) used the methodology in a Community care project for an in-patient facility system to analyzing patient-nurse management and activity. Lehaney (1996) defined an out-patient simulation device's information needs with a participatory SSM perspective.

When the application of ETHICS was investigated in the NHS, the researcher found many examples of QUICKethics, which is a brief form of ETHICS for managers.

The QUICKethics approach is applied to a medium size Acute hospital's organisational restructuring and a socio-technical analysis of several service pathways, (Mumford, 1995) with a focus on just the variance analysis with the active participation of user representatives from all agents of pathway service. In another Resource Management

project for a nursing unit, within 2 separate design meetings in an ‘ETHICS Weekend’ a detailed QUICKethics approach was applied which included variance and job satisfaction analysis involving several nurses. (Mumford, 1995) In another study, Community Nursing team’s management information system needs are investigated using QUICKethics with a focus on business mission analysis and key information needs definitions. (Mumford, 1995)

CHAPTER 3. CONDUCTING THE STUDY

This chapter includes six stages to investigate the research question performing Qualitative Research and Action Research on the provided NHS pathways. In first two stages, the details of the methodology and a pilot study will be described. In following four stages, the analysis sections investigated the research question will be described with their process and findings.

According to Checkland (1985) a successfully defined action research mechanism should include three important aspects; the framework of ideas, the methodology and the area of interest.

In this study, the action research components are set out as;

- F: Soft-systems and Socio-technical systems thinking
- M: SSM and ETHICS
- A: The Stroke pathway, the Retinopathy pathway

Although the SSM and ETHICS integration is the main investigation concept of this study, Soft-systems and Socio-technical systems principles were frequently used for guidance throughout the study.

The researcher found it very useful to use an A3 sketchpad for supporting reflection on the action of analysis throughout this chapter. During all SSM (c) and SSM (p) applications in this study, the analysis is communicated through freehand sketches of the Rich pictures, Human Activity Models and Role Activity Diagrams, as these hand drawing pictures are advised to be much useful and less restrictive than computer-generated ones (Fillery, Rusli, James, 1996) These sketches are iteratively improved in three versions through incremental interview analysis, the feedback provided with pilot study and EPICog meetings and continuous information provided by EPICog Research Director through phone meetings and emails.

Throughout all sections of this study, the information about pathways and their design processes are provided from personal resources of Ken Eason, which couldn't be referenced in this thesis, as these resources are in draft version.

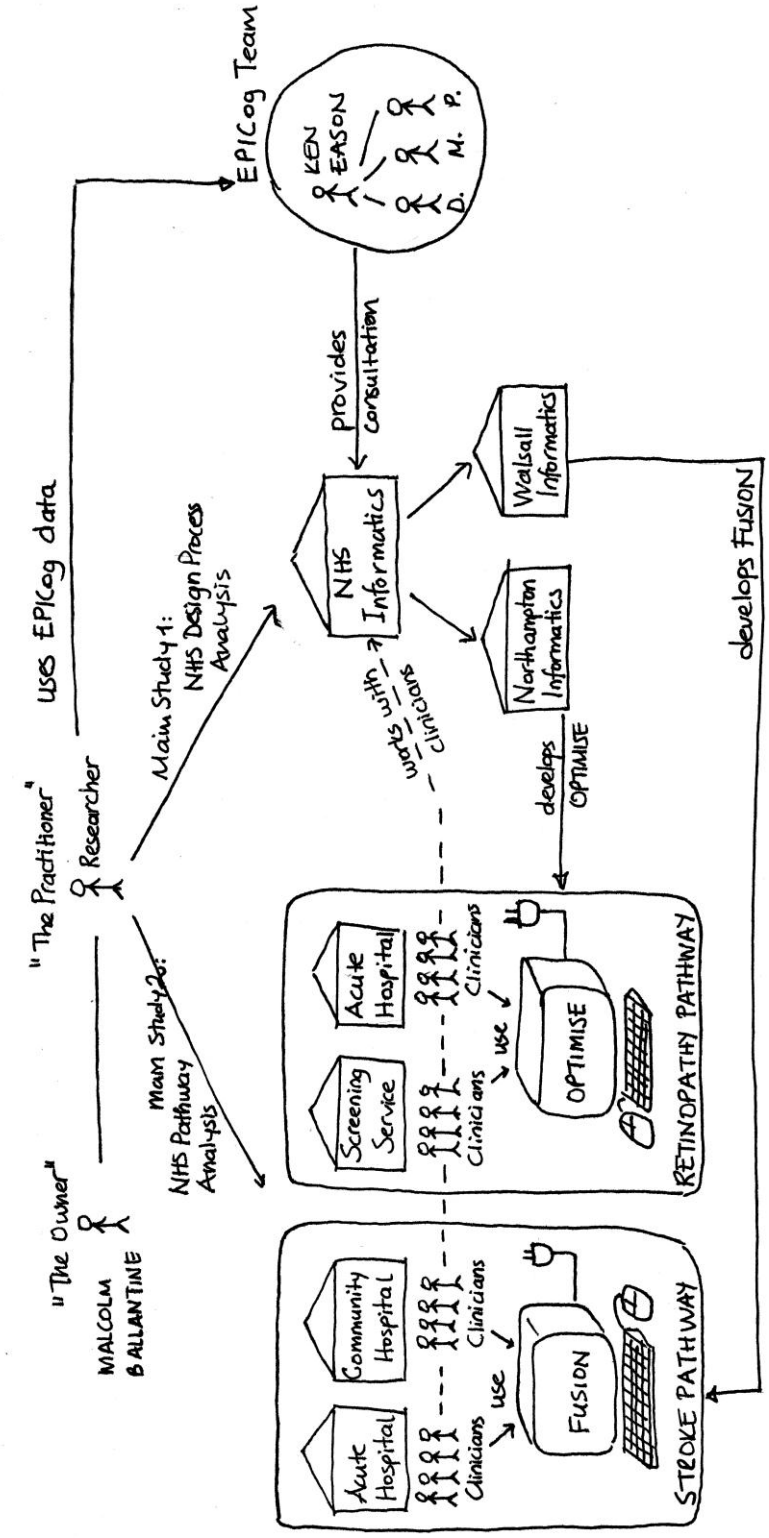

Figure1: SSM(p) General Rich Picture

3.1 Investigation of Methodology

This section describes the detailed Soft Systems Methodology (SSMp) analysis performed on the process of the research study. (Checkland, Winter, 2006b) This stage especially helped users to investigate the research question, methodology, metrics/objectives of the study and its limitations.

Rich Picture

Initially a rich picture was drawn to investigate the research study in *Figure 1*. As the rich picture describes there are two contexts in this study:

- The Diabetic Retinopathy Screening pathway, designed by the Northampton Informatics Retinopathy team
- The Stroke pathway, designed by Walsall Informatics Stroke team

The 'practitioner', who is the researcher, is working for the 'owner' of this study who is the researcher's supervisor Malcolm Ballantine. The 'client' of the study is defined as the EPICog team which is directed by Ken Eason who is directly consulting both the Norhtampton and Walsall Informatics departments on Stroke and Diabetic Retinopathy Screening pathways.

This rich picture revealed that the specific research question for the NHS pathway studies is "to explore whether applying an integrated methodology of SSM and ETHICS could enhance socio-technical design of the NHS Stroke and Diabetic Retinopathy pathways and could be feasible in Northampton and Walsall NHS design teams".

As the rich picture shows, two main studies are identified to explore this question.

The First Main study focuses on whether there is a need for applying the integrated methodology in NHS design strategies and to find out how these techniques could be applied in the current design structures of both teams.

The Second Main study is examining whether the integrated methodology is compatible by applying it to the Stroke and Diabetic Retinopathy Screening pathways contexts to discover if it can be advantageous to the pathways' socio-technical design.

Root Definition and Purposeful Activity Model for Methodology

The CATWOE elements of the research study are identified as in *Table 5* and the root definition for the methodology of the study is written using the 'PQR formula' as showed in *Table 6*.

CATWOE	Definition
Customers	EPICog Team; Ken Eason and three other team members
Actors	Researcher EPICog Team members
Transformation	• The messy and complicated organisational design for two pathways → Neat socio-technical solutions for both pathways • Unbalanced and unorganised design strategies → More democratic, organised and socio-technical design strategies.
Worldview	An integrated methodology of SSM and ETHICS can be useful for enhancing NHS strategies and therefore should be used by Stroke and Retinopathy Pathways.
Owners	UCL HCI-E Project Supervisor Malcolm Ballantine
Environment	Restricted amount of time and data

Table 5: CATWOE definition for the research study

PQR	Root Definition
P: A system for	A system for researcher to answer her HCI-E dissertation thesis research question
Q: To show	To show whether the integrated methodology could enhance socio-technical designs of the NHS Stroke and Diabetic Retinopathy Pathways
R: By investigating	By investigating • The need for applying this integrated methodology, • The compatibility of the integrated methodology, • The advantage of applying this integrated methodology, • The feasibility of applying this integrated methodology
PQR Root definition:	A system for researcher to answer her HCI-E dissertation thesis research question; to show whether the integrated methodology could enhance socio-technical designs of the NHS Stroke and Diabetic Retinopathy Pathway services, by investigating the need for, the compatibility of, the advantage and feasibility of applying this integrated methodology.

Table 6: The Root Definition for the study

Figure 2 show the Human Activity Model, which is drawn to investigate the ideal approach to define the system required in the root definition.

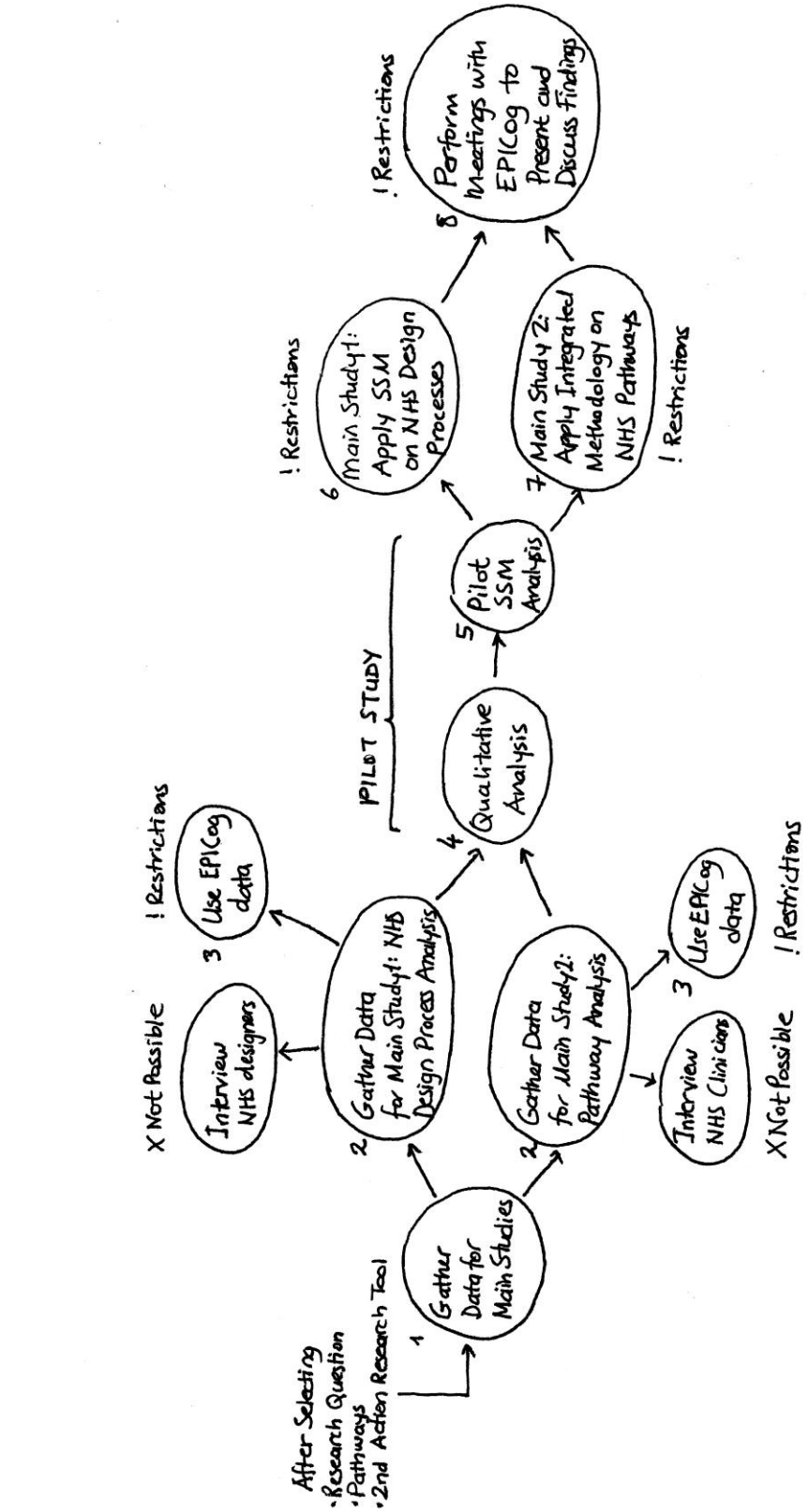

Figure 2. Conceptual Model of Root Definition

This conceptual model helped the researcher to structure the research methodology, its objectives, the integration of SSM and ETHICS, and the limitations of the study, which will be described in the following sections.

Methodology of the Study and its Objectives

The conceptual model revealed that the methodology should include four stages to answer the research question.

- A Pilot Study to initiate the research with the assistance of Ken Eason by performing the Qualitative Analysis and an initial SSM application.
- Main Study One: Design Process Analysis to investigate the needs and the ways to apply the integrated methodology in selected NHS design teams by applying SSM.
- Main Study Two: Pathway Analysis to apply the integrated methodology and experience its compatibility as well as the possible advantages in socio-technical design in practice.
- Meeting with the Socio-technical team to present the study, discussing and critiquing the needs of the findings by the EPICog team, and lastly conducting interviews to get feedback on the validity and the feasibility of the findings.

The integrated Methodology SSM and ETHICS

For the complementation of the SSM and ETHICS the researcher was inspired by the general structure of the ORDIT Methodology which is a socio-technical, user-centred and iterative requirements gathering methodology and stands for Organisational Requirements Definition of Information Technology Systems. (Eason, Harker, Olphert, 1996) This methodology consists of four iterative interrelated cycles, which basically consists of following sequence.

- Scoping Stage: the scope and scale of the future socio-technical system, its importance to stakeholders and defining the main reasons for change are defined.
- Requirements Gathering Stage: the system requirements are gathered.
- Modelling Stage: the ideal system is modelled to joint optimise the social and technical requirements of the system.
- Option Generation and Evaluation Stage: a discussion with stakeholders to arrive at a compromise through the priorities of the requirements is performed.

These four stages are used as a main template to combine the SSM and ETHICS methodologies. None of the sections in SSM and ETHICS are skipped and their sequence in the original technique is also unchanged. However to achieve good integration the methodologies are interleaved. The integrated methodology has nine steps as represented in *Figure 3*. Apart from the basic SSM and ETHICS stages the Role Activity Diagrams from socio-technical design (Wastell, White, Kawalek, 1994; Patel, 2000) and Checkland's (2006a) Human Activity Models are used in the methodology in order to model the existing system activities. The process of the methodology is detailed later in the Pathway Design section.

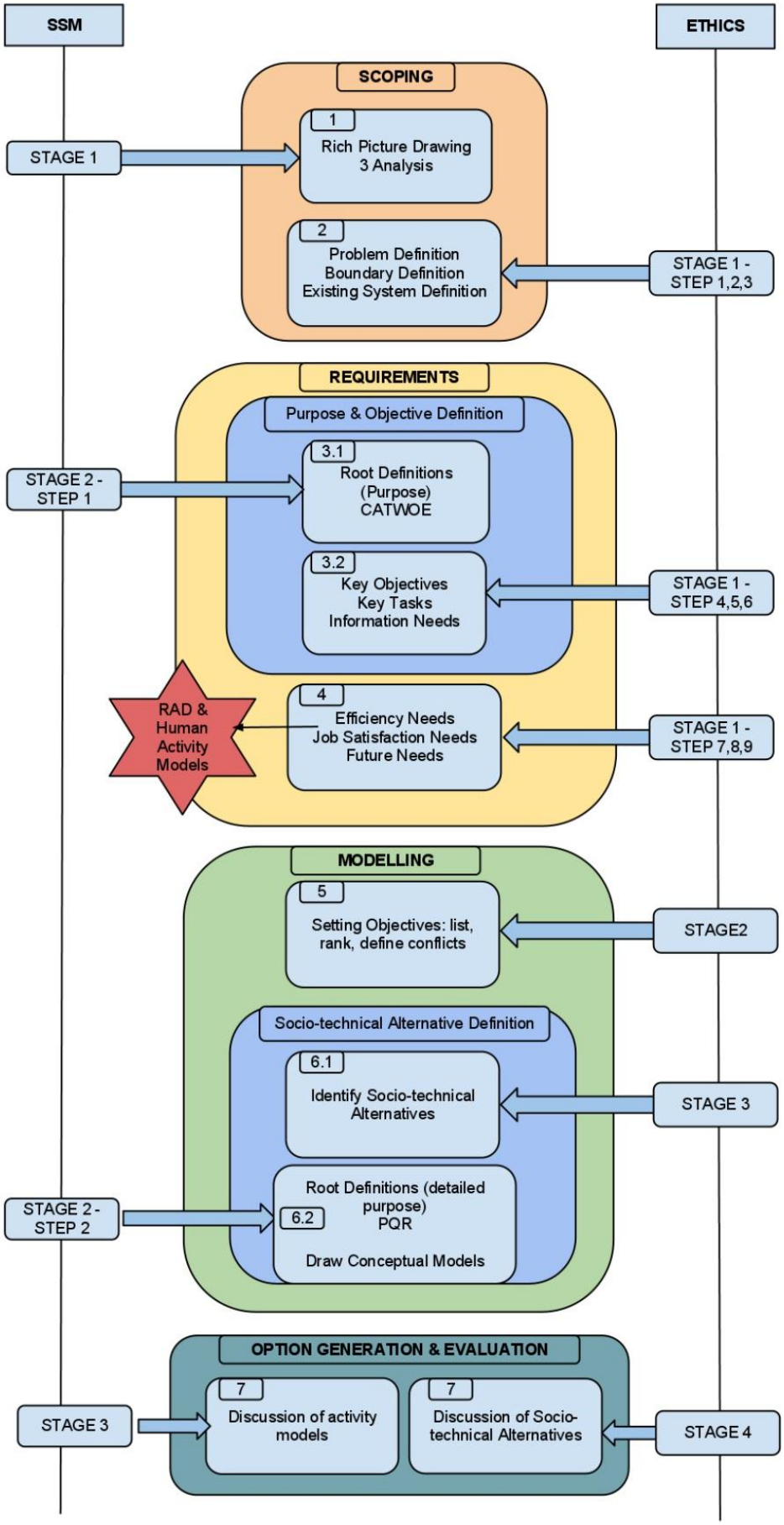

Figure 3. The integration of SSM & ETHICS techniques into one Methodology

Limitations of the study:

The conceptual model was useful to investigate this study's limitations. It has shown that some stages in the study will be suboptimal.

There are three key limitations.

Initial the researcher couldn't perform the data gathering, because she was unable to get ethical approval to interview the NHS clinicians and NHS designers in Northampton and Walsall. Therefore the data is gathered from EPICog's interviews with NHS clinicians and designers.

Secondly the EPICog interviews were constrained in context and were subsequently inadequate for applying some SSM and ETHICS stages since the data provided by EPICog wasn't meant to be gathered for a detailed analysis. EPICog didn't intend to make recommendations using a structured technique but aimed to identify the NHS problems with a general socio-technical and action research understanding. In some stages, the inadequacy of the data highly limited the research. e,g. Critiquing the organisational culture and hierarchy.

Third reason is that the findings of the study couldn't be presented to the NHS Informatics designers and their opinions couldn't be gathered. The final discussion stage of the integrated methodology in Pathway Analysis and the SSM application in the Design Process Analysis section also couldn't be performed, due to the lack of ethical approval, which prevented communication with the NHS designers. For this reason, at the end of Pathway Analysis, a specific socio-technical alternative couldn't be selected, but some social and technical objective lists and example socio-technical alternatives are introduced. For the Design Process the recommendations for the design teams are produced without the discussion stage.

The meetings with the EPICog team were arranged to compensate this limitation, however these meetings were restricted in number and duration, as the EPICog team were busy with writing their final draft of their project at the time of this study. Therefore the EPICog team's approval on the data was received towards the end of the

study with separate meetings for each EPICog team member, rather than within an iterative, routine and unified basis of feedback.

Lastly, the evaluation of the findings of the study were not able to be compared with the socio-technical teams results as their current project is not aiming to give specific recommendations. Therefore for evaluation, the discussions were performed by looking at study findings with each member.

3.2 Pilot Study

After investigating the research question and its methodology, a pilot study has been performed to initiate the study.

This study consisted of two steps,

- A Qualitative Analysis is performed on the EPICog's interviews with clinical team-members of the pathways.
- The 1st stage of SSM is performed, which is drawing the Rich Pictures.

For Qualitative Analysis, semi-structured interviews provided from EPICog that is based on the pathway context, its design history and significant design processes are used. These interviews included three interviews for Stroke and seven interviews for Retinopathy pathway with each agent's clinicians, user representatives and informatics facilitators and programme managers.

The coding performed in two stages with using Grounded Theory (Charmaz, 2006) by performing an initial open coding, and then a focussed axial coding with the enhanced coding schema.

The initial open coding performed by reading interviews couple of times and during these readings briefly performing colour-coding according to 'the pathway', 'the design process', 'the culture& politics' related themes. During this process, the basic color-

coding schema is detailed into two schemas: Pathway Analysis and Design Process Analysis schema for two main studies.

As the Pathway Analysis will use the integrated methodology, the pathway schema is included basic principles of SSM (Checkland, 2006a), ETHICS (Mumford, 1983) and Socio-technical Systems (Cherns, 1976), and emotional needs of users as given in *Table 7*. The soft issues are covered with stakeholders and their worldviews in the schema whereas socio-technical issues investigated with principles such as interdependencies, processes, transformations, information exchange, boundaries, communication, turbulence and workarounds. For specific analysis stages of ETHICS, future and efficiency needs are added. As ETHICS framework job-satisfaction questionnaire couldn't be applied due to access problems to NHS clinicians, job satisfaction is evaluated through investigation of emotions as, positive and negative emotions are major significance of overall job satisfaction. (Fisher, 2000) Therefore emotional words, positive or negative expressions, words conveying stress, expectation etc. added into coding schema and the job satisfaction is attempted to be predicted by the frequency of positive emotions and intensity of the emotional expressions used by interviewees.

Place of the process		
Related Trust		
Stakeholders	Major Staff Members Other stakeholders	Worldviews of Staff Members Information Systems used by staff Routine Activities
Problems detected	Social/Technical Environment	Social/ Technical Problems: Boundaries, Interdependencies Process (Sequential, Reciprocal), Communication, Transformations Information exchange, Inefficiency Job satisfaction (Future expectations, Role problems, Job enrichment, impoverishment, Negative/Positive emotions, Stress Environmental Problems: -Turbulence -Workaround
Planned Future Changes	Organizational Technical	

Table 7. Coding Schema for Pathway Analysis

As Design Processes Analysis will investigate the NHS design strategies applying SSM, design process schema is created with the use of: SSM, User Analysis, Requirements Gathering and Participatory Design concepts as shown in *Table 8*. For covering SSM issues, especially the culture and politics issues are investigated. For participatory issues, the user seniority, representative team size, participation structure etc. are included into the schema to investigate the practical dimensions of involvement. (Muller, Wildman, White, 1993) For user and requirements analysis, the analysis techniques and procedures are included to the coding schema.

Organizational Politics & Culture	IT Team Hierarchy IT culture IT politics
User involvement	User involvement stages Participation structure Representative team size Facilitator numbers The user involvement frequency The power on the decisions
User Analysis techniques	The kind of technique(s) used to gather user data The kind of technique(s) used to analyze user data
Requirements analysis methods	Requirements specification procedures Requirements prioritization procedures Decision making procedures

Table 8. Coding Schema for Design Process Analysis

After Qualitative Analysis is performed with the prepared schemas, the coded data is used to draw initial Pathway, Cultural and Political Rich Pictures of two pathways.

To present the pilot study, the researcher went to Loughborough University to get feedback from EPICog Research Director Ken Eason on the coded data and sketched Rich Pictures. This meeting provided an approval and initiation of the further SSM application of the research study as well as strengthening the researchers contextual background on the pathways and their design processes.

3.3 Study One: NHS Design Process Analysis

The first main study focussed on the questions of whether there is a need for applying an integrated methodology and what is the appropriate way to include the integrated methodology into the current NHS design strategies.

The current NHS design strategies applied for the two NHS Pathways are analysed using SSM. This analysis explored the problematic situations on the two hierarchical levels of the NHS design process; LHC and Informatics level. After investigating the needs of current NHS design strategies, the researcher attempted to generate a new design strategy including the integrated methodology. This section will be introduced by going through the stages of SSM analysis.

Rich Pictures

Each pathway's design process was investigated by drawing three Rich Pictures and performing 'Three Analysis'. The design process Rich Picture for each pathway (given in *Figure 4 and 5)* with 'Analysis One' identified the main design processes. The cultural Rich Picture (given in *Figure 6*) with 'Analysis Two' touched on the common organisational hierarchy and culture of Informatics teams considering Handy's (1985) four categories of organisational culture definition; power, role, task and person cultures. The political Rich Picture (given in *Figure 7*) with 'Analysis Three' considered general power and influence issues in the NHS design team's organisational structure according to French & Raven's (1959) five sources of power definition; reward, coercive, legitimate, referent, expert and connection power.

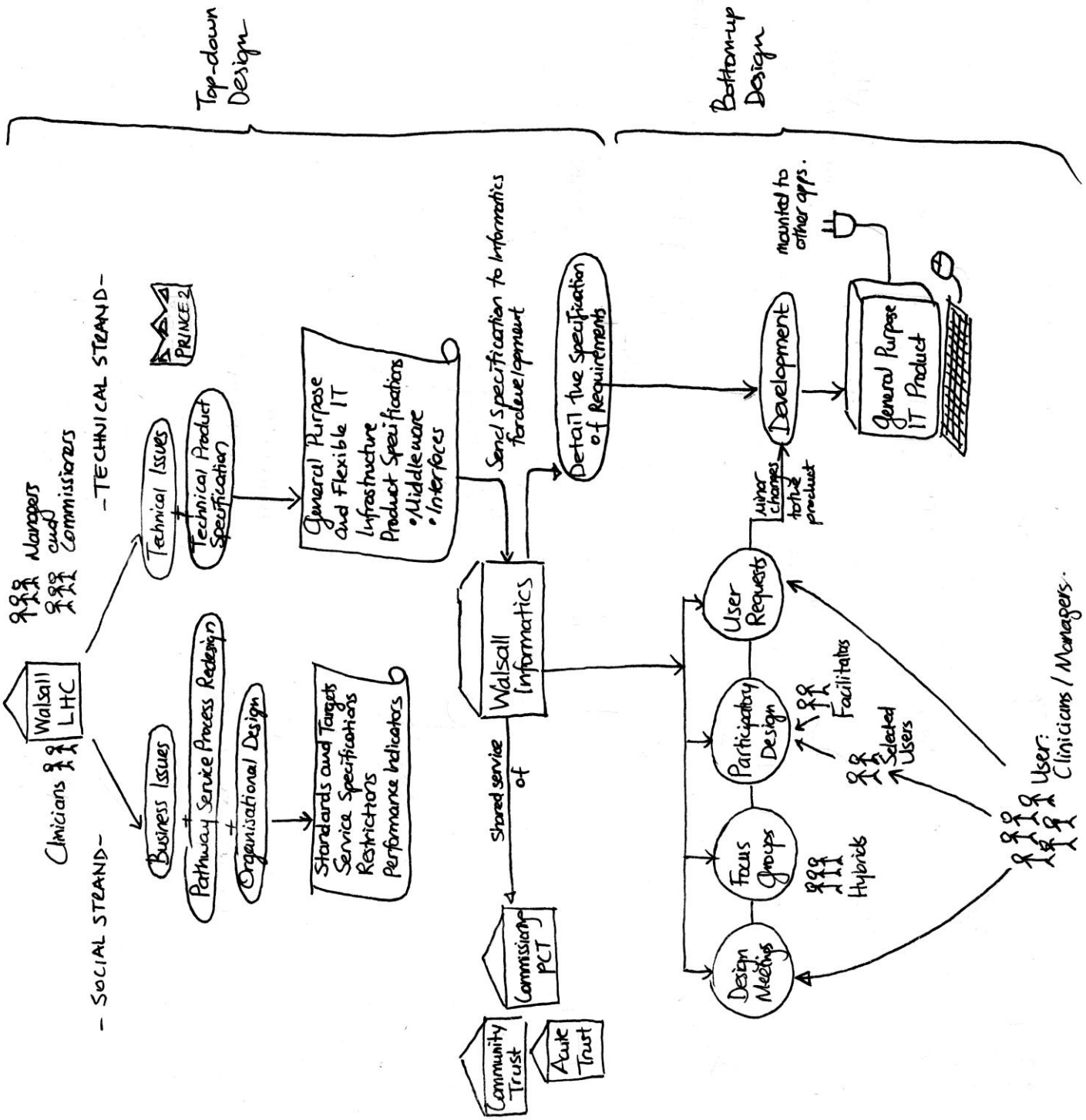

Figure 4. Design Process Rich Picture for Stroke Pathway

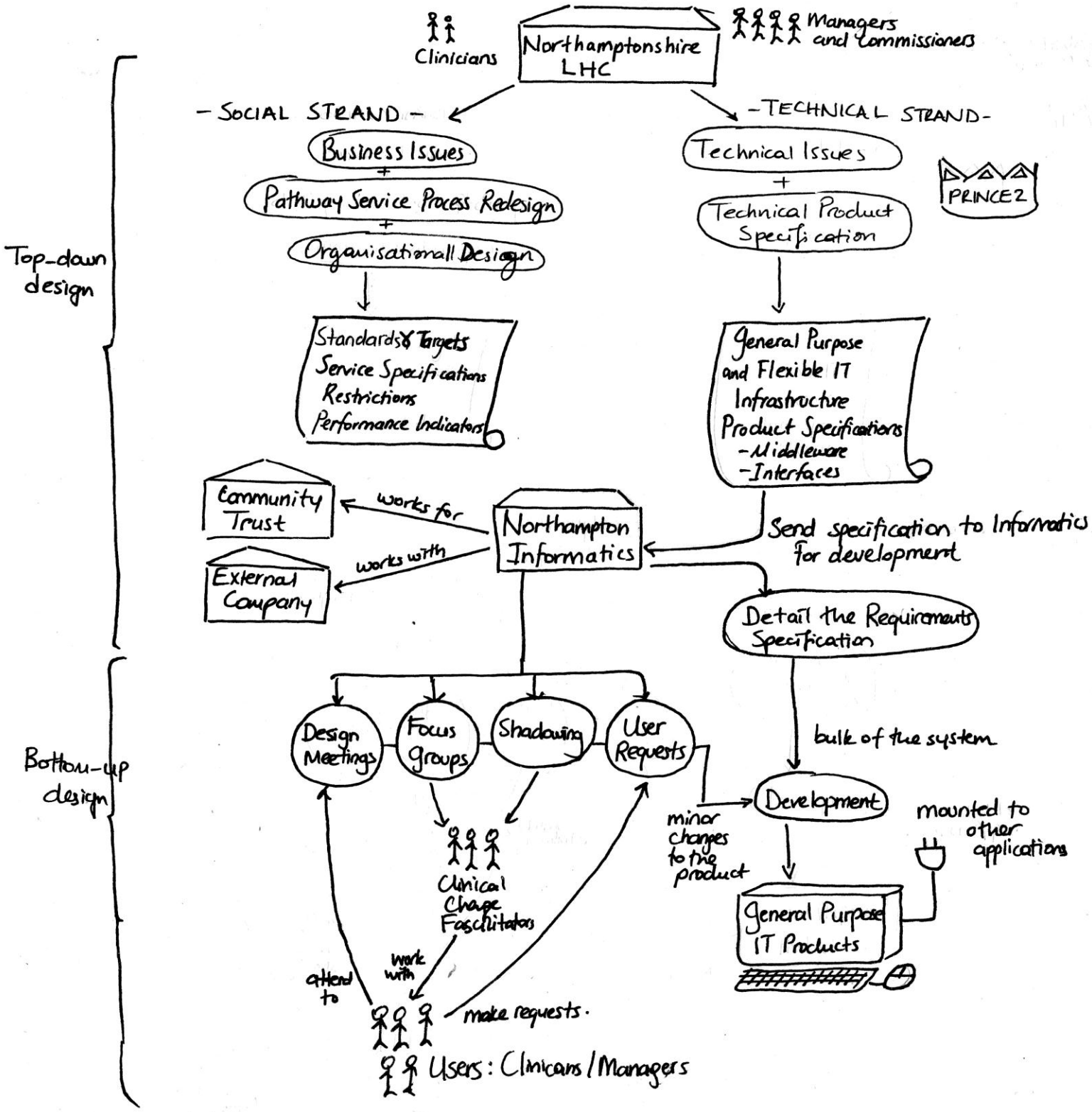

Figure 5. Design Process Rich Picture for Retinopathy Pathway

Analysis One: Top-down design and bottom-up design

For both pathways, there are two levels of the design teams; Local Health Communities (LHC) & Informatics teams.

Local Health Communities are part of the Department of Health, which has sixteen-groups covering the UK. Each LHC group has a multicultural structure that consists of county-based NHS Trust, Provider & Commissioner and Informatics representatives. LHC is responsible for maintaining the national and service level needs for each pathway and defining the specifications of technical tools that will be developed by Informatics.

NHS Walsall and Northampton Informatics departments are shared services within two Local Health Communities (LHC); the Walsall LHC and Northamptonshire LHC.

Walsall Informatics is a large and structured organisation, which provides service for many pathways of Acute, Community and the PCT Commissioners Trusts in the West Midlands. They are evolutionarily developing an 'e-care pathway' (IT supported care pathway) system called FUSION, which is a portal to improving and connecting several different e-health systems used in the Stroke Pathway. Northampton Informatics is a smaller service for only the Community Trust side of the pathway in the Northants. Northampton is developing an e-care pathway system called Optimise, which is a single database system, for Retinopathy Pathway agents.

Both Informatics teams include a management team, business change unit and an IT unit. The business change unit includes 'hybrids', which are also called business change facilitators or participation facilitators and are responsible for the end-user involvement. They generally come from a clinical background but have also built up IT knowledge through several years of experience working in IT departments.

Two design processes are performed for these NHS pathways; top-down design by the LHCs, and Informatics departments & bottom-up design performed by only Informatics departments.

‘Top-down’ design is a stage where the bulk of the organisational and technical system is defined in the LHC meetings involving Commissioners, Clinicians and Managers. This design process has two strands. In the first strand, organizational design and pathway service design are performed which provided the National Standards and Targets of the service. In the second strand the technical product specification is defined using PRINCE2 methodology (OGC, 2005), which is a process-based project management method for technical product development, and popularly used by the UK Government projects. (Siegelaub, 2006) The technical product specification is sent to the Northampton and Walsall Informatics teams to define the detailed specifications and development.

‘Bottom-up’ design is the stage where the already existing technical system is evolutionarily improved with user involvement. This process has four separate strands; Participative Approach, User Requesting, Design Meetings and Focus Groups. All these strands are performed by Walsall as well as Northampton with a quite different perspective on the participatory approach strand.

Both Walsall and Northampton Informatics teams adopt a popular concept in healthcare development; the Scandinavian Originated Participatory Model, which requires the active participation and ownership of the end-users. (Schuler, Namioka, 1993) Participatory Models traditionally have user involvement in the analysis and design processes and reduces the unquestioned power and authority of designer.

Walsall Stroke Informatics team unconsciously applies an unstructured Participatory Design (Schuler, Namioka, 1993), which aims to have the selected clinicians (‘user representatives’) participation in the analysis and design of the system, with the help of the facilitators who are responsible of directing the process and helping the user representatives.

On the other hand, the Northampton Retinopathy Informatics team unconsciously applies an approach they call ‘shadowing’ which is a closer to Beyer & Holtzblatzz’s Contextual Inquiry (1998). In the shadowing sessions, the hybrids conduct one-to-one field interviews and observation while the clinicians are performing their work in their work

environment. Without a structure or an evaluation tool, the hybrids evaluate the 'as is' state of the work processes and define a ‘to be’ state which includes the new requirements.

Secondly, there is a user request mechanism in both Informatics teams, which provides the acquisition of clinician requests through a proforma-filling procedure.

Thirdly, Informatics teams conduct design meetings with different clinicians in each meeting to gather different opinions and necessities.

Lastly, Informatics teams perform Focus Groups (Morgan, 1997), which in theory helps the design team to observe a large amount of participants in a short time. However Focus Group meetings with Informatics teams use the hybrids as the participants rather than clinicians. In these meetings hybrids give self-decisions about the design of the system based on their clinical background by imagining they are the users of the system.

The requirements gathered in those five strands are evaluated then filtered gradually and iteratively by separate teams including Management, Senior Informatics, Business Change Unit and Development. After this the Development team implements the selected requests.

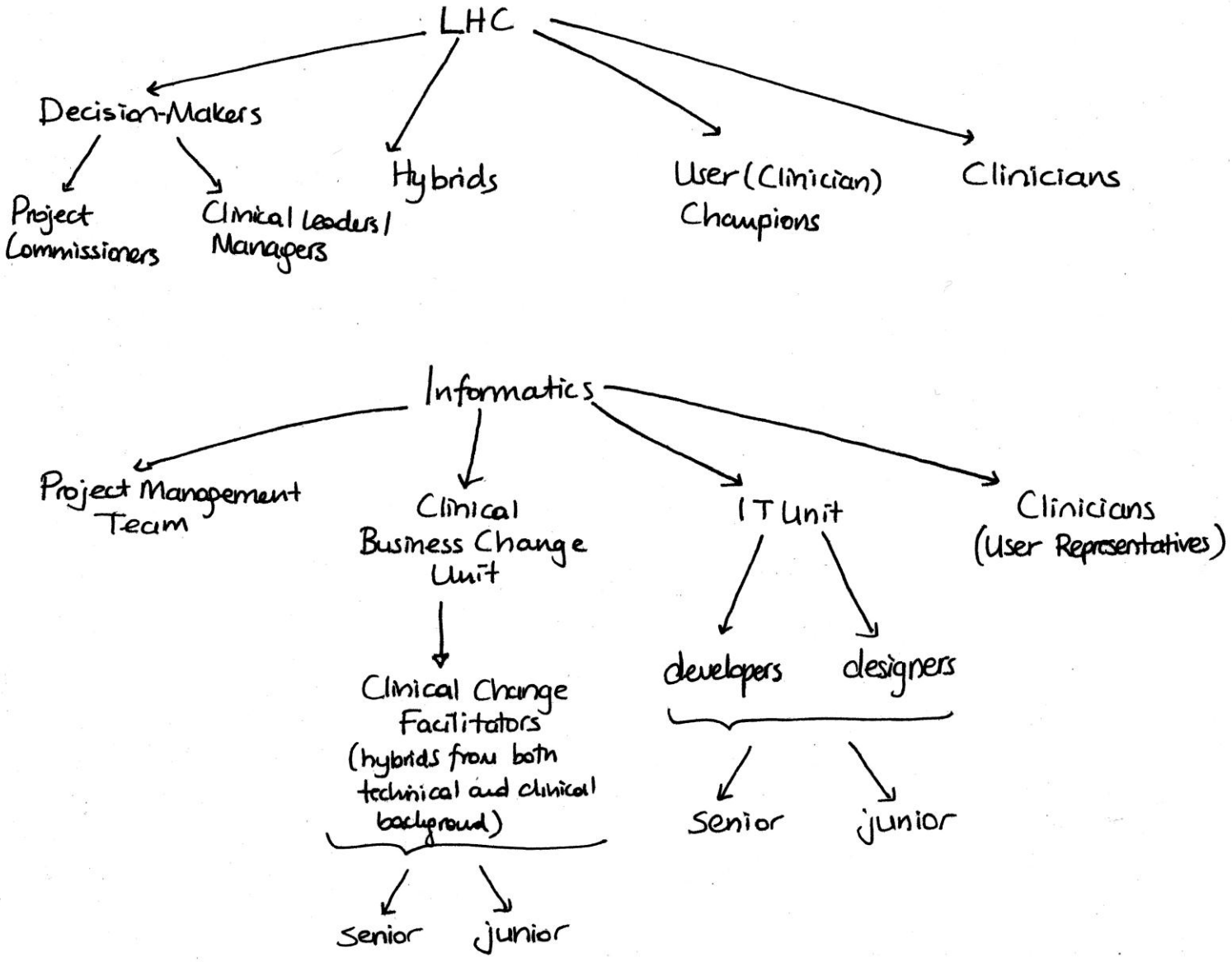

Figure 6. Cultural Analysis Rich Picture for NHS Pathway Design teams

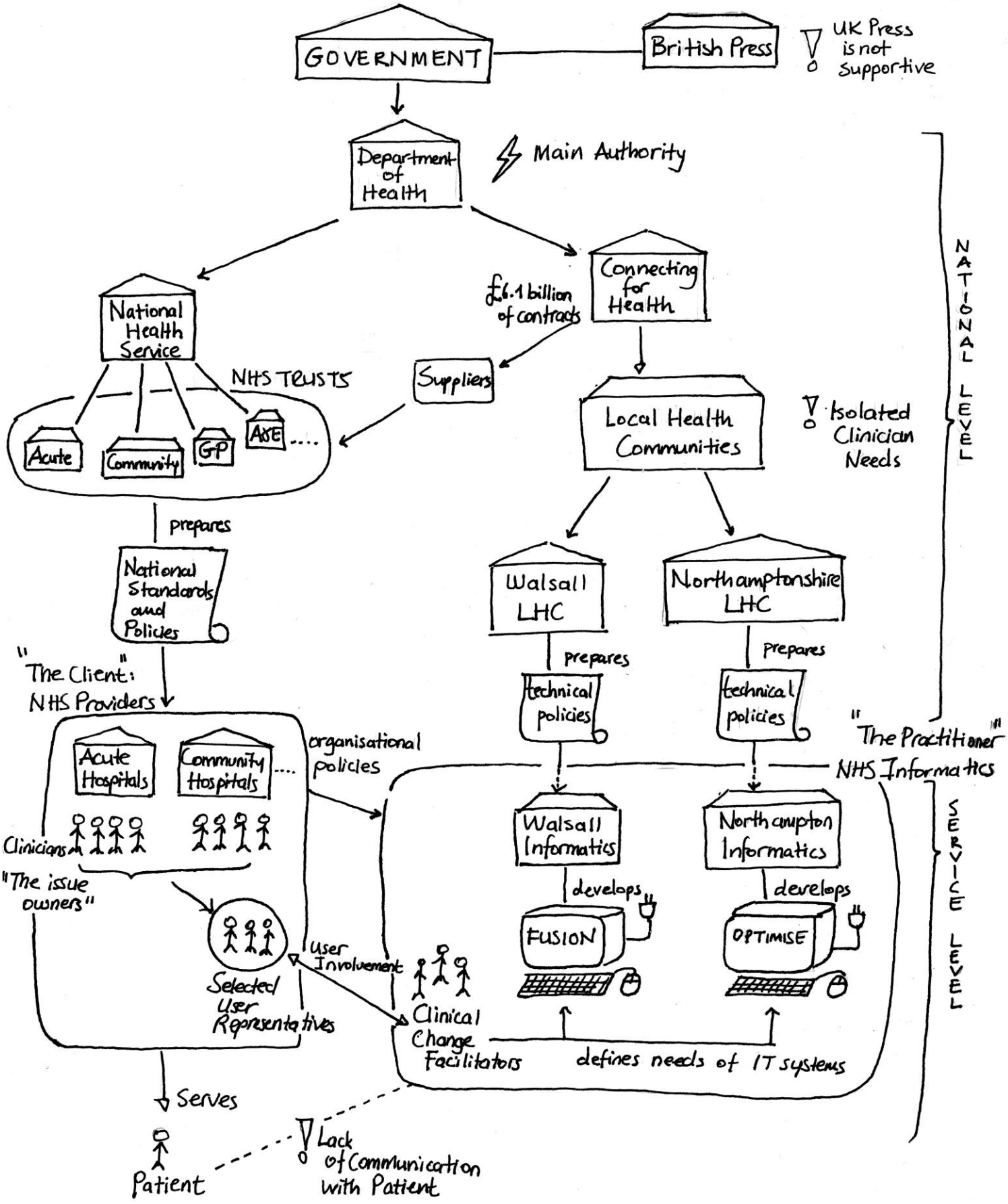

Figure 7. Political Analysis Rich Picture for NHS Pathway Design

Analysis Two - Three: Main Political and Cultural Analysis Details:

There are two levels in general cultural organisation, the 'National level' organisations, which includes the Government, Department of Health and its constituent LHCs and the NHS with its trusts. In the 'Service level' organisations, there are NHS dependents, which are NHS Providers and Informatics departments. These layers are shown in the Political Rich Picture in *Figure 7*.

In the big picture, there is an enormous legitimate power coming from the Government and the Department of Health that restricts the LHC in terms of resource and budget cuts. The Department of Health and its constituent's relationships are tremendously bureaucratic and these organisations contain role cultures.

The LHC role culture involves a multi-cultural team where Commissioners and Managers rule over the top-down design decisions due to their power. The power of influences in the PRINCE2 meetings, from highest to lowest, can be listed as Commissioners and Managers, Hybrids, User Champions and Clinicians. With the Department of Health's legitimate power, the LHC is forced to create technical policies to be applied by Informatics departments.

The Informatics Service is also a role culture with rapid role changes in the organisation caused by the turbulent environment. The Informatics is exposed to legitimate power from LHC and NHS Trusts that restricts the bottom-up and top-down design with specific technical and organisational service policies. Furthermore, LHC restricts the local autonomy of Informatics by dictating the top-down design decisions and restricting the bottom-up design changes with minor and local clinical changes, which are called 'tweaks'. The bottom-up user needs gathered by hybrids are controlled and filtered by the Informatics Project Management, Senior Informatics, and Development teams. Although some senior hybrids have an expert power on the request of the changes, generally their seniority is inadequate to actually be significantly influential on the design decisions.

Apart from NHS organisation, the socio-technical consultancy team, EPICog is a small organisational group that is based on person culture. Ken Eason who is the head of the team has an expert power over the Informatics department as well as the EPICog team. The Informatics team's resistance and selectivity of socio-technical consultancy seems to be reduced in this final year of the project.

The Problematic Issues Discovered from the Rich Pictures

Six main problems were discovered relating to the top-down and bottom-up design strategies and organisational issues.

Firstly, although the Walsall and Northampton Informatics teams have embraced a Participatory perspective that originates from the idea of making democratic design decisions (Schuler, Namioka, 1993), the NHS design structure has democracy issues listed as below;

At LHC level:

- LHC managers and commissioners have absolute power in design decisions.
- LHCs restrict the Informatics because the top-down requirements are directly coming from the LHC in a detailed way.

At Informatics level:

- The bottom-up changes are filtered by the LHC and the major changes are generally rejected at this stage.
- The seniority of the user representatives and facilitators are very low compared to informatics people, managers or developers, especially in Northampton.
- Informatics Business Change Units are facing reductions in the numbers of hybrids, which reduces the facilitators' power in the Informatics departments.
- Although there is a high level of user involvement in bottom-up design, all of the design decisions are filtered by Informatics and LHC, which causes many important recommendations to be rejected.

- The clinicians are involved only in bottom-up design, which is after the top-down design defines a large amount of the system in an authoritarian way.

Secondly, both the LHC and Informatics are lacking a structured socio-technical design methodology as separately listed below;

At LHC level,

- The organisational and technical design strands separate the socio-technical process; consequently the socio-technical design is performed without applying a rigid approach.
- The socio-technical design in LHC meetings depend on the chance of the good communication between the organisational and technical parties in the meetings.

At the Informatics level,

- Only technical design is performed.

Thirdly, the LHC is not applying a soft-approach. In the initial Start Up stage, PRINCE2 Methodology advises to investigate the basic business mission that triggers the project. It also requires defining and analysing the possible product in the Planning Stages 2nd step (OGC, 2005). Despite this, the LHC is not using any soft approaches or any specific tool for defining the possible service purpose, technical product purposes or alternative products appropriate to their business and organisation needs of pathway services.

Fourthly, the LHC and Informatics are not applying any structured and formal data gathering, user analysis, and requirements specification or evaluation technique as listed below.

In LHC level

- PRINCE2 is only a project management tool, and not fulfilling the necessities of a user-centred requirements analysis tool.
- Although the PRINCE2 methodology is highly based on reporting, the meetings are not organised in the light of previously documented reports.

Informatics level,

- Hybrids are only using analytical thinking and simple flow charts for system analysis and design.
- The ‘shadowing’ technique used for evaluation is also very limited as it only depends on observation of the users.

Fifthly, there is a user definition problem in both top-down and bottom-up designs. At LHC level,

- The users of technical systems are not considered as clinicians and the requirements gathering is performed according to the needs of commissioners and managers due to political reasons.

At the Informatics level,

- The hybrids in the focus groups are unconsciously putting themselves in the end-user position since they have a clinical background. This situation later causes ownership problems of the developed technical products as the product doesn’t reflect real user needs.

Sixthly, both LHC and informatics departments have resistance to major changes.
At LHC level,

- They normally prefer general purpose and flexible IT Infrastructures such as middleware or new interface equipment that can be mounted on the existing systems.

At the Informatics level

- The teams don’t want every possible system to be plugged into the current system.

Lastly, there are several participatory approach problems.
In the LHC

- There is no participatory approach applied in PRINCE2 meetings to increase the involvement of clinicians.

In Informatics,

- Northampton's shadowing method is lacking in terms of involving the end-user in the design as the requirements are defined by facilitator's observations of end-user needs.
- Walsall's Participatory design approach is unstructured and loose, as the facilitators don't apply a formal or rigid approach to teach and direct the user representatives to be involved in the design successfully.

Root Definition and Conceptual Model for Recommended Design Strategy

A root definition for new NHS design strategy is defined below according to the problems defined from the rich pictures.

"A design process for the Walsall Stroke and Northampton Retinopathy to improve their unstructured, undemocratic, and conservative design process and turn it into a soft systems and socio-technically driven fair and innovative design strategy."

With top-down design, a socio-technical tool is required for combining the separate social and technical design strands in the LHC level and solving the issue of leaving the socio-technical design to the chance of good communication in LHC meetings. Furthermore a soft approach is definitely required to help the LHC team to structure the purpose definition of the technical IT product with the participation of all stakeholders. Additionally it needs to recognise and solve the user definition problems at the LHC level and provide a user requirements gathering tool as PRINCE2 is not a user-centred approach and mainly is used for budgeting, risk assessment and project management issues. Moreover a participatory design structure is required for solving the user definition problem at LHC by involving the clinician's needs in the system design. Therefore there is a need to merge the Informatics participatory approach with the LHC's design.

To manage the socio-technical, soft and participatory design needs of the top-down strategy; the previously defined integrated methodology is recommended since it fulfils these needs through its integration of SSM and ETHICS. As the LHC level requires a

soft approach the SSM stages should be applied with commissioners and managers at the LHC level. As Informatics requires a participatory socio-technical approach the ETHICS stages of the integrated methodology should be applied with facilitators and user representatives at the Informatics level. As this integrated methodology combines SSM and ETHICS, it will merge the separate LHC and Informatics processes and turn them into parallel procedures that inform each other rather than one dictating the other.

However this recommendation requires the socio-technical needs to be defined by Informatics and provided to the LHC for discussion. As revealed in cultural and political analysis, the NHS design strategy has an authoritarian and bureaucratic top-down structure. Therefore making Informatics define all the socio-technical design and forcing the LHC to be dependent on Informatics seems to be a culturally and politically infeasible offer for the NHS. To solve this issue, a QUICKethics (Mumford, 1995) approach is recommended for the LHC managers and commissioners. The conceptual model, which summarises this ideal top-down strategy, is given in *Figure 8*.

The conceptual model recommends the new strategy should start similarly at the LHC level by applying a QUICKethics approach for initiating socio-technical design. After the QUICKethics, the integrated methodology could be applied as offered in the 'Investigation of Methodology' section. To trace the integrated methodology's sequence the LHC and Informatics should apply the relevant SSM and ETHICS stages consequently and give feedback to each other. Furthermore the parallel structure of the application and the feedback sessions between these separate levels should be organised through PRINCE2 meetings.

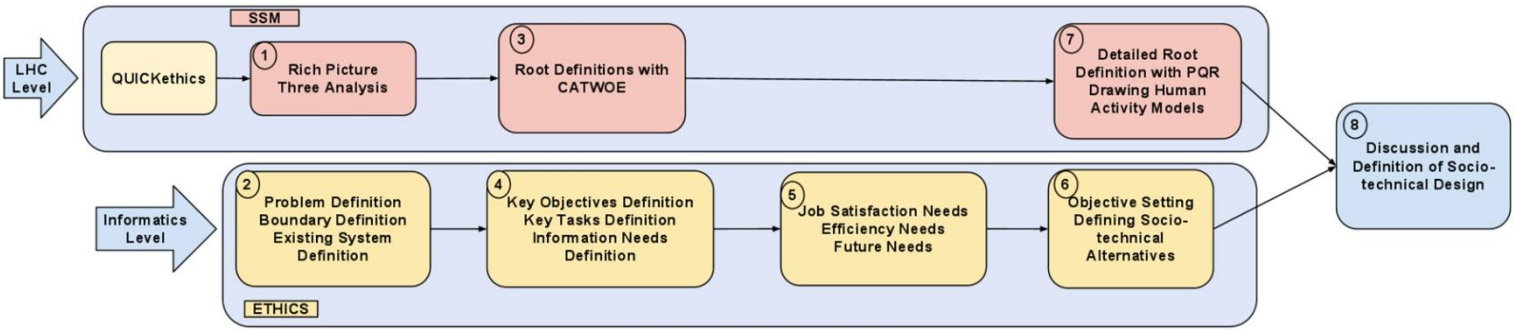

Figure 8. Top-down Strategy Conceptual Model (The Integrated Methodology)

At the bottom-up design, a socio-technical tool is required as the Informatics team was found to be related with only the technical design. As the purpose of the system is already defined at the top-down level, a soft approach is not required at this stage. Although IT teams seem to apply participatory approaches; Shadowing and Participatory Design, they both apply it unconsciously and in an unstructured fashion, which extends the design process.

The integrated methodology is not recommended for this stage because a soft approach is not required. However the ETHICS framework is recommended to manage the socio-technical and participatory design needs of the bottom-up strategy, which is to be used by Informatics facilitators. The ideal bottom-up strategy, is given in *Figure 9.*

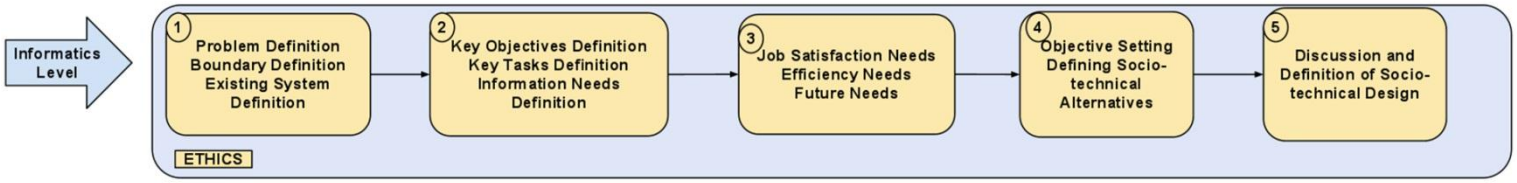

Figure 9. Bottom-up Strategy Conceptual Model (The ETHICS Framework)

As a result, to make these new design strategies applicable and to solve the user definition and democracy problems, some general recommendations are proposed for two hierarchical NHS design teams to make the application of the recommended strategy possible. These general recommendations were presented to the EPICog team and are given in *Table 9*.

To	General Recommendations
LHC	• The separate organisational and technical design should be merged and it should be performed as a socio-technical design • The PRINCE2 application should be soften for the flexibility of providing a nested purpose definition and requirements gathering stage as offered in the integrated methodology • The users of the system should be redefined so that clinicians can have voice over the needs analysis • In top-down design LHC & Informatics should be work in parallel and Informatics should be feed-in clinician based information to the top-level.
Informatics Groups	• Designers should perform socio-technical design not just technical. • Consensus participation should be applied rather than the representative participation (Mumford, 1983) in Walsall or the consultative participation (Mumford, 1983) in Northampton as in both these approaches the most of the decision-making is still left to the high level authorities such as LHC or Informatics managers. • A culture shift is required where the facilitators' seniority and technical knowledge should be increased and be more important in the design decisions.
Both	• Both teams should be more open to major and innovative changes.

Table 9. General Recommendations to NHS design teams

Summary

An SSM evaluation was applied to the Walsall Stroke and Northampton Retinopathy design processes which is performed in the top-down and bottom-up design levels by two hierarchical organisational units, the LHC and Informatics teams.

These evaluations revealed that the NHS design strategies not only have design strategy problems but also organisational problems. These problems related with cultural and political issues that restrict the changes in the strategies such as democracy and user definition issues.

While the top-down design strategy requires a soft-approach, a socio-technical design technique and a structured participative approach of the bottom-up design require a socio-technical design and a structured participative approach.

Consequently for the top-down level the integrated methodology is offered with a QUICKethics approach, whereas the bottom-up level only ETHICS is found to be required. To provide a politically and culturally feasible strategy change at both levels, general recommendations are made which compensate for the organisational problems in the LHC and Informatics levels.

3.4 Study Two: Pathway Analysis

This second main study focussed on the two purposes of this research study, which is to understand whether applying the integrated methodology is practically compatible and can enhance the socio-technical design.

NHS Stroke and Diabetic Retinopathy pathways were analysed using the integrated methodology to provide an example application and see the compatibility of techniques and improvements in socio-technical design of pathways.

As a result, two levels of findings are investigated. In the first level, the specific findings of the pathway analysis of the SSM and ETHIC stages. The second level findings emerged from researchers reflection on the experienced process, such as the advantages experienced while applying the methodology, and the differences and compatibility of applying the techniques to various contexts.

The pathway analysis's detailed results will not be described in this section since:

- This dissertation is aiming to find out the methodology's advantages on enhancing the socio-technical design and not focussing to find out a solution to the practical studies.
- The pathway analysis section is the most data-intense section of the study as it includes a detailed practical application of the integration of SSM and ETHICS on 2 separate pathways, which can only be described separately considering the word limits of this thesis.

However the reader is advised to refer to the *Appendix 1 and Appendix 2* to see the two detailed reports detailing the integrated methodology findings.

The rest of this section will briefly describe the applied process of the integrated methodology, its compatibility, and the advantages experienced throughout the pathway studies.

The Integrated Methodology Process, its Complementation and Advantages

Scoping Process

Stage 1. Defining the Problematic Situation Rich Picture Drawing

This stage started by drawing Rich Pictures and applying 'Three Analysis' to investigate the problematic issue and initially scope the system of interest (Checkland, Scholes, 1990).

For 'Analysis One', the intervention context, which is the pathway, is investigated. At this stage initially the pathway agents, their departments, the clinical team of these departments, the members of the teams and their main roles are detailed. *Table 10* is given showing the agents, departments and the clinical teams of the pathways to inform the reader about the users.

Stroke pathway	• Ambulance Service
	  ○ Ambulance team
	• Manor Hospital
	  ○ A&E Unit
	  ▪ A&E medical staff
	  ○ Stroke Unit
	  ▪ Stroke Nursing Staff
	  ▪ Multidisciplinary Stroke Team: Psychologist, Nutritionist, Occupational Therapist, Physiotherapist, Speech Therapist
	  ▪ Social Care Worker
	• Community Hospital
	  ○ Integrated Stroke Unit
	  ▪ Stroke Nursing Staff
	  ▪ Multidisciplinary Stroke Team:
	  ▪ Psychologist, Nutritionist, Occupational Therapist, Physiotherapist, Speech Therapist
	  ▪ Social Care Specialist
	  ▪ Out-patient Hospital Specialist
	• GP Practices
	  ▪ GP

Retinopathy pathway	• GP Practices
	  ○ GP
	  ○ Diabetic nurse
	• Screening Service
	  ○ Admin Team
	  ○ Screening Team
	  ▪ Healthcare Assistant
	  ▪ Screeners/Grader
	• Acute Team
	  ○ Ophthalmologist
	  ○ Booking Office

Table 10. Pathway Agents and their clinicians

The critical relationships between the clinicians are defined by considering the coordinated handover and communication activities. The worldviews of departments and clinical teams are listed on worldview tables, to define their conflicts. Later these conflicts and problematic issues, such as each agent's particular problems with IT working tools, are listed in the 'Problematic Situation' lists.

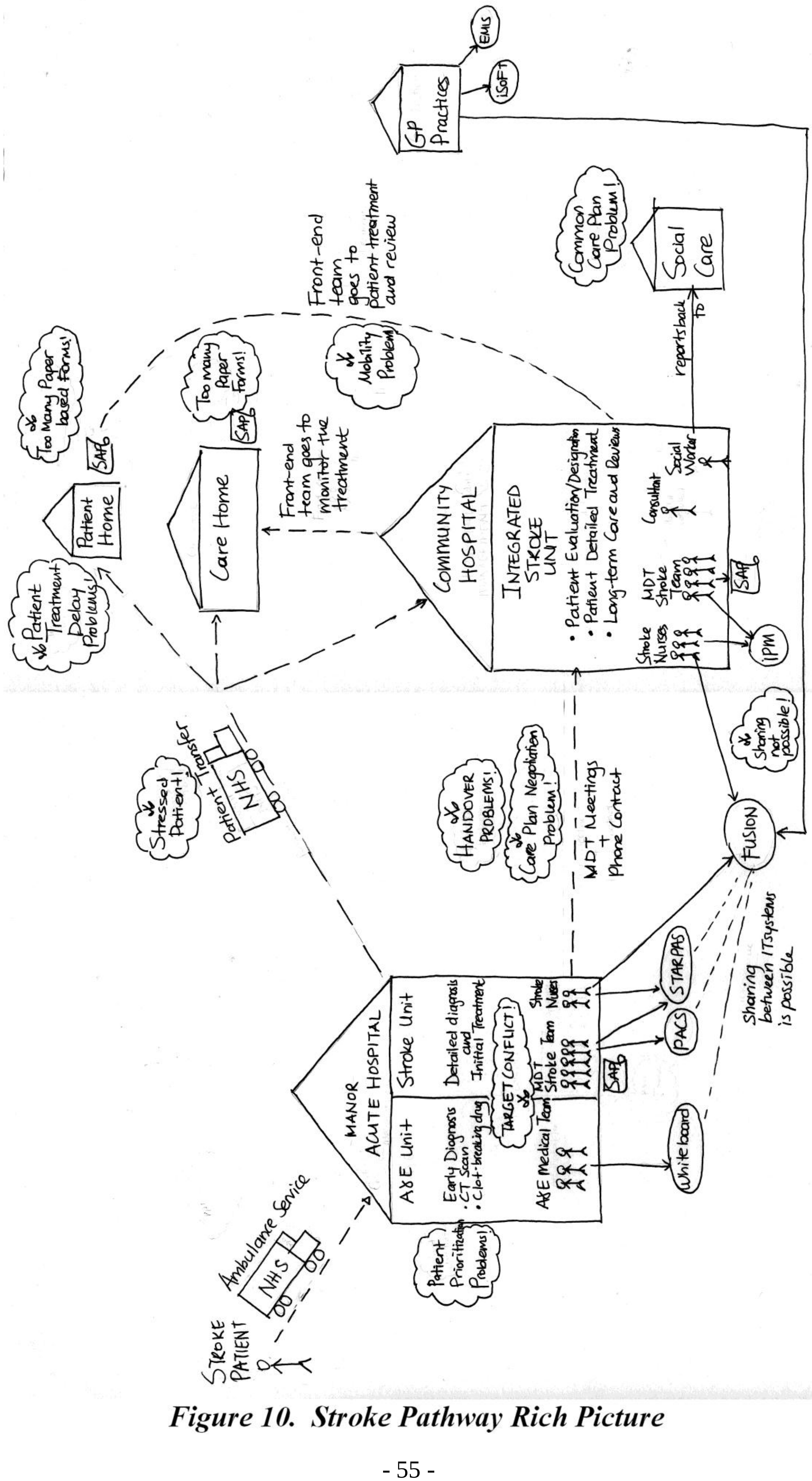

Figure 10. Stroke Pathway Rich Picture

The cultural and political rich pictures are drawn for each pathway for Analysis Two and Three. Due to the correlation between cultural and political context, these are analyzed together to understand what kind of changes are culturally and politically feasible for the two pathways. The cultural rich pictures included the high-level organizational role hierarchy of the agents of the pathway. The political rich pictures investigated the major resources of power and influence on the pathway services, which had many commonalities with the pathway design political rich picture. Problematic issues and conflicts aroused from rich pictures are added to Problematic Situation lists. *Table 11* shows some important examples of these problems.

Pathway	**Major Cultural Problems**
Stroke	1. Community Stroke team requests more detailed information from Acute Stroke team after handover, however Acute team find the shared data adequate.
Retinopathy	2. GPs think that Screening Service does not regard their work whereas the Screening team thinks that they are not getting correct diabetic information.
Pathway	**Major Political Problems**
Both	1. British Press is not encouraging & supporting the improvement process of NHS.
Both	2. Government restricts the budget of Informatics changes.
Both	3. The clinical targets are defined by NHS Trusts, the technical targets are defined separately by LHC.
Both	4. The technical systems are mainly used for management purposes not for serving patient or clinicians

Table 11. Major Cultural and Political Issues

Stage 2.1 Investigating the need for a change

The Problematic Situation lists defined via Rich Picture analyses was used as a definition of the need for change.

Stage 2.2 Defining the system boundaries

The design boundaries are selected from the visually defined system boundaries with Pathway Rich Pictures including organizational boundaries, pathway facilities and the IT

systems used at facilities. As the boundary definitions are highly dependent on the politics and culture in organisations (Peltu, Eason, Clegg, 2008), the organizational restrictions defined with Analysis Two and Three are used to define the *'social shaping'* of the system and eliminate changes that are not culturally and politically feasible. Considering these analyses, the *'boundary management'* details are specified.

Stage 2.3 Defining the Existing System

The pathways' existing system workflows are defined according to Beer's Viable System Model (1984) in fives stages by specifying operational, prevention, co-ordination, development and control activities.

For operational tasks, the researcher included an additional feature to this ETHICS stage by drawing the existing day-to-day task flows of all clinicians via visual models. These models later turned into networks of the current agent activities, which were later used to see the handover procedures in detail. For the models, the researcher was inspired by the Human Activity Models of Checkland (2006a) and the general Role Activity Models concept from the socio-technical systems design.

Checkland (2006a) uses the Human Activity Models to represent the conceptualized activities for ideal situations. However, SSM's flexibility values the practicioner's worldview and the requirements of the context. Consequently the researcher decided to use these models to investigate the existing system in ETHICS's operational activity definition stage.

The interviews were interpreted according to the clinicians understanding of their own work, process and with this interpretation the complicated current workflow of existing system was defined according to the specific worldviews of the end-users. A network of Stroke Human Activity Models which include several agents' routine work and interaction are given in *Figure 11*.

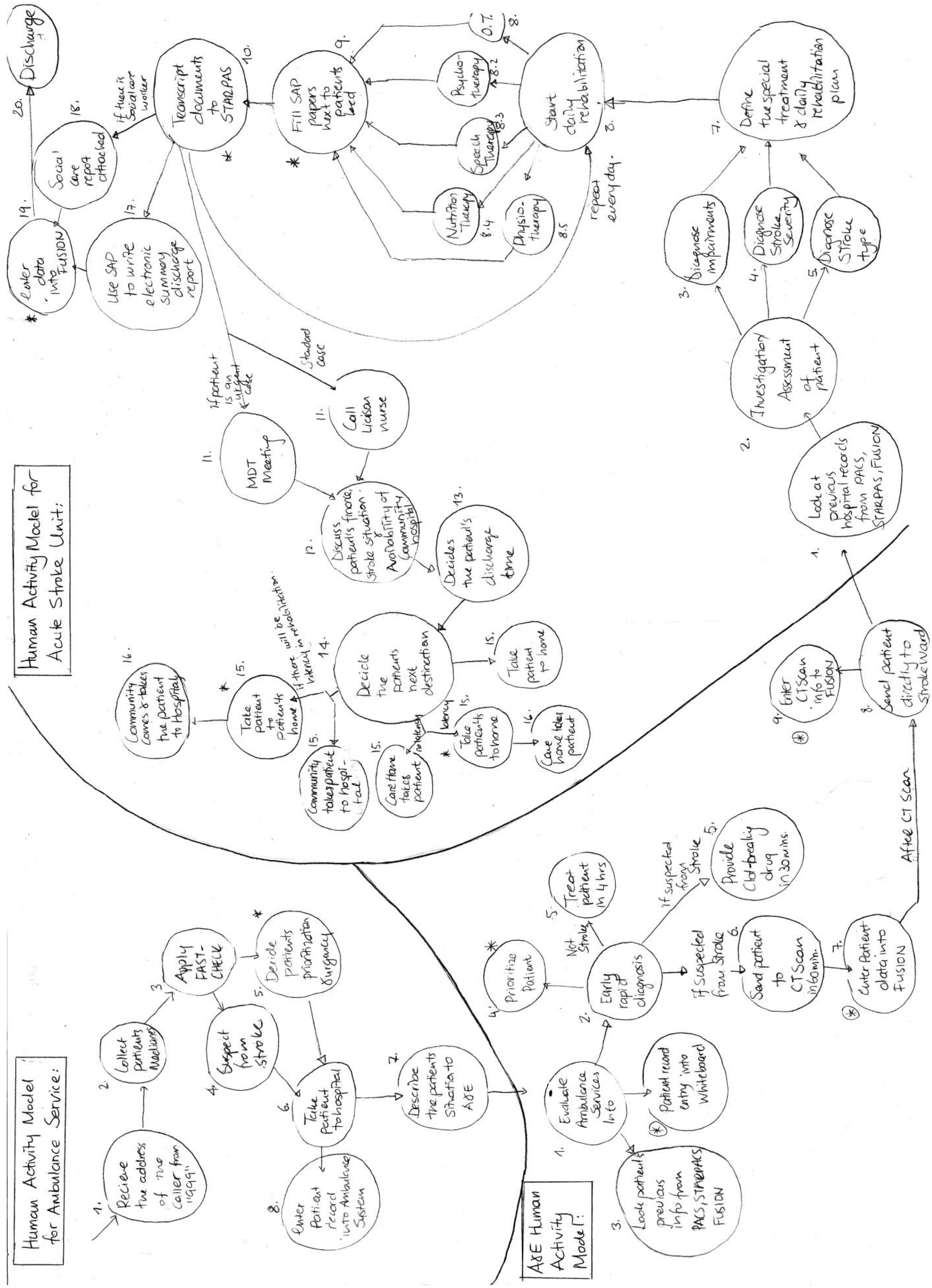

Figure 11. Stroke Human Activity Model Network

To enrich this stage further other soft and socio-technical modeling methods are explored. The research realised that Data-flow Diagrams are used in both the Business Process Redesign (Wastell, White, Kawalek, 1994) model, which uses some stages from SSM's and Socio-Technical principles, and Atkinson's (2000a) SISTeM framework, which merges SSM and a hard systems perspective. Patel's (2000) requirements analysis technique is introduced for NHS information systems is also found to use Role Activity Models for both the workflow modeling and socio-technical reasons. For these reasons, Role Activity Diagrams are embraced in the use of the integrated methodology. Role Activity Diagrams differ from Human Activity Models because they don't focus only single user workflow but consider the overall workflow of the pathway. The retinopathy RAD is given in *Figure 12*.

Lastly, the existing prevention, co-ordination, development and control activities are specified by tracing and questioning the workflow of the social and technical tasks drawn in the Pathway Rich Pictures, Human Activity Models and Role Activity Models.

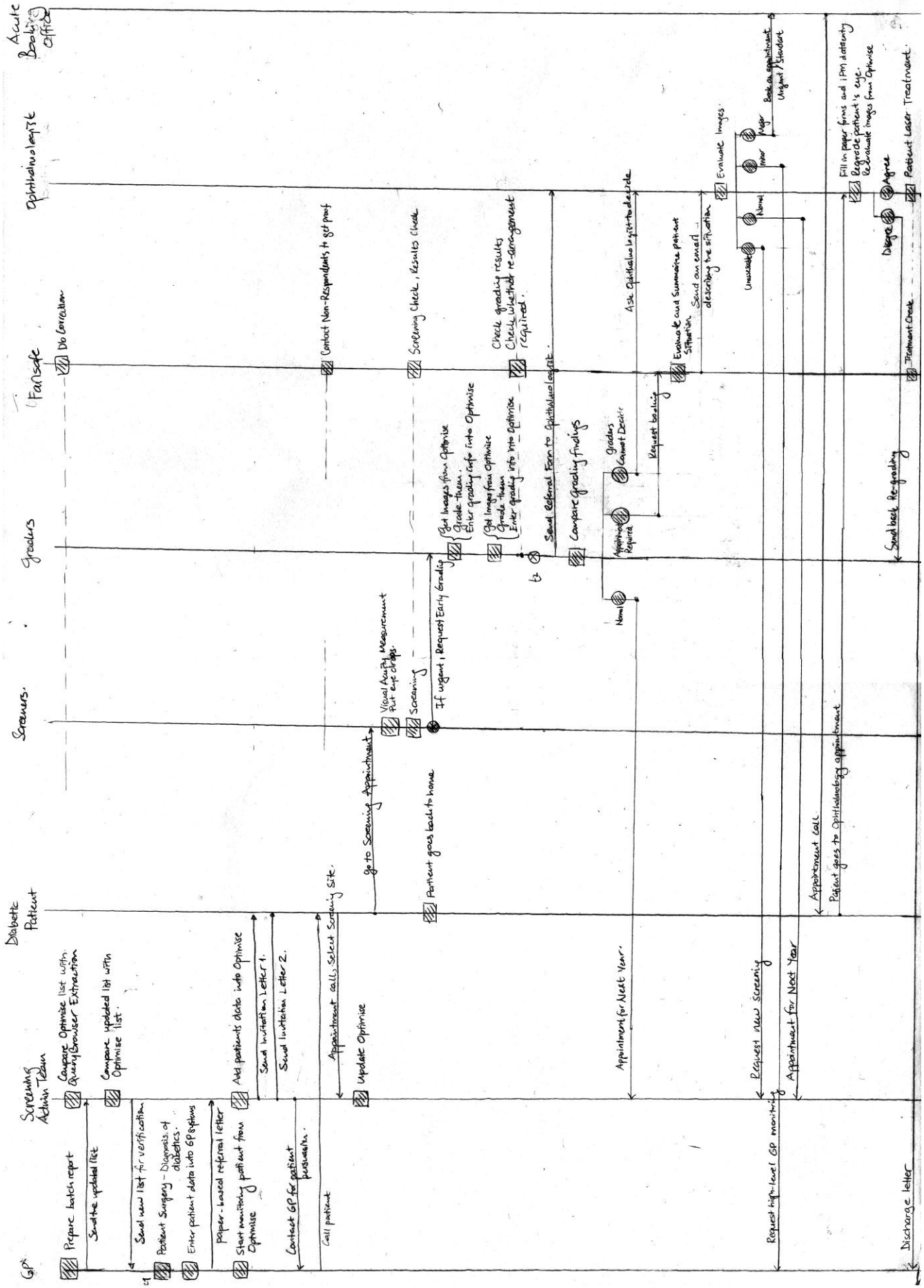

Figure 12. Retinopathy RAD

The Compatibility of the techniques

As advised by Singh et al.(2007), SSM is found to be greatly valuable by incorporating it with ETHICS, especially to reduce the inadequate instructions of the first three steps of ETHICS.

Firstly, the conflicts and problematic issues defined in the rich pictures fed into the problem definitions stage of ETHICS.

Secondly, while Analysis One with pathway Rich Pictures revealed the design boundaries of the system, Analysis Two and Three defined what is culturally and politically feasible in NHS's turbulent environment and authoritarian management.

Lastly, ETHICS's existing definitions started defining the high-level workflow in the SSM Rich Pictures, and deepened it with using Human Activity Models and Role-Activity Diagrams.

The Advantages Experienced in The Scoping Section

Firstly, the Rich Picture drawing stage was found to merge its soft systems thinking origins with socio-technical systems thinking. The pathway rich pictures functioned as a socio-technical map/diagram of the pathway that visualizes specific agent's inputs, outputs, work transformations and interdependence of their interaction including information exchange and handovers. Therefore Rich Pictures provided an initial evaluation of the system with a socio-technical perspective. The systems high-level '*socio-technical co-optimization'* is explored by considering social system's primary tasks, their collaboration and interaction with technical system. This stage uncovered that pathway systems are not co-optimized and their current technical system is not providing the clinician's needs. It has been found that the clinicians are performing 'workarounds'

in their practices to make the system work appropriately. Furthermore, the clinicians were observed to have other major issues with the IT systems, such as the existence of several IT technologies used for the same purpose, data access problems, handover, communication and information sharing problems.

Secondly, three analysis levels of rich pictures were useful to divide the complex and rich pathway data, which was acquired from unstructured interviews, into context, culture and political situation. As the NHS is a complex organizational structure that has a turbulent environment and ever-changing culture (Mumford, 1991), the cultural analysis stage was essential for understanding these messy and ambiguous organisations and their problems. For example, for the Stroke pathway the organizational communication gap between multidisciplinary teams in Acute and Community Hospitals revealed a current norm definition problem between these healthcare services. The Community Stroke Unit was expecting to get detailed information about the stroke patient from the Acute Unit, whereas the Acute Stroke Unit thought the shared data is sufficient. Furthermore, the political analysis was valuable to comprehend the authoritarian politics and its restrictions that limit the design changes such as the Informatics budget restrictions.

Thirdly, the rich pictures provided a graphical visualization tool (Monk, Howard, 1998) considering the stakeholder analysis. It explored the '*multi-stakeholder needs'* by looking at the divergent stakeholders and their worldviews in a pluralistic way. (Mansell, 1991) Investigating these worldviews and their major conflicts in detail reflected the major socio-technical flaws and problem areas in these pathways. For example the one major communication conflict in Retinopathy was investigated between the GPs and the Screening Service. Screening Admin Team requested in-time notification of the diabetic patient identification through referral letters, whereas the GPs prefer sending several diabetic patient records in one batch report. This communication conflict is causing poor latency in patient recognition.

Furthermore, the modeling methods used were useful to define the processing of the existing system. Human Activity Models were useful in defining a graphical visualization of the workflow and the Role Activity Diagrams were valuable to emphasize the '*interdependencies of the jobs'*. These flow-models are used frequently in the current stages; especially in the job satisfaction and variance analysis stages.

Lastly, the investigation of prevention and control activities for the Viable System Model was also rewarding. The prevention activities investigation showed that both systems are very nonresistant to the possible work problems. For example, in the Retinopathy pathway resistance was attempted through the Failsafe officer's work, which is to prevent possible problematic situations. The investigation of control activities of both pathways revealed that the Fusion and Optimise systems are successful at checking whether the department meets the national targets and standards, however it does not provide an investigation of the progress of the patient or the overall performance of the team.

Requirements Gathering Process

Stage3. Purpose and objectives setting

Stage3.1 Defining the purpose of the system with CATWOE definitions

The purpose of the socio-technical system is defined by two CATWOE definitions for the social and technical systems. These definitions provided the general purpose of the pathway service and technology, through the worldviews of the actors of the systems who are clinicians. The general purpose of each system is given in *Table 12.*

Stroke Social System	Improving the social system to provide a better experience to the stroke patient throughout the care service by faster stroke identification, faster and safer rehabilitation and treatment, continuous monitoring with a stronger focus on their long-term needs.
Stroke Technical System	Improve the technical system that helps the clinicians through their work and helps the manager through monitoring the hospital service.
Retinopathy Social System	Improving the social system to monitor the diabetic patients from age 12 throughout their lifetime for preventing any possible retinal abnormalities caused from the disease by early detection, early prevention and if necessary early treatment
Retinopathy Technical System	Provide an improved resilient technical system to help clinicians helps the clinicians through their work to serve a less-interrupted and faster service.

Table 12. General Purpose Definition with Patient's Worldviews

Stage3.2 Defining Ideal Key objectives, Key Tasks and Information Needs

According to the defined purposes, the objectives of the socio-technical systems are defined with the key objectives. This stage also investigated the current business mission definitions in the National Stroke Strategy (DoH, 2007) and the patient needs through UK Diabetic and Stroke Statistics. The revised key objectives for both pathways are defined in *Table 13*. These key objectives are decomposed to its key tasks to question the social and technical information needs of the socio-technical system.

Stroke Key Objectives	1. Raise awareness in Patients about stroke and FAST-ACT with media and GP support 2. Detect stroke high-risk patients and take precautions against a possible stroke. 3. Reduce the death rate after stroke by fast diagnosis 4. Improve patient experience by safer, tailored, comfortable, faster and psychologically supported service 5. Fully cure each stroke patient and increase the number of patients recovered successfully by early limitation, monitoring and treatment 6. Hospitals shouldn't compete but collaborate by sharing resources and information. 7. Prevent the recurrence of stroke with monitoring
Retinopathy Key Objectives	1. Raise awareness in Patients about diabetics through media and GP support. 2. Improve identification of diabetic patients 3. Improve patient experience with providing good quality service 4. Fast and early identification, screening, treatment and discharge of every patient. 5. Providing screening and treatment at right time 6. Providing screening and treatment at right place 7. Providing safe service

Table 13. Key Objectives Defined according to the defined general purposes

Stage4.1 Defining Job satisfaction Needs

The pathway rich pictures, role activity diagrams and human activity models are used for performing walkthroughs on the existing system to investigate its possible job satisfaction problems. Furthermore, the stakeholder worldviews, which include important quotations from important pathway clinicians, and the conflicts of these worldviews, are reinvestigated for emotional needs. The positive and negative emotional needs gathered from interviews are categorized according to the Job Satisfaction model. Moreover, probable reasons for organizational stress are investigated because job stress and satisfaction are inversely related (Miles, 1976). It is found that both pathways have several important job satisfaction problems including psychology, knowledge, efficiency and task fit issues. These are shown in *Table 14*.

Stroke	1. Service is based on punishment and lacking the reward of the successful work. The clinicians are punished with financial penalties due to the work deficiencies caused by missing the service targets. 2. The clinicians found to be highly frustrated for using several systems for same purposes.
Retinopathy	3. Service found to be highly stressful for Failsafe Officers caused by their excessive amount of responsibility to check every activity for meeting the national targets. 4. The clinicians don't trust in IT systems and therefore depend on reports, letters, patient forms for system resilience.
Common	5. Systems don't fit the personal interests of the clinicians, as they are only data management tools rather than data analysis or working tools. 6. Systems are not providing communication and collaboration between agents which is causing reduction in personal skill and knowledge to be shared 7. High stress caused by meeting the conflicting national service targets between different agents.

Table 14. Stroke and Retinopathy major Job Satisfaction problems

Stage4.2 Defining Efficiency Needs

The *'variance analyses'* of both pathways was performed using the drawn Human Activity models and Role Activity Diagrams representing the routine activities of each clinician and their interdependencies. Walkthroughs with these models are again performed to question the potential problematic issues of each activity in the models. These walkthroughs investigated the technical and social inefficiency and ineffectiveness of the system (Wastell, White, Kawalek, 1994) such as the service latency, communication and resource-sharing problems. Some major key and secondary variance examples for each agent are listed in *Table 15*.

Stroke	1. The excessive use of SAP paper based forms to enter patient data. These are later causing live data entry problems into FUSION and other e-healthcare record systems. 2. The information sharing problem between Fusion portal and GP and Community e-healthcare record systems 3. The lack of communication between Acute and Community Stroke Units.
Retinopathy	4. The data extraction from GP service's e-healthcare record system to Optimise using Quest Browser is including incorrect and incomplete data. 5. The information sharing problem between Optimise and GP and Acute service's e-healthcare record systems 6. The communication through letter and reports showing the non-resilient electronic communication between agents.

Table 15. The major variances of Retinopathy & Stroke

Stage4.3 Defining Future Needs

The future needs of the socio-technical systems are defined looking at the possible near and far future technological developments, the economical changes, customer expectations and organizational changes. Some important examples of the pathways are given in *Table 16*.

Stroke	1. The mobile technologies found to be valuable to make investments when the technological improvement of hand held devices; such as PDA technologies, mobile phones and tablets are considered. 2. For far future, possibly with the technological improvements the speech recognition devices, handwriting scanners and genomic diagnosis of Stroke can be considered. 3. There is a future plan for a 'Merger project' for organizational merge of Community and Acute Stroke Units.
Retinopathy	4. An improved screening service can be reached using an electronic and collaborative retina screening, archiving and sharing system such as EYEPACS .

Table 16. The possible future needs examples of Retinopathy & Stroke

The Complementation of Techniques

The socio-technical system's CATWOE definition from SSM filled a gap in the ETHICS requirements gathering stages, which was defining the purpose before the definition of needs and objectives of the system.

SSM inspired by Vickers' Appreciative Systems (1965) focuses on a soft systems approach to find purpose whereas ETHICS focuses on the objective seeking which is a similar perspective to the goal seeking paradigm of hard systems approach. Both purposes and objectives have great importance in solving organizational problems (Vickers, 1965). However the objectives shouldn't be set unless a clear purpose has been identified. Therefore the use a 'soft' approach of SSM purpose definitions complemented with the 'hard' approach of objective definition of ETHICS provided inadequate and random definition of the detailed objectives. Consequently the CATWOE stage was complementary and very useful for providing a '*systems view*' with the definition of organization's strategic purposes and key objectives. (McNamara, 2005)

Another valuable SSM and ETHICS complementation was investigated during defining job satisfaction and efficiency needs with the walkthroughs on the pathway Rich Pictures, Human Activity Models and Role Activity Diagrams.

The Advantages Experienced in Requirements Gathering

Firstly, the SSM purpose definition stage showed that these two pathways are suffering from the lack of vision to improve the clinical practice, as are many other British health services. (Mumford, 1991) The CATWOE definitions draw attention on the need to provide a technical system for clinicians, which was ignored because of political reasons. The ideal technical systems decided upon, have the purpose of serving clinical staff to help them perform their jobs better.

Secondly, the job satisfaction investigation touched on the emotional needs of the social environment. With defined emotional needs, it was observed that both pathway clinical teams might have different personal needs other than the obvious devoting themselves to improving healthcare. This stage also provided an affective evaluation of the current socio-technical system through its users' point of view and generated creative objectives because it reflects the desires and imagination of the users. It revealed the important finding that both pathway clinicians are unhappy with the information systems because these systems are not serving their work, but they are instead serving the systems. Commonly, the national targets found to be causing conflicts, communication problems and work stress over the pathway.

Thirdly, the '*variance analysis'* was easy to perform with the previously drawn flow-models. The visually defined workflow and complex task-interrelations were helpful to brainstorm solutions to the problematic situations in the existing operational system. Role Activity Diagrams were especially useful for the Retinopathy Pathway, which has a sequential and reciprocal handover procedure where in some cases current agent passes the patient to the next agent, in some cases due to some pathway problems the current agent should refer back to the previous agent. The role activity models revealed the communication problems and deadlocks in the Retinopathy process. The human activity models were especially useful for comparing the workflow of different agents. For example, Acute and Community Stroke Units' workflow comparisons revealed the unbalanced patient experience on different parts of the pathway.

Furthermore, these modeling methods were not only useful in evaluating the work process but also evaluating the current 'job design' in socio-technical terms. (Patel, 2000) As these techniques revealed the organizational structure and the current role distribution, they were useful to examine the overall work distribution in the clinical teams and investigate whether there are any job enlargements and job impoverishment problems in the current socio-technical system. For example, the job distribution balance problem investigated with the usage of Role Activity Models in the Retinopathy pathway, which revealed that the workload of Failsafe officers excessively increased when the Ophthalmologists' and GPs' did not perform their responsibilities.

Lastly, the future needs investigation in ETHICS provided a generation of futuristic socio-technical objectives according to the rapidly changing organizational environment, conditions, stakeholder needs and expectations. Therefore with the help of the future definition section the researcher foresee some probable system needs and objectives. This stage was also useful at providing the basic socio-technical design principle of the 'design for incompletion' action as it plans the possible future developments and evolution of the system.

Modelling Section Process

Stage5 Objectives Setting

All defined information needs are separated into four types of key objective lists including major technical, minor technical, major organizational and minor organizational objectives. Major technical changes can be generalized as new innovative developments whereas minor technical changes found to be middleware, interface infrastructures between systems and tweaks that are more likely to be accepted by the Informatics and LHC teams. Major organizational changes are generally national level and cross-boundary changes which includes classical solutions such as merges, hospital collaborations (Mumford, 1991), whereas the minor changes are accepted to be agent-

based role changes, which could be easier to put into reality. Some specific examples of these four levels of objectives are provided in the *Table 17*.

At this stage it was observed that the organizational needs for the Stroke pathway are more than its technical needs whereas, the technical needs for Retinopathy are more than its organizational needs. This result was expected because the Stroke pathway is found to be suffering mainly from communication problems owing to the organizational issues, whereas the retinopathy pathway is found to be very successful in terms of the communication effort between and within clinical teams, however it lacks powerful technological tools to communicate and collaborate.

Major technical	New innovative developments such as:
	• **Stroke Pathway**:
	  ○ Stroke Team Progress Management tool for monitoring team and their patient's progress
	  ○ Mobile-Fusion Application for providing easy data entry of patient treatments at home
	• **Retinopathy Pathway**:
	  ○ EYEPACS Collaborative Working tool provide electronic imaging and collaboration through archiving and sharing retina images.
	  ○ Optimise Reminder for Failsafe Officers to remind and prioritize daily work

Minor technical	Middleware, interface infrastructures between systems and tweaks such as: • **Stroke Pathway**: Fusion Portal Enhancements such as enlarging Fusion portal with binding Community and GP e-healthcare record systems to Fusion • **Retinopathy Pathway**: Quest Browser Nightly Extraction tool to perform auto extraction of diabetic patient information from GP e-healthcare record systems.
Major organizational	Merges, structure changes, big role changes such as: • **Stroke Pathway**: Merge of Acute & Community stroke services for resolving communication and patient handover problems between them. • **Retinopathy Pathway**: Add a GP role for booking initial appointments for screening at GP surgeries after diabetes identification.
Minor organizational	Small role additions such as: • **Stroke Pathway**: Put a Stroke Nurse in A&E for early stroke detection • **Retinopathy Pathway**: Acute service should use Optimise tool for data entry

Table 17. Examples of Major/Minor Organizational/Technical Objectives

These lists are prioritized by ranking each objective from one (low) to five (high) according to the benefits, limitations and necessity to their user groups. After defining the conflicts between the objectives, they are divided into three levels of objective lists; the multipurpose objectives are useful for more than one user, the personal objectives that are useful for only one agent and the national/service level objectives that include general objectives that can be provided by national or hospital level. Some examples of

multipurpose, personal and national/service level objectives of the pathways are given in the *Table 18*.

As the researcher could not gain access to the NHS designers and staff, these objectives cannot be discussed with them. Therefore the priority objectives are set as the high-prioritised multipurpose objectives.

Stroke	Multi-purpose level (Priority objectives)	• Enhance Fusion Portal • Mobile-Fusion Tool • Fusion Management Tool • Fusion Handover Planner Tool • Merge Acute and Community Ward
Stroke	Personal level	• GPs should check discharged patient more often • GPs should be notified for patient data updates on Fusion
Stroke	Service level	• Put a stroke nurse in the A&E Unit • Provide three years psychological help to the stroke patients
Stroke	National level	• Government should fund life scans for possible, current and previous stroke patients • Government should fund home care for stroke patients
Retinopathy	Multi-purpose level (Priority objectives)	• Optimise Portal development • Optimise Target Management Tool • Optimise National Standard templates Addition • Nightly Extraction tool for Quest Browser, which queries diabetic patient records from GP e-healthcare record system. • EyePACS
Retinopathy	Personal level	• Add a GP role for booking initial appointments for screening at GP practices. • Optimise Reminder for Failsafe Officers to remind and prioritize daily work
Retinopathy	Service level	• Increase Screening Service clinician number • Increase Acute Ophthalmologist number
Retinopathy	National level	• Use Mass media to raise awareness • Share patient documents with patients that want to perform screening in other counties or regions.

Table 18. Examples of Four levels of objectives

Stage6. Socio-technical Alternative Definition

Stage6.1 Identifying socio-technical alternatives

Two methods are discovered to generate socio-technical alternative examples by merging '*social design options'* and '*technical design options'*.

Firstly, the merging was performed in four steps:

1. Defining compatible social and technical priority objectives by considering their conflicts
2. Making additions from defined personal, service and national level objectives by considering their conflicts
3. Checking all social and technical objectives for possible additions
4. Checking the conflicts defined in the pathway rich pictures to see whether all problematic issues are accommodated.

Secondly, the researcher discovered that the SSM's 'the PQR' formula shares the same structure with ETHICS's definition of key objectives, tasks, and the information needs stages. The PQR formula, which can be explained as 'do P, by Q, to perform R' is reformulated as 'do key task, by key information need, to perform key objective'. A large number of detailed socio-technical alternative root definitions could be generated in addition to the first method by using this merge of PQR formula with key objective/task/need definition.

As a result of this stage, several compatible organizational and technical priority objectives were selected for generating a socio-technical alternative example.

Stage 6.2 Defining Detailed Root definitions & Drawing Human Activity Models

The decided socio-technical alternative example is defined as a root definition and it is conceptualized by drawing an ideal Human Activity Model. After this, a scenario is created to demonstrate the workings of the socio-technical alternative.

The Compatibility of techniques

On one hand, the ETHICS '*user participation'* structure is beneficial since it covers some of SSM's limitations.

Firstly, the ETHICS '*joint-optimisation'* stage guarantees to prevent inequality in customer requirements through participative definitions of objectives and discussions. Whereas SSM findings are criticized for not always sufficiently providing balanced (Presley, Sarkis, Liles, 2000),'critical/ethical' and democratic requirement definitions. (Jackson, 1991)

Secondly, while SSM discussions can be unstructured during the comparison and questioning stage of the activity models (Ledington, 1999) when considering real world situation. ETHICS is assumed to solve this structural issue with its participatory discussions where the stakeholders prioritise the objectives according to their benefits, limitations, necessities and conflicts.

On the other hand, SSM usage was found to be informative, as firstly the alternative solution is selected by ETHICS '*joint-optimisation'* and specified in detail with the SSM root definition and conceptual models. The detailed SSM root definition of the socio-technical alternative provided fulfilment of the possible *'minimum critical specification'* of technical system. (Chern, 1976) This specification could later be enhanced and turned into the requirements specifications. (Mansell, 1991)

The Advantages Experienced in Modeling

Firstly, the objective setting section was helpful to define objectives into several categories. Initially it generated four types of major/minor technical and social needs which were prioritised and grouped into three levels; personal, multi-purpose and national/service. The priority objectives were the 'must' changes whereas the service level changes proved that ETHICS could be applicable at national level socio-technical systems design in NHS.

Another important section was the definition of conflicts between objectives. ETHICS was not adequate for solving all socio-technical conflicts (Mumford, 1995), however this stage helped researchers to identify the problem and offer possible compromised scenarios for the necessary cases.

Secondly, in the socio-technical alternative generation and selection, the prioritized and grouped objectives with conflict definitions provided an easy formulation of the '*joint-optimization*' of socio-technical alternatives.

Lastly, both of the techniques are found to be useful at generating creative recommendations. (Presley, Sarkis, Liles, 2000) Socio-technical alternative generation from ETHICS and Conceptual model questioning and discussion from the SSM stages is useful when brainstorming and generating ideas. Although they are both powerful in creating redesign ideas, SSM leads frequently to various abstract ideas (Presley, Sarkis, Liles, 2000), however the ETHICS framework turns them into concrete and specific ideas.

Summary

The integrated methodology was applied over two healthcare pathways, which aimed to reduce the practicality limitations and enhance the socio-technical pathway design.

The integrated methodology complemented SSM and ETHICS nicely, particularly in the problem, boundary, purpose/objective and socio-technical alternative definition stages. It is assumed that the practicality problems of SSM and ETHICS are reduced owing to missing instructions and highly philosophical structure by using this detailed structured approach.

The integrated methodology experienced was useful in fulfilling socio-technical design principles and therefore is advantageous to use in socio-technical design. These previously defined principles are summarized in *Table 19* where the principle names are adopted from Mumford(1996) and Eason et al.(2008). For both pathways the integrated methodology generated several types and levels of objective lists and example socio-technical merges to be further discussed in the interview stage to investigate the integrated methodology's feasibility.

No	Adopted From	Socio-technical Principle
1	SSM	**Multi-stakeholder needs**
		Consider all stakeholders' worldviews and needs including owner, customer, user and other affected actors in Pathway Rich Pictures.
2	SSM & ETHICS	**Boundary management**
		Define the design boundaries according to what is culturally and politically feasible according to Cultural and Political Rich Pictures and Analyses.
3	SSM	**Social shaping**
		The system needs are shaped according to Cultural and Political Rich Pictures and Analyses.
4	SSM & ETHICS	**A systems view**
		Define both purposes and objectives for organization, user and technology with general CATWOE Root Definitions and Key Objectives
5	SSM & ETHICS	**Interdependencies of jobs**
		Define transformation and dependence of work tasks to one another and the overall job and the close dependence of users with the technology by; initially, investigating Pathway Rich Pictures in Analysis One, then, defining the existing system with Human Activity Models and Role Activity Diagrams.
6	Role Activity Diagrams	**Job design**
		Evaluate the balance of the current job design with Role Activity Diagrams and avoid one person's job enrichment becoming another person's job impoverishment.
7	SSM & ETHICS	**Variance control**
		Identify all key and secondary variances and efficiency needs with questioning current existing system via walkthroughs on Human Activity models and Role Activity Diagrams.
8	SSM & ETHICS	**Job satisfaction**
		Identify job satisfaction needs of the social system with questioning current existing system via walkthroughs on pathway Rich Pictures, Human Activity models and Role Activity Diagrams.
9	SSM & ETHICS	**User ownership & User participation**
		Build ownership of systems and their design by those who use and manage through user consultation and participation in all stages of the design.
10	SSM & ETHICS	**Design for Incompletion**
		The design should be iteratively and continuously performed considering future needs.
11	ETHICS	**Considering technical/ social design options**
		Define possible technical/ social alternatives in Technical/ Social Objective Setting section.
12	ETHICS	**Joint optimisation of technical and social solutions.**
		Define the effective socio-technical system that is co-optimising the selected technical and social system objectives within the Socio-technical Alternative Selection section.
13	SSM	**Minimum critical specification of technical system**
		Define the essential objectives with the detailed PQR root definitions and conceptualise it with ideal Human Activity Models.

Table 19. Socio-technical Principles Adopted by the Integrated Methodology

3.5 Meetings with The Socio-technical EPICog team

This section is reflecting four separate meetings performed with each EPICog team member.

Questionnaires were completed before each meeting. At the beginning of the meeting the researcher did a slide-show presentation to explain the study and findings to the team members. A discussion and critique of the findings followed as the time constraint limited the researcher from detailing all the findings in the presentation. Finally a semi-structured interview stage was performed to explore the opinions of each team member regarding the following objectives;

- The value and validity of the integrated methodology and it's compatibility
- The acceptability and feasibility of the social and organisational objectives and the recommended NHS top-down and bottom-up design strategies
- The advantages of using SSM, ETHICS and the integrated strategy for the NHS pathway socio-technical design

The final objective gives an answer to the third purpose which is the practicality and acceptability of the integrated methodology by real organisations.

The meetings were tape-recorded. For pragmatic reasons, only relevant parts of the meetings are hand-transcribed. The interviews are coded with Grounded Theory (Charmaz, 2006) according to the given objectives.

As the EPICog members prefer their name not to be mentioned in the body of the thesis, the names and findings are kept anonymous throughout this section.

The Process

To make best use of the interview time available with the team in the interview stage, some closed questions were put in the questionnaire and emailed to the team members in advance of the interview. This questionnaire included 'Yes/No' type questions and

focussed on approving the identified problems of the NHS design strategies and team member's knowledge of SSM and ETHICS. The researcher evaluated the questionnaire results before each interview to structure the presentation and the interview questions accordingly.

In the beginning of the meetings, the information sheet and consent forms were given to the participants.

During the initial stage, the slide show presentation is performed. It included the study and its objectives, a brief summary of SSM and ETHICS processes, a description of how the techniques are complemented with each other in the study, the summary of the Pathway Analysis and Design Process Analysis findings and the recommendations to the IT teams design strategies. During the presentation, five A1-size SSM posters which were prepared using sketches of rich pictures and flow-models from main studies, and detailed ETHICS reports are referred to give examples of findings. All of the members know the ETHICS and SSM techniques; especially two members who have used the techniques in real life projects and one team member taught them in lectures. Therefore, the SSM and ETHICS process were not described in detail.

During the discussions, the researcher followed Checkland & Poulter(2006a) advice by performing informal walkthroughs of the SSM posters that are hung on the walls. Additionally ETHICS reports were investigated to discuss the detailed findings. According to a team member's preference, the discussion stage was performed in parallel with the presentation stage to discuss the study and frameworks in detail. Two photos taken during presentation and discussion sessions are given in *Figure 13 and 14*.

Before the interviews started, the questionnaire results were briefly discussed to resolve any confusion about the questionnaire findings. The interviews included questions more focussed on the strengths and limitations of SSM and ETHICS considering its possible application through the IT teams, the results of the pathway and design process analysis such as the complementation of the techniques, the acceptability of the recommendations in pathways, and in the IT design processes. In some interview questions the discussion turned to the posters and reports.

For the presentation slides, interview questions, and questionnaire questions please refer to the *Appendix 3, 4 and 5*.

Figure 13. Presentation to the Research Director

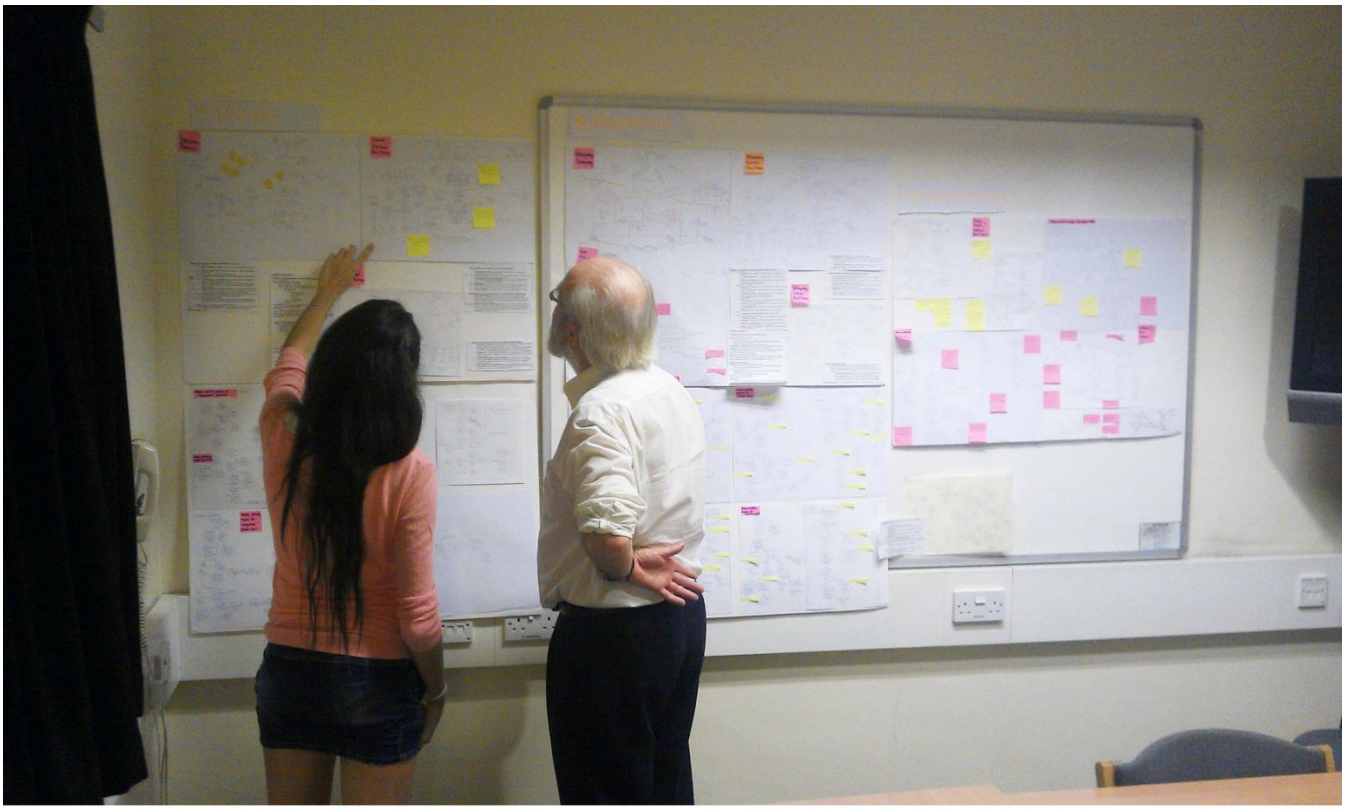

Figure 14. Discussions with Chief Investigator

The Findings

Questionnaire Findings

The questionnaires and their discussions provided approval for the first Main Study and its findings. Interviewees agreed with the proposed descriptions of the problems in the NHS design strategies and the needs defined in the Design Process Analysis were also validated.

For the current top-down strategy, interviewees agreed that the design was performed only with hard systems approaches. The purpose of system was restricted with the policy and standards making and monitoring of the pathway services. Interviewees mentioned the need for a structured soft, socio-technical and participatory approach.

For the current bottom-up strategy, interviewees confirmed that Informatics is only performing a technical design and their participatory approaches are inadequate and unstructured. Therefore the need for a structured tool helping Informatics to adopt soft, socio-technical, and participatory design was agreed. Further detailed findings are given in *Table 20.*

LHC	• A soft approach required in LHC • A socio-technical approach required in LHC • LHC decisions are very restrictive on Informatics, which disrupts the democratic decision-making procedure in NHS Pathway Design.
Informatics	• A socio-technical approach is required in Informatics • A structured requirements analysis tool is required for Informatics to gather user needs. • A participatory design tool is required to structure the user involvement in Informatics. • Facilitators generally have low seniority in Informatics, which disrupts the democratic decision-making. • Walsall Stroke IT found to be more autonomous and democratic than Northampton Retinopathy IT

Table 20. Detailed Questionnaire Results

Discussion Findings

The discussion section provided confirmation of the second Main Study and its detailed findings. Interviewees, who have a comprehensive understanding about these pathways and their problems, found the integrated methodology findings on the pathways to be correct and valid. The team members enjoyed seeing their data being used with a different approach and found the findings generally consistent with the ideas they discussed in their Action Research workshops.

Interview Findings

The interviews revealed the EPICog team's opinions about the recommended design strategies, the integrated methodology, its findings and its most advantageous stages, which will be described in following sections.

1. The compatibility and socio-technical value of the integrated methodology

The confirmation of the integrated methodology was sound, and found to be a good structure which captures the complexity and is worth applying on socio-technical design problems. Using the ORDIT methodology (Eason, Harker, Olphert, 1996) for merging SSM and ETHICS stages was approved as a compatible and valid integration both by the founder of the ORDIT methodology and by other team members.

The idea of using Checkland's (2006a) Human Activity Models and socio-technical Role Activity Models to shed light on Mumford's (1995) existing system investigation stage was found to be an inventive combination of both techniques.

Integrating ETHICS with SSM was seen to be useful at increasing the practicality of both techniques as both techniques complement each others' missing points. The integrated methodology was said to be reduce the limitations of adopting a philosophical perspective and having inadequate instructions (Pekkola, Kaarilahti, Pohjola, 2006), not considering socio-technical and user-centred design adequately.

Interviewees mentioned a similar limitation of techniques with Pekkola et.al (2006) which is SSM's soft issues and ETHICS job satisfaction philosophy might be hard to grasp by designers with clinical and technical background due to inadequate instructions of these techniques and may not find them practical. However, as described in the Pathway Analysis section the integrated methodology increases the practicality of SSM and ETHICS and turns them into a more structured approach with step-by-step instructions filling each other's gaps in the process.

Interviews emphasized that in the separate usage of SSM or ETHICS, they should be embellished with other techniques to reduce their design inadequacies. However the

integrated methodology already compensates for some of these. For example, SSM was found to be inadequate in socio-technical understanding and in the investigation of users' emotional needs whilst ETHICS was found to be have work design and task allocation issues. Initially the integration provided a socio-technical and emotional aspects to SSM. An interviewee found the integration valuable for exploring the stakeholder's emotions in the Rich picture worldview definitions which were inspired from the ETHICS job-satisfaction perspective. Furthermore, investigating the details of organisational roles in Role Activity Diagrams was evaluated as another advantage of the complementation when exploring the job distributions between technical and organisational system.

Furthermore the integrated methodology is observed to be compatible with the EPICog teams socio-technical strategy that is based on iterative Qualitative Research, Action Research and feedback discussion sessions with IT teams. It was discovered that the EPICog team also regarded investigating customers and job satisfaction issues useful in their analysis by using the Capability-Maturity Model (Paulk et al., 1997).

2. The recommended design strategies use and acceptability

The new NHS top-down design strategy, which offers usage of the integrated methodology and QUICKethics, was evaluated as a good and beneficial starting point to structure this problematic and malfunctioning process.

The integrated methodology was found to be useful in compensating for the lack of a soft approach and legitimising soft issues that are assumed to be neat and tidy by the LHC designers. It was found to be helpful for making the designers comprehend and regard the messiness of the complicated situation, which includes enormous diversity and variance in the needs of the front-line staff. Although mentioned as a very unrealistic offer, an interviewee considered SSM as an alternative for PRINCE2 methodology.

The integrated methodology's socio-technical thinking which originates from ETHICS was found to be highly promising by the interviewees at enhancing the socio-technical design of the pathway's collaborative healthcare process and technologies on both

bottom-up and top-down strategies. Additionally it was found to be useful at providing a systematic structure to the already existing but unstructured participation, requirements gathering and design process in Walsall and Northampton's Informatics.

The opinions on the practicality of SSM, ETHICS and the integrated methodology were highly contradictory as shown in *Table 21*. However, the original structure of the techniques or even a 'nice and neat, put-together format' like the integrated methodology were found unlikely to be accepted by the NHS for two reasons.

Firstly, the general recommendations offered in Pathway Analysis make the integrated methodology practical require highly radical organisational changes. Several limitations defined by interviewees are listed in *Table 22*.

Secondly, the integrated methodology was evaluated to be a too structured and long-winded process for the NHS design teams. However the QUICKethics approach in top-down design is found to be applicable, as it is providing a summary approach.

Therefore all interviewees agreed that the integrated methodology should be reworked and summarized to make it a brief, flexible and efficient tool for design teams to not only help structuring their design but also to save money and time. It has been decided that the new structure should only include the stages of the integrated methodology that are most useful to the NHS design teams.

Interviewee	Useful	Practical	Not practical
Interviewee 1	All	Some parts of both	Integrated methodology
Interviewee 2	SSM, Integrated methodology	SSM	Integrated methodology, ETHICS
Interviewee 3	All	None	Integrated methodology, SSM, ETHICS
Interviewee 4	All	ETHICS	Integrated methodology, SSM

Table 21. Interviewee Answers on Use & Practicality

LHC	• LHC approves only a controlled democracy, might not accept a pure democracy. • LHC teams may not prefer to use the integrated methodology as it is over-structured. • LHC is ignorant to the front-end team's working processes and as they prefer to control and monitor the clinicians rather than trying to help them to do the job better. • In LHC although "more strategically thinking Informatics people" could easily adopt SSM, Managers and Commissioners might be inadequate to understand and apply political and cultural analysis. • The projects have resource and budget restrictions. An over-structured method lengthens the design process and increases the required budget.
Informatics	• Informatics team is restricted with specific schedules and quite short timelines. A long-winded approach is infeasible to be applied properly. • Clinical Change Facilitators are working with prioritized jobs. In the turbulent NHS environment, the priorities of these jobs changes frequently and the local work is easily disrupted. This structured integrated methodology might be hard to apply. • Fully democratic participation requests huge amount of budget to be spent on user involvement. • The projects have resource and budget restrictions. An over-structured method lengthens the design process and increases the required budget.

Table 22. Limitations of the integrated methodology at LHC and Informatics level

The new bottom-up strategy of using ETHICS as a participatory design tool for facilitators and user representatives to participate and express themselves technically was said to especially useful by three interviewees. As the Informatics teams are currently looking to restructure their strategies, the acceptance of the bottom-up design strategy is seen to be more likely. However for practicality reasons the required restricting was discussed.

Furthermore for bottom-up recommendations all interviewees shared the same idea that Walsall Infomatics as a large and more autonomous organisation would be better in adopting participatory techniques and more receptive to the offered changes. Northampton IT, which is smaller and less autonomous and less structured in participation, would be more problematic in adopting the structure. However the Retinopathy pathway was found to be in need of such a structure more than the Stroke team.

"If you say it is feasible to do it in Walsall, I would say yes. If you ask if it is feasible in Northants, I would say it's quite hard. That is partly in Walsall they are collaborating -with end-users- with elaborate ways, and I think they lack the tools to do it well…"

Apart from restructuring, interviewees recommended trainings and workshops on techniques for the NHS design teams to make the selected techniques more appropriate to the LHC and Informatics teams.

- A training for QUICKethics, and SSM should be given to LHC
- A workshop on ETHICS should be given to the Informatics clinical change unit.
- The addition of organisational/cultural analysts at the top-level for facilitating SSM usage.
- A Socio-technical consultation is necessary for Informatics to build up a socio-technical understanding.

3. The acceptability of the Integrated Methodology Findings

The integrated methodology was found to lead to insightful and interesting conclusions about new ways of developing pathway services and technologies. Both pathway social and technical objective lists and conflict tables were found valuable and useful for Walsall and Northampton Informatics teams as the findings go beyond the teams current unimaginative and constraint thinking by dealing with the full socio-technical issues from service to national level.

While some of the findings were found similar to discussion issues on EPICog Action Research sessions, some of them pursue a different and useful perspective.

One of the interviewees commented on Retinopathy findings as follows;

"I'm not sure by what process you have done it but the lists of primary changes in both cases are pretty much what I would have come up with."

Another interviewee commented about new changes positively as:

"Use Optimise, [Portal recommendation] that's interesting… Broadly I think they [the recommendations] are right… But by and large, I think that's a good structure for it… I think in fact the list would be of interest of itself, because they [LHC & Informatics] don't necessarily do that. So that's useful."

Although some changes were found to be more likely to be supported and easy to perform, some major changes might not get approval due to conflicts with a national policy or they require too many resource.

4. The most useful stages in SSM & ETHICS

For restructuring the offered strategies, the interviewees suggested retaining only the most advantageous stages of SSM and ETHICS. These were found to be: from SSM, the Rich Picture Drawing, Three Analysis, CATWOE stages and from ETHICS, existing system description, job satisfaction needs, variance analysis, Objective setting and Socio-technical alternative selection stages. Further the Human Activity Model and Role Activity model usage in existing system definitions, job satisfaction and variance analysis were also seen as valuable. The advantages of these stages were mentioned by several interviewees and are detailed in *Table 23*.

SSM	**Rich Picture Advantages:** • Increasing the active worldviews in the system, which is currently under control of only Managers and Commissioners. • Defining the system multi-perspective from different angles such as stakeholders; budgeting, patient satisfaction, job satisfaction views etc • Increasing solving the communication and collaboration conflicts in system by making LHC members breaking the barriers through discourse about all stakeholders' perceptions on the problem. • Providing an easy and enjoyable way to visualise the problematic situation, communicate, brainstorm ideas through rich pictures. **CATWOE Advantages:** • Filling the missing purpose definition stage in PRINCE2 meetings with defining the pathway service's and the technical system's main purpose by unpacking the background, the motivation, the philosophy with CATWOEs root definitions.
ETHICS	**Job Satisfaction Advantages:** • Providing ownership of the designed technology as it is participatory. • Improving productivity with increasing job satisfaction and improving clinician's enthusiasm to their job. **Variance Analysis & HAM/ RAD Usage Advantages:** • Using the Human Activity Models (HAM) and Role Activity Diagrams (RAD) in variance analysis to structure the facilitators design processes, as they are already using a simpler version of these flow-charting methods. **Objective Setting & Socio-technical alternative Selection Advantages:** • Articulating number of alternatives and looking at the comparative merits of different ones by working through socio-technical alternatives as the Informatics people generally tend to plug the first solution that they have.

Table 23. SSM & ETHICS's most useful stages

Summary

This section yielded the EPICog design team's confirmation that the two main studies and their findings are sound.

The EPICog team approved that the integrated methodology is a compatible and promising approach to considerably enhance the socio-technical design of pathway services and technologies. Interviewees also agreed that some of the practicality issues of SSM and ETHICS are reduced with this integration.

Despite the fact that the integrated methodology is useful to generate socio-technically equipped findings and provide a more democratic and innovative socio-technical design which solves the design strategy problems of design teams, it is found practically

infeasible to apply in top-down design. This is due to the NHS's highly conventional and bureaucratic environment, its various organisational limitations and the over-structure of the methodology. Compared to the top-down strategy, the bottom-up recommendation of using ETHICS is found to be much more feasible however similarly over-structured. Furthermore as Walsall Informatics was found to be less problematic than Northants in terms of organisational restrictions, the recommended design strategy should be much more feasible for Walsall.

Although the interviewees found the design strategies impractical, a future study with NHS Walsall and Northampton designers is advised to introduce a summarised version of the methodology and investigate both of these version's practicality:

"I think you've done a great job because it's like, I honestly think it's good that you have worked very much from the data and also the interview stuff that you have been given and the material, and you've tried to capture what is going on... I think if you were to do this for you thesis and then present this to them when you've finished ... You'd get an audience. You know they will be quite interested"

CHAPTER 4. DISCUSSION

The interview analysis has shown that to legitimise the application of the recommended design strategies defined in Design Process Analysis, which is the integrated methodology in top-down strategy, and ETHICS in bottom-up strategy, the researcher should be more pragmatic with the recommended methodologies structure.

Although the Interview Analysis findings approved the detailed advantages defined in Pathway Analysis, interviewees gave more importance to certain aspects of the techniques. To summarize the integrated methodology and ETHICS for the use of NHS, the following most advantageous stages mentioned by EPICog members are used as the main steps.

The main steps of SSM to be used are:

1. Rich Pictures and three analysis
2. CATWOE root definitions

The main steps of ETHICS to be used are:

1. Existing system definitions with Human Activity Models/Role Activity diagrams.
2. Job satisfaction Needs
3. Efficiency Needs using Human Activity Models/Role Activity diagrams
4. Defining Socio-technical alternatives

With the usage of these main steps, previously recommended ideal design strategy is transformed into a new, pragmatic and much more practical design strategy for the NHS. For top-down design, the integrated methodology is simplified with the main steps found for SSM and ETHICS (as shown in *Figure 15*) and for bottom-up design, the recommended ETHICS framework is simplified according to the main steps found for ETHICS (as shown in *Figure 16*).

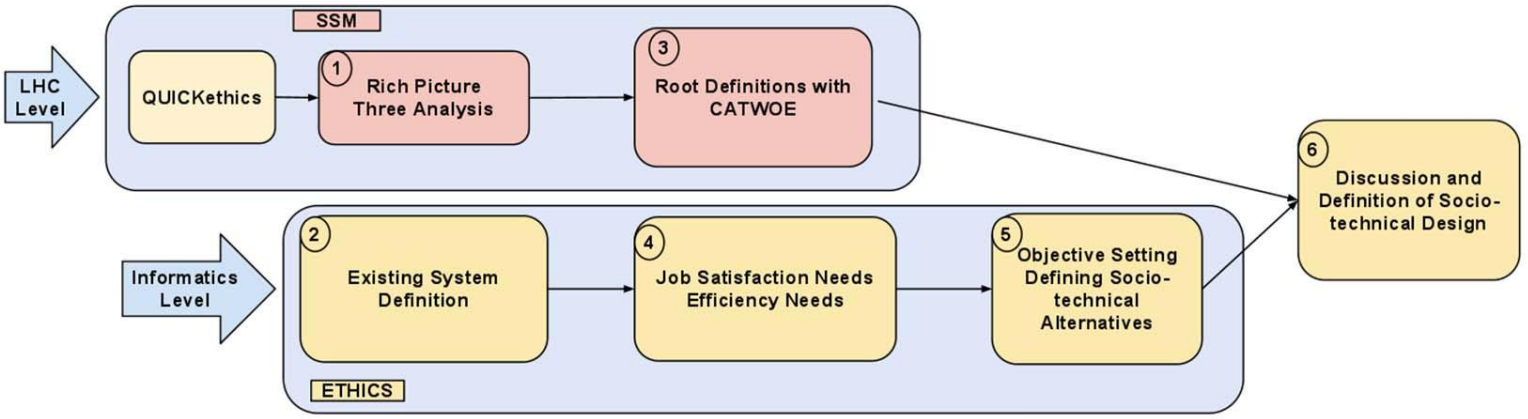

Figure15. Summarized Integrated Methodology (Top-down Strategy)

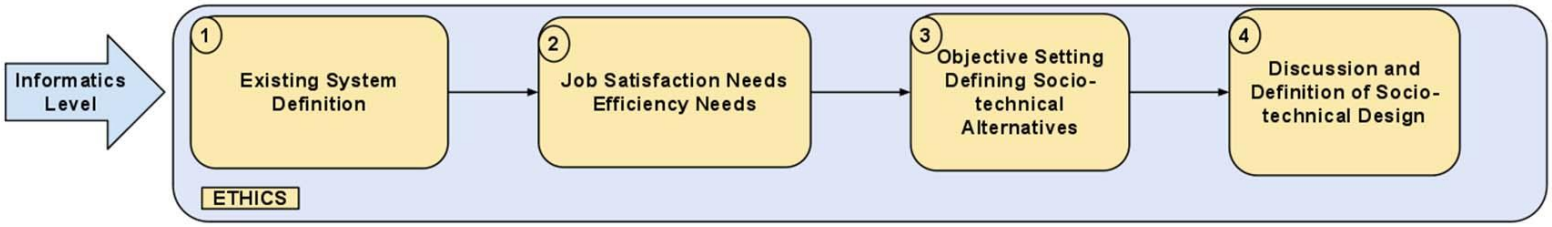

Figure16. Summarized ETHICS (Bottom-up Strategy)

As a result of this section, the third purpose of the research question, which is investigation of the practicality of the integrated methodology, is performed. With the findings of the interviews, the researcher introduced a presumably more practical and pragmatic version of the integrated methodology for complex and problematic organisations like NHS pathway services. The feasibility and desirability comparisons of both versions of the methodology are summarized in *Table 24.*

	Integrated Methodology	Summarized Integrated Methodology
Desirability	Integrated Methodology is desirable since: • The integration is compatible. • It is socio-technically enhancing the design. • The integration increases the practicality of techniques with detailed instructions and reducing limitations with complementation.	Summarized version is more desirable since: • The integration is compatible. • It is socio-technically enhancing the design. • The integration increases the practicality of techniques with detailed instructions and reducing limitations with complementation. • The approach is brief, pragmatic and therefore easy to use.
Feasibility	Integrated Methodology is not feasible since: • Methodology's over-structured process disrupts the feasibility. • The organisational problems in NHS hinder the adoption of the integrated methodology.	Summarized version is much feasible since the feasibility problem is reduced to: • The organisational problems in NHS hinder the adoption of the integrated methodology.

Table 24. Desirability and Feasibility Comparisons of Both Versions

In future studies, the practicality of the summarized integrated methodology should be further investigated with the NHS teams, possibly by performing a presentation including two integrated methodology versions: detailed and summarised versions and the pathway findings. Provided that design teams like one of the versions, some practical trials could be performed with related designers using the selected version.

Furthermore, the summarized integrated methodology might lead to the investigation of the use of Multiview2 Framework (Avison, Wood-Harper, Vidgen, Wood, 1998) as another future study. Although Multiview2 doesn't include any explicit stages from SSM and ETHICS, it is inspired by SSM and ETHICS philosophies. Therefore, its structure may be valuable to investigate further studies on summarized integrated methodology.

CHAPTER 5. CONCLUSION

This study aimed to investigate whether using Checkland's (2006a) Soft Systems Methodology with Mumford's (1995) ETHICS Framework could be compatible, enhance socio-technical design in information systems design problems, and applicable in real world situations.

An integrated 'soft' and 'socio-technical' methodology is introduced by binding SSM and ETHICS frameworks using the four main sections of socio-technical requirements definition tool, ORDIT Methodology (Eason, Harker, Olphert, 1996).

Two Main studies are performed to investigate and justify the conclusions of the research question by using two NHS pathway examples; Stroke Pathway and Diabetic Retinopathy Screening Pathway, which are designed by separate NHS design teams in Walsall and Northampton.

In Main Study One, the design processes taking place in NHS Walsall and Northampton design teams are analysed by applying SSM methodology. This study showed that NHS design strategies have many design problems. In particular, the results showed that there is a need for soft and socio-technical approach in both NHS pathways and it is suitable to apply the integrated methodology to solve their information systems problems. This study resulted in the introduction of a new NHS design strategy which recommends integrating SSM and ETHICS for the NHS top-down and socio-technical pathway design and the ETHICS framework for evolutionary and participatory NHS bottom-up design.

In Main Study Two, each pathway was analysed by applying the integrated methodology as it was recommended for the top-down strategy. This study addressed the first purpose of the research question, which is to show that the SSM and ETHICS integrated methodology is compatible on a practical level. Results of this study provided recommendation lists consisting of organisational and technical objective lists and possible socio-technical design alternatives. More importantly, the researcher experienced several advantages of applying the integrated approach, which answered the

second and main purpose of the research question that the integrated methodology could considerably enhance the socio-technical design of these two NHS pathway's information systems design problems. In the Meeting with the EPICog team, the researcher presented the findings of two main studies to EPICog. Not only did this stage provide the approval of the pathway and design process analysis findings, but it also provided feedback on the third purpose of the research question, which is investigating the feasibility of application of the integrated methodology. Based on the given feedback in the meetings, although the integrated methodology added SSM and ETHICS's benefits while reducing their several limitations and practicality problems, application of the methodology at top-down design was found to be impractical since it is over structured for NHS design teams that are restricted by many organisational problems. After this stage, the integrated methodology was condensed into a summary version which including only the most advantageous stages defined according to the interviewees.

In conclusion, this study has shown that the integration of SSM and ETHICS methodology is practically compatible and promising approach to enhance the socio-technical design of organisational IT problems. It is important to keep in mind that the necessity of the methodology should be investigated in the IT design strategy. This study demonstrated that IT strategies could adopt this methodology when a soft and socio-technical approach is required in the IT design strategy. Although the IT teams within complex organisations, such as the NHS, which is the UK's largest and most complex organisation (Goodwin, 2000), could be facing very complex organisational restrictions and problems, the feasibility problem may be overcome by adopting the summary version of the integrated methodology.

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Appendix

APPENDIX 1. Integrated Methodology Report for Stroke Pathway

In this report, the following applied sections of the Integrated Methodology on Stroke Pathway will be described.

Scoping Section

1. Rich Picture Drawing and Analyses One-Two-Three

2. Problem Definition / Boundary Definition / Existing System Definition

Requirements Gathering Section

3. Root Definitions with CATWOE / Key Objectives, Key Tasks, Key Information Needs

4.Job Efficiency Needs / Efficiency Needs / Future Needs

Modelling Section

5. Setting Objectives

6. Identifying Socio-technical Alternatives / Defining the alternative with Root Definition & Conceptual Model

Scoping Section

1.Rich Picture Drawing and Analyses One-Two-Three

1.1. Pathway Rich Picture and Analysis One

This Pathway Rich Picture is shown in *Figure1*.

The stroke patient's pathway rich picture defines the pathway process that starts with the Ambulance Service medical team taking the patients call and bringing the patient to the hospital as soon as possible and performing diagnosis of stroke FAST (Face Arms Speech Test). Ambulance Service handover the patient to Acute Hospital's A&E Unit clinicians which is responsible of detecting the stroke formally via CT-Scan and giving clot-breaking drugs to the patient for initial prevention and reduction of stroke effects. The next agent, Acute Stroke Unit's multidisciplinary team, is mainly responsible of performing the initial detailed diagnosis and rehabilitation treatment according to the patient's stroke type, severity and level and provides a tailored care plan with its multidisciplinary stroke team according to patient's special therapy needs such as speech therapy, psychotherapy, nutrition therapy, occupational therapy, physiotherapy. After the acute rehabilitation treatment is over, the handover to the Community Stroke Unit is planned and performed. Community Stroke Unit multidisciplinary team communicates with the Acute Stroke Unit multidisciplinary team for discussing the patient's situation and the further needs. After this stage the responsibility of patient is handover to the Community Stroke Unit for further intervention. In this stage the patient could be served in the Community Hospital, in the Care Home or at the patient's own home. For the case when the patient is sent to Community Hospital the condition of the patient is assessed and the further treatment is performed according to the current specific needs with the help of the Social Care worker. For the cases of treatment in Home Care, the further assessment has been provided however Social Care monitors the process by the Community Stroke front-end teams that are visiting the patient periodically and assessing the given treatment. For treatment at patients home, the front-end teams from Community Stroke Unit are visiting patient periodically to give required assessment and treatment. When the second detailed rehabilitation treatment is finished, the patient discharges from the last agent and the long-term monitoring stage starts for which the Community Stroke Unit is responsible of. For three years the follow up check-ups of patient is performed and monitored by Community Stroke Unit and the patients GP.

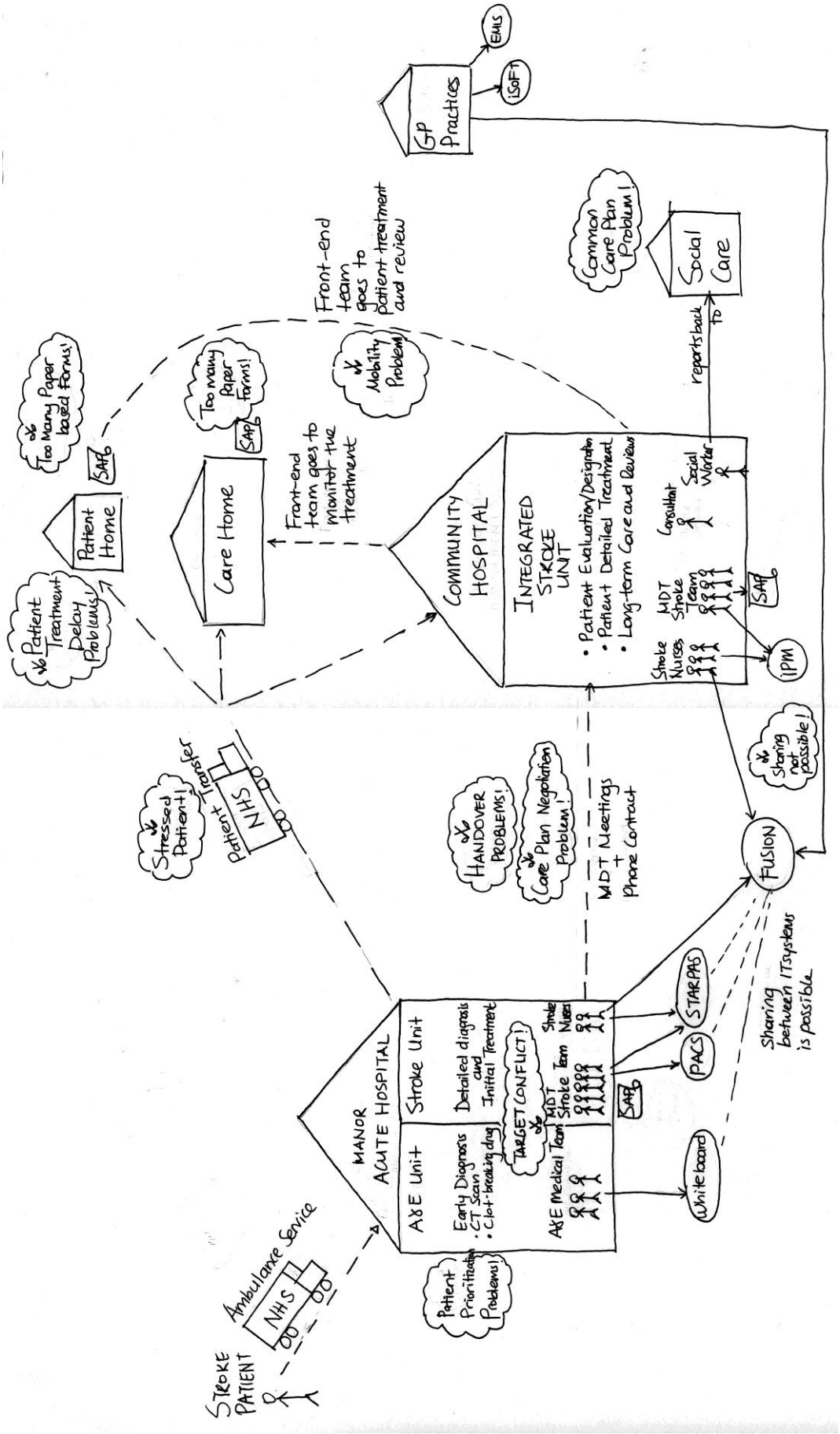


Figure1. Stroke Pathway Rich Picture

1.2. Cultural Rich Picture & Analysis Two

The cultural rich pictures in *Figure 2* included the high-level organizational role hierarchy of the agents of the pathway.

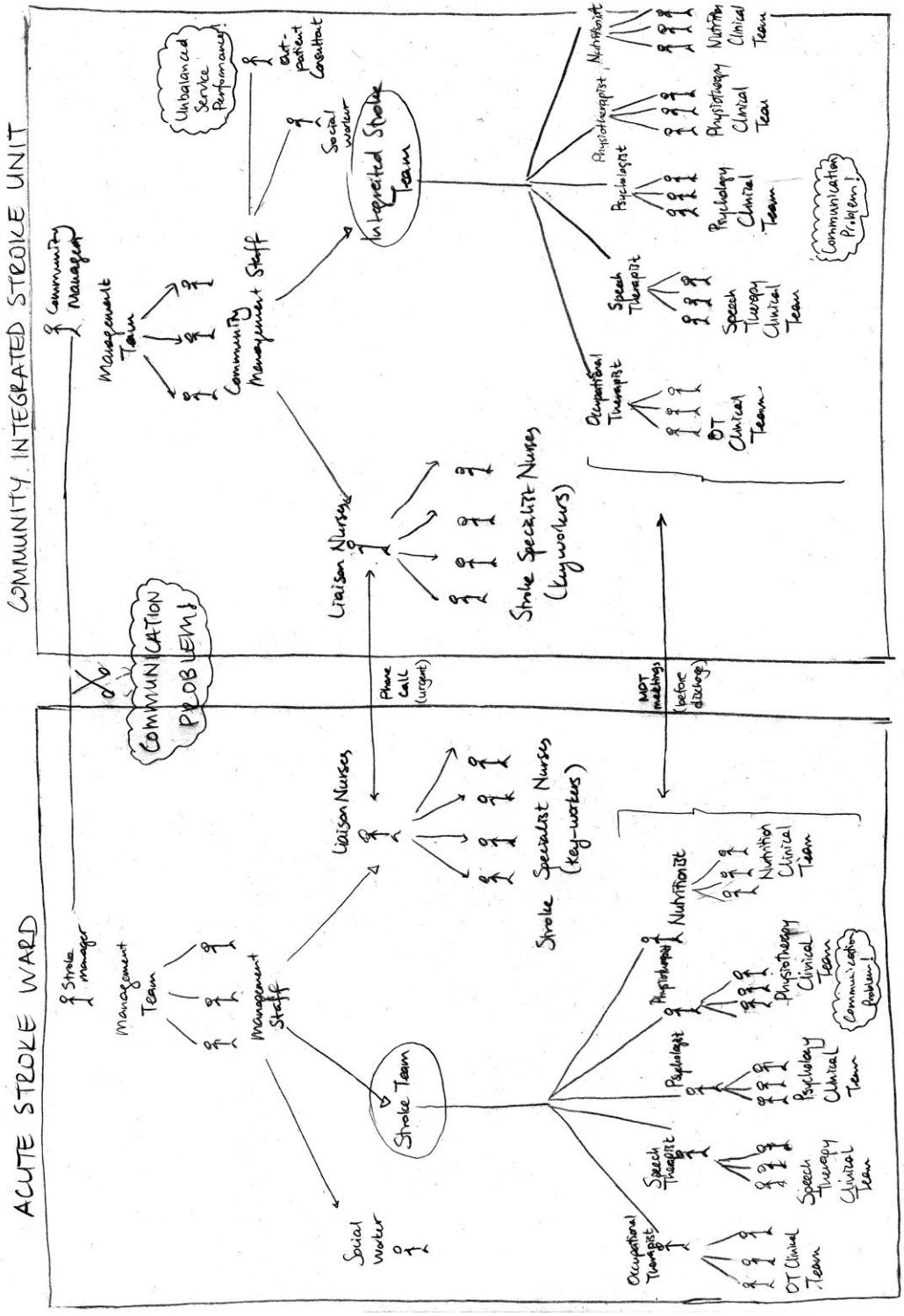


Figure2. Cultural Rich Picture

1.3. Political Rich Picture & Analysis Three (for both pathways)

In the political analysis another rich picture is drawn in *Figure 3* including the major resources of power and influence such as Government, Department of Health and its constituent organizations. These investigated organizations are Connecting for Health (CfH) and Local Health Communities (LHC), Information Management and Technology (IM&T), National Health Service (NHS), NHS Trusts, NHS providers specifically Manor Hospital, Community Hospital Acute Hospital and Screening Service.

In the big picture, there is an enormous legitimate power coming from the Government and the Department of Health that restricts the LHC and NHS in terms of resource and budget cuts.

Department of Health has the NHS, Connecting for Health and Local Health Community as its constituents and these organisations and their relationships are tremendously bureaucratic and therefore consist of a role culture.

CFH & LHC

NHS Connecting for Health (NHS CFH) is part of the Department of Health Informatics Directorate. Its role is to maintain and develop the NHS national IT infrastructure.

The LHC role culture has 16-groups where each group has a multicultural structure that consist of county based NHS Trust representatives, Providers and Commissioners representatives, and their Informatics representatives. Their role is to maintain and develop the service level needs for each pathway and define the specifications of technical tools that will be developed by Informatics. With the Department of Health's legitimate power, the LHC is forced to create technical policies to be applied by Informatics departments.

NHS, NHS Trusts and NHS Providers

NHS is defined as a typical role culture, which includes some groups that have power cultures. It consists of NHS Trusts and Providers.

The NHS Providers such as; Manor Hospital, Community Hospital, Northampton General Hospital are defined as smaller role cultures that consists of bureaucratic organisations. Department of Health applies a legitimate power to the NHS and its Trusts to create organisational service level policies that are called as 'national performance targets' to be applied by NHS Providers.

The clinicians in NHS Providers are especially exposed to coercive power from NHS Trusts to apply organisational policies defined by Trusts to perform their job according to the National Standards. This basically is based on a punishment system, which causes financial deductions in the clinician's salary depending on their performance to fulfil the defined requirements.

However some part of these NHS Providers observed to include power cultures. Consultancies and hospital specialist teams have power culture structure with their clinical team as all the work centres about the consultants and specialists in those groups. These groups of people act independent from the overall role culture of the hospital within their culture, which is called as 'firm' by them. All the junior doctors are dependent on the value and rule of their consultant or the specialist doctor. The specialists and consultants are using their expert power on their clinical teams and trainees.

Informatics

The Informatics Service is also a role culture with rapid role changes in the organisation caused by the turbulent environment. The Informatics is exposed to legitimate power from LHC and NHS Trusts that restricts the bottom-up and top-down design with specific technical and organisational service policies. Furthermore, LHC restricts the local autonomy of Informatics by dictating the top-down design decisions and restricting the bottom-up design changes with minor and local clinical changes, which are called 'tweaks'. The bottom-up user needs gathered by hybrids are controlled and filtered by the Informatics Project Management, Senior Informatics, and Development teams. Although some senior hybrids have an expert power on the request of the changes, generally their seniority is inadequate to actually be significantly influential on the design decisions.

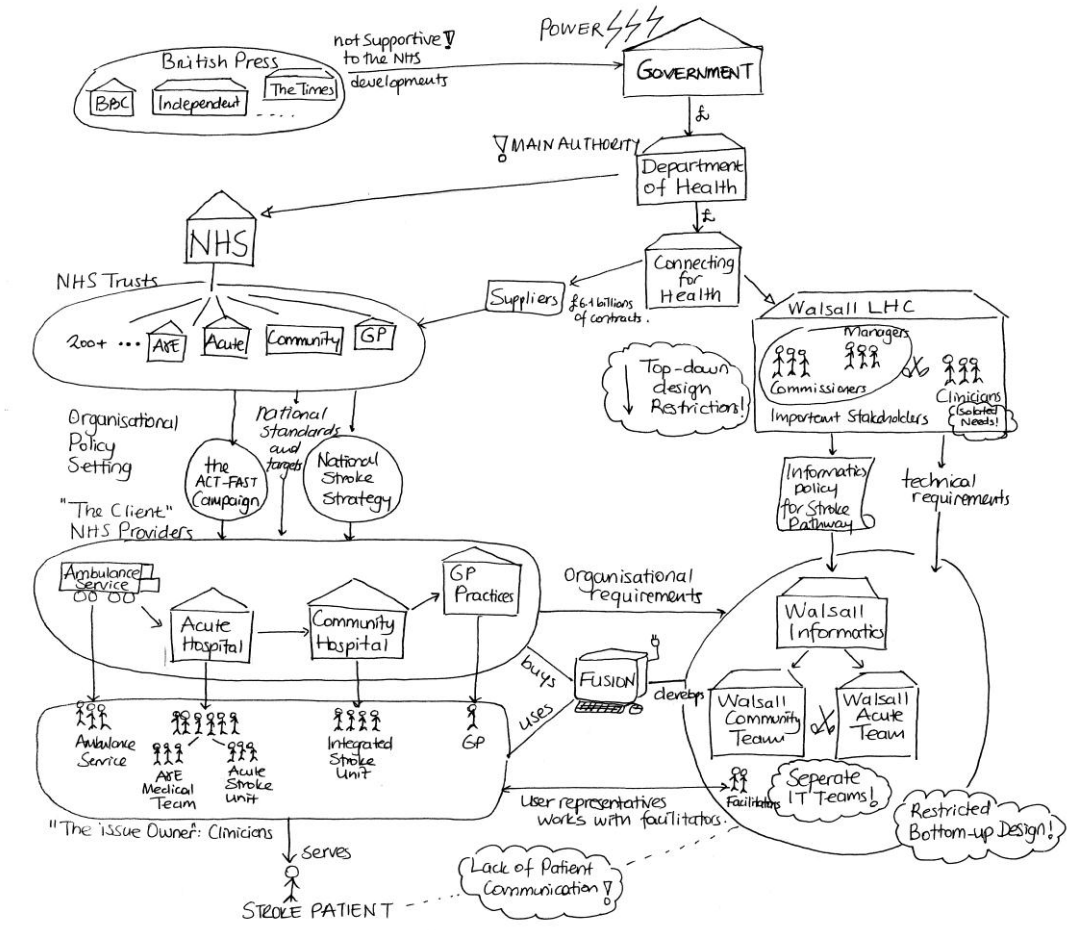


Figure3. Stroke Pathway Political Rich Picture

2. Problem Definition / Boundary Definition / Existing System Definition

2.1 Problem Definition

In this section the 'Problematic Situations' identified from Rich Pictures are used.

Common Problems and Conflicts aroused from Political Analysis

1. **Problem between British Press and NHS:** British Press is not encouraging and supporting the improvement process of NHS.
2. **Government budget** restricts the amount of change that can be done. The systems are fixed and it is expensive to change the overall system.

3. **Separate top-down policy enforcements:** From NHS Trusts the clinical targets are defined, from the Local Health Communities the technical targets are defined. The IT team needs to interpret those separate needs.
4. **Management tool:** The systems are mainly used for management purposes. The clinicians are not benefit from it. The LHC decides on the product specifications and pathway redesign with considering managers and commissioners needs.
5. **Patient Participation:** Development team has a lack of communication with Patient.
   Previous stroke patient's opinions are not involved in the design process

Problems and Conflicts from Stroke Pathway Rich Picture

1. A&E vs. Stroke Unit
   a. **Patient Prioritization Conflict:** A&E can miss the stroke patient and diagnose late.
   b. **Handover Target Conflict**: A&E sends the patient to ct scan and discharges it from FUSION
2. Acute Stroke Unit and Community Integrated Stroke Unit
   a. **A working tool to help clinicians**: Front-end teams require a mobile device for data entry.
   b. **A mobile working tool for SAP**: Hospital clinicians require a mobile device to reduce and manage the bedside paper forms
   c. **Handover Target Conflict**: The Acute team wants to discharge patient early, the Community team needs to be ready before taking patient. Causing patient treatment delays.
   d. **FUSION data information sharing Conflict**: Community does not have enough information about the patient from Stroke Unit before the handover. The Acute Unit is using FUSION at discharge. Causing patient treatment delays.
   e. **Data Management vs. Data Analysis:** Hospital clinicians require a system that analyses the patient progress and clinician performance
3. GP vs. Department of Health policies:
   a. **GP responsibility:** The Government policies increase the GP responsibilities and reduce the hospital clinician's responsibilities. GPs are not very happy with that.
4. Social Care vs. Acute Stroke Unit & Community Stroke Unit
   a. Require a common care plan: The Social Care wants to have a voice to define the care plan of the patient. The monitoring feedback is only entered into FUSION.

Separate Problems and Conflicts aroused from Political Analysis of Stroke Pathway

1. **Patient confidentiality:** Stroke Patient is in an urgent condition; therefore patient confidentiality is not important for the patient who is in a life and death situation. However the department of health is always too strict in terms of patient confidentiality and sharing patient information. This leads to role-based access in the systems and limited amount of data sharing.
2. **Problem of separate IT Health Groups**: Acute Care IT Group, Community Health IT Group. This separate IT Groups develop separate systems as Ken is described as Silos effect (Ken, 3rd meeting); which means the developed systems don't talk to each other. However Walsall is more improving in this sense, as it is a shared service for Acute, Community and Primary Care Trusts.

Problems and Conflicts aroused from Cultural Analysis of Stroke Pathway

1. **Out-patient consultant:** Community Hospital has out-patient consultant which makes a difference between the Manor hospital and Community hospital
2. **Social worker:** Community Hospital doesn't have to have social worker, which reduces the resilience of the organisational system as monitor of the service is lacking in this situation. It also causes different quality degrees of Acute and Community Stroke care.
3. **FUSION User:** The person who is responsible from entering the data into FUSION is not defined. It might be any medical staff, a nurse, the specialist nurse etc. It must be the key-worker nurse.
4. **Communication between Acute & Community:** The system doesn't provide the communication between Integrated Stroke teams very well. The only communication is through Liaison Nurses on phone and in MDT meetings with teams if the patient's conditions are urgent.
5. **Multidisciplinary team communication:** The communication within teams is also disconnected. The Stroke teams have several specialist doctors and they have their own clinical teams that are not very connected to each other.

2.2 Boundary Definition

The system boundaries are defined as the whole pathway starting from Ambulance Service, continuing with A&E and Stroke Ward in Manor Hospital and ending with Integrated Stroke Unit in Community Hospital. However the system re-design will also cover the GPs who are responsible of monitoring the patient. The design will cover the pathway facilities of the agents. Any other responsibilities of agents unrelated with stroke patient will not be involved.

Business activities expected to be affected:

- Clinician numbers
- Financial budget

Existing technology expected to be affected:

- FUSION

Parts of the organisation boundaries:

- Ambulance Service
- Manor Hospital's A&E and Stroke Ward,
- Community Hospital's Stroke Unit
- Social Care
- GP Practices

Parts of the organisation's environment affected:

Suppliers

- Walsall IT team
- Bayswater Institute EPICOg socio-technical team

Customers

- Mainly the Community & Manor Hospitals

2.3 Existing System Definition

In the existing system definition stage the departments, their agents and clinician teams are identified. After this a Horizantal Input-Output Analysis performed. Lastly, the Stafford Beer's Viable System Model is performed.

2.3.1. Departments, Sections and staff:

- Ambulance Service
  - Ambulance team

- Manor Hospital
  - A&E Department
    - A&E medical staff
  - Stroke Ward
    - Medical Staff
    - Nursing Staff
      - Lead Nurse- Senior Nurse.
      - Liaison Nurses
      - Discharge Nurse
      - Junior nurses.
    - Rehabilitation Staff
      - Physiotherapist
      - Speech Therapist
      - Psychologist
      - Occupational Therapist
      - Nutritionist
    - Social Care Worker
- Community Hospital
  - Stroke Manager
  - Community Stroke Nurse:
    - Stroke Liaison nurses- key worker for patient
  - Specialist Stroke Team
    - Physiotherapy
    - Speech Therapy
    - Psychological therapy
    - Occupational therapy
    - Nutrition therapy
  - Social Care Specialist
  - Out-patient Hospital Specialist – Consultant does the regular review.

- GP Practices
  - GP

2.3.2 Horizontal Input - Output Analysis:

Ambulance Service

- Input: A call is taken from 999.
- Main Activity: Suspect from stroke, apply FAST-ACT check and take patient to hospital as fast as possible
- Output: The patient who had his initial intervention is taken to the hospital.

A&E

- Input: The undiagnosed patient comes to the A&E.
- Main Activity: Diagnose the stroke with CT Scan and give clot-breaking drug
- Output: The diagnosed stroke patient is sent to Stroke Ward.

Stroke Unit

- Input: The patient with a stroke diagnosis had arrived to Stroke Ward.
- Main Activity: Assess the stroke, diagnose the patient in detail and start the initial rehabilitation treatment.
- Output: The patient discharged to detailed rehabilitation

Community Hospital

- Input: The discharged patient who had the initial treatment arrives from Stroke Ward to Community Hospital.
- Main Activity: The integrated stroke unit reviews the patient, decides on patient daily care-plan and applies the rehabilitation treatment. The social worker monitors the service and reports it to Social Care Services.
- Output: The patient is discharged from Community to GP control.

GP

- Input: The discharge summary of the patient and a discharge notification.
- Main Activity: Monitor the patient records after discharge
- Output: Enter monitored patient's data into GP systems such as EMIS, iSOFT.

2.3.3. Stafford Beer's Viable System Model:

2.3.3.1. Operating activities.

These are the routine tasks of clinical team members that enable the principal functions of the department to be carried out. Initially brief descriptions of the activities described in lists, then the detailed flow-models are shown.

Ambulance Service Operating Activities:

1. FAST check: suspect from a stroke
2. Collect medicines, pills from patients home
3. Take patient to hospital as soon as possible.

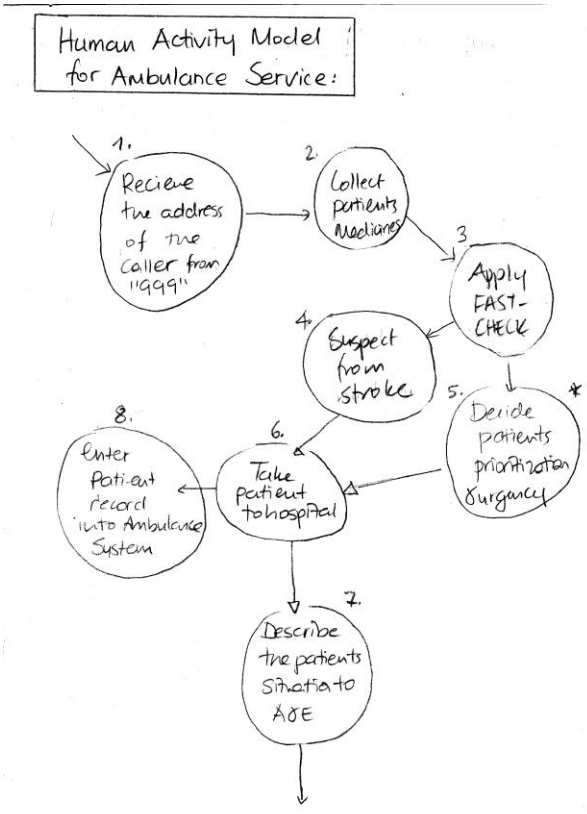


Figure4. Human Activity Model for Ambulance Service

A&E Unit Operating Activities:

1. Patient entry to Whiteboard system.
2. If Ambulance suspected from stroke
    a. Send suspected patient to diagnosis
3. If not suspected suspect stroke,
    a. Early rapid diagnosis.
4. Diagnose Stroke: Perform CT Scan.
5. Give Clot-breaking drug in 30-60 mins.
6. Send the patient to the Stroke Ward as soon as possible for starting the rehabilitation.

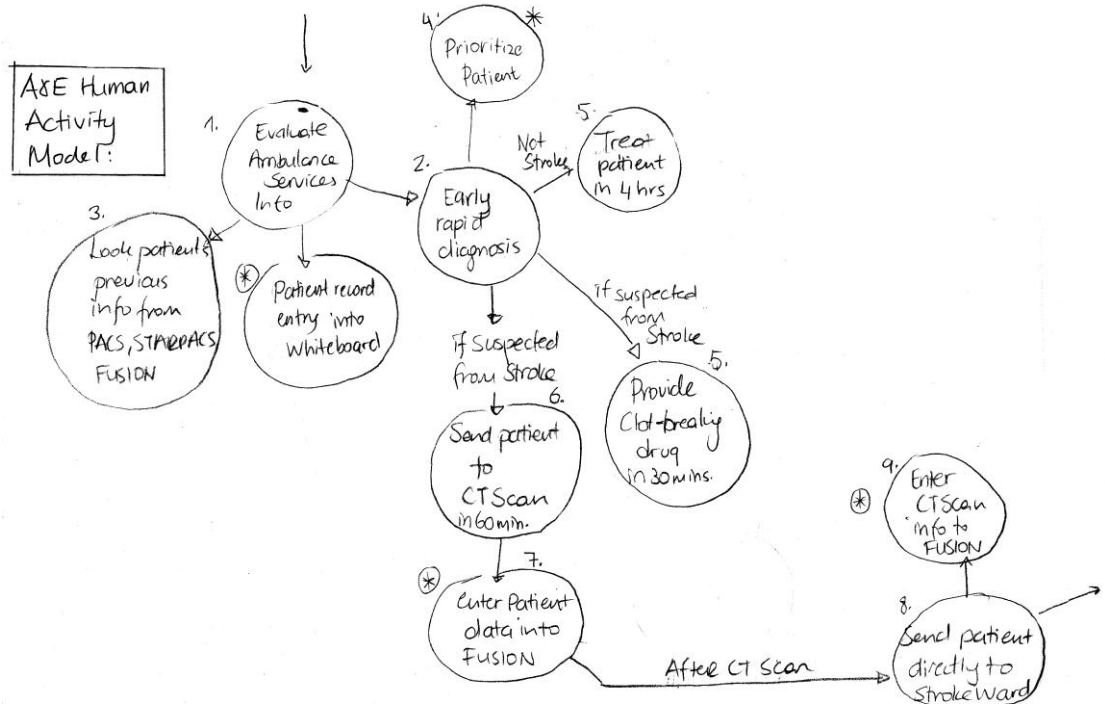


Figure 5. Human Activity Diagram for A&E Unit

Acute Stroke Ward Operating Activities:

1. The initial work is to limit the damage… (You haven't have time to go round each course.)
2. Try to find previous hospital records of the patient from STAR PAS, PACS, FUSION.
3. Investigation / Assessment of the situation of a stroke patient:
    a. Diagnose stroke type.
    b. Diagnose stroke severity.
    c. Diagnose impairments of the patient caused by stroke.
    d. Define the special treatment/ rehabilitation daily plan for the patient according to the patient's stroke type, severity and impairments.
4. Start rehabilitation programme
    a. Physiotherapy
    b. Speech Therapy
    c. Psychological therapy
    d. Occupational therapy
    e. Nutrition therapy
5. Fill SAP paper based documents kept by the patient's bedside
6. Transcript the paper documents into STARPAS
7. At the time of discharge:
    a. A nurse use other records- paper and STAR PAS to transcribe information into FUSION.
        i. Reports from specialists
        ii. Patient care plan is written as a patient summary of care report
    b. A member of the medical team prepare the electronic discharge summary on FUSION.
    c. Social care worker put his report into PARIS and also FUSION.

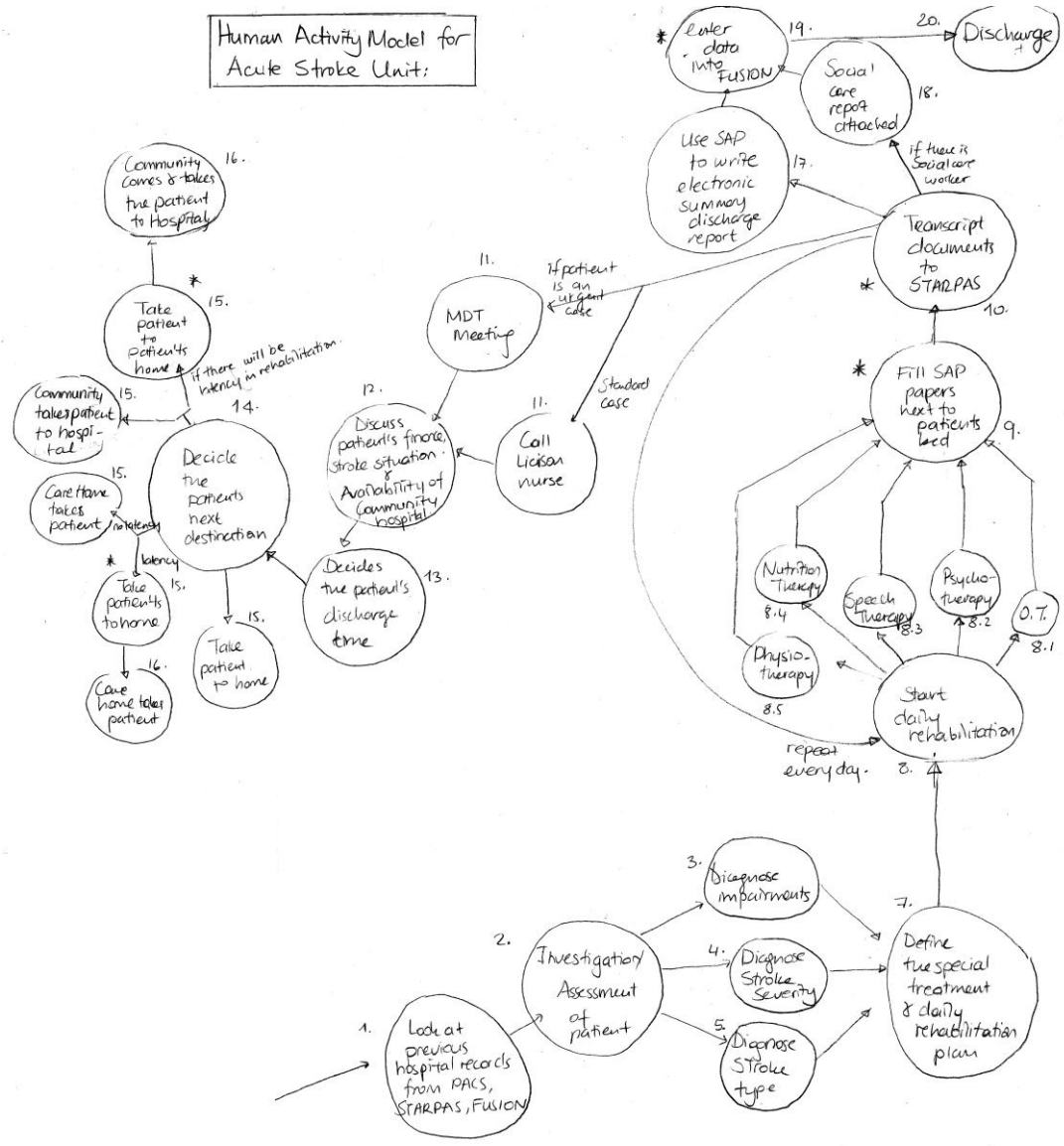


Figure6. Human Activity Model for Acute Stroke Unit

Community Integrated Stroke Unit Operating Activities:

1. Before discharge of patient from Stroke Ward, information exchange between Stroke Unit and Community
    a. A service visit the ward meet patient and attend multi-disciplinary team meetings to understand the specific needs of the patient
    b. Sending information email
    c. Making phone contact
2. Getting initial information about patient's stroke severity and type.
3. Getting information about patient's financial situation.
4. Community makes sure that they can provide suitable care for patient.

    a. If they cant, the therapy delayed for a period.
5. Categorizing patient according to the Bartel Score. Deciding the next destination of the patient
    a. Patient stays in the hospital
    b. Patient is sent to Care Home
    c. Patient is sent to patient's house.
6. Once the patient is ready to discharge from Stroke Ward, Community service picks up the patient.
7. Medical Team reviews patient's situation according to previous rehabilitation
    a. Medical team refers back to Stroke Register
    b. Medical team tries to communicate with Stroke Unit if more information is necessary.
8. Decide a care plan: DAILY SCHEDULE for patient rehabilitation.
9. If patient is at community hospital
    a. Apply Multidisciplinary care therapy plan at hospital
    b. Paper documents are filled in according to the treatment daily
    c. Any face-to-face activity with patient, group-activity is transcribed into iPM.
    d. Summary care report: A summary of the rehab programme entered into Community model of Stroke Register.
10. If patient is at care home
    a. Care home applies the treatment
    b. Front-line teams go there for review and advise on the treatment
11. If patient is at care home or patients home
    a. Front-line teams go there to apply the treatment
    b. Single Assessment Process: fill set of agreed, paper-based documents and leave them in the patient's home.
    c. Take the carbonated copy to the hospital
    d. Transcript both into iPM with the referral details such as date, time, duration of contacts, type of the contact, who entered it,
    e. Summary care report: A summary of the rehab programme entered into Community model of Stroke Register.
12. Weekly meetings to review the progress of patient and revise the care plan
13. Get monthly reports from Informatics about the performance and activity levels of the team.
14. At any time they can use the disaster management templates for getting reports.
15. At the time of discharge:
    a. A member of the medical team prepares the electronic discharge summary on FUSION.
    b. Social care worker put his report into PARIS and also FUSION.
16. After discharge in long term: Regular Check-ups and tests and post stroke reviews
    a. Hospital consultant has out-patient sessions with the patient at regular intervals – 3 months, 6 months, 1 year, 2 year, 3 year.
    b. A nurse from Community reviews the patient.

c. Apply Bartell Score of the overall success of the patient progress. (but it is hard to perform manually)
d. They both write a review.
e. If patient has a problem related with stroke, he/she can ask for a home visit.
f. They have the Leeds University project for post stroke.

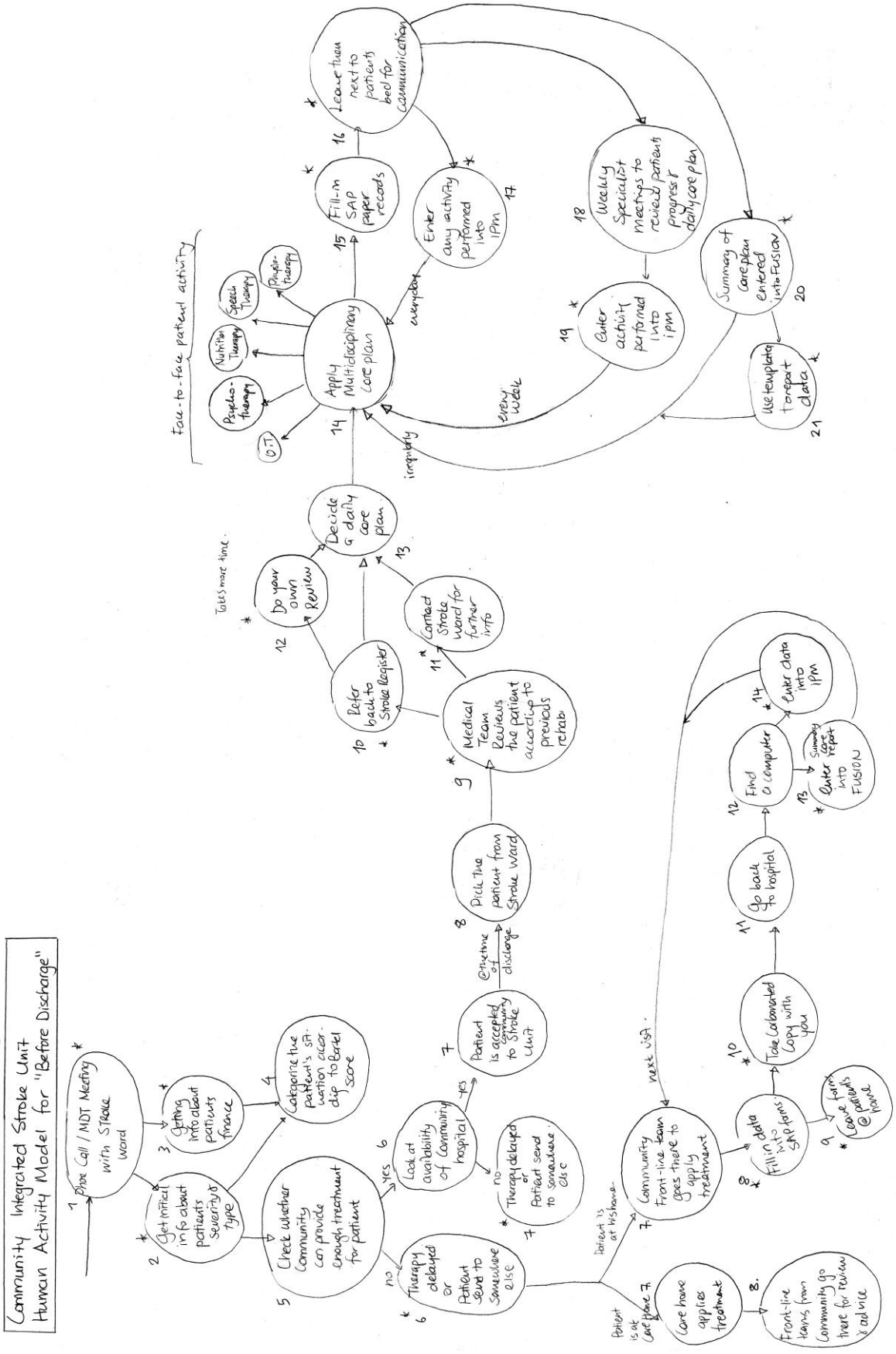


Figure7. Human Activity Model for Community Unit- 'Before Discharge'

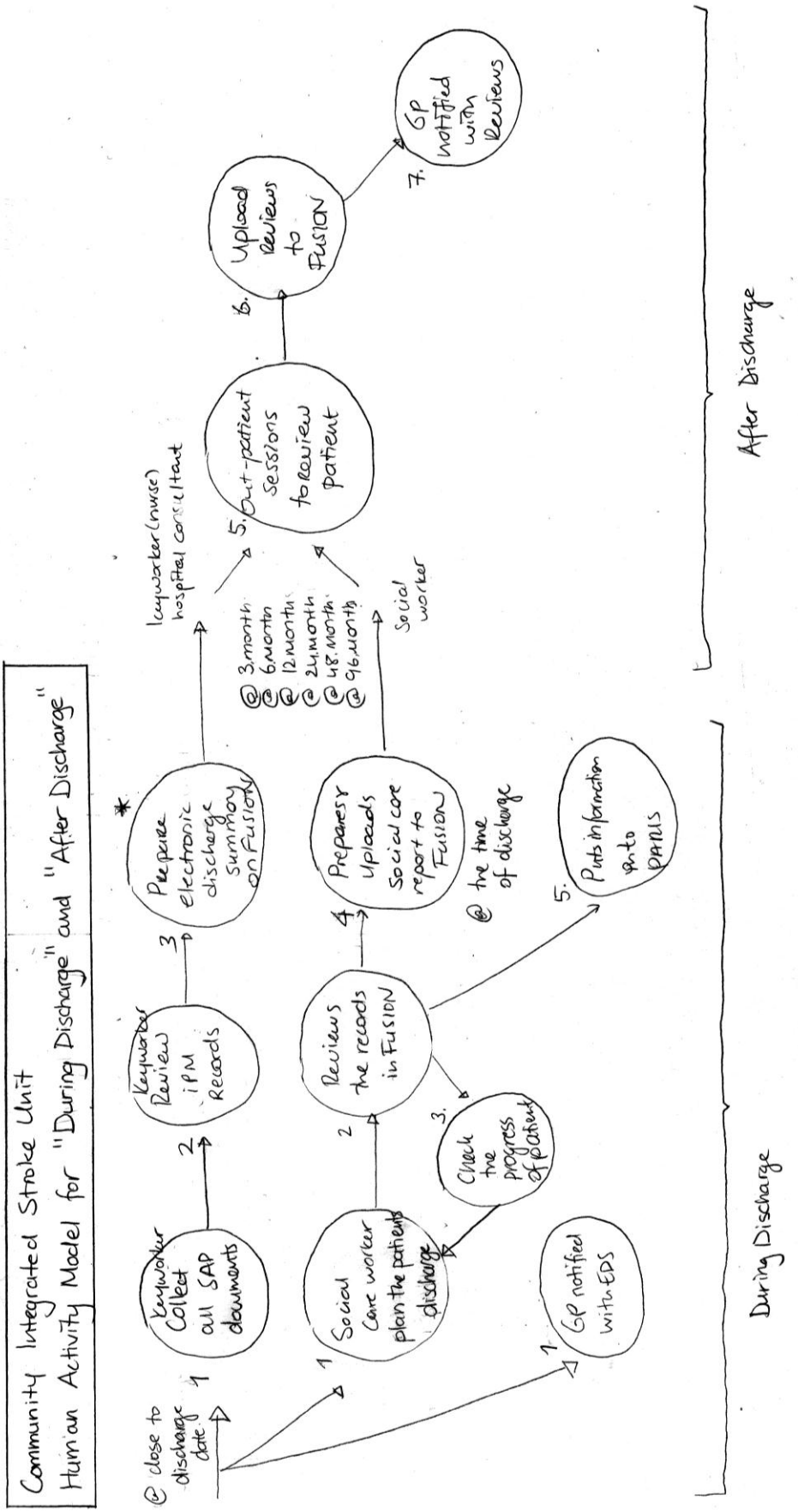


Figure 8. Human Activity Model for Community Unit- 'During & After Discharge'

GP:

1. GP admission to the Stroke Unit (rarely happens)
    a. GP discovers the patient had a stroke.
    b. Front end team from Stroke Unit goes to see patient
    c. Arranges admission to Stroke Unit, Integrated Assessment Unit.
2. Regular admission – through Ambulance service
    a. GP gets electronic notification that the patient had a stroke.
3. GP updates the system to see whether clinical staff has uploaded any new information.
4. At any time GP can get the electronic summary reports to review the patient's progress.
5. When the patient discharged from hospital, an electronic discharge note is sent to GP.
6. After discharge, GP gives patient the medication that has been prescribed and provides an ongoing monitoring

2.3.3.2. Prevention/solution activities.

These are the activities directed at preventing work problems occurring and correcting these when they do occur.

- To prevent and limit the damage of the stroke the patient needs to be diagnosed early and give clot-breaking drug.
- To provide quality control and risk assessment, which is mainly monitored by management and Stroke Audits, the FUSION system reports whether the clinicians meets the target deadlines. The management applies financial reductions for the targets that are unmet or met late.
- The Social care can monitor the treatment of the patient in both Acute & Community Services.

2.3.3.3. Co-ordination activities.

These are the activities and tasks that have to be coordinated within the department and between the department and other departments and sections.

In Stroke pathway, the coordination activities are mainly sequential activities that trigger each other. There are no simultaneous activities in the existing system.

- Ambulance Service - A&E:
    - Ambulance Service notifies A&E that they are suspected from stroke.
    - A&E increases the priority of the patient and decides to treat him within 30mins.

- A&E – Stroke Ward:
    - A&E sends the diagnosed stroke patient to Stroke Ward.

    - Stroke Ward looks whether they have bed for patient.

- Stroke Ward – Community Stroke Unit:
    - Stroke Ward communicates with Community near to discharge of patient by phone or meeting in Multi-disciplinary
    - Community investigates the patient's situation, whether their resources are able to serve him and the next destination of the patient.

2.3.3.4. Development activities.

These are the activities, products, services etc. handled by the department need to be developed and improved. Activities are same as described above sections.

Products:

- FUSION

Services:

- A&E Service
- Stroke Service
- Community Service

2.3.3.5. Control activities.

These are the activities to control the total department so that it works efficiently, meets its targets and achieves its objectives.

The technical system FUSION has a functionality to check the targets of the organization according to the National Programme's National Stroke Strategy performance indicators. The system is successful in terms of this, however it doesn't provide either target management or investigation of clinician's personal performance or the stroke service's overall performance.

Requirements Gathering Section

3. Root Definitions with CATWOE / Key Objectives, Key Tasks, Key Information Needs

3.1. Root Definitions with CATWOE

CATWOEs for ideal social system and technical system is generated.

3.1.1. CATWOE for Social system

Customer: **intended beneficiaries of the organisational system.**

- Stroke Patient

Actors: **who take action in the system**.

Ambulance Service Paramedics

Manor Hospital - A&E Unit Medical staff in A&E

Manor Hospital and Community Hospital's Stroke Units

Specialist Nurses

Specialist Teams

Occupational Therapist

Speech Therapist

Psychologist

Nutritionist

Physiotherapist

Social care worker

GP and its Nurses

Transformation: Patient with an undiagnosed urgent case arrived to hospital → Patient's stroke diagnosed, assessed and treated.

Worldview:

Improving the social system to provide a better experience to the stroke patient throughout the care service by faster stroke identification, faster and safer rehabilitation and treatment, continuous monitoring with a stronger focus on their long-term needs.

Owner: Manor Hospital, Community Hospital

Environment: Entire healthcare and social care environment. Anywhere where the patient treatment takes place: Manor Hospital, Community Hospital, Patient's home, Care Homes, GP Practices etc.

3.1.2. CATWOE for Technical system

Customer: **intended beneficiaries of the technical system.**

- Management teams of Manor Hospital and Community Hospital
- Ambulance Service Paramedics
- Manor Hospital - A&E Unit Medical staff in A&E
- Manor Hospital and Community Hospital's Stroke Units
    - Specialist Nurses
    - Specialist Teams
        - Occupational Therapist
        - Speech Therapist
        - Psychologist
        - Nutritionist
        - Physiotherapist
    - Social care worker
- GP and its Nurses

Actors: who take action in the system.

- Same with the customer

Transformation:

- No patient record → Defined patient record holding information about patient's care plan, handovers, progress
- Clinician's and their teams previous situation → Clinician's and their teams current situation

Worldview:

Improve the technical system that helps the clinicians through their work and helps the manager through monitoring the hospital service.

Owner: Manor Hospital, Community Hospital

Environment: Entire healthcare and social care environment. Anywhere where the patient treatment takes place: Manor Hospital, Community Hospital, Patient's home, Care Homes, GP Practices etc.

3.2. Key Objectives, Key Tasks, Key Information Needs

3.2.1. Key Objectives

According to the identified purpose definitions with CATWOEs, the key objectives are defined. The existing business mission is defined by answering the question of "Why does this department or function exist?" The ideal business mission is investigated by answering "What should it be doing?"

Current Business Mission: Why does this department function or exist?

Cure of stroke patient and return them to their normal live.

- Take the patient to hospital
- Diagnosis of stroke
- For prevention and treatment of stroke damage, give a specialised rehabilitation according to patients stroke type and severity
- Safe and early discharge
- Continuity of monitoring by GP and regular reviews on 3 months, 6 months, 12months, 24 months, 48 months, 96 months of discharge.

Key Objectives: What should it be doing?

1. Raise awareness in Patients about stroke and FAST-ACT
2. Detect stroke high-risk patients and take precautions against a possible stroke.
3. Reduce the death rate after stroke.
4. Fully cure each stroke patient and increase the number of patients recovered successfully.
5. Improve patient experience.
6. Hospitals shouldn't compete but collaborate.
7. Prevent the recurrence and avoid another stroke happen again because someone who has already experienced a stroke is at increased risk of having another.

Enhanced Business Mission:

1. Giving them faster stroke identification, continuous monitoring, faster rehabilitation, faster access to the right kind of treatment, at the right place, at the right time, with a stronger focus on their long-term needs.
2. Provide a faster and safer patient experience with clinicians applying National Programme's target and standards.

3.2.1. Key Tasks

The key objectives are decomposed into its key tasks by considering what must be completed to fulfill the particular objective, irrespective of how the department is organized or the technology it uses.

Key Objective 1: Raise awareness in Patients about stroke and FAST-ACT

- Use media to consciousness raising.
- GPs should inform people above 65. %25 of all strokes are under 65. (UK Statistics)

Key Objective 2: Detect stroke high-risk patients and take precautions against a possible stroke.

- Provide identification of high-risk groups and elder patients with GP Practices.
- Encourage people to do regular life-scans and check-ups
- Invite and support the elders and high-risk patients for life-scans from the government.

Key Objective 3: Reduce the death rate after stroke.

1/3 of the patients are lost during the Ambulance service. 1/3 of the patients are lost during the A&E. 1/3 of the patients will be able to move on the Stroke Ward and Community care. (Both Ken & http://www.nursingcenter.com/prodev/ce_article.asp?tid=1020604)

Considering this 1/3 rule the system should offer;

- Fast Diagnosis in Ambulance Service
- Fast Diagnosis in A&E

Key Objective 4: Fully cure each stroke patient and increase the number of patients recovered successfully.

- Early stroke limitation
    - Early detection of stroke
    - Giving the clot-breaking drug early.
    - Starting the rehabilitation early.

- Stroke treatment and monitoring
    - Provide an organised overall treatment for patient.
        - Define personal goals for patient, and monitor them.
        - Define team goals for service clinicians, and monitor them.
        - Receiving an adequate amount of rehabilitation.
        - Provide psychological support to the patient. 1/3 of all stroke patients have post-stroke depression and this depression affects their performance of survival and cognitive and functional recovery.
        - Provide psychiatric help up-to 3 years.

        (http://en.wikipedia.org/wiki/Stroke)

        (http://psychology.wikia.com/wiki/Post_stroke_depression)

Key Objective 5: Improve patient experience.

- Safer service.
    - Provide full recovery.
    - Apply National Strategy Standards.
    - Provide good and planned handovers.
    - Decrease the amount of time that the patient waits in A&E to get service.
    - Decrease the amount of time that the patient waits to be served by Ambulance Service.
    - Increase the rate of early diagnosis in both A&E and Ambulance Service.

- Comfortable service.
    - Provide the patient a care as if they are in their homes.
    - After initial diagnosis and treatment, provide home care.
    - With longer treatment and monitoring provide a feeling of safety.

- Tailored service.
    - To improve the current services

- Provide the early discharge of the patient as no one likes to stay at hospital.
    - Prevent and limit the damage of the stroke early.
    - Provide necessary treatment as early as possible.

- If it is possible for patient, provide the initial treatment at home as early as possible and send the patient for home care

  (http://strokerecovery.com/at-home/)

- Improve the psychological situation of the patient.
  - Motivate patient
  - Provide psychological treatment to patient.
  - Support the patient's family. (http://rusk.med.nyu.edu/stroke)
  - Include the family caregiver to treatment
  - Give training to the family caregiver.
  - Provide psychological support to the patient's family
  - Lessen the handovers so that reduce the patients stress for change.

    (http://www.strokeassociation.org/STROKEORG/LifeAfterStroke/Life-After-Stroke_UCM_308546_SubHomePage.jsp)

Key Objective 6: Hospitals shouldn't compete but collaborate.

- Share the resources of the Manor and Community Hospitals
- Increase the communication and collaboration between them. (http://www.nursingcenter.com/prodev/ce_article.asp?tid=1020604)

Key Objective 7: Prevent the recurrence and avoid another stroke happen again because someone who has already experienced a stroke is at increased risk of having another.

- Continuity of the care plan to prevent the recurrence
- Provide life scans regularly
- GPs control risky conditions.
- Raise awareness to how to control
  (http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Stroke_prevention_for_high_risk_groups?open)
  (http://www.strokeassociation.org/STROKEORG/LifeAfterStroke/HealthyLivingAfterStroke/Healthy-Living-After-Stroke_UCM_308568_SubHomePage.jsp)

3.2.3. Key Information Needs

Information Needs: The information required completing the key tasks are defined.

Key objective 1: Raise awareness in Patients about stroke and FAST-ACT

No	Key task	Information Need
1	Use media to consciousness raising.	Campaigns for raising patient awareness
2	GPs should inform people above 65. %25 of all strokes are under 65. (UK Statistics)	Add a new responsibility to GP role definition

Table1. Key Objective 1's Key Tasks

Key objective 2: Detect stroke high-risk patients and take precautions against a possible stroke.

No	Key task	Information Need
1	Provide identification of high-risk groups and elder patients with GP Practices.	Add a new responsibility to GP role definition
2	Encourage people to do regular life-scans and check-ups	Add a new responsibility to GP role definition
3	Invite and support the elders and high-risk patients for life-scans from the government	Government fund for life-scans above 65

Table2. Key Objective 2's Key Tasks

Key Objective 3: Reduce the death rate after stroke.

No	Key task	Information Need
1	Fast Diagnosis in Ambulance Service	• FAST-ACT • Access to FUSION, so that they can learn whether patient had it before.
2	Fast Diagnosis in A&E	Put a Stroke Nurse in A&E for early prioritization.
2	Patient awareness	Use mass media to educate public on Stroke symptoms.

Table3. Key Objective 3's Key Tasks

Key Objective 4: Fully cure each stroke patient and increase the number of patients recovered successfully.

No	Key task	Information Need
1	Early stroke limitation. • Early detection of stroke for giving the clot-breaking drug early. • Starting the rehabilitation early.	• Ambulance access to learn previous stroke record. • Stroke nurse to A&E
3	Early stroke limitation. • Starting the rehabilitation early.	Fusion Handover: • Communicate with Stroke Unit • Handover patient to Stroke Unit early. • Organisation of the handover if there exists a problem
4	Efficient stroke treatment and monitoring • Define personal goals for patient, and monitor them.	• Provide key workers and motivators for patient Fusion Management: • Support and monitor patient with FUSION.
5	Efficient stroke treatment and monitoring • Define team goals for service clinicians, and monitor them.	For Stroke Ward, Community Unit • Provide a team goal and weekly review it.
6	Efficient stroke treatment and monitoring • Receiving an adequate amount of rehabilitation.	• Provide more beds for Acute in each hospital • Increase the A&E clinician number
7	Efficient stroke treatment and monitoring • Cure post-stroke depression	• Check whether patient has post-stroke depression. • Provide psychological help up-to 3 years.

Table4. Key Objective 4's Key Tasks

Key Objective 5: Improve patient experience.

No	Key task	Information Need
1	Safer service. • Apply National Strategy Standards.	FUSION Management: Monitor clinician's personal performance and teamwork performance.
2	Safer service. • Provide good and planned handovers.	FUSION Handover: Good communication between agents. • A&E – Stroke Ward • Stroke Ward - Community
3	Safer service. • Decrease the amount of time that the patient waits in A&E to get service.	• Correct patient prioritization • Put management monitoring for A&E prioritization. • Less patients per clinician in A&E
4	Safer service. • Decrease the amount of time that the patient waits to be served by Ambulance Service.	Good ambulance assignment according to patients address. – out of scope
5	Safer service. • Increase the rate of early diagnosis in both A&E and Ambulance Service.	• Ambulance access to learn previous stroke record. • Stroke nurse to A&E
5	Safer service.	• Cause less handovers to reduce patients stress
6	Comfortable service. • Provide the patient a care as if they are in their homes. • After initial diagnosis and treatment, provide home care.	• Increase home care. • Government fund for home care • With longer treatment and monitoring provide a feeling of safety.
8	Tailored service. • To improve the services	• Respond to each stroke patient's unique needs with tailored care plans • Full specialist team • Enough number of clinicians
10	Early discharge of the patient • Prevent and limit the damage of the stroke early.	• Ambulance access to learn previous stroke record • Stroke nurse to A&E
11	Early discharge of the patient • Provide necessary initial treatment as early as possible.	• Increase the number of Stroke clinicians • Increase the patient activities as much as possible • Monitor the progress of patient
12	Early discharge of the patient • Send the patient for home care	Government fund for home care treatment
13	Stroke Patient Psychology. • Patient support	• Provide key workers and motivators for patient to support and monitor patient. • Provide a psychologist for each stroke

		patient.
14	Stroke Patient Psychology. • Support the patient's family.	• Include the family caregiver to treatment • Give training to the family caregiver. • Provide psychological support to the patient's family
15	Stroke Patient Psychology.	• Cause less handovers to reduce patients stress

Table5. Key Objective 5's Key Tasks

Key Objective 6: Hospitals shouldn't compete but collaborate.

No	Key task	Information Need
1	Share the resources of the Manor and Community Hospitals	Increase the information sharing through FUSION FUSION portal to combine systems Enforce the clinicians use FUSION on time
2	Increase the communication and collaboration between them.	• Merge the Acute Care and Community Care Trusts • Create a common care plan • Increase the data sharing with FUSION.

Table6. Key Objective 6's Key Tasks

Key Objective 7: Prevent the recurrence and avoid another stroke happen again because someone who has already experienced a stroke is at increased risk of having another.

No	Key task	Information Need
1	Continuity of the care plan to prevent the recurrence	Monitor and review of the patient's situation by GP, social worker and a stroke nurse.
2	Provide life scans regularly	• Support life scans of stroke patients regularly with the patient reviews • Government fund for stroke patient ilfe scans
3	Control of risky conditions.	GPs should check the patient frequently.
4	Raise awareness	GP raise awareness about the control of stroke

Table7. Key Objective 7's Key Tasks

4.Job Satisfaction Needs / Efficiency Needs / Future Needs

4.1. Job Satisfaction Needs

For this section, Mumford advices researchers to use a questionnaire based on current theories of job satisfaction together with the pattern variables of Talcott Parsons. This

questionnaire separates the job satisfaction reasons into 5 main categories: Efficiency, Task Structure, Ethics, Psychological, and Knowledge based factors.

In this section, I described the possible psychology, knowledge, efficiency and task structure factors of clinicians according to the interviews and the walkthroughs performed on the existing flow-models, since I am not allowed to conduct interview or questionnaires with NHS staff.

PSYCHOLOGY FIT: The satisfaction aroused from the fulfillment of personal interests such as recognition, achievement, responsibility, status, advancement and work interest.

Factor1: Increase the personal interests.

No	Factor	Information Need
1	Frustration in data entry in FUSION: They are not personally interested in entering data into FUSION since, FUSION is not helping them for their work.	• Use FUSION as a working tool. • Reduce data entry
2	Community nurses are never sure about whether these systems are helping them to show how well they are doing or whether they help you in the care process.	FUSION Management: • Use the FUSION as a patient progress tool. • Use the FUSION as a clinician performance management and personal progress-monitoring tool.

Table8. Psychology Fit Needs

KNOWLEDGE FIT: The satisfaction aroused from personal skills and knowledge to be used.

Factor1: Create a service collaborating environment.

No	Factor	Information Need
1	Develop clinicians skills with knowledge sharing, learning collaboratively	FUSION Communication: • Knowledge sharing with FUSION by a Stroke patient library and individuality of each case.
2	Collaboration on patients care plan between Stroke Ward and Community	FUSION Communication: • Provide discussions and collaboration of separate agents
3	Collaboration on patients care plan within Stroke Ward and Community	• Increase the MDT meetings • Increase the FUSION users • Data entry to FUSION about patient separately apart from meetings.
4	Accumulated Service Knowledge	FUSION Wiki: • Clinician development and training by FUSION

Table9. Knowledge Fit Needs

EFFICIENCY FIT: The satisfaction aroused from seeking an equitable effort-reward bargain & controls.

Factor1: Create a service proves and awards the clinicians efforts.

No	Factor	Information Need
2	There exists only a punishment system but not rewarding.	FUSION progress management. • Provide financial additions to the high performance improvements detected on FUSION. • Provide financial additions to the target fulfilments
	Stress caused by financial penalties for entering the data late into the FUSION and iPM.	Provide better IT systems if they are forcing these penalties. • Mobile data entry systems • Connections to mobile workers. • Reduction of data entry. - FUSION portal & mobile systems

Table10. Efficiency Fit Needs

TASK STRUCTURE FIT: The satisfaction aroused from the nature of the work activities and skills, targets and feedback relation.

Factor 1: Create feedback on their performance.

No	Factor	Information Need
1	Either patient progress and clinicians performance can't be monitored from FUSION.	FUSION progress management analysis: • Feedback the progress of the patient • Feedback the personal performance of the clinician • Show the overall performance of the each specialist team
2	Monitor the target fulfilment of clinicians	FUSION progress management analysis. • Monitor clinicians' acts according to the National Stroke Strategy targets.

Table 11. Task Structure Fit Needs -1

Factor 2: Skills related with Information Systems

No	Factor	Information Need
1	Stroke Ward is busy and don't have time to enter data twice.	• Reduce data repetition. • Improve FUSION portal with iPM, EMIS connection.
2	Using iPM is highly labourious, frustrating to use and time-consuming.	• Improve iPM. – out of scope. • Encourage using FUSION by making it better. • Working with Community Trust for using FUSION.

Table12. Task Structure Fit Needs -2

Factor 3: Increase the job satisfaction of the clinicians by improving communications between agents

No	Factor	Information Need
1	Increase communication within and between A&E and Stroke Unit	Urgent information of Stroke Unit current availability and transfer of patient. Whiteboard and FUSION connection. • Notify Whiteboard user about the current capacity of Stroke Ward. • Notify FUSION when a stroke patient is entered to system.
2	Documentation transfers between Stroke Ward and Community Hospital is problematic. Community Hospital is concerned about the quality and usefulness of the information they are receiving from the Stroke Register reports	Create a common national template all Acute and Community services agreed on.
3	Community thinks Stroke Ward Specialists are reluctant to share detailed information.	• Merge the Acute and Community trusts. • Increase the communication between them with frequent general MDT meetings
4	Solve the controversy and competition between Stroke Unit and Community Unit	Solve the conflict between them • Representatives • Merge

Table 13. Task Structure Fit Needs -3

Factor 4: Improve the job satisfaction of the clinicians by improving their personal efficiency

No	Factor	Information Need
1	Clinicians that work in front-end teams in patient's homes and care homes in both Stroke Unit and Community hospital are unhappy about going back to hospital to enter	• Mobile data entry device • Wireless Connection

	patient data.	
2	Acute vs. Community conflict.	Community feel positive about the converging Acute Trust and Community Trust.
3	Social care job is neglected by both Acute and Community care.	• Social care asks for a joint care planning • For better monitoring, social care feedback and collaboration should be valued by both services.

Table14. Task Structure Fit Needs -4

4.2. Efficiency Needs

In this section, I described the possible efficiency and effectiveness needs of the current technologies according to the walkthroughs performed on the existing system flow-models.

AMBULANCE SERVICE

No	Key Variance	Description	Information Need
1	Patient confidentiality	They have access to FUSION, but can't access to Stroke Register and any GP record.	• Mobile device • Access to FUSION Stroke Register

Table15. Ambulance Service Variances

A&E

No	Key Variance	Description	Information Need
1	Data Entry to Multiple IT systems	They still need to use other services like Whiteboard, PACS, STARPAS	Improve FUSION portal
2	Wrong Patient Prioritization	Patient prioritization can be done incorrectly. Missing a stroke patient or giving less importance.	Put a Stroke Nurse in A&E

Table16. A&E Variances

STROKE UNIT

No	Key Variance	Description	Information Need
1	Multiple system usage-multiple data entry problems	They still need to use other services like PACS, STARPAS	Improve FUSION portal- not just monitoring but upload of data from PACS, STARPAS to FUSION.
2	Patient confidentiality	They don't have access to GP records.	• Improve FUSION portal • FUSION access to GP records

3	Data Clinical value	It has value to the managers, statisticians and auditors who checked whether Walsall is meeting the targets of the National Stroke Strategy.	Make FUSION a working tool. Make data live • Monitor patient progress Hold structured, detailed data • Patient database • Clinician training- medical studying Discuss the data over system • Collaborative monitoring the patient data, and progress • Combined patient care plan
4	A lot of paper records	SAP requires a lot of paper documentation and the management of those are tedious.	FUSION Mobile data entry: • Reduce paper records • Solve paper management problems
4	Transcript SAP documents to STARPAS	Clinicians need to	FUSION Mobile data entry + FUSION portal = data entry only to FUSION,

No	Secondary Variance	Description	Information Need
1	Live data problem	The STAR PAS and paper records are the only live data.	FUSION should include live data. Enforce use of FUSION
2	Late Stroke Register	FUSION is not detailed enough to hold treatment data as STAR PAS or SAP.	Increase the data fields of FUSION
3	FUSION is @discharge	It is hard to use Multiple systems They like to use STARPAS more	• Make FUSION useful • Make FUSION only system to use.
4	Late Stroke Register	It is hard to delete patients from FUSION. Need to call Informatics.	FUSION- removal of a patient register
5	Late Stroke Register	Stroke Specification is an incremental procedure.	FUSION- incremental stroke definition
6	Late Stroke Register	Workaround: to avoid wrong timing of data entry, register to FUSION when patient is discharged.	FUSION- Enforce the data entry on time according to the targets
7	Target conflict	A&E sends the patient to CT scan and enters the data into FUSION as discharge	FUSION pre-conditions: • Avoid electronic discharge unless data of CT scan is entered.
8	Free text entry problem	Problem for categorization of the data in reports.	• Modify FUSION templates for reports.

			• Balance free vs field entry. • A qualitative analysis of essential fields for GP and the community staff.
9	Double entry in FUSION	Social care report, stroke summary and stroke information has repetitions. In time critical situations (A&E), it can problematic.	FUSION: Create national templates for data entry in different reports
9	Shared data problem with Community Unit	1. If patient is a serious case, MDT-Meeting. 2. Otherwise, they are communicating through phone. The amount of data exchange is restricted in both cases.	FUSION data should provide continuous feedback about patient's situation to Community starting from just after the patient's entry to Stroke Unit. 1. Role definition change for Stroke Nurses
9	Late contact problem with Community Unit	Communication at very close time to discharge might cause delays in patient's rehabilitation.	FUSION data should be entered just after entry to Stroke Unit. 2. Role definition change for Stroke Nurses

Table17. Acute Stroke Unit Variances

COMMUNITY INTEGRATED STROKE UNIT

No	Key Variance	Description	Information Need
1	Multi-system usage	FUSION cannot reach iPM & EMIS & iSOFT	Improve FUSION portal by combining iPM with it.
2	Live data problem	Community services can reach the electronic discharge summary after the discharge of the patient.	Improve FUSION portal • Provide live data entry in Stroke Unit • Provide live data sharing with Community & GP before discharge.
3	Communication between stroke specialists	Stroke specialist team are working separately from each other.	• Provide FUSION access to specialists. • Collaborative stroke registry • Collaborative stroke care plan
4	Data entry problems	Double Data Entry to FUSION and iPM.	FUSION Portal to merge Community IT tools
5	FUSION is used rarely	Compared to iPM and SAP, FUSION entry is done rarely as they are used to iPM. Although iPM is slow…	• Mobile FUSION • Improve FUSION's use
6	Mobility	• For home care patients	• FUSION Mobile to data entry

	problem	the specialist needs to go back to community hospital to enter the patient • Paper system is not resilient, paper can be lost	• Wireless Connection.
7	Clinical value	• Currently FUSION is only used for data management • It is used after discharge	FUSION Working tool • Help team members to care for the patient.

No	Secondary Variance	Description	Information Need
1	Rediscovery of patient situation due to inadequate communication	• The data provided from Stroke Unit is repetitive, difficult to analyze, unstructured, and missing. • The Community team looses time while rediscovering patient's situation.	Improve FUSION report templates • Include information such as the applied care plan details etc. • A quantitative study for investigating the structure of the data with templates.
2	Conflicts of Acute & Community	• Early discharge model from Stroke Unit, Community is not prepared still. • Patient has delays in therapies.	Frequent communication after patient entered into Stroke Unit. • Live stroke registry • Community nurse role definition change; add every day.
6	Patient care is not resilient	SAP papers and MDT meetings provide the communication between team. Something missing or wrong can be detected only in a week of time.	• Electronic data entry • System should analyze the patient care and feedback about it.
3	Data entry problems	There is still a huge demand on the local and regional changes for the templates	Create national templates for reports according to regional and local needs.
4	Meeting Performance Targets	Reports show their compliance to the timescales but the system doesn't enforce the data entry on time.	FUSION data entry on time: • Data entry preconditions for checking targets.
5	Patient progress	• Clinicians wants to see the patient progress rather than looking at SAP • But they are not performing regular reviews.	FUSION Management: Notify clinician team for a patient review. Report on the patients progress

6	Clinician Progress	Activity levels of the team can be reached from Informatics monthly.	Report personal and team based activity and development.
6	Social Care is just reporting	Social care is monitoring the service but the clinicians seem to ignore them and their feedback.	• Collaborate with Social Care in care plan decisions. • Review Social Care Reports in FUSION to improve the service.

Table18. Community Integrated Stroke Unit Variances

GP PRACTICES

No	Secondary Variance	Description	Information Need
1	Upload Problem	The GP is not notified about the new uploads into the Stroke Registry.	FUSION notification feature
2	GP has limited access to FUSION	The GP does not want to see every detail however this reduces the resistance of the overall organisational service.	• FUSION data entry: more clean and structured • Provide care plan details to GP.

Table19. GP Variances

4.3. Future Needs

In this section the future needs are assessed according to what is likely to change in the research situation in the future.

Changes in available technology.

- Far future:
  - Speech recognition devices
  - Hand writing scanners
  - Genomic diagnosis of Stroke Possibility http://www.fukuoka-stroke.net/english/project_outline.html
- Near future:
  - Hand held devices; PDA, mobile phones, tablet computers
  - Collaborative Stroke Registry http://www.clinipace.com/xpertblogs/templates/template3.aspx?articleid=10&zoneid=2

Changes in legal requirements: none

Changes in economic factors (e.g. product and labor markets).

- Technology and therefore the equipments getting cheaper.
- Mobile devices and PDAs getting cheaper
- The service looks at the tablets with keyboards

Changes in employee or customer attitudes, expectations or fashions.

- Stroke ward and community unit expects a mobile device for front-end teams.
- Other Trusts are also wishing to go towards the mobile direction. But they are having problems in converging some applications into those new mobile systems. Using separate devices for different systems is inappropriate. But since Walsall Informatics is already trying to make all agents use FUSION, this is not a problem for them. It might be even helpful to encourage the agents to leave data entry to old systems and use FUSION more.

Changes in company organisation (e.g. the merging of plants, departments or sections).

- The Merger project will take place in March 2011, which aims to bind the Community and Acute Trusts.
- A project to bring together the Physiotherapy and Social Services. (According to Ken, this is not very possible to happen.)

Modelling Section

5. Setting Objectives

The 4-levels of objectives are defined; technical major, technical minor, organisational major and organisational minor. After this the conflicts between these objectives are identified. Lastly these objectives grouped into 3-types multipurpose, personal, national/service level.

TECHNICAL MAJOR OBJECTIVES

No	Major Change	Pri	Benefit	Limitation / Necessity
1	Enlarge Fusion Portal FUSION portal to combine systems Provide sharing: iPM, PARIS, EMIS, iSOFT	5	• Increase hospital collaboration • Increase resource sharing • Live data sharing between all agents. • Reduction of data entry in all systems • Reduce time spent for entering data • Monitoring the data in one system • Increase the job satisfaction with reducing spending their skills and time with redundant work.	Requires working with other Trust's systems. Problems with merging systems with different environments. -Absolutely Necessary-
2	Mobile-FUSION	5	• Systems for home care. • Reduce the clinician work stress • Increase the clinician job satisfaction • Reduction of data entry • Increase the personal efficiency • Reduce paper records • Make system more resilient • Investment to the future	Budget -Absolutely necessary-
3	FUSION Management 1 - Patient progress - Target monitoring	5	Manage the service to provide a safer & early treatment by instant notifications • Monitor patient's care plan &	No limitations -Absolutely

	and warnings		progress. • Monitor on patients target fulfilment. • Enforce clinicians to apply service needs on time by warnings (applying National Standards) • Solve target conflicts with precondition notifications (Avoid discharge from A&E unless CT Scan data is entered etc.) • Feedback on all monitoring and progress • Make Fusion a working tool. Increase the interest of clinicians • Create a job satisfaction by feedback.	necessary-
4	FUSION Management 2 - Clinician performance - Team performance - Award and reductions management	4	• Monitor clinician's personal performance • Monitor teamwork performance. • Increase the interest of clinicians • Show the rewards and reductions related progress. • Create a job satisfaction by feedback system.	Monitoring might stress clinicians -Absolutely Necessary-
5	FUSION Handover	5	• Good communication during hand-over • Organise the handover beforehand, foresee possible handover problems and avoid delays in handovers • Plan early start of treatments and Early limitation • Notify the agents about the availability of the next destination agent (A&E to see Ward's bed capacity, Ward to see Community's) • Make Fusion a working tool. • Safer service	Maybe the trusts will merge However still might be useful for A&E -Absolutely Necessary-

Table20. Major Technical Objectives

TECHNICAL MINOR OBJECTIVES

No	Minor Change	Pri	Benefit	Limitation / Necessity
1	FUSION Ambulance access	2	• Fast diagnosis in the ambulance service • Safer Service • Prevent and limit the damage • Early discharge • Nearly full recovery	Paramedics job change Agreement with Ambulance Service Trust. Patient Confidentiality - Not necessary -
2	Collaborative care plan	5	• Increase information sharing • Create collaborative care plan and registry: provide discussions on care plan. • Provide a common national template • Increase collaboration between Specialist Team • Make Fusion a working tool. • Increase job satisfaction with collaboration	Might conflict with merging. -Absolutely Necessary-
3	GP Notification	4	• Notify GP about a new review on FUSION	Might conflict with merging -Absolutely Necessary-
4	FUSION Wiki-Collaborative learning	3	• Knowledge sharing with a Stroke Patient Library • Clinician assistant development and training • Collaborative learning • Increase job satisfaction with collaboration and improving personal skills	Portal reformatting Requires someone to validate -Not necessarily-
5	Increase the data fields of FUSION Stroke Register	5	• Hold more detailed data. • Prevent late stroke registry	-Absolutely Necessary-
6	Removal of a patient register	2	Prevent late stroke registry	Easy removal of patients -Absolutely Necessary-
7	Incremental Stroke Register Entry	5	Prevent late stroke registry	-Absolutely Necessary-
8	FUSION Templates	5	Create National templates for Stroke Registry Balance free vs fixed entry	A qualitative study for required must fixed fields -Absolutely Necessary-

Table21. Minor Technical Objectives

ORGANISATIONAL MAJOR OBJECTIVES

No	Major Changes	Pri	Benefit	Limitation / Necessity
1	Campaigns and use of mass media to educate public on Stroke symptoms and raising patient awareness	5	• Raise awareness for early detection. • Early detection with patient suspecting.	Budget -Necessary-
2	Government fund for life scans above 65 and previous stroke patients	5	• Detect possible stroke patients early • Prevent the recurrence	Budget -absolutely necessary-
3	Provide motivators for patient to support, monitor and psychological help up to 3 years	5	• Support patient psychology • Increase the efficiency of the treatment • Cure possible Post Stroke Depression • Fasten the treatment	Budget -absolutely necessary-
4	Family care giver trainings	4	• Support patients psychology • Support patients treatment • Raise awareness	Budget Role additions to agents -Necessary-
5	Provide psychological support to care giver	3	• Support patients psychology • Support care givers psychology	Budget Depends on hospital policy -Absolutely necessary-
6	Provide more beds/clinician for Acute in each hospital	5	• Receive adequate treatment • Receive on time treatment • Efficient service	Budget Depends on hospital policy It might already exist -Necessary-
7	Increase A&E clinician number	5	• Receive on time detection • Efficient and early stroke treatment • Safer service	Budget Depends on hospital policy It might already exist -Necessary-
8	Increase Acute Ward clinician number	5	• Increase the patient activities. • Provide accelerated stroke treatment • Send patient at home as soon as possible • Provide comfortable service	Budget Depends on hospital policy It might already exist -Necessary-
9	Government fund for home care	5	• Early discharge • Increase patient comfort • Reduce their stress • Improve their psychology	Budget -Absolutely necessary-
10	Common care plan for Acute & Community.	5	Solve communication, handover problems	Conflicts with FUSION improvements Requires organization between -Absolutely necessary-
12	Review life scans regularly in patient GP reviews	4	Prevent the recurrence	GP role addition -Absolutely necessary-

13	GPs should check discharged patients more often.	5	• Prevent the recurrence • Provide feeling of being taken care • Reduce patients stress • Improve patient experience	GP role addition Depends on GP schedules Depends on GP Trust It might already exist. -Absolutely necessary-
14	Merge Acute and Community services	5	Comfortable service • Cause patient to have less stress • Improve patient experience • Improve patient psychology Safer service • Increase the collaboration • Solve tension caused by target conflicts, controversy and competition between hospitals • Create a common care plan Increase the job satisfaction in both side's clinicians	Dramatic organizational change causes stress on staff -Absolutely Necessary-
15	Provide longer treatment or monitoring	5	• Provide a feeling of safety • Comfortable service	Requires changing National standards, Budget -Necessary-
16	Provide a full specialist stroke team in Acute & Community with enough number of clinicians	5	• Tailored service • Safe service • Respond each patients unique needs	Budget Depends on hospital It might already exist -Necessary-
17	Provide financial additions to the high performance in teams, clinician's personal progress and fully recovered patients etc.	4	• Not only a punishment system but also a rewarding system. • Increase job satisfaction	Budget Depends on hospital policy -Necessary-
18	Improve the collaboration between Acute and Social care, Community and Social care.	5	• Better care plan • Joint care planning • Better monitoring by Social care • Improve job efficiency of social worker	No limitation -Absolutely Necessary-

Table22. Major Organisational Objectives

ORGANISATIONAL MINOR OBJECTIVE

No	Minor Changes	Pri	Benefit	Limitation / Necessity
1	GP responsibility of informing the public – especially high risk patients and previous stroke patients-	5	• Detect possible stroke patients early • Prevent stroke • Raise awareness on how to detect and avoid stroke and what to do after, life scan encouragement	GP role addition Maybe GPs are already doing it. -Absolutely Necessary-
2	Put a Stroke Nurse in A&E	5	• Detect possible stroke patients early by early prioritization • Safer service • Prevent and limit the damage • Early discharge • Nearly full recovery	A&E budget Maybe GPs are already doing it. -Absolutely Necessary-
3	Provide team goals and weekly review it: For both Acute Stroke & Community?	5	Provide definition of team goals to increase the effectiveness of service.	Role additions to both teams -Absolutely Necessary-
4	Put management monitoring for A&E prioritization.	3	• Safer service • Enforce A&E staff to early detection	Role additions to both teams Being monitored might cause stress -Absolutely Necessary-
5	Enforce the clinicians to use FUSION on time	4	• Share resources effectively • Communication and collaboration • Provide better service management • Continuous and live entry in FUSION • Complete data	Role additions to all clinicians Might cause stress Doesn't solve the whole problem - Necessary-
6	Increase MDT meetings	3	Increase communication between agents	Role additions to both teams Hard to organize without a system -Absolutely Necessary-
7	Provide Community representative in Stroke	3	• Increase the communication between agents • Solve the handover problems such as delays, missing information etc.	Budget for providing several representatives for each hospital Doesn't solve the whole problem -Not necessarily-

Table23. Minor Organisational Objectives

Conflicts:

- Collaborative Care plan vs. Increase MDT meetings
- Collaborative Care plan vs. Community Representative in stroke
- Acute Community Merge vs. Community Representative in stroke
- Acute Community Merge vs. Fusion Handover
- FUSION Management vs. Enforce the clinicians to use FUSION on time
- FUSION Management vs. Provide team goals and weekly reviews
- FUSION Management vs. Management monitoring in A&E

Changes important to everyone or a large group of people

No	T/O M/m	Change	Prio	Group
1	T M	Fusion Portal	5	All
2	T M	Mobile-Fusion	5	All
3	T M	Fusion Management 1	5	All
4	T M	Fusion Handover	5	All
5	T m	Collaborative care plan	5	Acute Stroke Unit, Community Unit, Social Care
6	O M	Improve communication between Social care and Acute/Community	5	Acute Stroke Unit, Community Unit, Social Care
7	T m	Fusion national templates	5	Acute Stroke Unit, Community Unit
8	T m	Incremental stroke register	5	Acute Stroke Unit, Community Unit
9	T m	Enrich Stroke register data fields	5	Acute Stroke Unit, Community Unit
10	O M	Common care plan for Acute & Community	5	Acute Stroke Unit, Community Unit
11	O M	Merge Acute and Community Ward	5	Acute Stroke Unit, Community Unit
12	O m	Provide team goals for Acute and Community Ward	5	Acute Stroke Unit, Community Unit
13	T M	Fusion Management 2	4	Acute Stroke Unit, Community Unit
14	O M	Family Care giver training	4	Acute Stroke Unit, Community Unit
15	O M	Provide psychological support to family care giver	3	Acute Stroke Unit, Community Unit
16	T m	Fusion collaborative learning	3	Acute Stroke Unit, Community Unit
17	O m	Increase MDT meetings	3	Acute Stroke Unit, Community Unit
18	O m	Provide Community representative in Stroke	2	
19	O m	Enforce clinicians to use Fusion on time	2	Acute Stroke Unit, Community Unit

Table24. Multipurpose Level Objectives

Personal changes

No	T/O M/m	Change	Prio	Group
1	O m	Put a stroke nurse in the A&E	5	A&E
2	O M	GP should check discharged patient more often	5	GP
3	O M	GP should inform the public especially high risk.	5	GP
4	O M	Review life scans in GP reviews.	4	GP
5	T m	GP notification for Fusion update	4	GP
6	O m	Put management monitoring in the A&E	3	A&E
7	T m	Fusion Ambulance Access	2	Ambulance Service

Table25. Personal Level Objectives

National/ Service level:

No	T/O M/m	Change	Prio	Group
1	O M	Campaigns to raise awareness	5	National level
2	O M	Government life scan funds	5	National level
3	O M	Government home care funds	5	National level
4	O M	Provide longer treatment	5	National level
5	O M	Provide full specialist stroke team	5	Service level
6	O M	3 years Psychological help	5	Service level
7	O M	Increase A&E clinicians	5	Service level
8	O M	Increase Acute Ward clinicians/ Beds	5	Service level
9	O M	Provide rewarding system for personal progress	4	Service level

Table26. National/Service Level Objectives

6. Identifying Socio-technical Alternatives / Defining the alternative with Root Definition & Conceptual Model

6.1. Identifying Socio-technical Alternatives

The changes 2 and below priority are neglected in this stage.

Firstly, all of the defined **priority objectives** are highly recommended in *Table27*. These changes are the initial changes that must be performed.

1	T M	Fusion Portal	5	All
2	T M	Mobile-Fusion	5	All
3	T M	Fusion Management 1	5	All
4	T M	Fusion Handover	5	All
5	T m	Collaborative care plan	5	Acute Stroke Unit, Community Unit, Social Care
6	O M	Improve communication between Social care and Acute/Community	5	Acute Stroke Unit, Community Unit, Social Care
7	T m	Fusion national templates	5	Acute Stroke Unit, Community Unit
8	T m	Incremental stroke register	5	Acute Stroke Unit, Community Unit
9	T m	Enrich Stroke register data fields	5	Acute Stroke Unit, Community Unit
10	O M	Common care plan for Acute & Community	5	Acute Stroke Unit, Community Unit
11	O M	Merge Acute and Community Ward	5	Acute Stroke Unit, Community Unit
12	O m	Provide team goals for Acute and Community Ward	5	Acute Stroke Unit, Community Unit

Table27. High-priority Objectives

Other **priority changes** that have **lower priorit**y can be defined as future evolutionary changes as shown in *Table28*.

1	T M	Fusion Management 2	4	Acute Stroke Unit, Community Unit
2	O M	Family Care giver training	4	Acute Stroke Unit, Community Unit
3	O M	Provide psychological support to family care giver	3	Acute Stroke Unit, Community Unit
4	T m	Fusion collaborative learning	3	Acute Stroke Unit, Community Unit

Table28. Low-priority Objectives

One important issue observed was the need to make FUSION a mobile working tool project, this includes a combination of minor changes to help clinicians to do their job better.

- Mobile-FUSION
- FUSION Management
- FUSION Handover
- FUSION Communication
- FUSION Wiki

These possible developments can be useful to turn FUSION into a working tool. Secondly, apart from priority objectives**, the personal objectives** that have high recommendations are highly recommended by researcher. The minor changes are recommended for sooner implementation. (*Table29*)

1	O m	Put a stroke nurse in the A&E	5	A&E
2	O M	GP should check discharged patient more often	5	GP
3	O M	GP should inform the public especially high risk.	5	GP

Table29. High-priority Personal Objectives

The personal objectives that are has **lower priorities** can be added to the future changes. *(Table30)*

1	O M	Review life scans in GP reviews.	4	GP
2	T m	GP notification for Fusion update	4	GP
3	O m	Put management monitoring in the A&E	3	A&E

Table30. Low-priority Personal Objectives

There are also service changes defined which would be counted as **National Level or Service Level** changes. All of these changes are highly recommended however since they are related with top-level design, there might be possible restrictions about them. It is observed that Stroke changes require more service level and national level changes than Retinopathy pathway. *(Table31)*

1	O M	Campaigns to raise awareness	5	National level
2	O M	Government life scan funds	5	National level
3	O M	Government home care funds	5	National level
4	O M	Provide longer treatment	5	National level
5	O M	Provide full specialist stroke team	5	Service level
6	O M	3 years Psychological help	5	Service level
7	O M	Increase A&E clinicians	5	Service level
8	O M	Increase Acute Ward clinicians/ Beds	5	Service level
9	O M	Provide rewarding system for personal progress	4	Service level

Table31. High-priority Service/National level Objectives

Thirdly and most importantly, there exist **conflicts** between some technical and organizational changes. Some conflicts could create unnecessary implementation or organizational changes. These should be taken into account in order to avoid redundancy. Therefore for some change bigger decisions alternative technical and organizational objectives are investigated for foreseeing what is required in worst situation to improve the socio-technical system.

- If Collaborative care plan will not be applied, then the following changes have to be applied;
    - Increase MDT meetings
    - Community Representative in stroke

- If FUSION Management could be developed, then the following changes can be skipped.
    - Enforce the clinicians to use FUSION on time
    - Provide team goals and weekly reviews
    - Management monitoring in A&E

- If Acute and Community Merge will happen then,
    - There is no need for a community Representative in stroke
    - Fusion handover is no longer necessary.
    - Collaborative care still has importance but lower.

In the next step, conceptual models can diagram the ideal changes and the models can be discussed with the different levels of Informatics team.

The researcher strongly advises to at least perform the 'absolutely necessary' design changes in minor organizational changes. As most of the necessary ones depend on hospital policies, the researcher cannot make any decision on those. However these necessary minor changes absolutely improves the service standards of agents.

All defined major organizational changes are recommended for application, especially the absolutely necessary ones.

There exist conflicts between organizational and technical changes. These should be taken into account and the organizational changes should be selected appropriately.

In the next step, conceptual models can diagram the ideal changes and the models can be discussed with the different levels of Informatics team.

6.2. Defining the alternative with Root Definition & Conceptual Model

In this stage, an example root definition is generated to show how root definitions and conceptual models can be used in discussions.

From the priority objectives some objectives are selected and an example root definition is constructed for Stroke pathway. After this the root definition is represented with a conceptual model and a scenario is produced to reflect the new workflow.

6.2.1. Root Definition of an example socio-technical alternative

"A socio-technical system that includes a jointly optimised social and technical system in which;

- An improved social system in
    - To improve the **social communication** between Social Care & Acute
    - To provide a **shared care plan**
    - To improve the social communication between Acute & Community with a merge.
    - To improve the team performances with good organisation and team goal management where the main work activities shared appropriately and performed collaboratively for better service.
- An improved technical system
    - To merge the unconnected system with a **Portal**
    - To monitor the **patient progress and clinician performance** with a Management tool
    - To provide **communication before and during handovers** with a Communication tool
    - To improve FUSION data sharing with National Standardised templates and data fields.
    - To provide a common care plan with a Collaborative care plan tool.

6.2.2. Conceptual Model of the example socio-technical alternative

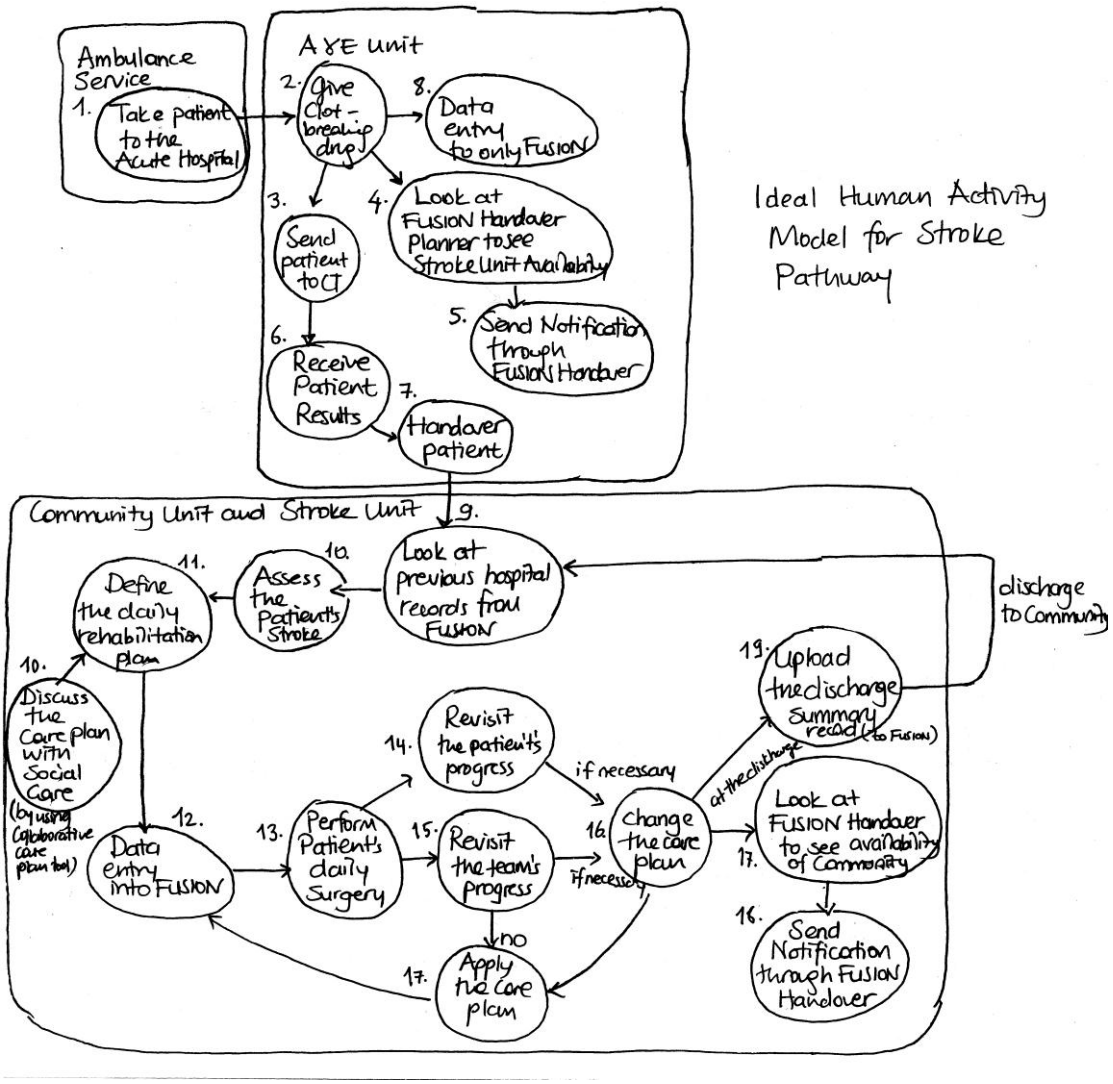


Figure9. Conceptual Model for the example socio-technical alternative's root definition

6.2.3. An Example Scenario for conceptual model

The ambulance service takes the stroke patient to the hospital. In the emergency after the patient is being suspected from stroke, immediately clot-breaking drugs are given to patient and the patient is sent to CT scanning. While waiting for the lab results, by using FUSION Handover the Stroke unit's current availability is queried and a request is sent to the Stroke Unit for handover procedure. After getting the results from the laboratory, the patient record is closed with the lab results. The patient is handover to Stroke unit. After handing over the Stroke unit checks the patient's pervious hospital records from FUSION Portal, for helping the assessment of the stroke case. With Stroke Unit multi-disciplinary teams and social care's common surgery, the stroke is assessed and the daily rehabilitation plan is decided. This care plan is entered into FUSION. Everyday, the

multidisciplinary team performs the daily treatment, checks the patient's progress and the team's progress according to the decided targets of patient care plan. If the care plan needs change, this is performed. If the care plan doesn't require any change, the treatment is performed as planned. When it is close to discharge time, the Community Stroke Unit is contacted through FUSION handover planner to plan the handover and to see the availability of the Community Hospital. After the handover is planned, the discharge summary is uploaded to FUSION Portal. The Community Unit performs the same stages with the Acute Unit however it does perform the handover to the GP. (The long term care plan is nor covered in this scenario and conceptual model.)

APPENDIX 2. Integrated Methodology Report for Retinopathy Pathway

In this report, the following applied sections of the Integrated Methodology on Retinopathy Pathway will be described.

Scoping Section
1. Rich Picture Drawing and Analyses One-Two-Three
2. Problem Definition / Boundary Definition / Existing System Definition

Requirements Gathering Section
3. Root Definitions with CATWOE / Key Objectives, Key Tasks, Key Information Needs
4.Job Efficiency Needs / Efficiency Needs / Future Needs

Modelling Section
5. Setting Objectives
6. Identifying Socio-technical Alternatives / Defining the alternative with Root Definition & Conceptual Model

Scoping Section

1.Rich Picture Drawing and Analyses One-Two-Three

1.1. Pathway Rich Picture and Analysis One

Figure 10 shows the Pathway Rich picture for Retinopathy

The diabetic retinopathy screening pathway rich picture defined the process of pathway which starts with the GP surgery where the patient's GP detects the diabetes problem and handover the patient to Screening service for the eye screening with a referral letter to the Screening Team's Admin Team. Screening team sends notification letters to patient for booking appointments. When the patient returns to the letters with calling the Team for appointment the screening stage starts. The screening teams screeners firstly screen the patient and the photographic images of the retina is send to the graders for performing the grading process. 2 separate graders grade the images. The graders perform handover of the patient to the Acute Ophthalmology for the evaluation of grading results and treatment. In this last stage the Ophthalmologist decides the urgency and severity of the patient and refers the Acute Booking Office with a letter for booking an appointment for the laser treatment if necessary. Then Booking Office calls the patient for an appointment. After patient booking the treatment appointment the laser treatment is performed and the patient is discharged from the Acute Hospital. This discharge causes another handover, which is the patient responsibility of being monitored is given back to the GP. During this sequence of processes, however there could be many complications at any stage of this pathway and this might be arouse a necessity of iteration of the previous stages. For example, the patient may not return to the calls,

letters or appointments, which might require the intervention to call back the patient by the Failsafe officer who is responsible of detecting and avoiding any possible flaws of the system or the patient's GP. There could be screening or grading problems such as the images may not be assessed because of poor quality images or graders might have dissidence, where such a situation can cause iteration of the screening and grading stages.

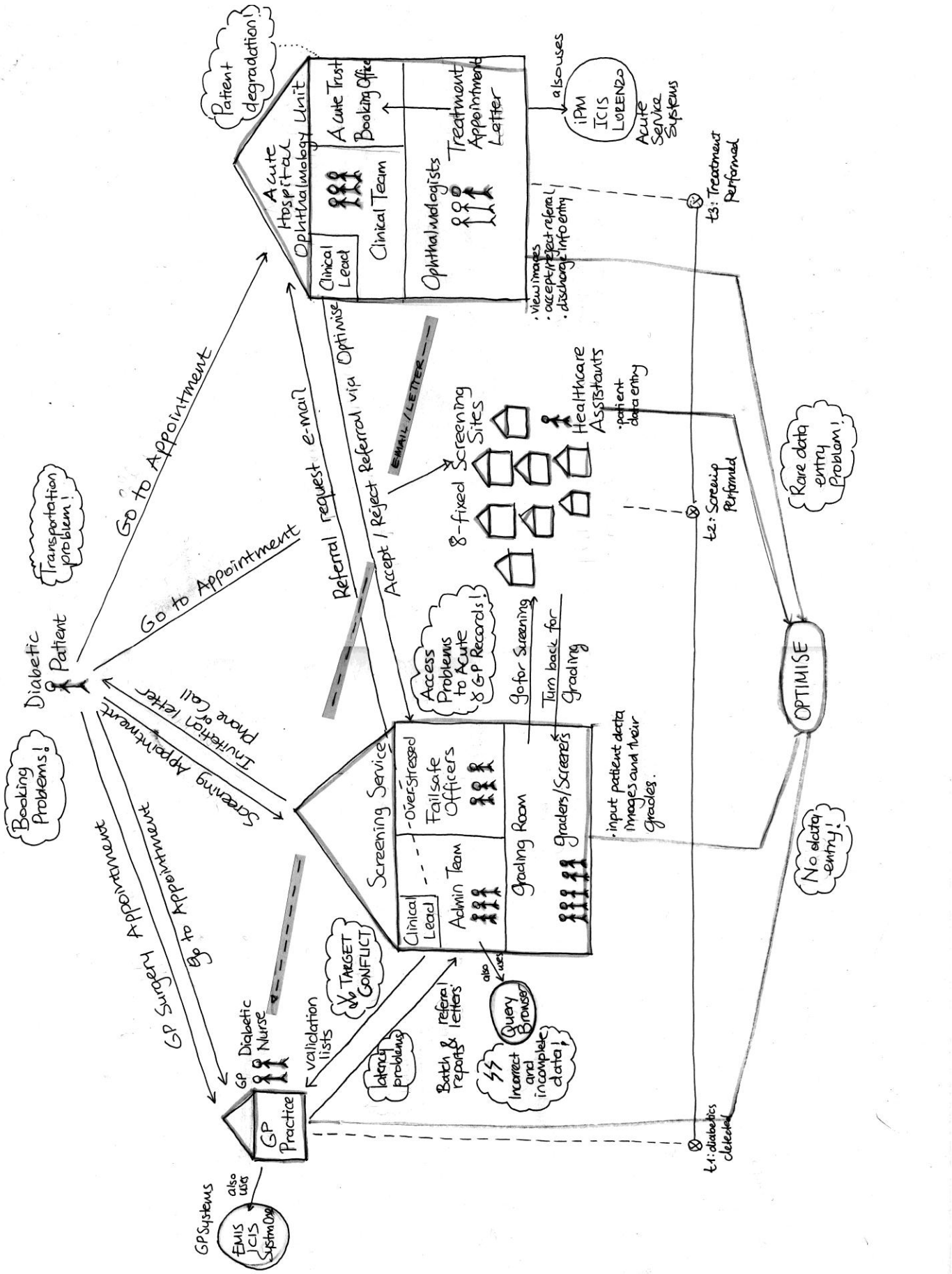


Figure 10.Retinopathy Pathway Rich Picture

1.2. Cultural Rich Picture & Analysis Two

The cultural rich pictures in *Figure11* included the high-level organizational role hierarchy of the agents of the pathway. Since political and cultural context is same for both pathways, they are defined in common. For Analysis Two refer to Stroke pathway's cultural and political analysis.

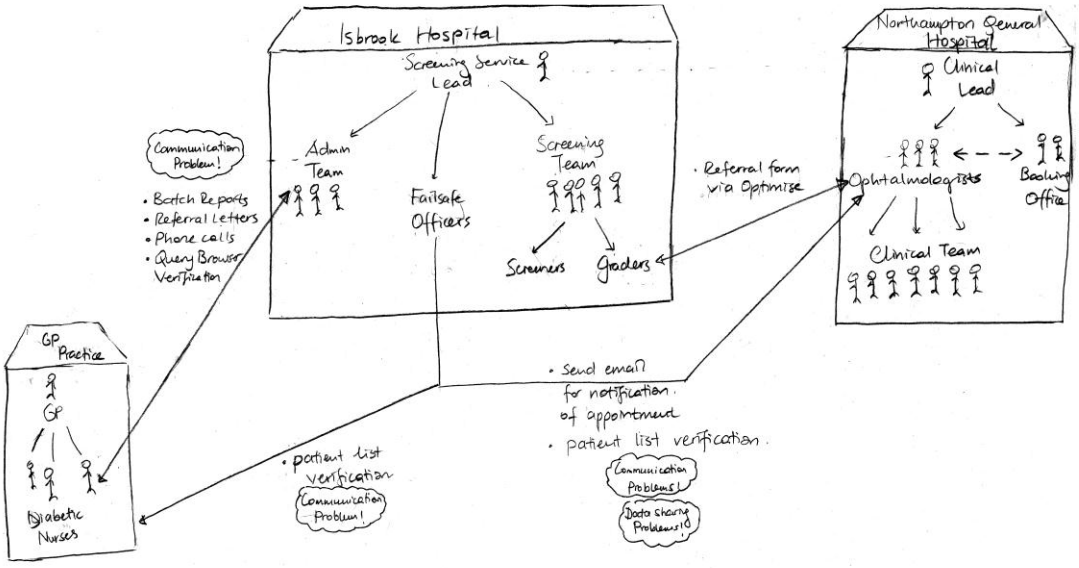


Figure 11.Retinopathy Cultural Rich Picture

1.3. Political Rich Picture & Analysis Three

The cultural rich pictures in *Figure12* included the high-level organizational role hierarchy of the agents of the pathway. Since political and cultural context is same for both pathways, they are defined in previous Stroke report in Political Analysis section. Refer to Stroke pathway's cultural and political analysis.

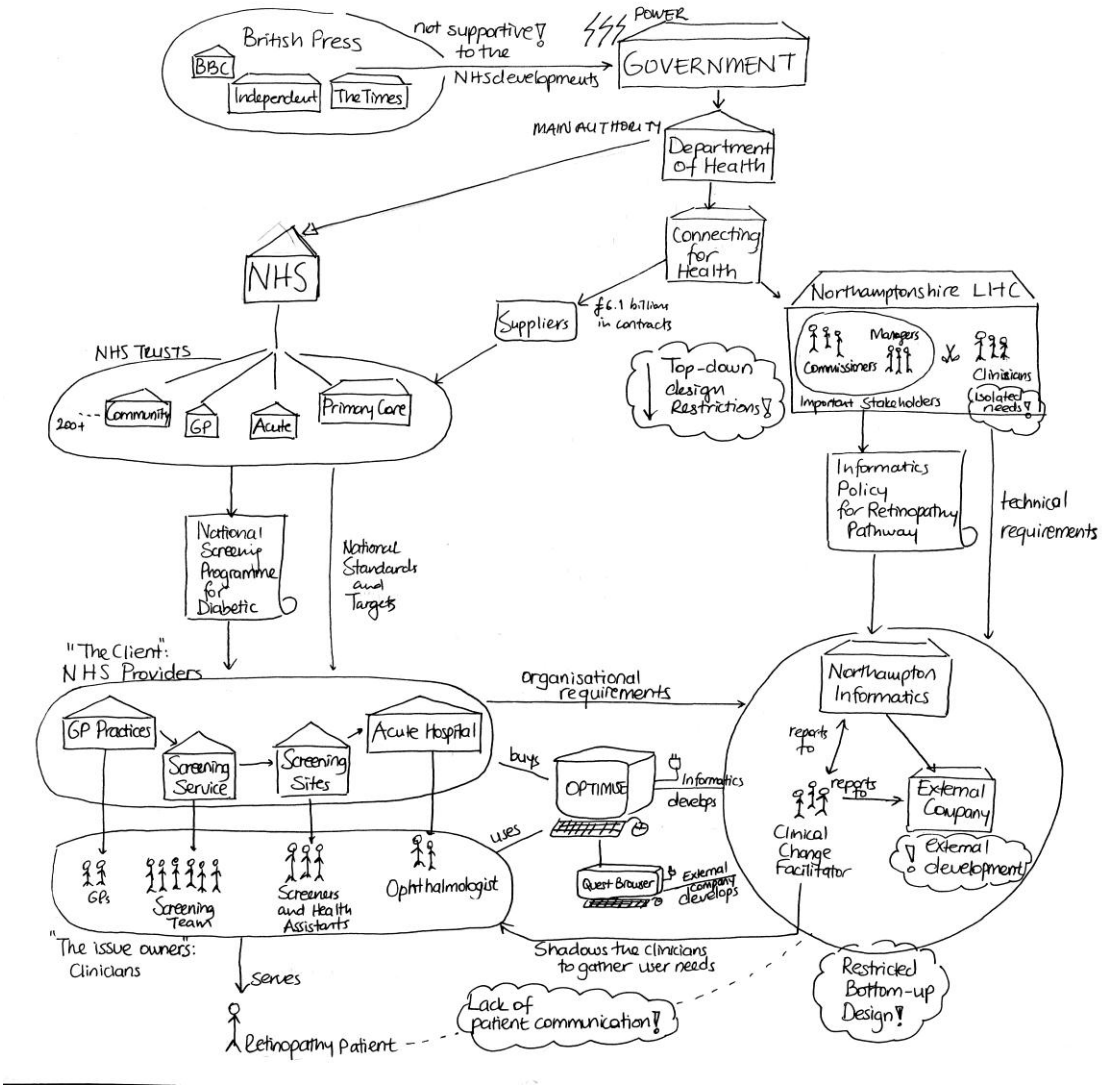


Figure 12.Retinopathy Political Rich Picture

2. Problem Definition / Boundary Definition / Existing System Definition

2.1 Problem Definition

In this section the 'Problematic Situations' identified from Rich Pictures are used.

Common Problems and Conflicts aroused from Political Analysis

1. **Problem between British Press and NHS:** British Press is not encouraging and supporting the improvement process of NHS.
2. **Government budget** restricts the amount of change that can be done. The systems are fixed and it is expensive to change the overall system.
3. **Separate top-down policy enforcements:** From NHS Trusts the clinical targets are defined, from the Local Health Communities the technical targets are defined. The IT team needs to interpret those separate needs.
4. **Management tool:** The systems are mainly used for management purposes. The clinicians are not benefit from it. The LHC decides on the product specifications and pathway redesign with considering managers and commissioners needs.
5. **Patient Participation:** Development team has a lack of communication with Patient.
   Previous stroke patient's opinions are not involved in the design process

Problems and Conflicts from General Retinopathy Pathway Rich Picture

1. GP vs. Failsafe:
   a. **Data entry**: GP do not prefer to data entry to Optimise. They love their own systems.
   b. **I don't have enough time**! : GP don't have enough time to report back to Failsafe.
   c. **Failsafe access problem**: Failsafe couldn't access to GP records because of the patient data confidentiality problem.
   d. **Patient degradation**: GP late data entry.
2. Ophthalmologist vs. Failsafe:
   a. **Data entry**: Ophthalmologist do not prefer to data entry to Optimise. They love their own systems.
   b. **I don't have enough time**! : Ophthalmologist doesn't have enough time to report back to Failsafe.
   c. **Failsafe access problem**: Failsafe couldn't access to GP or Acute records because of the patient data confidentiality problem.
   d. **Patient degradation**: Ophthalmologist booking problem.
3. GP vs. Screening Office:
   a. **Target conflict:** GP is informing the screening team at the end of the annual year. Screening team is not getting live data.
   b. **Data entry**: GP is entering data according to his/her template. Quest browser is looking for separate fields.

    c. **I don't have enough time**! : GPs don't have enough time to report back every referral.
    d. **Night Extraction:** both sides are expecting to have a night extraction
4. Failsafe
    a. **Over-stressed vs. afraid to be jobless:** Requires a job balance.
5. Patient vs. Screening Team & Failsafe:
    a. **Transportation problem:** The elders and infirm patients have hard time to go to screening and treatment.
    b. **Reminding**: The patient temporarily ignored the appointment should be reminded.
    c. **Appointment booking problem:** Patient living outside the borders or in the boundaries want to book appointment in a closer place.
    d. **Waiting long time:** patient degradation happens in many places since patient service is separate and

Problems aroused from Political Analysis of Retinopathy Pathway

1. **Northampton IT is not a shared service**. Northampton NSF IT team is only serving for Community Trust; the Acute Trust has its own development team. Silos effect (Ken, 3rd meeting); the developed systems don't talk to each other. Acute system is separate from Community system.
2. **Inadequate User Involvement.** In Contextual inquiry there exists a user involvement problem; Clinicians are only interviewed, not attending on the design work.
3. **Separate IT Systems:** Optimise and Quest Browser.

Cultural Analysis Rich Picture:

1. **Communication Problems:** There exist huge communication gaps and delays on the system that causes patient degradation. Apart from the communication between Graders and Ophthalmologists, which is performed by an electronic referral letter, the communication between agents are provided by letters, emails, reports, phone calls and meetings.
    a. **Batch Reports and Referrals:** GP - Admin Team communicates through batch reports, referral letters, phone calls, patient list verification meetings
    b. **Patient verification list:** Failsafe officer – GP patient list verification meetings
    c. **Email:** Failsafe officer – Ophthalmologist email notification for appointment and detailed information about patient's condition, patient list verification meetings.

2.2 Boundary Definition

For this point, the system boundary is defined as the whole pathway starting from GP Practice, continuing with Screening Team in Screening Service and ending with Ophthalmology in Acute Trust Hospital. The design will cover the pathway facilities of the agents. Any other responsibilities of GP's or Acute Trust will not be involved. It will involve the improvement of common retinopathy IT systems: Optimise and Quest Browser.

2.3 Existing System Definition

In the existing system definition stage the departments, their agents and clinician teams are identified. After this a Horizontal Input-Output Analysis performed. Lastly, the Stafford Beer's Viable System Model is performed.

2.3.1. Departments, Sections and staff:

Departments:

- GP Practices
    - GP
    - Diabetic nurse
- Screening Service
    - Admin Team
    - Screening Team
        - Healthcare Assistant
        - Screeners/Grader
- Acute Team
    - Ophthalmologist
    - Booking Office

2.3.2 Horizontal Input - Output Analysis:

- GP Surgery:
    - Input: Patient with any complaint comes.
    - Main activity: GP detects the diabetes problem and refers the patient to eye screening
    - Output: A referral letter to the Screening Team

- Screening:
    - Input: Receives the referral letter,
    - Main activity: books an appointment for patient and Performs Screening.
    - Output: Inputs images into Optimise

- Grading
    - Input: Receives patient name in the screened queue.
    - Main activity: Performs Grading and enters data into Optimise
    - Output: An electronic referral through Optimise are sent to Ophthalmology

- Ophthalmology:

- Input: Receives the electronic referral.
- Main activity: Reviews Screening Results and makes an appointment for treatment by referral letter, treats the patient
- Output: Discharge letter sent to GP.

2.3.3. Stafford Beer's Viable System Model:

2.3.3.1. Operating activities.

These are the routine tasks of clinical team members that enable the principal functions of the department to be carried out. Initially brief descriptions of the activities described in lists, then the detailed flow-models are shown.

GP Human Activity Model for Patient Surgery

- Patient surgery.
- Diabetes detection.
- GP data entry into GP systems about the patient's disease.
- Informing patient about the disease.
- Referring the patient to eye screening with a referral letter.

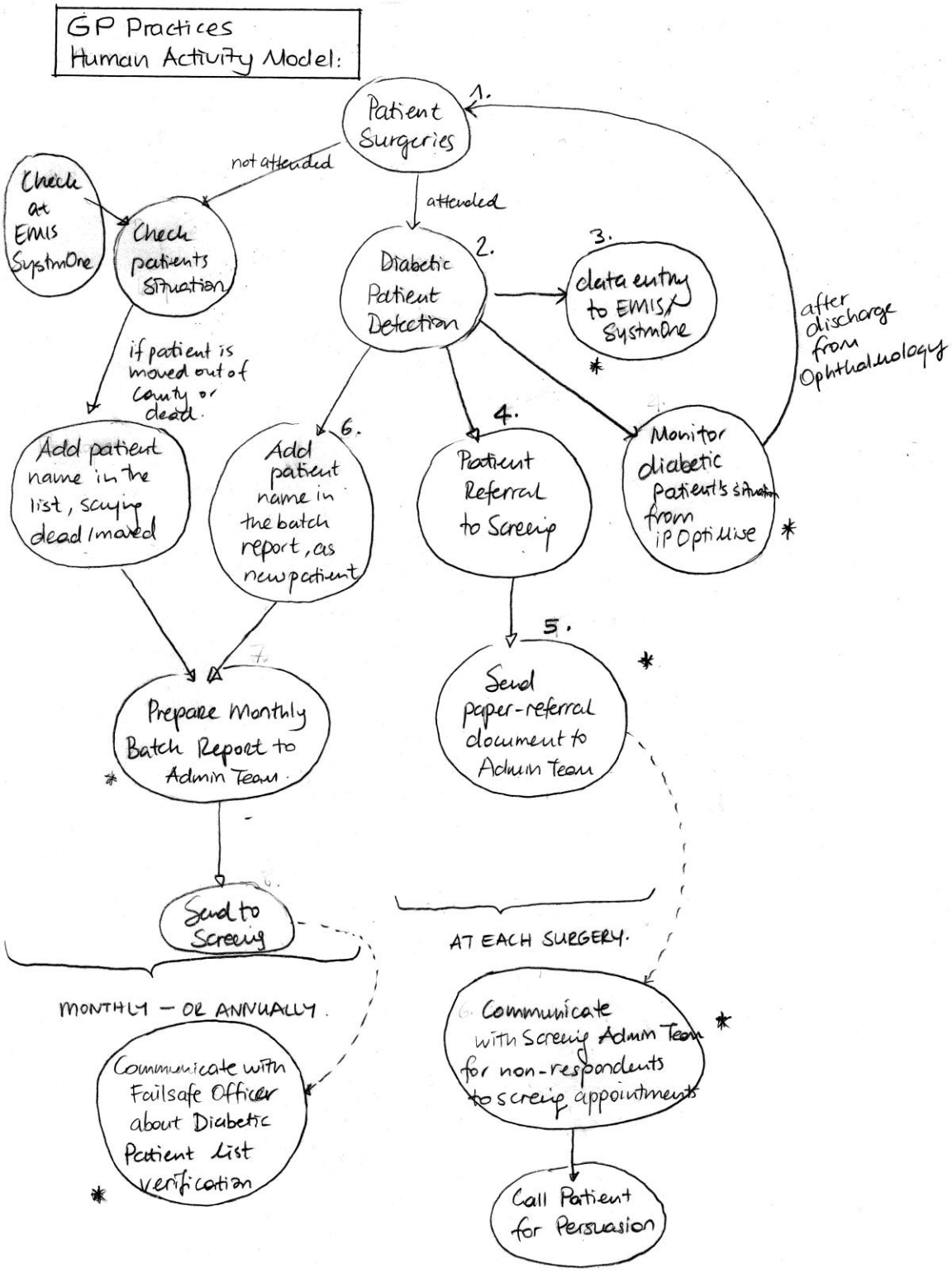


Figure 13.Human Activity Model for GP

Admin Team Human Activity Model

- Arrange an appointment with Screening Admin Team:
- Receiving the referral letter.
- Sending a letter to the patient.
- Booking an appointment for patient when patient calls.

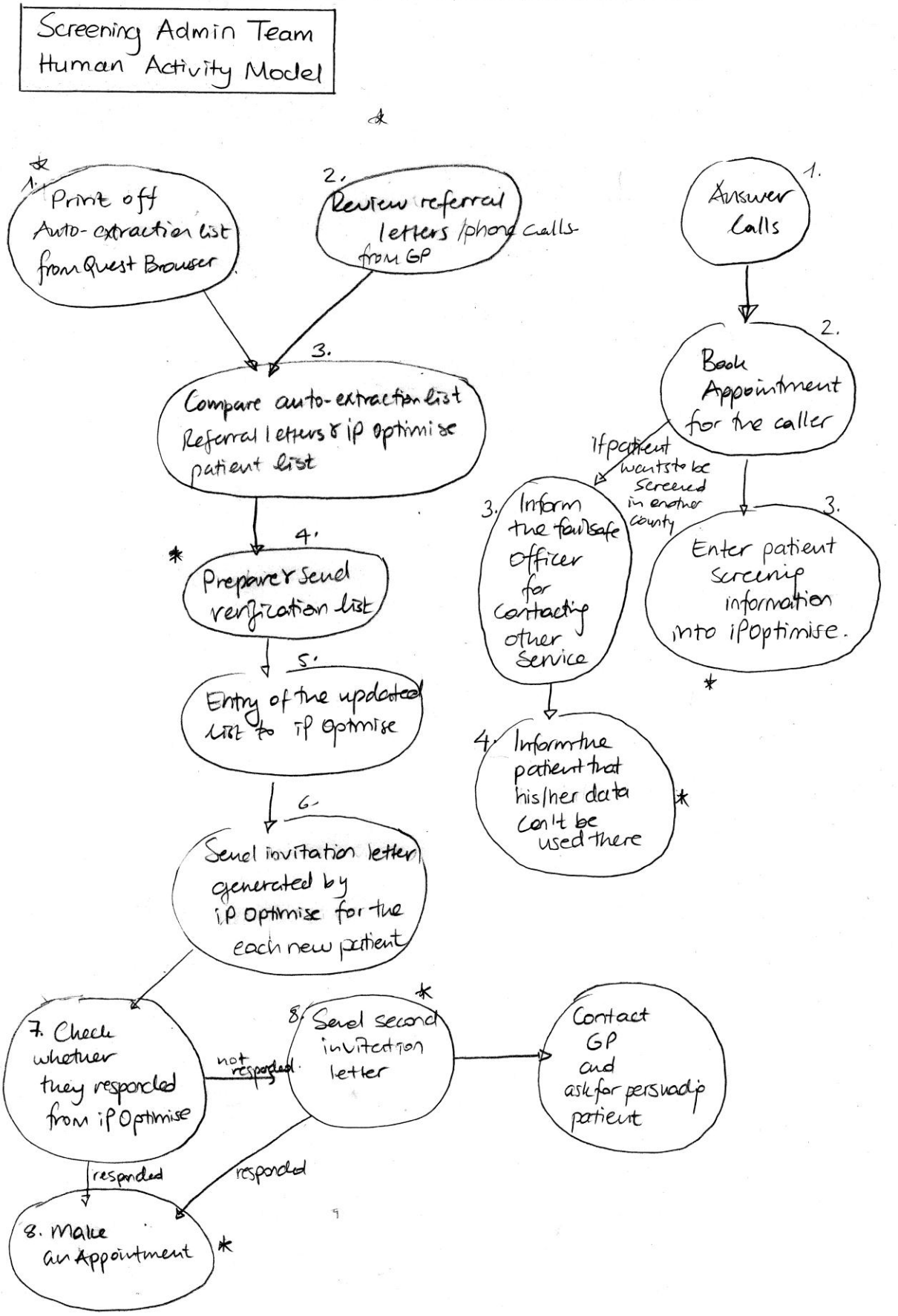


Figure 14.Human Activity Model for Admin Team

Healthcare Assistant Human Activity Model for Screening Preparation

- Screening appointment.
  - Create patient record.
  - Prepare patient to the screening.

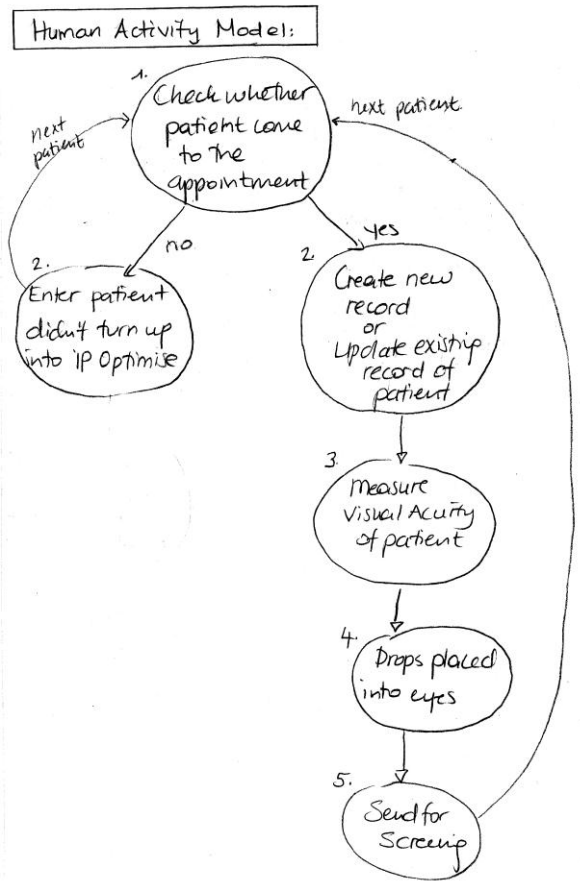


Figure 15.Human Activity Model for Healthcare Assistant

Screener / Grader Human Activity Model for Screening and Grading

- Screening.
  - Performing Screening in fixed sites.
  - Sending patient to home.
  - Performing initial diagnosis.
  - Deciding the urgency.
    - Major changes: Requesting early grading.
  - Uploading the images to Optimise.
- Grading.
  - Performing Grading.
  - Entering grading data into Optimise.
  - Sending the results to Ophthalmology by an electronic referral through Optimise.
  - Emails the review and appointment request.

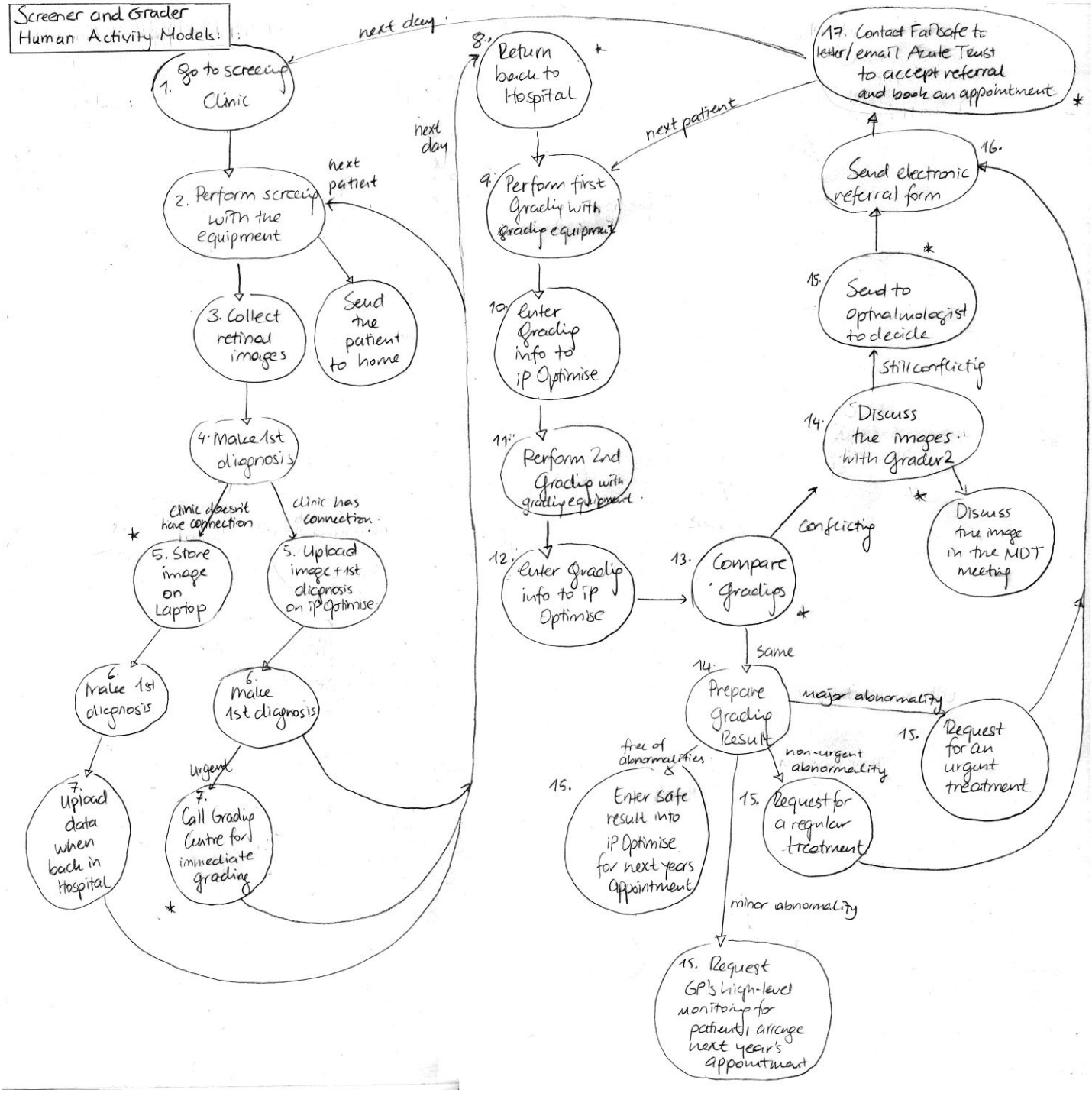


Figure 16.Human Activity Model for Screener / Grader

Failsafe Officer Human Activity Models

- Db correction Human Activity Model
- Screening Appointment Check Human Activity Model
- Screening / Ophthalmology / Treatment Results Check Human Activity Model

Figure 17.Human Activity Model for Failsafe Officer- 'Screening & Ophthalmology Treatment Check'

Figure 18.Human Activity Models for Failsafe Officer- 'DB Correction' and 'Screening Appointment Check'

Ophthalmology Human Activity Model

- Receives the electronic referral.
- Reviewing Screening Results.
- Deciding the acceptance or rejection of referral.
    - Reject:
        - Free of changes:
            - Requesting appointment for next year.
        - Not assessable:
            - Requesting to send the patient for grading.
        - Patient information entry to Optimise and Acute System.
    - Accept:
        - Decide the urgency
            - Minor Abnormalities
                - Requesting high-level GP monitoring
            - Major Abnormalities
                - Urgent Referral
                    - Requesting urgent appointment
                - Non-urgent Referral
                    - Requesting standard appointment
        - Sending appointment letter to Booking Office
        - Treat patient.
        - Patient information entry to Optimise and Acute System.
        - Discharge the patient
        - Send a discharge letter to GP.

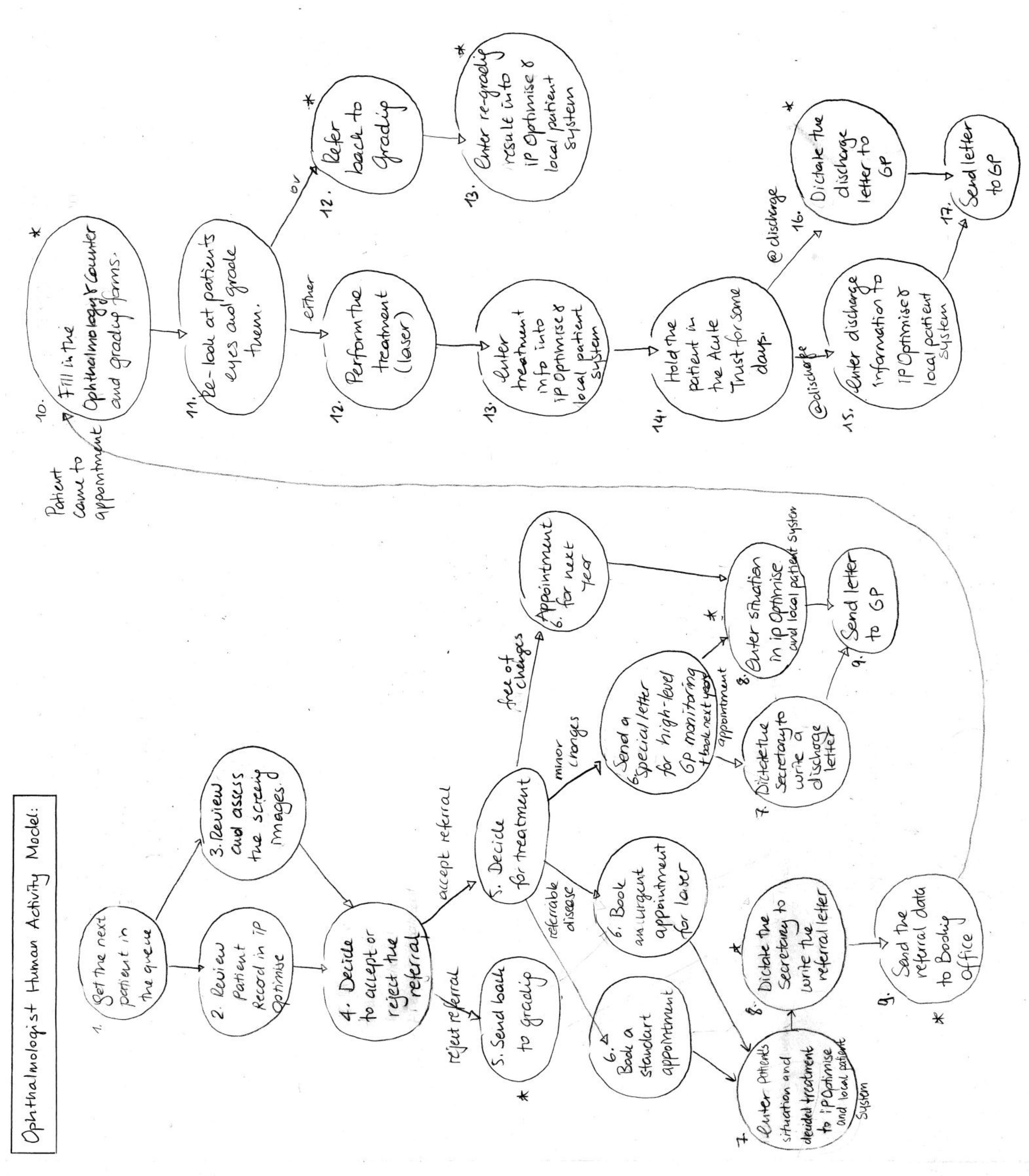


Figure 19.Human Activity Model for Ophthalmologist

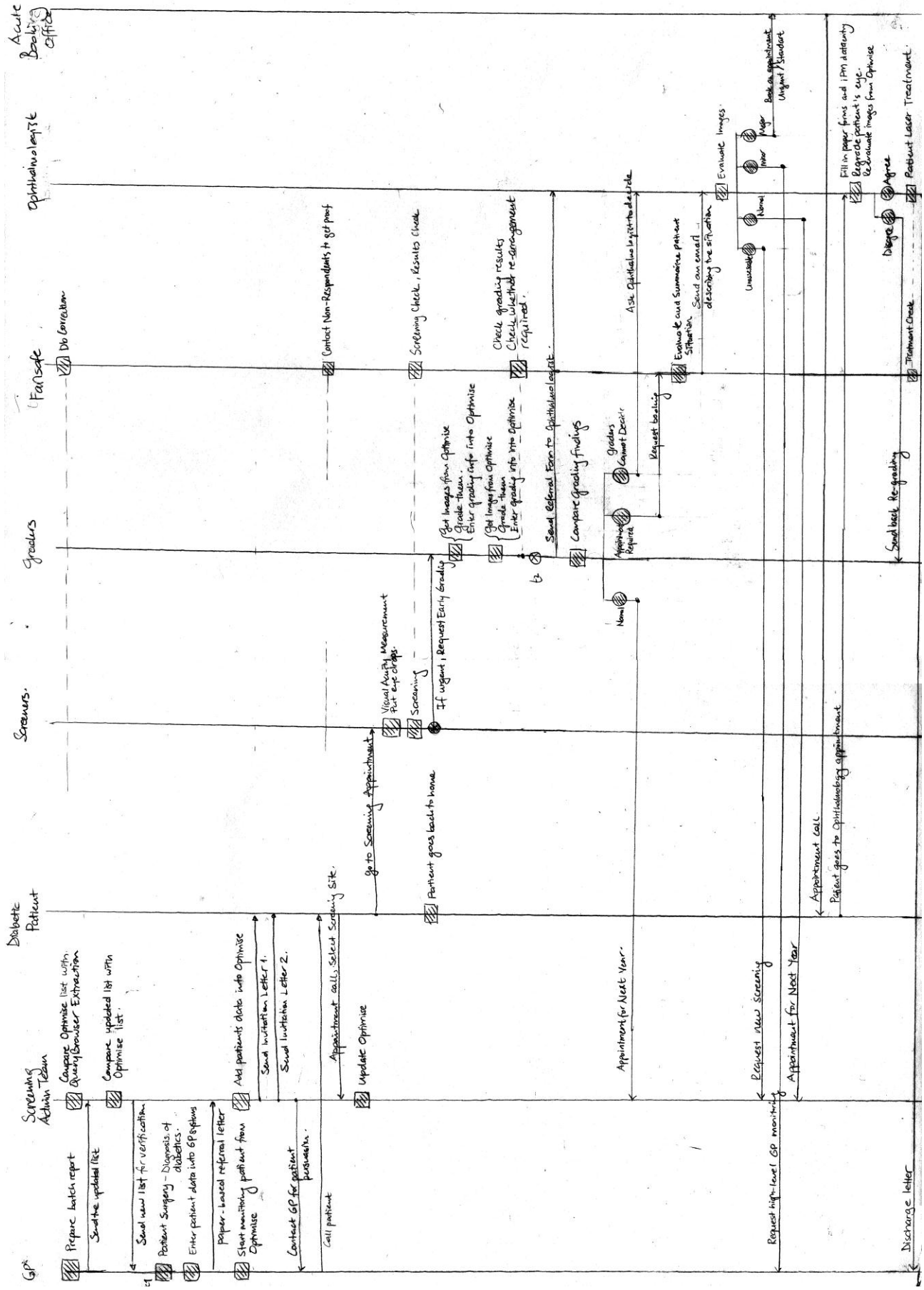


Figure 20.Role Activity Diagram for Retinopathy Service

2.3.3.2. Prevention/solution activities.

These are the activities directed at preventing work problems occurring and correcting these when they do occur.

Failsafe Officers all job description: (for details see Failsafe conceptual model)

- Db correction
- Screening Appointment Check
- Screening Results Check
- Ophthalmology Review Check
- Treatment Results Check

2.3.3.3. Co-ordination activities.

These are the activities and tasks that have to be coordinated within the department and between the department and other departments and sections

In Retinopathy system the coordination activities are mainly sequential activities that trigger each other. There are no simultaneous activities in the existing system.

- GP-Screening Service:
  - GP-Screening Team
    - Referral letter receive
    - Patient invitation letter sending
  - Admin team - GP
    - Request calling patient.
    - GP calling patient.

- Screening Team:
  - Admin Team- Screener
    - Patient calls
    - Appointment book for screening
  - Screener- Grader

        - Upload the images to Optimise
        - Downloads images from Optimise.
    - Graders- Ophthalmologist
        - Upload the grades and referral form.
        - Accept/reject the referral

- Ophthalmologist
    - Failsafe Officer- Ophthalmologist
        - Sends email to Acute Trust and Ophthalmologist.
    - Ophthalmologist- Booking Office
        - Sends appointment letter.
        - Returns a date to patient.

2.3.3.4. Development activities.

These are the activities, products, services etc. handled by the department need to be developed and improved. Activities are same as described above sections.

Products:

- Quest Browser
- OPTIMISE
- Booking Systems of Screening and Acute Trust
- Screening and Grading Equipments

Services:

- GP Referral Service
- Screening Appointment Service
- Screening and Grading Service
- Ophthalmology Review Service
- Ophthalmology Appointment Service

- Failsafe Service

2.3.3.5. Control activities.
These are the activities to control the total department so that it works efficiently, meets its targets and achieves its objectives.

The technical system OPTIMISE doesn't have any functionality to manage and control the whether the organization is meeting National targets and measure service performance. Failsafe officers mainly handle this job.

However there exists National Programmes performance indicators that are checked each annual 'QOF returns'.

- English National Screening Programme for Diabetic's targets are:
  - Find the right patient
  - Treat the patient at right time
  - Monitor the patient through life-time
  - Avoid and reduce the eye-damage of the patient.
  - Provide live information in clinics to provide reliable and safer treatment.(http://www.retinalscreening.nhs.uk/pages/default.asp?id=2)

Requirements Gathering Section
3. Root Definitions with CATWOE / Key Objectives, Key Tasks, Key Information Needs

3.1. Root Definitions with CATWOE
CATWOEs for ideal social system and technical system is generated.

3.1.1. CATWOE for Social system
Customer: intended beneficiaries of the organisational system.
- Diabetic Patient

Actors: who take action in the system.
- GP and its Diabetic nurse
- Screening Service's Admin Team, Screening Team which consists of Healthcare Assistant and Screeners/Grader
- Acute Team's Ophthalmologist and Booking Office clerks

Transformation: Undiagnosed patient went to GP surgery → Patient's diabetes diagnosed, diabetic screening performed and possible eye abnormalities treated.
Worldview: Monitor the diabetic patients from age 12 throughout their lifetime for preventing any possible retinal abnormalities caused from the disease by early detection, early prevention and if necessary early treatment.
Owner: Screening Service in Isbrook Hospital

Environment: Entire healthcare and social care environment. Anywhere where the patient treatment takes place: Screening Service in Isbrook Hospital, Northamptonshire General Hospital, Kettering General Hospital, 8- fixed screening sites, GP Practices.

3.1.2. CATWOE for Technical system

Customer: intended beneficiaries of the technical system.

- Management teams of Screening Service in Isbrook Hospital, Northamptonshire General Hospital, Kettering General Hospital
- GP and its Diabetic nurse
- Screening Service's Admin Team, Screening Team which consists of Healthcare Assistant and Screeners/Grader
- Acute Team's Ophthalmologist and Booking Office clerks

Actors: who take action in the system.

- Same with the customer

Transformation:

- No patient record → Defined patient record holding information about patient's care plan, handovers, progress
- Clinician's and their teams previous situation → Clinician's and their teams current situation

Worldview:

- Provide an improved resilient technical system to help clinicians to serve a faster and safer service.

Owner: Screening Service in Isbrook Hospital

Environment: : Entire healthcare and social care environment. Anywhere where the patient treatment takes place: Screening Service in Isbrook Hospital, Northamptonshire General Hospital, Kettering General Hospital, 8- fixed screening sites, GP Practices.

3.2. Key Objectives, Key Tasks, Key Information Needs

3.2.1. Key Objectives

According to the identified purpose definitions with CATWOEs, the key objectives are defined. The existing business mission is defined by answering the question of "Why does this department or function exist?" The ideal business mission is investigated by answering "What should it be doing?"

Current Business Mission: Why does this department function or exist?

- English National Screening Programme for Diabetic's aim of the programme is to reduce the risk of sight loss amongst people with diabetes, by the prompt identification and effective treatment if necessary of sight threatening diabetic retinopathy, at the appropriate stage during the disease process. (http://www.retinalscreening.nhs.uk/pages/)

- Identify diabetes, monitor the disease and deliver a clinical eye screening service to the rapidly increasing population of diabetic patients in UK starting from age 12

until they die. (Garvican, O'Leary, 2008)

- Type 2 diabetes is the more common of the two main types and accounts for around 90 per cent of people with diabetes. Since 1996 the number of people diagnosed with diabetes has increased from 1.4 million to 2.6 million. (Diabetes UK Statistics 2010)

- By 2025 it is estimated that over four million people will have diabetes. Most of these cases will be Type 2 diabetes, because of our ageing population and rapidly rising numbers of overweight and obese people. (Diabetes UK Statistics 2010)

Key Objectives: What should it be doing?

1. Improve patient experience
2. Improve identification of diabetic patients
3. Raise awareness in Patients and Persuasion of patients.
4. Early discharge of every patient.
5. Screening and Treatment at Right time
6. Screening and Treatment at Right place
7. Providing safe service

Enhanced Business Mission:

1. Giving them faster diabetics identification, continuous monitoring, faster screening, faster access to the right kind of treatment, at the right place, at the right time, with a stronger focus on their long-term needs.
2. Provide a faster and safer patient experience with clinicians applying National Programme's target and standards.

3.2.1. Key Tasks

The key objectives are decomposed into its key tasks by considering what must be completed to fulfill the particular objective, irrespective of how the department is organized or the technology it uses.

Key objective 1: Improve patient experience.

- Monitor patient's place in the pathway
- List possible diabetic patients that are undetected in a GP's list
- Invite patient & Book appointment
- Take images
- Provide accurate grading
- Sharing screened images
- Treat patient

Key Objective 2: Easy and early screening and treatment without delays, repeats or any time-consuming process.

- Fast identification
- Avoid patient appointment latency

- Fast Screening & Grading
- Fast Reviewing the grading
- Avoid Booking Office latency
- Fast Treatment

Key Objective 3: Improve identification of diabetic patients

- Persuade patients to come to GP surgery
- GPs diabetic patient detection in surgeries
- GPs notification to Screening team in time
- Encourage unwillingly patients

Key Objective 4: Raise awareness in Patients and Persuasion of patients.

- Persuasion through mass media
- Persuasion through GP of the patient.

Key Objective 5: Screening and Treatment at Right time

- GP notification at right time.
- Patient screening appointment at best time.

Key Objective 6: Screening and Treatment at Right place

- Booking Appointment at the easiest place for transportation of the patient
- Consider the elders, infirmly patients and people away from the screening sites

(http://www.imperial.nhs.uk/aboutus/news/news_030246
http://www.diabetes.co.uk/diabetes-and-the-elderly.html)

Key Objective 7: Providing safe service

- Make sure GP, Admin Team, Screener, Grader, Ophthalmology is serving patient safe
- Make sure Failsafe is checking every detail about patients.

3.2.3. Key Information Needs

Information Needs: The information required completing the key tasks are defined.
Key objective 1: Improve patient experience.

No	Key task	Information Need
1	Monitor patient's place in the pathway	OPTIMISE already does it
2	Diagnose patient- find possible undiagnosed patient	GP role addition: Call to surgery to the possible patients with diabetes symptoms
3	Invite patient & Book appointment	Booking appointments from GP
4	Take images accurately	Good equipment and professional clinicians
5	Provide accurate grading	Good equipment and professional clinicians
6	Sharing screened images	OPTIMISE already does it
7	Treat patient	Good equipment and professional clinicians

Table32. Key Objective 1's Key Tasks

Key objective 2: Early discharge of every patient: easy and early screening and treatment without delays, repeats or any time-consuming process.

No	Key task	Information Need
1	Fast identification	Coordinate with GP to learn possible patients
2	Avoid screening appointment latency	Perform screening appointment at GP
3	Fast Screening & Grading	3. Separate screeners and graders 4. Increase the clinician and reduce patient per clinician
4	Fast Reviewing the grading	Collaboration and comparison of graders and ophthalmologists.
5	Avoid Acute Booking Office latency	Failsafe access to Acute booking service- already exists. Failsafe should see their appointments from OPTIMISE
6	Fast Treatment	Reduce patient number per ophthalmologist

Table33. Key Objective 2's Key Tasks

Key Objective 3: Improve identification of diabetic patients

No	Key task	Information Need
1	Persuade possible patients to come to GP surgery	Add GP responsibility to persuade possible patients
2	GPs diabetic patient detection in surgeries	Diabetic nurses does it
3	GPs notification to Screening team in time	• GP should use Optimise • Optimise should support target monitoring
4	Encourage unwillingly patients	Provide mobile screening

Table34. Key Objective 3's Key Tasks

Key Objective 4: Raise awareness in Patients and Persuasion of patients.

No	Key task	Information Need
1	Persuasion through mass media.	Campaigns for raising patient awareness
2	Persuasion through GP of the patient.	Add GP responsibility to call to persuade patients not turning up to screening or treatment appointments.

Table35. Key Objective 4's Key Tasks

Key Objective 5: Screening and Treatment at Right time.

No	Key task	Information Need
1	GP notification at right time.	Monitor the QOF targets with a system
2	Patient screening appointment at best time.	Make GP responsible for screening appointment

Table36. Key Objective 5's Key Tasks

Key Objective 6: Screening and Treatment at Right place.

No	Key task	Information Need
1	Booking Appointment at the easiest place for transportation of the patient	Provide Selection of Screening Service- already exists Provide Choose & Book to service in other counties
2	Consider the elders, infirmly patients and people away from the screening sites in transportation	Provide mobile vans for people unable to come for screening

Table37. Key Objective 6's Key Tasks

Key Objective 7: Providing safe service.

No	Key task	Information Need
1	Performance monitoring	A system to monitor the performance of the clinicians on the pathway and make sure all processes performed according to the national programme's timeline and other standards.
2	System resilience is dependent on human performance	A reminder system for Failsafe Officer merged with Optimise.

Table38. Key Objective 7's Key Tasks

4.Job Satisfaction Needs / Efficiency Needs / Future Needs

4.1. Job Satisfaction Needs

For this section, Mumford advices researchers to use a questionnaire based on current theories of job satisfaction together with the pattern variables of Talcott Parsons. This questionnaire separates the job satisfaction reasons into 5 main categories: Efficiency, Task Structure, Ethics, Psychological, and Knowledge based factors.

In this section, I described the possible psychology, knowledge, efficiency and task structure factors of clinicians according to the interviews and the walkthroughs performed on the existing flow-models, since I am not allowed to conduct interview or questionnaires with NHS staff.

TASK STRUCTURE FIT

Factor1: Decrease the work stress

No	Factor	Information Need
1	Meeting targets are highly hard	Provide proof of what each clinician did to perform his/her work into the system. Performance Management Tool
2	Solve target conflicts	National targets are creating stress between agents. Monitor target performance of each agent.
3	Too much stress on Failsafe Officers	Make technology resillient
4	The clinicians don't trust in IT systems.	Reduce their worry to lose data by back-ups into another db

Table39. Task Structure Fit Problems -1

Factor 2: Increase the job satisfaction of the clinicians by improving communications between agents

No	Factor	Information Need
1	Reduce communication with letters and email.	Improve the electronic communication
2	Enforce using Optimise	Add role definition to Screening & Acute for using Optimise
3	Ease communication between all agents	Provide a portal

Table40. Task Structure Fit Problems -2

Factor 3: Improve the job satisfaction of the clinicians by improving their personal efficiency

No	Factor	Information Need
1	Reduce the number of IT systems they need to use	Merge systems with a portal
2	Increase the amount of time they spent for patients	Reduce the data entry - Merge systems - Create standard templates for data entry. Reduce management jobs . - Provide reminders
3	Increase service efficiency as a group	Better communication & collaboration Better use of technology . Better equipments
4	Ease data sharing between all agents	Provide a portal

Table41. Task Structure Fit Problems -3

KNOWLEDGE FIT

Factor1: Create a service collaborating environment.

No	Factor	Information Need
1	MDT meetings are creating a shared knowledge and increases job satisfaction as a group	Create a virtual collaborative learning system

Table42. Knowledge Fit Problems

4.2. Efficiency Needs

In this section, I described the possible efficiency and effectiveness needs of the current technologies according to the walkthroughs performed on the existing system flow-models.

GP

No	Key Variance	Description	Information Need
1	Using 2 systems	EMIS, SystmOne to patient data entry, Optimise to monitor diabetic patient	Optimise Portal
2	Conflict of targets	Late recognition of patients from screening team since the batch reporting is performed monthly or annually	Optimise Management Tool
3	Verification of patient list	For inviting correct patients, GP verifies the paper list.	Correct QuestBrowser Nightly Update
4	QOF Targets skipped	Monitoring the targets and standards for each patient.	OPTIMISE Management Tool

No	GP Secondary Variance	Description	Information Need
1	Data restriction	GP's have restricted rights on Optimise. They can't enter data.	Optimise access rights
2	Patient Confidentiality	Persuading patient on phone.	GP role definition
3	Data Entry	Data entry on GP systems is free. There is a necessity for a national standard for the diabetic patients info template.	Optimise National Templates
4	Missing High risk patients	High risk patients are the ones that never come to GP surgery.	GP role definition

Table43. GP Variances

ADMIN TEAM

No	Key Variance	Description	Information Need
1	Verification of patient list	Comparison of auto-extraction list, batch reports, referral letters and Optimise list and sending GP to verify. Causes loss of time	Correct QuestBrowser Nightly Update
2	Choosing Screening Service	For patients that request screening in other services, their previous data is not accessible from another county.	Eyebook for Optimise – main booking system that provides choose & book
3	Choosing Screening Service	Elders or infirm patients have difficulties to go to fixed sites	Mobile screening
4	Booking Invitation Letter from Service	Patient may not respond to any letter. Book the appointment when patient is at GP surgery.	GP role definition
5	Access to GP records	Not available. Screening hold their own data	Optimise Portal

No	Secondary Variance	Description	Information Need
1	Patient Recalling	Persuading patient on phone.	GP role definition
2	Quest Browser is not resilient	Database is erroneous or incomplete. • Querying is done wrong. • GP not informing on time.	Correct QuestBrowser
3	Auto-extraction	It is only done in every 3 months. Nightly update is required to save GPs to reporting and referral	Nightly Update
4	Patient degradation	Patient didn't come to screening appointment Failsafe call GP	GP role definition to call patient- already does Communication tool

Table44. Admin Team Variances

HEALTHCARE ASSISTANT VARIANCES

No	Key Variance	Description	Information Need
1	Patient transportation	Patient can't drive after screening.	Mobile Screening

Table45. Healthcare Assistance Variances

SCREENER & GRADER VARIANCES

No	Key Variance	Description	Information Need
1	Verification of patient list	Comparison of auto-extraction list, batch reports, referral letters and Optimise list and sending GP to verify. Causes loss of time	Correct QuestBrowser Nightly Update
2	Communication with screener & graders	Call for urgent communication	Communication through Optimise
3	Screening-Grading transportation	Screeer & graders are same. Screeners need to transport from site to hospital.	Separate role of screener & graders
4	Sending Re-screening	Time-consuming and demotivating for patient.	EYEPACS - Collaboration tool
5	Lack of collaboration and communication	When graders decisions conflict, the decision is passed to ophthalmologist. MDT later.	EYEPACS - Collaboration tool
6	Data send to Ophthalmology	Although the data entered into Optimise, the failsafe provides report to Acute.	Optimise Portal

No	Secondary Variance	Description	Information Need
1	Patient degradation	Re-screening required after screening or grading	EYEPACS - Collaboration tool
2	Patient degradation	Patient didn't come to screening appointment	

Table46. Screener/ Grader Variances

FAILSAFE OFFICER VARIANCES

No	Key Variance	Description	Information Need
1	Manual data	All data used and entered by Failsafe is manual- referral letters, extraction lists, batch reports, unscreened patients list, non-responded patients list.	Correct QuestBrowser Nightly Update Optimise Report Generator
2	Admin job	Failsafe is doing Admin teams job when cleaning database.	Correct QuestBrowser Nightly Update
3	Reminder	A reminder app for failsafe merged with Optimise.	Optimise Failsafe Reminder
4	Opt. Meeting	Time consuming to visit ophthalmologist	Optimise Collaborative verification system
5	Opt. job	Failsafe is doing Opt. job when entering treatment data into Optimise.	Optimise Portal
5	Access to other systems	Failsafe can't access to GP systems. However it has read only access to Acute Booking Appointment systems	Optimise Portal

No	Secondary Variances	Description	Information Need
1	Referral and booking emails to Acute	No standard template for the data sent. Weak data share with email or letter.	Communication through Optimise
2	Contact GP for validation	Phone calls might be inefficient	Collaborative validation tool
3	Contact Opt. for check	Phone calls might be inefficient	Communication through Optimise
4	Meet Opt. for check	Phone calls might be inefficient	Communication through Optimise
5	Lack of Report generator	Data Querying Performed with SQL	Optimise Report Generator

Table47. Failsafe Officer Variances

OPHTHALMOLOGY VARIANCES

No	Key Variances	Information Need	Information Need
1	3 Systems Problem	The data entry to Optimise is not regular. They don't have time to enter data into 3 separate systems. • Patient paper based forms • Acute Systems • Optimise	Optimise Portal
2	Choosing Acute Service	For patients that request treatment in other hospitals, their previous data is not accessible from another county.	Share documents with patient
4	Booking System	Ophthalmologist writes a letter to request and appointment from Booking Office	Eyebook- Same booking system merged with Optimise.

No	Secondary Variances	Description	Information Need
1	Send Letter to Booking Office	• Manual letter generation • Sending letter is not a good communication way.	Communicate through Optimise
2	Patient degradation	Patient didn't come to treatment appointment.	Avoid patient loss with Failsafe
3	Patient degradation	Ophthalmologist may find the image good enough for assessment and request re-grading Time consuming. Missing targets.	EYEPACS - Collaboration tool: Better communication with screeners, graders and ophthalmology.
4	Send letter to GP	Notify GP the discharge or minor changes. Communication lack.	Communicate through Optimise

Table48. Ophthalmologist Variances

4.3. Future Needs

In this section the future needs are assessed according to what is likely to change in the research situation in the future.

Changes in available technology.

- EYEPACS (https://www.eyepacs.org/)

Changes in legal requirements.

- The disease cannot be treated therefore the number of the diabetics patient population is growing exponentially. Increase clinician numbers.

Changes in economic factors (e.g. product and labour markets).

- Technology and therefore the equipments getting cheaper.

Changes in employee or customer attitudes, expectations or fashions.

- Increase of the population definitely requires increase of the clinician numbers per service and increase of the services in the Counties in order to meet national targets and standards.
- Furthermore the increasing diabetic population demands requires efficiency of the system. The detection-screening-treatment pathway must be shorter than it is.

Changes in company organisation (e.g. the merging of plants, departments or sections).

- No change expected

Modelling Section

5. Setting Objectives

The 4-levels of objectives are defined; technical major, technical minor, organisational major and organisational minor and given in *Tables 49-50-51-52*. After this the conflicts between these objectives are identified. Lastly these objectives grouped into 3-types multipurpose, personal, national/service level. (*Tables 53-54-55*)

MAJOR TECHNICAL OBJECTIVES

No	Major Changes	Prio	Benefit	Limitation/Necessity
1	EYEPACS	4	• Provide easiness of monitoring images and applying complex functions on it. • Provide collaborative decision • Future technology	Both technical & organizational change. Requires the way those people work. - Necessary -
2	Collaborative LearningTool	3	• Create a virtual collaborative learning environment to share the common knowledge of retinopathy cases that are discussed in MDTs	Both technical & organizational change. Requires the way those people work. - Necessary -
3	Collaborative Working Tool	4	Collaboration tool for Ophthalmologist, Screener, Graders • Comparison of images • Discussions • Decisions • Avoid re-grading, re-screening • Reduce demotivating returns and iterations for patient	Both technical & organizational change. Requires the way those people work. - Necessary -
4	Optimise Portal	5	• All agents will use the same system to monitor data. • Reduce the data entry repetitions • Make data entry to Optimise regular • Reduce Failsafes meaningless work.	Working with the other development teams. Ophthalmologist might prefer paper report filling. - Absolutely Necessary -
5	Optimise Target Management	5	• Analyse personal performance and team performance according to National targets • Reduce the stress of coping with hard targets	Clinicians might be stressed to be monitored - Absolutely Necessary -
6	EyeBook: Choose&Book	2	• Provide a selection of places to screen and get treatment for patient. • Main booking system for Screening Pathway • Reduce the appointment booking procedures in Acute and Screening Service • Failsafe access to Bookings	Other county's services should support this decision too. Acute Trust has separate IT team - Not necessary -
7	Mobile Screening	4	• Serving elderly, infirm patients • Serving unwilling patients • Serving patients that are at boundaries	The system is just changed. Increase of staff and equipment budget

			• After screening patient transportation is hard	- Absolutely Necessary -
8	Optimise Collaborative Verification	1	• Provide an easy way to verify patient treatment With Acute With GP	No limitations - Maybe -
9	Optimise Reminders	5	• Ease the stress of Failsafe officers • Increase the resistance and safety of the service and system	No limitations -Necessary -
10	Communication through Optimise	3	• Accounts for each patient and request lists and possibly link to their email system. • Reduce phone traffic, letters, lists, reports, paper based forms • Urgent cases, when person couldn't be reached. • Call patient without delay	Make clinicians depend on technical systems so much. Acute Trust has separate IT teams -Necessary-
11	Optimise Report &Letter Generator	5	• Provide invitation letters • Provide data querying from database as any agent wants. • Solve SQL problem	No limitations -Absolutely Necessary- (Especially useful for failsafe and admin team)

Table49. Technical Major Changes

MINOR TECHNICAL CHANGES

No	Prio	Minor Changes	Benefit	Limitation/Necessity
1	5	Failsafe Access Rights Enhancement	Failsafe can monitor Acute and GP systems related only with diabetics patients	GP & Acute can reject this in terms of patient confidentiality. - Necessary-
2	5	Optimise National Standard Templates	Quality Assurance, safety Entry of useful data	No limitation -Absolutely Necessary-
3	5	Debug Quest Browser	Solve wrong querying	No limitation. -Absolutely Necessary-
4	5	Night extraction for Quest Browser	Solve referral letter, batch reporting, Database verification problems	No limitation. -Absolutely Necessary-
5	1	GP Access Rights Enhancement	Solve GP diabetic patient late notification problem	GP role change. -Absolutely Necessary-
6	5	Provide connection to all screening clinics	Communication with Grading and even ophthalmology	No limitation -Absolutely Necessary-
7	5	Provide computers to all Acute ophthalmology departments	Electronic data sharing is essential	No limitation -Absolutely Necessary-

Table50. Technical Minor Changes

MAJOR ORGANISATIONAL CHANGES:

No	Prio	Major Changes	Benefit	Limitation/Necessity
1	5	Mobile Screening	Mobile screening for elders	Organizational change in screener-grader role. -Absolutely necessary-
1	5	Call possible diabetes to surgery	Identify high-risk patients	Organizational change in GP role. - Necessary-
2	5	Separate Screeners and Graders role	Avoid transportation duration and 1 day latency for grading images	Requires increasing number of screeners and graders. -Necessary-
3	5	Increase clinician amount	Keep up with the increasing population of diabetic patients	Limited amount of staff can be hired. - Necessary-
4	5	Reduce patient number per ophthalmologists	Faster treatment appointments	Limited amount of staff can be hired - Absolutely necessary-
5	1	Add responsibility of using Optimise in GP	Monitor GP reporting diabetics patients	Double data entry for GP. OPTIMISE must be a portal -Necessary-
6	5	Use Mass media to raise awareness in public	Identify high-risk patients	Budget -Necessary-
7	4	Acute should use Optimise	Data merging and sharing	Organisational change of Acute and Screening -Absolutely Necessary-

Table51. Organisational Major Changes

MAJOR ORGANISATIONAL CHANGES:

No	Prio	Minor Changes	Benefit	Limitation/Necessity
1	5	Share documents with patients	Patient can use the data in another County.	-Absolutely Necessary-
2	5	Book Screening appointments from GP	Avoid non-respondent patients Late recognition of invitations	Organizational change in GP role. - Absolutely Necessary -
3	4	Add responsibility of persuasion of non-respondents to GPs roles	Identify high-risk patients high-risk patients	Organizational change in GP role. -Absolutely Necessary-

Table52. Organisational Minor Changes

CONFLICTS:

- Quest Browser vs. Increase GP's access rights
- Quest Browser vs Collaborative validation
- Quest Browser vs Access to GP systems
- Quest Browser vs Add GP responsibility of using Optimise
- Optimise Portal vs Add Acute responsibility of using Optimise
- Optimise Portal vs Optimise Verification
- Optimise Portal vs Failsafe Access Rights
- Optimise Communication vs Optimise Report & Letter Generator

Changes important to everyone or a large group of people

No	T/O M/m	Change	Prio	Group
1	T M	Optimise Portal	5	All
2	T M	Optimise Target Management	5	All
3	T m	Optimise National Standard templates	5	GP, Failsafe, Admin Team
4	T m	Debug Quest Browser	5	GP, Failsafe, Admin Team
5	T m	Nightly Extraction Quest Browser	5	GP, Failsafe, Admin Team
6	T m	Provide connection to clinics	5	Screener, Grader, Ophthalmologist
7	T m	Provide computers to Acute	5	Ophthalmologist, Failsafe
8	T M	Mobile Screening	5	Screener, Grader
9	T M	Separate Screeners and graders	5	Screener, Grader
10	T M	EyePACS	4	Screener, Grader, Ophthalmologist
11	T M	Collaborative Working Tool	4	Screener, Grader, Ophthalmologist
12	T M	Communication through Optimise	3	Failsafe, Opht, Screener, Grader
13	T M	Collaborative Learning Tool	3	Screener, Grader, Ophthalmologist
14	T M	Eyebook	2	All

Table53. Multipurpose Level Objectives

Personal changes

No	T/O M/m	Change	Prio	Group
1	O M	Call possible diabetes to surgery	5	GP
2	O M	Book screening appointments from GP	5	GP
3	T M	Optimise Reminder	5	Failsafe
4	T M	Optimise Report and Letter Generator	5	Failsafe
5	T m	Failsafe Access Rights Enhancement	5	Failsafe
6	O m	Acute must use Optimise	4	Ophthalmology
7	O m	GP calls non-respondent patients for screening	3	GP
8	T m	GP Access Rights Enhancement	2	GP
9	O m	GPs must use Optimise	1	GP
10	T M	Optimise Collaborative Verification	1	Failsafe

Table54. Personal Level Objectives

National/ Service level:

No	T/O M/m	Change	Prio	Group
1	O M	Increase clinician number	5	Screening
2	O M	Increase ophthalmologist number	5	Acute
3	O M	Use Mass media to raise awareness	5	All
4	O m	Share documents with patients	5	All

Table55. National/Service Level Objectives

6. Identifying Socio-technical Alternatives / Defining the alternative with Root Definition & Conceptual Model

6.1. Identifying Socio-technical Alternatives

The changes 2 and below priority are neglected in this stage.

Firstly, all of the defined priority objectives are highly recommended. (*Table56*) These changes are the initial changes that must be performed.

1	T M	Optimise Portal	5	All
2	T M	Optimise Target Management	5	All
3	T m	Optimise National Standard templates	5	GP, Failsafe, Admin Team
4	T m	Debug Quest Browser	5	GP, Failsafe, Admin Team
5	T m	Nightly Extraction Quest Browser	5	GP, Failsafe, Admin Team
6	T m	Provide connection to clinics	5	Screener, Grader, Ophthalmologist
7	T m	Provide computers to Acute	5	Ophthalmologist, Failsafe
8	T M	Mobile Screening	5	Screener, Grader
9	T M	Separate Screeners and graders	5	Screener, Grader

Table56. High-priority Objectives

Other priority changes that have lower priority can be defined as future evolutionary changes. (shown in *Table57*.)

1	T M	EyePACS	4	Screener, Grader, Ophthalmologist
2	T M	Collaborative Working Tool	4	Screener, Grader, Ophthalmologist
3	T M	Communication through Optimise	3	Failsafe, Opht, Screener, Grader
4	T M	Collaborative Learning Tool	3	Screener, Grader, Ophthalmologist

Table57. Low-priority Objectives

Secondly, apart from priority objectives, the personal objectives that have high recommendations are highly recommended by researcher. (*Table58*) The minor changes are recommended for sooner implementation.

1	O M	Call possible diabetes to surgery	5	GP
2	O M	Book screening appointments from GP	5	GP
3	T M	Optimise Reminder	5	Failsafe
4	T M	Optimise Report and Letter Generator	5	Failsafe
5	T m	Failsafe Access Rights Enhancement	5	Failsafe

Table58. High-priority Personal Objectives

The personal objectives that are has lower priorities can be added to the future changes. (shown in *Table59*)

1	O m	Acute must use Optimise	4	Ophthalmology
2	O m	GP calls non-respondent patients for screening	3	GP

Table59. Low-priority Personal Objectives

There are also service changes defined which would be counted as National Level or Service Level changes. All of these changes are highly recommended however since they are related with top-level design, there might be some restrictions about them. (shown in *Table60*)

1	O M	Increase clinician number	5	Screening Service
2	O M	Increase ophthalmologist number	5	Acute Service
3	O M	Use Mass media to raise awareness	5	National level
4	O m	Share documents with patients	5	

Table60. High-priority National/Service Level Objectives

Thirdly and most importantly, there exist conflicts between some technical and organizational changes. Some conflicts could create unnecessary implementation or organizational changes. These should be taken into account in order to avoid redundancy. Therefore for some change bigger decisions alternative technical and organizational objectives are investigated for foreseeing what is required in worst situation to improve the socio-technical system.

- If Quest Browser will not be applied there are 2 options defined;
    - 1st option:
    - Increase GP's access rights in Optimise
    - Add GP responsibility of using Optimise

    - 2nd option:
    - Optimise Collaborative Verification
    - Access to GP systems from Failsafe and Admin team

- If Optimise Portal could not be developed, then the following changes have to be applied.
    - GP & Acute use Optimise
    - Optimise Collaborative Verification
    - Failsafe Access Rights

- If Optimise Communication will be developed than there is no need for Optimise Report & Letter Generator.

Lastly, the risks of job changes are investigated. The researcher discovered a possibility of job enrichment in GP, which might cause a job impoverishment of the Failsafe officer. The design group must be selective about those job shifts and should find a balance between service efficiency and job satisfaction objectives.

6.2. Defining the alternative with Root Definition & Conceptual Model

In this stage, an example root definition is generated to show how root definitions and conceptual models can be used in discussions.

From the priority objectives some objectives are selected and an example root definition is constructed for Retinopathy pathway. After this the root definition is represented with a conceptual model and a scenario is produced to reflect the new workflow.

6.2.1. Root Definition of an example socio-technical alternative

- An improved technical system
    - To merge the unconnected system with a **Portal**
    - To provide easier screening and grading with a collaborative work device called **EYE-PACS**
    - To provide improved data extraction from GP systems with a **nightly extraction** facility.
    - To increase communication by supporting technical devices and connection
    - To improve Optimise data sharing with National Standardised templates and data fields.
    - To provide shared and earlier appointments with **EyeBook**

- An improved social system
    - To reduce the amount of screening & grading time and increase resilience with **separating screener & graders**.
    - To provide shared and earlier appointments with **EyeBook**

6.2.2. Conceptual Model of the example socio-technical alternative

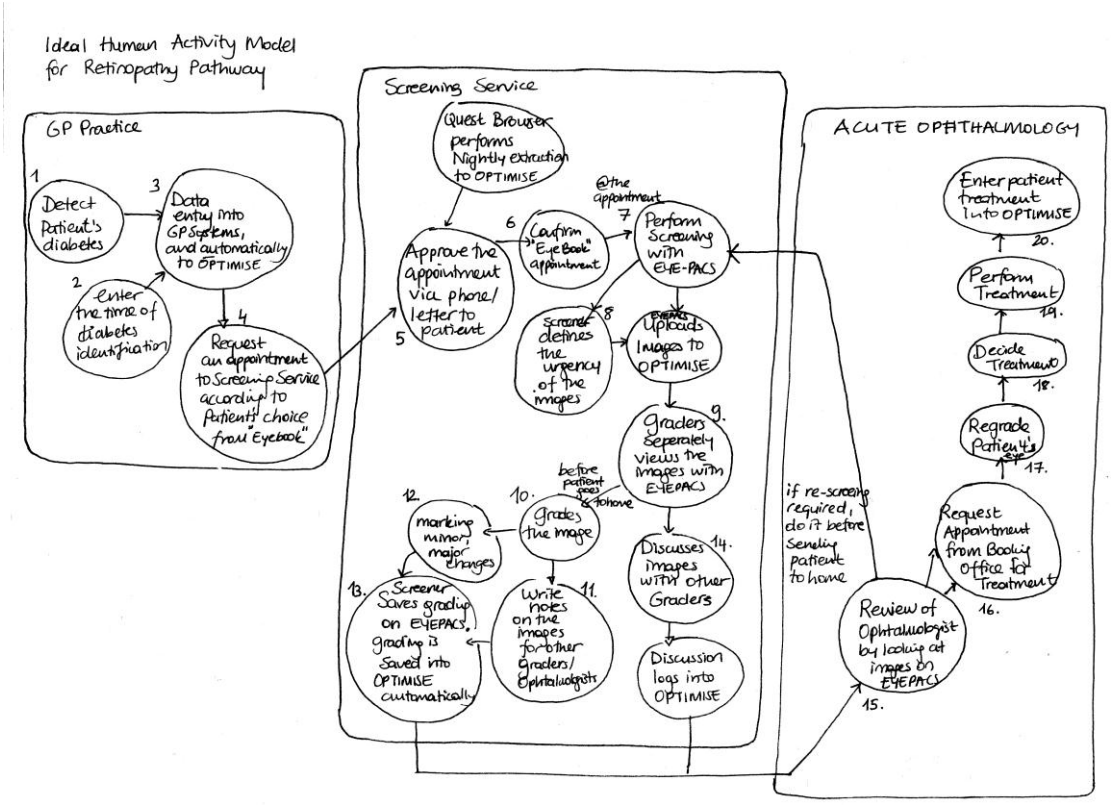


Figure 20. Ideal Conceptual Model for Retinopathy Service

6.3.3. An Example Scenario for the Conceptual Model

After the GP identifies diabetes of a patient, enters the patient data into Optimise Portal with the exact time the identification is performed. While patient is still in the GP Practice, GP nurse will arranges an initial appointment to the Screening Team by using EyeBook. The Screening Service also retrieves the GP's patient record via Quest Browser Nightly Extraction. After checking the record, accepts the EyeBook request and responds to the patient as soon as possible via letter or phone call. When patient comes to the screening appointment, the screening is performed using EYEPACS. The taken retina images are automatically uploaded to the Optimise Portal. Two Graders separately views, grades the images on EYEPACS. Grader2 marks some section in the retina image to indicate major retinal changes. The Grader1 disagrees the marking on the retina drawn by Grader2. The reviews are sent to Ophthalmologist for evaluation. The ophthalmologist evaluates the grading, marks and notifications on the images. He requests a normal type appointment for treatment. The booking office calls the patient. After patient comes to the ophthalmology, the patient is regarded and treatment is performed.

APPENDIX 3: Questionnaire Questions

Questionnaire to investigate the need for SSM & ETHICS in Walsall & Northampton NHS Informatics Teams' Design Strategies

Personal Questions:

1. What kind of role were you responsible in EPICog?

2. What kind of Socio-technical analysis or design tools, frameworks, techniques have you used in EPICog? (If you are not using any socio-technical approach, please briefly describe what your role was requiring in EPICog)

3. Are you aware of Mumford's ETHICS framework and Checkland's Soft Systems Methodology?
   Yes ☐
   No ☐

4. (If yes) Have you ever used it? When did you last use it?

For common Local Health Communities top-down design strategies:

The hard system approaches, (such as conventional systems engineering, operational research, systems dynamics) based upon the idea of performing engineering improvements on the defined real-world problems by discovering the optimal solutions. In hard systems approaches, the purpose is already defined or can be fully described and translated into objectives.

On the other hand, the soft system approaches (such as soft systems methodology) aim to investigate the problematic situation where it is generally hard to describe a specific purpose for the system. These approaches do not aim to solve the messy problematic situation but to investigate and learn more about it and set a purpose to the system.

1. Are they applying any soft approaches to define the possible products that can meet their business objectives in LHC Meetings?

Yes ☐

No ☐

2. Can we say that as PRINCE 2 methodology is based on investigating an already defined technical solution, it is directing the LHC to the hard system approaches without considering the need for a soft approach?

Yes ☐

No ☐

3. As NHS top-down strategy is in association with pathway process redesign and organizational change, it requires a socio-technical perspective to define the organizational changes. Do they apply any socio-technical analysis tool in LHC meetings?

Yes ☐

No ☐

4. It seems NHS doesn't take into account the need of the clinicians in the beginning of the top-down design process. LHC define the needs of the service and possible technical product according to the needs of commissioners and managers. Did NHS try to apply a participatory approach for these top-down decision LHC meetings before to increase the involvement of the user in the specification of the IT product and clinical service?

Yes ☐

No ☐

5. Do you think that NHS Top-down design at LHC level might need a soft approach?

Yes ☐

No ☐

Not sure ☐

6. Do you think that NHS Top-down design at LHC level might need a socio-technical approach?

Yes ☐

No ☐

Not sure ☐

For bottom-up design strategies in Walsall & Northampton IT departments:

1. Participation: Do you find the user-representative number adequate per project in Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

2. Participation: Do you find the clinical change facilitator number adequate per project in: Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

3. Participation structure: Do you think there is a structure on the structure of their user involvement approaches on both Informatics departments? In other words, are they following a structured participatory technique for providing user involvement in design process like ETHICS framework?

Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

4. Requirements Analysis: For requirements analysis Walsall & Northampton designers are feeling highly restricted, since LHC is already given highly detailed technical product requirements and policy specifications to them.

a. Do you know whether Informatics departments are applying any requirements analysis tools rather than defining changes through facilitators?

Yes ☐

No ☐

Not sure ☐

b. Do you think that Informatics departments need a requirements analysis tool at this stage although the requirements are generally specified?

Yes ☐

No ☐

Not sure ☐

5. Do you found IT teams participatory approaches democratic in terms of clinical end-user involvement? In other words, do you think that the clinical user representatives and other clinical end-users involved in design meetings have a wide sphere of influence in the bottom-up design decisions?

Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

6. Do you think the Informatics departments have enough voice over the bottom-up design decisions when compared to LHC?

Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

7. Do you think the clinical change facilitators have enough voice over the bottom-up design decisions?

Walsall Stroke IT Team:

Yes ☐

No ☐

Northampton Retinopathy IT Team:

Yes ☐

No ☐

8. Are Walsall Stroke and Northampton Retinopathy IT teams applying any socio-technical approach in bottom-up design process?

Yes ☐

No ☐

9. Are Walsall Stroke and Northampton Retinopathy IT teams applying any soft systems approach in bottom-up design process?

Yes ☐

No ☐

10. Do you think that NHS bottom-up design strategy might need a soft approach?

Yes ☐

No ☐

Not sure ☐

11. Do you think that NHS bottom-up design strategy might need a socio-technical approach?

Yes ☐

No ☐

Not sure ☐

Thank you for participating in this questionnaire.

APPENDIX 4: Interview Questions

Objective1: Whether there is a need for NHS to apply SSM and ETHICS?

Questions about the need for SSM/ETHICS in LHC top-down strategies:

1. What do you know about the techniques, frameworks, tools LHC are using in PRINCE2 Meetings to define the service redesign and technical product specifications?
2. What are the limitations of the current NHS top-down organisational design process?

Questions about the need for SSM/ETHICS in bottom-up analysis in Walsall & Northampton:

3. What do you know about the techniques, frameworks, tools Walsall /Northampton IT's using apart from their informal user involvement way?
4. What are the limitations of the current Walsall / Northampton bottom-up organisational design process?

Objective 2. Whether applying SSM & ETHICS could be advantageous to NHS design strategy?

Questions about perspectives on SSM & its use to the organisational design process of NHS:

The EPICog perspective on SSM

5. What do you think about SSM as a soft approach?
6. What do you think about the advantages of it?
7. Is there anything you don't like about it?

The use of SSM in NHS design process

8. Do you know NHS's perspective about such soft approaches?
9. What might be the contributions of using a soft approach in the NHS top-down and bottom-up design process?
10. To what extent might SSM fit into their current analysis methods and design strategy? What do you think about its use as a problem and purpose investigation method?
11. Could you please comment on the specific stages limitations or strengths that of the framework? Which stages could be useful for NHS design? Can we go through the posters..
    a. What do you think about the use of Rich picture drawing?
    b. What do you think about the use of purpose definitions with root definitions?
    c. What do you think about the use of Conceptual models in discussion of design change decision-making process?

Questions about perspectives on ETHICS & its use to the organisational design process of NHS

The EPICog perspective on ETHICS

12. What do you think about ETHICS as a socio-technical requirements specification, validation and prioritization method?
13. What do you think about the advantages of it?
14. Is there anything you didn't like about it?

The use of ETHICS in NHS design process

15. Do you know NHS's perspective about such socio-technical approaches?
16. What might be the contribution of using a soft approach analysis in the NHS top-down and bottom-up design process?
17. To what extend might ETHICS can fit into their current analysis and design methods? What do you think about its use as a Socio-technical requirements gathering approach?
18. Could you please comment on the specific stages limitations or strengths that of the framework? Which stages could be useful for NHS design? Can we go through the document..What do you think about the possible use of;
    a. Existing system definitions stage
    b. What do you think about the use of Role activity models and Conceptual Models for defining the existing system work design?
    c. Objective definitions stages with considering job satisfaction and efficiency needs of technical system with variance analysis?
    d. The joint optimisation stage where the prioritization according to the benefits, limitations and necessity are evaluated. It is close to the Japanese style of decision-making where the objectives are come under review several times, the conflicts and possible alternatives of technical and social objective merges are considered.

Questions about Socio-technical consultancy process of EPICog and SSM & ETHICS adequacy

19. What kind of socio-technical analysis/ design guidelines, frameworks or tools are you using in your work to approach socio-technical problems?

Objective 3. Whether the types of recommendations are acceptable by NHS?

Questions about my analysis on NHS Pathways:

20. What do you think about the complementation of the methods and the value of this structure of the methodology of the study? (SSM, ETHICS and The Ordit Methodology.)
21. Is there anything that you liked especially on complementation of both methodologies and thought that could be useful for the design of NHS?
22. What could be the value of those major vs. minor recommendations and acceptability of such frameworks that produces such recommendations?

Objective 4. Whether SSM & ETHICS is applicable in NHS?

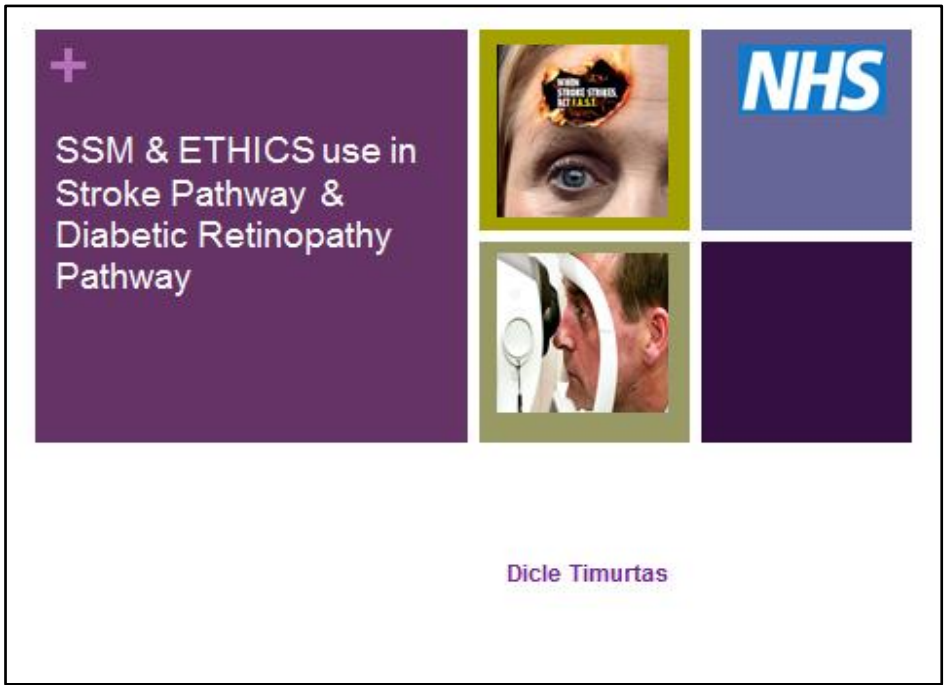
Questions about my analysis on Design Process:

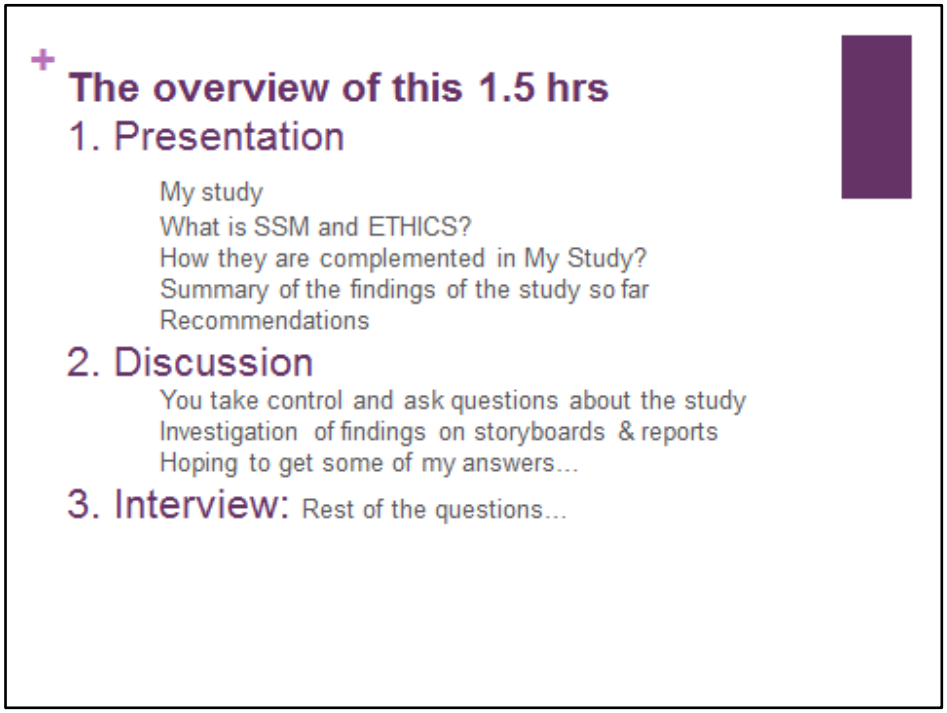
23. What do you think about the value and acceptability of my design strategy recommendations in the NHS?

Conclusion: Is there anything that you would like to add?

Thank you for your participation.

APPENDIX 5: Presentation Slides





My Study

Brief Description

- **The Subject**: Whether applying Checkland's Soft Systems Methodology complemented with Mumford's ETHICS framework should be applied in the NHS design strategies.
- **The Context**: Stroke pathway & Diabetic Retinopathy Screening pathway

My Study

The Objective

- **Understanding whether SSM or ETHICS frameworks should be used…**

1. Is there a need for NHS to apply SSM & ETHICS?
2. Is applying SSM & ETHICS useful for these pathways?
3. Is it feasible to apply SSM & ETHICS in these pathways?

My Study

The Methodology

- **Interview Analysis with Grounded Theory for Study1 & Study 2:** Coding Schema created with
  - SSM Guidelines
  - ETHICS Guidelines
  - Socio-technical Principles
  - Emotional needs of users
  - Participation structure and user involvement details
- **Study1**: Applying SSM & ETHICS separately on both pathways
  - Not for finding the best solution for pathways
  - Investigating the context
  - Experiencing possible advantages of framework
  - Finding some example results
- **Study2**: Applying SSM on investigating design process of both Informatics teams - Walsall & Northampton
  - Understanding the need for frameworks, the feasibility to apply them
- **Interviews** with Socio-technical team to back-up the findings

What is SSM?

The Definition & Characteristics

- Organised flexible process of enquiry for interpreting, investigating and learning organisational problems. Not a problem solving approach...
- It does not tackle with well-defined problems, aims to investigate of the fuzzy, ill-defined organisational problematic situations.
- Gives importance to the different worldviews of all stakeholders and their conflicts.
- Gives importance to conceptualization of the stakeholders purposes and the activities with an interpretive (Wittgensteinian) approach.

What is SSM?

The Process

- Four Stage of SSM
  1. Defining the Problematic Situation
  2. Making Purposeful Activity Models
  3. Discussing the Activity Models:
  4. Taking action to perform improvement

What is SSM?

Stage 1. Defining the Problematic Situation

- The rich pictures are informal drawings to represent the researcher's interpretation and understanding about the complex and ill-defined situation.
- They include stakeholders: actors, owner, client, practitioner, their viewpoints, their processes and the current recognised issues & conflicts.
- 3 Analysis
  - Analysis One: Intervention itself
  - Analysis Two: Cultural Analysis: organisational structure: roles, norms, values.
  - Analysis Three: Political Analysis: power and influence

What is SSM?

Stage 2. Making Purposeful Activity Models

- Initially, the researchers looks for the possible worldviews of the stakeholders. Defines clashes and problems.
- Secondly, Root Definitions are defined including purpose statements related to a complicated action, conflict or problem.
- Root definitions can be defined including
  - **What, how, why to change**: the 'PQR structure': do P, by Q, for R
  - **CATWOE definition**: customers, actors, transformation, worldview, owner, environment.
- Lastly, Human Activity Models are drawn by decomposing the activity of the ideal purpose defined in root definition into an activity sequence.

What is SSM?

Stage 3. Discussing the Activity Models:

- The discussions should involve all stakeholders.
- Going through each activity in the conceptual model
  - Questioning if the **activity exists** in the current situation
    - Who does perform it? How does it performed? Should it be improved? Does the activity has dependencies?
  - Questioning if **the activity doesn't** exist in the current situation
    - Should it be added? How should it be added?

What is SSM?

Stage 4. Decision, Planning & Taking action to perform improvement

- Try to find accommodation between the list of changes within a discussion.
- Plan change

What is ETHICS?

The Definition & Characteristics

- A socio-technical and participatory design approach
- It does not claim to clear out all of the technical and social problems of a system.
- Its aim is to provide a compatible set of technical and organizational objectives. Organizational objectives are as important as the technical objectives.
- Considers the existing system evaluation and the ideal system design.
- Values job satisfaction and technical efficiency.
- Participation Structure:
  - Design Group: designers, analysts and user representatives (min 1rep. per user group)
  - Steering Committee: managers, commissioners

What is ETHICS?

The Process

- **Stage 1:** Definition of needs
- **Stage 2:** Setting objectives
- **Stage 3:** Identifying socio-technical solutions and making a design choice
- **Stage 4:** Implementation of the design decision
- **Stage 5:** Follow-up evaluation
- **Stage 6:** Reports for the company

What is ETHICS?

Stage 1: Definition of needs

- It includes 8 steps investigating existing system & an ideal system
- Existing System Investigation:
  - *Step 1* questioning the need for a change in the system
  - *Step 2* investigation of the system boundaries
  - *Step 3* investigation of the existing system: Stafford Beer's Viable System Analysis
- Ideal System Investigation
  - *Step 4* ideal business mission and key objectives
  - *Step 5* the key tasks, by decomposing key objectives into its subtasks
  - *Step 6* related organizational or technical information needs
  - *Step 7* the job satisfaction of workers and its relation with the job itself.
  - *Step 8* is to measure the efficiency needs of the system by a variance analysis
  - *Step 9* is to define the future needs of the system.

What is ETHICS?

Stage 2: Setting objectives

- *Step 10:*
  - **Listing** all defined information needs: efficiency, job satisfaction and future objectives for the new system is set considering the key objectives and key tasks defined in *Step 4* and *Step 5 as well*.
  - **Ranking** each these design changes from 1 to 5: according to the benefits, limitations and necessity of each objective with their user groups.
  - **Dividing objectives according to their use:** for all users or individual user groups.
  - **Defining conflicts between objectives**
  - **Defining priority objectives with a discussion:** that are accepted by all user groups

What is ETHICS?

Stage 3: Identifying socio-technical solutions and making a design choice

- The alternative socio-technical solutions involving possible combinations of organizational and technical objectives defined.
  - *Step 11,* the possible technical changes are defined
  - *Step 12,* the possible organizational changes are defined in parallel
  - Consideration of possible merges of technical and social changes form the alternative socio-technical solutions.
  - Selection the best alternative from these socio-technical solutions considering socio-technical principles and guidelines.
  - *Step 13* includes detailed definition of new socio-technical systems detailed work design.

What is ETHICS?

Stage4-5-6: Implementation, Evaluation, Documentation

- *Step 14* identifying the best implementation strategy and performing implementation
- *Step 15* evaluation of the implemented product using variance analysis and job satisfaction analysis
- *Step 16* is for documentation of theory & practice to the company.

Complementation of SSM & ETHICS for Requirements Analysis

Use of ORDIT Methodology (Eason, 1993) for Socio-technical Requirements Analysis

- **1. Scoping**
- **2. Requirements Gathering**
- **3. Modelling**
- **4. Option Generation and Evaluation**

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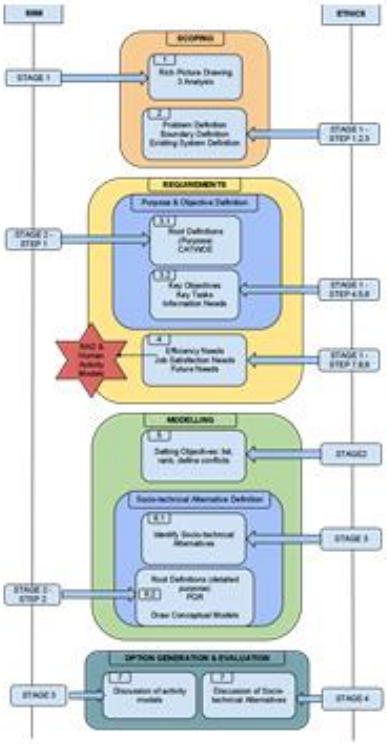
Complementing SSM & ETHICS with each other



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Findings

Findings of Study1: SSM & ETHICS on the pathways

4 levels of results:

- **Major technical**: new innovative developments such as:
  - Stroke Pathway: Team Progress Management tool, Mobile-Fusion Application, Collaborative care plan tool, Fusion Handover Planner
  - Retinopathy Pathway: EYEPACS Collaborative Working tool, Optimise Reminder
- **Minor technical**: middleware, interface infrastructures between systems and tweaks such as:
  - Stroke Pathway: Fusion Portal, Improvements on Fusion (National data entry templates)
  - Retinopathy Pathway: QueryBrowser Improvements, Failsafe Access Enhancements
- **Major organizational**: merges, structure changes, big role changes such as:
  - Stroke Pathway: Merge Acute & Community, Family care giver training
  - Retinopathy Pathway: GP Role for booking initial appointments
- **Minor organizational**: small role additions such as:
  - Stroke Pathway: Put a Stroke Nurse in A&E.
  - Retinopathy Pathway: Acute service should use Optimise.

Findings

Findings of Study1: SSM & ETHICS on the pathways

- 3 types of results:
  - Priority objectives: important to all users so 'Must changes'.
  - Personal objectives: important to specific users.
  - Service level/national level: ETHICS can be applicable at top-down design.

- So this 3 types of results provides… easy formulation of alternatives through indicating importance and conflicts.

Findings

Findings of Study1: SSM & ETHICS on the pathways

- **Advantages of using frameworks**
  - SSM informing ETHICS in many levels: problem definition, objectives, alternative selection.
  - **SSM is advantageous in**
    - **Summarizing complex data,**
    - **Finding conflicts on worldviews, stakeholder analysis,**
    - **Improving Creativity in recommendations**
    - Possible: Improving Participation, communicating and discussion with rich pictures and conceptual models
  - **ETHICS is advantageous in**
    - **Joint optimization: suitable and balanced set of objectives. Prioritized and conflict indicating objectives provides structure for discussion**
    - **Structure socio-technical design**
    - **Structure requirements gathering, analysis, specification, and prioritization**
    - Structure participation
  - **Common**: Both can be used for evaluation & design

Findings

Findings of Study2: SSM on Design Processes

- **Undemocratic System: level of influences**
  - Commissioners, Managers > Hybrids > User Champion > Real Clinician End-Users
    - At Top-down design: the technical changes are decided according to commissioners & managers needs, clinicians are not influencing the design of technical system
    - Although there are user champions in PRINCE2 meetings the hybrids are controlling the meeting.
  - LHC > Informatics
    - LHC filtering for Informatics changes. Major changes are rejected by LHC. Minor tweaks are allowed.
    - Senior informatics & Management > Clinical Change Facilitators (Hybrids) > Development team >User Representatives > User
    - There is a user request mechanism starting from senior informatics, business change group and then developers.
    - Facilitator reductions and seniority (especially in Northampton)
    - Development team gives the last decision and the prioritizes the decision.
- **No structure** or formal technique usage for user analysis, requirements gathering, user participation

Findings

Findings of Study2: SSM on Design Processes

- **No socio-technical design**: LHC is performing it unconsciously and separately. Informatics are just performing technical design.
- **No soft approaches:** LHC is defining the purpose of the technical system via discussions in PRINCE2 meetings
- **Wrong user definition**
  - At top-down design, commissioners & managers are users, the clinicians are not users.
  - Hybrid take over in design decisions causing ownership problems
- **Resistance to major change**
  - LHC resistance: resistance to major changes
  - Informatics resistance: don't want a systems spawning

Recommendations

Top-down & Bottom-up design strategies

- **For top-down strategy**: socio-technical design
  - Use QUICKethics AND SSM at LHC level combined with PRINCE2
  - Use ETHICS at Informatics level in parallel

- **For bottom-up strategy**: socio-technical evaluation and redesign
  - Use ETHICS at Informatics level

Recommendations

General Design Strategy Changes

- LHC
  - Merge separate organisational and technical design in LHC and make it socio-technical.
  - Soften the PRINCE2 application: nested Purpose definition and requirements gathering stage use the SSM & ETHICS nested.
  - Redefine the user: Clinicians should have voice over needs.
  - In top-down design LHC & Informatics should be work in parallel
- Informatics
  - Informatics should perform socio-technical design not just technical.
  - Consensus participation should be applied.
  - Increase the facilitator numbers and their seniority.
- Common
  - Both teams should be more open to major changes
  - Overall we can say that Retinopathy needs such a structure more than the Stroke team when design process is considered.

The objectives of this interview

Discuss my findings according to my results…

What do you think about these questions?

- The need for SSM & ETHICS
- Possible Advantages of SSM & ETHICS
- Feasibility of SSM & ETHICS

Would you like to ask any questions ?

Which part of the findings do you find more interesting and want to investigate more for answering those questions?