Soft Systems Model of the MSc Programmes of Computer Science Department

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# Soft systems model of the MSc Programme of Heriot-Watt University

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Declaration

I, Panagiotidou Angeliki, confirm that this work submitted for assessment is my own and is expressed in my own words. Any uses made within it of the works of other authors in any form e.g., ideas, equations, figures, text, tables, programs etc are properly acknowledged. A list of the references employed is included.

Signed:

Angeliki Panagiotidou

Date: 12 / 8 / 2013
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Abstract

An information system consists of a set of techniques which identify problem situations, analyse them by collecting data, develop possible solutions and finally implement the most efficient option. More organisations, day-to-day’, apply information systems in order to achieve efficient management, to reduce the cost and to oppose the growing competition. Information systems have become a critical way for welfare organizations to operate in the current world.

The aim of this project is to investigate and identify concerns and problems relating to the MSc Programme of Heriot-Watt University, to analyse them and finally propose solutions for solving the problem. After careful analysis and consideration of different methodologies, it will be achieved by using Soft Systems Methodology (SSM). SSM takes into account people’s Weltanschauungs in order to help system analysts to structure people’s thinking about the present world and to compare it with the world that it could become.

This will be accomplished by using data from questionnaires and discussion groups with current and potential MSc students of Heriot-Watt University as well as by interviewing directors and professors of MSc Programme. The outcome will be a critical discussion about SSM and a number of suggestions to improve the MSc Programme with the intention that this research will be the starting point of SSM development in the real world.
Soft systems model of the MSc Programme of Heriot-Watt University

Glossary of Abbreviations

- SSM - Soft Systems Methodology
- RUP - Rational Unified Process
- SSADM - Structures, Systems Analysis and Design Method
- ETHICS - Effective Technical and Human Implementation of Computer-based Work Systems
- MACS – Mathematics and Computer Science
- HWU - Heriot-Watt University
- CS - Computer Science
1. Introduction

Most organisations nowadays, if not all, use information systems to help them achieve effective management by making good decisions and providing good quality services to the customers. Due to the fact that all the systems are complicated, the need for techniques and tools to make them comprehensible is generated. Methodologies were created in order to analyse a system, to identify and analyse the problem situations and to find ways to cope with them. Methodologies are categorized in hard and soft groups. Hard methodologies are a traditional way for solving problems and are used in structured problem situations in which system analysts follow specific steps in order to solve the problem. On the other hand, soft methodologies are used in ill-structured and complex situations and they focus on investigating human factors and individuals Weltanschauung.

This project will analyse the problematic situation of MSc Programmes of Computer Science department of Heriot-Watt University with the Soft System Methodology (SSM). It will focus on identifying stakeholder’s concerns, creating the Rich Picture and a Purposeful Activity model and finally suggest a way to improve the difficult situation. I first became interested in Soft System Methodology through attending the course “Information Systems Methodologies” in the first semester of my master degree. The fact that SSM emphasises humans’ viewpoints attracted me and made me keen on applying my knowledge and analytical skills to investigating a real problematic and complex situation which involves a human element.
Soft systems model of the MSc Programme of Heriot-Watt University

1.1 Aim
My purpose is to create a soft model in order to improve MSc Programmes of Computer Science department of Heriot-Watt University.

1.2 Objectives

1. Research in books, papers and articles analyzing different methodologies with the intention of finding the most appropriate method corresponding with my desired outcome.

2. Identify the stakeholders (directors, lecturers, students, employers) of Computer Science MSc Programmes through the website.

3. Examine and analyse stakeholder’s viewpoints by distributing questionnaires or interviews with the stakeholders of MSc Programmes of CS (current and potential students, head of school, directors, professors).

4. Generate the Rich Picture of MSc Programmes of CS department of HWU.

5. Analyse the first stage of SSM by gathering and analyzing information from the questionnaires and interviews, as well as analysing the problem situation concerning the social and political environment.

6. Evaluation of the Rich Picture by sending it via e-mail and discussion with academic staff and then regeneration of the Rich Picture.

7. Creation of a Purposeful Activity Model for CS master Programmes, including
   i. Root Definition
   ii. CATWOE
   iii. Three e’s
   iv. Conceptual Model

8. Create a debate concerning the conceptual model and the new rich picture.

9. Define actions to improve the problematic situation of MSc Programme of Heriot-Watt University.

10. Create a critical analysis of SSM.
2. Literature Review

In this chapter, after searching and reading books, papers and articles, I will outline the basic characteristics of Rational Unified Process (RUP), Effective Technical and Human Implementation of Computer-based Work Systems (ETHICS), Structures, Systems Analysis and Design Method (SSADM) and Soft Systems Methodology (SSM) that I found relevant to my project and I will explain my reasons for my final decision.

2.1 Introduction

This paper will analyse hard and soft systems methodologies in order to realize that soft system methodologies are more appropriate for analyzing the real problematic situation of MSc Programmes of Computer Science department. In the following pages, there will be an analysis of Rational Unified Process (RUP), Effective Technical and Human Implementation of Computer-based Work Systems (ETHICS), Structures, Systems Analysis and Design Method (SSADM) and Soft Systems Methodology (SSM). There will be an outline of each methodology, the advantages and disadvantages of each one as well as the reasons for my final choice. After careful consideration, I decided to use SSM to analyse the problematic situation of MSc Programmes of CS as far as there are no specific objectives and it is dealing with a real world situation where there is a social and human activity element.

2.2 Hard Vs Soft systems

2.2.1 Hard systems

Hard systems approach is used in structured and well-defined situations which have clear objectives, based on reality, and specific goals. Hard systems were established in 1960 and since then, they are a traditional way of finding the ideal solutions. These methods collect data and view them as computation elements which help them structure a solution.

2.2.2 Soft systems

Soft systems approach is used for human activity systems in un-structured and complex situations. They are unsuitable for engineering approaches and they are mostly used in “messy” situations where the human factor is vital. These methods do not have goals and it might be very dangerous for the under consideration system to enforce a solution which expresses a specific purpose. Soft systems are
considered as a procedure for using the real world and individuals Weltanschauung in order to gather information about the situation and to gain a systemic perception.

### 2.2.3 The distinction between Soft and Hard Systems

Hard and soft systems are developed to create software solutions in order to solve real complex problems. Complex problems are categorized in two aspects, the technical, which is dealing with the deterministic rules that control the physical environment and it is better confronted by hard systems; and the human, which is dealing with the eccentricity and changeability of human factor and it is better confronted by soft systems. [Bailey E. (1996)]

The difference between Soft and Hard systems is very important and it determines the methodology which should be used in every situation. It is specified that the hard systems are suitable for well-structured technical-engineering problems and soft systems are suitable for chaotic and ill-defined situations which involve the human factor and social considerations. [Checkland P. (1999)] Soft models are dealing with situations which are difficult to be defined as far as it has to investigate and analyse stakeholder’s viewpoints and interests such as political, social and economic issues. [Saleh Al-zahrani, (1994), David Cairns]
2.3 Hard Systems

2.3.1 Rational Unified Process (RUP)

2.3.1.1 The methodology

The Rational Unified Process (RUP) is a well-structured and well-designed software development process. It is a hard system as far as it does not take under consideration the human factor. The first rational approach was introduced in 1995 and the first Rational Objectory Process 4.0 was introduced in 1996. Rational Unified Process has been developed over the years and the last version is the Rational Unified Process 2003 which is the first version that uses the new Unified Modeling Language (UML 0.8). RUP has an iterative architecture and its goal is to produce high-quality software that meets users’ requirements on time and within the estimated cost. It is a process product and a process framework which can be used and extended in order to suit with the needs of the implementing organization.

RUP answers the questions of who (Roles) is doing what (Artifacts), when (Workflows) and how (Activities). RUP consists of two dimensions; the horizontal, which symbolizes the dynamic structure and shows the lifecycle of the process through phases, iterations and milestones, and the vertical dimension, which symbolizes the static structure through 9 disciplines that crowd all the activities. (See figure 1) [Cooper K. et al., (2006)]

RUP is broken down into 4 phases.

**Figure 1: RUP Dimensions**

**Phase 1: Inception phase**

In this phase, system analysts have to identify stakeholder’s objectives and analyse system’s requirements and constraints with the intention of specifying the project’s scope as well as its boundaries.
Phase 2: Elaboration phase

The aim of this phase is to analyse the problem situation and its requirements, to identify the possible risks and to create a project plan which mitigates the most important risks. This is the most critical phase as it is the last step before the software construction starts. At the end of this phase, the project’s vision and requirements are clear and stakeholders should decide whether or not the project will proceed to the construction and transition phase.

Phase 3: Construction phase

This phase is an engineering process which focuses on managing the available resources, prioritising the requirements, analysing the specifications, controlling the procedures and finally applying the correct code, test and design to the appropriate solution. The solution should fulfill the organization’s purpose and an estimation of cost, quality and time as well as a risk assessment should provide detailed insight into tackling any problems or issues.

Phase 4: Transition phase

This is the last phase which is responsible for delivering the software to the production team. A number of tests take place in order to solve the potential problems and to mitigate the risk of errors during the process. This phase is responsible for training system users and to support them in every step. At the end of this phase, stakeholders should agree that the final project meets their requirements and that it is ready for deployment.

[Kruchten Philippe (2003), Scott W. Ambler (2005)]

2.3.2.1 Advantages of RUP

RUP is a well-structured approach to a software engineering project which focuses on precise documentation. It emphasizes finding ways to mitigate the risks of client’s changing requirements. RUP is an open methodology and it provides on-line support to the users by providing a well-structured training tutorial in which there is a step by step explanation of how to use it. RUP needs less time and it spends less money due to the fact that it can re-use and extend the components of previous analysis from the implementing organization. These advantages make RUP an option for analyzing MSc Programmes of CS as there is a need for a re-usable methodology due to the changeable situation over time and the time constraint.
2.3.2.2 Disadvantages of RUP

There are also some weaknesses in using RUP. RUP needs experienced system developers in order to develop software which meets the methodology’s requirements. In addition, the process of RUP is very good but at the same time too complex which makes it difficult to apply it correctly. Unfortunately, RUP does not apprehend the social aspects of software development and it will be difficult to re-use RUP’s previous components in developing new technologies. For all these reasons, RUP is not appropriate for analysing the MSc Programme of CS as far as it does not take under consideration people’s perspectives and cultural environment. It is also disorganized which might drive it to an undisciplined system.
2.3.2 Structures, Systems Analysis and Design Method (SSADM)

2.3.2.1 The methodology

Structured Systems Analysis and Design Methodology (SSADM) is a standard hard system methodology for the analysis and design of computerized systems which was introduced in 1981 by CCTA (Central Computing and Telecommunications Agency) and its development was completed in 1991. SSADM follows the structural standards which outline the structure of the development system by specifying the main tasks, their boundaries and the final output system. Also, it provides system’s developers with specific techniques and guidelines, tools as well as explicit rules for SSADM’s use. Finally, it follows documented standards for recording the details of system’s deliverables. [Government of the Hong Kong Special Administrative Region (2012)] SSADM consists of five stages which are divided into 7 steps.

Phase 0: Feasibility study

Step 0: Feasibility: This step certifies that the project is feasible and worth following. Developers analyse the potential problems, and produce a list of possible solutions with their estimate cost and feasibility level.

Phase 1: Requirements analysis

Step 1: Investigation of current environment: Analyses the processes of the current system, identifies the current problems and analyses user’s requirements.

Step 2: Business system options: Developers and users make a list of new system options with their relevant cost and benefits from which the client has to select the best option for the new system in their organization/business.

Phase 2: Requirements specification

Step 3: Definition of requirements: Developers forget the boundaries of the current system and try to create the structure of new system’s data with a new design (and) based on system’s requirements.

Phase 3: Logical system specification

Step 4: Technical system options: After the previous steps, developers and users have a general idea of how the new system will be and as a consequence, they can now consider the technical aspect of the system.

Step 5: Logical design: Specifications of the new system take place in this step. The user has to decide about the design of the new system and specify what the new system will do.
Phase 4: Physical design

Step 6: Physical design: This step focuses on the design and the environment that the new system will work as in well as the specifications for system’s performance.

[Avison and Fitzgerald, (2003)]

2.3.2.2 Advantages of SSADM

SSADM is a hard, structured methodology which emphasizes on system usability by analyzing user’s needs. It focuses on specifying the project’s objectives and needs at the development stage in order to respond quickly to changes by modifying the project plan to the new requirements. Moreover, it develops a time frame and gives specific guidelines of how it will be managed and controlled by the appropriate person in order the project to be delivered on-time. SSADM defines a definite quality level from the beginning of the project in order to identify and fix the errors during the stages by involving users and enabling the option to modify and monitor. SSADM uses diagrammatic techniques and CASE tools which can be easily taught and used even by inexperience staff. Furthermore, it divides the logical from the physical system with the intention to reduce the cost of a future system implementation as far as it will not need the development of new hardware or software. To conclude, SSADM is promising on-time delivery and agreed quality, by using and training staff effectively and ensuring an overall improvement of project productivity. For all the above reasons, SSADM is a good choice for analyzing the MSc Programme of Heriot-Watt University. SSADM is useful as far as it gathers all the requirements from the beginning and does not need a lot of time for training and explaining the methodology step by step.

[Government of the Hong Kong Special Administrative Region (2012), ITC Infotech India Ltd]

2.3.2.3 Disadvantages of SSADM

Despite the advantages, SSADM might be costly because of the extensive analysis of project and user requirements. Furthermore, as a result of the wide variety of descriptions and error checks, the planning might become lengthy and unclear which will cause confusion of the objectives. However, SSADM is beneficial for big companies as it gives them the opportunity to re-use the system data for other projects. Big companies can increase their income and they can reduce project cost and time. [ITC InfoTech India Ltd] SSADM also assumes that the system’s requirements cannot be changed over time. For these reasons, SSADM is unlikely to be used for analyzing the MSc Programmes of CS.
2.4 Soft Systems

2.4.1 Effective Technical and Human Implementation of Computer-based Work Systems (ETHICS)

2.4.1.1 The methodology

The Effective Technical and Human Implementation of Computer-based Systems (ETHICS) is a soft problem solving methodology introduced by Enid Mumford in 1983. It was developed to help the establishment of organisational systems that involved new technologies. It emphasizes the human side of systems by encouraging stakeholders to participate in the design process with the intention of setting their own objectives by developing strategies. The main idea of ETHICS is to improve Job satisfaction and Job efficiency. Regarding Mumford E. (1983) job satisfaction is determined “as the attainment of a good "fit" between what employees are seeking from their work - their job needs, expectations and aspirations - and what they are required to do in their work - the organizational job requirements which mound their experience”. ETHICS places emphasis on the Design Process and consists of five stages and fifteen steps.

Stage 1: Analysis of Required System

This stage focuses on identifying stakeholder’s requirements and analysing the desired characteristics of the new system. It also detects the potential problems, sets the objectives and constructs system’s constraints.

Stage 2: Analysis of the Existing System

An analysis of an organisation’s existing system is takes place in this phase, in an incompatible way. System analysts should identify the possible variances, to set up the appropriate efficiency goals and to categorize regulator activities.

Stage 3: Agreeing Objectives

Stakeholders should come to an agreement of the relevant objectives. A prioritization of these objectives should take place as well as a connection with the existing and required system. Furthermore, job satisfaction objectives should meet new system’s purpose.

Stage 4: Designing the Organizational System

In this stage, the development of numerous approaches is taking place by considering different technical options.
Stage 5: Implementing the System

The final stage focuses on structuring the implementation strategy of the new system by involving changes in planning in order to reduce the estimated duration.

15 Steps of ETHICS:

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>2.</td>
<td>System boundaries</td>
</tr>
<tr>
<td>3.</td>
<td>Description of existing system</td>
</tr>
<tr>
<td>4.</td>
<td>Definition of key objectives</td>
</tr>
<tr>
<td>5.</td>
<td>Definition of key tasks</td>
</tr>
<tr>
<td>7.</td>
<td>Diagnosis of efficiency needs</td>
</tr>
<tr>
<td>8.</td>
<td>Diagnosis of job satisfaction needs</td>
</tr>
</tbody>
</table>

[Mumford E., (1983)]

2.4.1.2 Advantages of ETHICS

ETHICS focuses on people’s perceptions by using questionnaires in order to gather information about job satisfaction. It emphasizes the design process of the new system instead of the implementation. Furthermore, ETHICS analyses and describes the whole organization and not just the problem situation. Also, the final system has a good combination of technology and satisfaction of stakeholders’ needs. In addition, it can easily adapt to changes and finally achieve the organisation’s goals. ETHICS would be a good methodology for analyzing MSc Programme CS of HWU as far as it pays attention to peoples’ needs and encourages them to give advice and train others rather than being a passive listener.
2.4.1.3 Disadvantages of ETHICS

However, ETHICS does not connect the new developed system with the stakeholders’ desired system. Also, system’s users must be trained in order to cope with the new improved system which takes time. Furthermore, stakeholders might not want to participate in the design process which will cause difficulties in communication between different departments. ETHICS depends on the participation of a big group of people in order to achieve job satisfaction which as a result, makes it unsuitable for analysing the MSc Programmes of CS as we are not sure if stakeholders are willing to help.
2.4.2 Soft Systems Methodology (SSM)

2.4.2.1 The methodology

Soft Systems Methodology (SSM) was developed by Peter Checkland and his colleagues at the Lancaster University in the 1970s. SSM is a qualitative action-oriented methodology which has the ability to deal with real, ill-structured, fuzzy problematic situations. [Checkland, (1981)]. SSM is a soft system which tries to comprehend and shape the wicked and uncertain situation of complex organisations which Lester Stan (2008) referred to as, “there are often no straightforward ‘problems’ or easy ‘solutions’”’. As Checkland (1999) cited Tayyab Maqsood, Andrew Finegan and Derek Walker for support, SSM is suitable in situations that the problem “cannot be formulated as a search for an efficient means of achieving a defined end; a problem in which ends, goals, purposes are themselves problematic”. [Checkland, (1999), p. 316]

Williams Bob (2005) highlights that SSM’s purpose is to compare the world today, with how the world might be in the future. SSM encourages systems analyst to investigate the cultural perspective of the organization as well as the different viewpoints of humans who are involved in this problematic situation. [Maqsood T., Finegan D. A., Walker H.t. D.]

SSM consists of four stages which represent the real and conceptual world.

Stage 1: Finding Out


a. Making Rich Picture

b. Analysis One (the Intervention Itself)

c. Analysis Two (Social)

d. Analysis Three (Political)

Stage 2: Making Purposeful Activity Models

In this stage, SSM analysts are creating models of purposeful activity in order to ask questions and to help them understand better the real world situation. In every human activity, people have different purposes which are contradicted, which is why SSM uses these models. Therefore, these models have to ensure that the learning process of the complex real world will be organized and not random.

Soft systems model of the MSc Programme of Heriot-Watt University

Stage 3: Using Models to structure Debate

Throughout the SSM process, system analysts have built the rich picture of the problem situation and have created one or two models which can be used so as to structure and begin the debate about how the situation will be changed. [Reynolds M. and Holwell S. (2010)]

Stage 4: Defining ‘Action to Improve’

In the last stage, SSM will define the final actions which will improve the problem situation. In order to achieve this, it has to find accommodation for a group of people who have the same concerns without forgetting the probability of consensus.

2.4.1 Advantages of SSM

SSM has a variety of strengths. First of all, it is trying to deal with an un-structured, messy, confusing and complex situation and finding the best way to improve the problem situation. It is also takes under consideration all the particular Weltanschauung or worldview, which is the main advantage of SSM. Human activity systems are complicated which is why SSM is arguing and debating for the real world situation. SSM is a structured way of dealing with the problem situation by providing specific steps which must be followed by system analysts. SSM is a leaning system and can be used for solving the biggest part of real-world problems. Finally, SSM is the best way for analyzing MSc Programmes because it uses a structured way for finding a solution to messy, complex and unstructured problems, such as the one that this project is concerned with. SSM is also appropriate as far as it focuses on stakeholders worldvies which is what we need in our case.

2.4.1.2 Disadvantages of SSM

On the other hand, SSM has some disadvantages. First of all, the organization should adapt to the SSM approach and people should get used to the way that it works. According to Lester Stan (2008), SSM processes may have a lot of organisational boundaries and specific structures, which cause instant solutions to the problem, but without changing the problem area. This might happen if the results of the first step are considered as constraints. Moreover it might happen if the required changes have not been decided yet and the desired situation has not yet been specified. [Lester Stan (2008)] Furthermore, it fully analyses stakeholder’s perspectives on which it spends a lot of time and resources. As a result, SSM is unsuitable for problems that need an immediate solution. The main problem of using SSM in MSc Programme is the need for stakeholders’ contribution in analysis which might be difficult to achieve.
3. Discussion

After careful consideration of the previous methodologies and a comparison of their pros and cons, I designed a table in which the left column consists of the main characteristics of our situation and checked which methodology, of the ones that I examined, is fulfilling these requirements. (Figure 2)

<table>
<thead>
<tr>
<th>METHODOLOGIES</th>
<th>HARD SYSTEMS</th>
<th>SOFT SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHARACTERISTICS</td>
<td>RUP</td>
<td>SSADM</td>
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<tr>
<td>Unstructured problem situation</td>
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<td></td>
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<tr>
<td>Complex problem situation</td>
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<tr>
<td>Concern about human factor</td>
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<tr>
<td>Explore human worldview</td>
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<tr>
<td>Changeable requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social aspects</td>
<td></td>
<td></td>
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<tr>
<td>Not specific objectives &amp; goals</td>
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</tbody>
</table>

Figure 2: Table with investigated methodologies and their characteristics.

As a result, the most appropriate methodology for analyzing the problematic situation of MSc Programmes of CS of HWU is the Soft Systems Methodology (SSM). SSM uses a structured way for finding a solution to messy, complex and unstructured problem situations; it includes the human factor and focuses on investigating stakeholders’ worldviews. Furthermore, it concerns itself with the social aspects of the situation and the requirements can be changed. Finally, it does not have specific objectives and goals; it promotes investigation, which is what we need in our problem situation.

My decision is also based on examining a various number of cases which used SSM in order to solve different problem situations. More specific, Jitna Por (2007) used SSM to carry out an analysis about the personal tutor’s role in nurse education, assuming that “forces the user to look for a solution that is more than technical” and also SSM “with SSM, the process is as important as the output”. Williams Campbell Mark (2000) uses SSM to investigate the information system of a small company by representing the effectiveness of rich picture. Furthermore, Warwick Jon (2008) used the SSM
application to facilitate the analysis of an educated mathematics module, emphasizing that the reason for using this methodology was to capture and highlight the views and the conflicting expectations of those who participated in the module. In addition, Maqsood, Finegan and Walker applied SSM in five different studies to Knowledge Management. According to them, these studies “are increasingly becoming highly competitive, more complex and difficult to manage” adding that “they become problems that are difficult to solve using traditional approaches”. Finally, Niu, Lopez, Cheng (2011) presented “an exploratory case study investigating the hypothesis that ‘soft systems approach would identify all the flaws in requirements practices and suggest improvements suited to an organisation’s context’” and they came to the conclusion that “SSM has a rich value in scrutinizing and improving the human-centred RE activities” where RE is the software requirements engineering.

In addition, SSM was successfully used in various other cases which made me keen on applying it.

The analysis of MSc Programmes of CS will enable me to identify the current or potential problems and find ways to improve the situation. It will also allow me to critically evaluate the effectiveness of Soft Systems Methodology and compare it with the results of other case studies. Furthermore, it will enable me to make suggestions for future work.

All the previous reasons made me keen on applying Soft Systems Methodology for analyzing the MSc Programmes of Computer Science department of Heriot-Watt University as it deals with complex problematic situations, does not have specific purpose and objectives and takes into account culture and human activity element.
4. SSM Methodology

Khisty Jotin(1995) supports that “every observation could be considered valid according to a particular Weltanschauung or world outlook” as far as the notion is to evaluate a variety of Weltanschauung concerning the problem situation.

More specific, according to Khisty Jotin(1995), SSM has the following characteristics which are represented in the figure 3.

- SSM attempts to solve ill-structured problems.
- System analysts can find the way to improve or solve a problematic situation.
- It is advantageous to investigate the background and the history of the problem.
- SSM has followed two analysis selections, logic-driven and culture-driven. Both of them will interrelate and each one will illuminate and support the other.
- There is an opportunity for choosing a purposeful human activity system in order to help the debate.
- In the debate, models of the nominated human activity system are compared by viewing real world’s Weltanschauung.
- The outcome of the debate should be a desirable systematically change and culturally reasonable.
- In the end, the decision for the actions to improve the problematic situation will be taken.
SSM is a learning system and consists of seven stages which represent the “real” and conceptual world. Khisty Jotin(1995) mentioned that SSM “uses the system’s ideas to organize four basic mental processes: perceiving (stages 1 and 2), predicting (stages 3 and 4), comparing (stage 5), and determining needed changes and actions (stages 6 and 7)”. Furthermore, SSM uses systems thinking in order to understand the problem situation. In the beginning, systems’ thinking identifies some relevant purposeful activities systems and organizes a debate to secure the best understanding of the real world situation. [Schmidt Thomas (2006)] More specific, the stages can be seen in (the) figure 4.
Figure 3 presents the investigative procedure which makes clear the distinction between the real world situation and the systems thinking.

However, four SSM activities were presented recently by Peter Checkland which includes the previous stages and adds more clarifications.

**Stage 1: Finding Out**

Checkland, P. and Poulter, J. (2006) cited Reynolds M. and Holwell S. (2010), separate the first activity in four parts as it was presented in the previous chapter. However, other writers, like Lester Stan (2008) separate it in the following three parts.

- **a.** Description of the problem situation
- **b.** Develop the Rich Picture
- **c.** Stakeholders worldviews- Social Environment-Political Environment

Below there is an analysis based on Checkland, P. and Poulter, J. (2006) separation.
Making Rich Picture

The first action of system’s analysts is to identify and fully describe-express the problem situation that needs attention. This usually happens by viewing stakeholders’ and people who faced the problem and whose perceptions will be affected by the changes. Checkland, P. and Poulter, J. (2006) cited Reynolds M. and Holwell S. (2010) supporting that “the complexity of human situations is always one of multiple interacting relationships”. For that reason, analysts are using Rich Picture which is a diagrammatic representation of the relationships and flow of communications in the system. The development of Rich Picture aims to express deeply the overall situation in all its richness. Rich Picture does not have a formal structure or any restrictions and it is usually hand drawn. The purpose of Rich Picture is to include informally, the main entities, elements of structure, processes, people’s concerns, conflicts and current or potential issues about the situation of concern. [Reynolds M. and Holwell S. (2010), Williams Campbell Mark (2000), Manchester Metropolitan University] Figure 5 presents an example of a Rich Picture from the Swedish State University.

![Rich Picture of Swedish State University](image)

**Figure 5: Example of the Rich Picture of Swedish State University**

a. Analysis One (the Intervention Itself)

This analysis concerns itself with peoples’ roles who are involved in SSM analysis. SSM is focused on the role of ‘client’, which is the person (or a number of people) responsible for making this
investigation happen; the role of ‘Practitioner’, which is the person (or a number of people) that perform the process; and the role of ‘issue owner’, which combines all the people who faced the problem and those directly affected by the changes and the final outcome. One person or a group of people can participate in more than one role which is why Peter Checkland used the word ‘roles’. [Reynolds M. and Holwell S. (2010)] The following figure presents SSM’s roles in a diagram.

![Diagram of SSM’s roles](image)

`Practitioner(s)`
- Carries out the intervention using SSM

`Issue Owner(s)`
- Possible persons (or groups) takes to ‘our’ the issues addressed

The following figure presents SSM’s roles in a diagram.

**Figure 6: SSM’s Analysis One**

b. **Analysis Two (Social)**

Analysis two focused on the social aspect of the problem situation which is vital for SSM as it is considered as an action-oriented system. In order for this analysis to be successful; analysts have to understand and to take local ‘culture’ under careful consideration. Also, the designed solution should be culturally feasible excluding desirability. However, there is no a specific definition for the world ‘culture’. Kluckhohn’s and Kroeber’s survey in 1950s, quote Reynolds M. and Holwell S. (2010) that 300 different meanings were suggested. For that reason, SSM uses a specific model which is simple and at the same time subtle. This model involves three elements; these are roles, norms and values and they are dynamic elements. In figure 7, there is an analysis of how each element helps and changes the other elements.
All these elements are producing “the social texture of a human situation, something which will endure and change over time”. [Reynolds M. and Holwell S. (2010)]

More specific, ‘roles’ according to Reynolds M. and Holwell S. (2010) are “social positions which mark differences between members of a group or organization”. These roles can be internal in the organization or informal from the local culture. ‘Norms’ are expressing the likely behaviour which relate to a specific role and ‘values’ are the criteria which specify a way of judging people’s behavior in a role. Finally, it is clear that these three elements are closely connected and they interact with each other in a dynamic way. [Reynolds M. and Holwell S. (2010), Checkland and Scholes (1990)]

c. Analysis Three (Political)

Analysis three focused on the political aspect of the problem situation. According to Reynolds M. and Holwell S. (2010), the purpose of analysis three is “to find out the disposition of power in a situation and the processes for containing it”. Although there are a lot of models in the political science, SSM mostly uses a model from the field of Aristotle claimed that there would be different interests between people who are interacting with each other and are living in the same society. In order for this society to work as a whole over time, these interests must be accommodated. It would be an inevitable political dimension in organisations that people have different viewpoints and share different interests.
Stage 2: Making Purposeful Activity Models

This stage consists of five steps (Figure 8) whose purpose according to Reynolds M. and Holwell S. (2010) is to create “a model of a purposeful ‘activity system’ viewed through the perspective of a pure, declared worldview, one which has been fingered as relevant to this investigation”.

1) The PQR Formula
   Do P
   By Q
   In order to contribute to achieving R

2) Root Definition

3) Mnemonic CATWOE
   - ‘Customers’ (victims, beneficiaries)
   - ‘Actors’
   - ‘Owners’
   - ‘Environmental constraints’
   - Transformation
     Process and
     Worldview

4) Primary Task Issue-based

5) Monitoring and control the operations

Figure 8: Purposeful Activity Model [Reynolds M. and Holwell S. (2010) pag. 220]

The first step is the development of a PQR formula which explain ‘what’ to do (P), ‘how’ to do it (Q) and ‘why’ to do it (R). The purpose of this step is to help create the next step of Root Definition.

Root Definition is the most challenging step as far as it makes the transition from the “real” world to the system world and it is the main aim of the purposeful activity system. The purpose of Root Definition is to recognize the idea that there might be different worldviews which will create the rich picture. It must be noted that there is a possibility for having more than one Root Definition due to different perceptions. [Williams Campbell Mark (2000), Reynolds M. and Holwell S. (2010), Williams Bob (2005)]

The third step consists of six elements which form the mnemonic “CATWOE” and help to structure the SSM. (figure 9)

⇒ Customers - Who will benefit from system’s changes?

⇒ Actors – Who will implement system’s activities?
Soft systems model of the MSc Programme of Heriot-Watt University

- Transformation process – What input were transferred in order to achieve a specific output?
- Weltanschauung – Which viewpoints make the system meaningful?
- Owner – Who controls the start and stop of the activity?
- Environmental Constraints – What environmental constraints affects the system?


It must be noted that after the analysis of CATWOE, it would be useful to find the appropriate measure of performance that the system can be judged upon. For that reason, there are the ‘three Es’ criteria of efficacy, efficiency and effectiveness which monitor each case separately. The criteria were introduced by Checkland and as Schmidt (2006) referees, ‘Checkland describes any system model as a combination of an operational system and a monitoring and control system’. These criteria can work as performance measure for any model except of some particular situations in which there might need to use criteria such as elegance or ethicality. [Reynolds M. and Holwell S. (2010)] More specific:

**Efficacy** worries about whether the system works correct and the transformation process is being achieved.

**Efficiency** compares the efficient use of the resources with the value of the output system.

**Effectiveness** concerns about whether the system has been designed with the right way in order to achieve the long term goals.

[Warwick J. (2008)]

![Figure 9: CATWOE](Reynolds M. and Holwell S. (2010) pag. 220)
In the fourth step, there is a conversation about the distinction of Root Definition as ‘Primary Task’ or ‘Issue-Based’. The purposeful activity models have boundaries which may or may not match with the internal organization’s structure. Every system analyst should create multiple purposeful activities in order to choose the few which can represent organization’s structure. The boundaries of ‘Issue-Based’ models cut across organization’s boundaries and the boundaries of ‘Primary Task’ match organisation’s structure. It should be noted that most system analysts are using a combination of these two types.

The last step combines all the necessary activities that were found earlier in order to define the transforming process and finally to create a conceptual model. In this step, system analysts should use all the information that required, to think logical and to start modeling some real parts of the purposeful activity. [Reynolds M. and Holwell S. (2010)]

Stage 3: Using Models to structure Debate

SSM is using models to start a debate and create structured questions about the model by using a matrix approach, due to the fact that discussions are usually unstructured and they are driven to a lack of clarity. Although human groups have different perceptions which change over time, models are taking into account all of the different worldviews during the debate. There are no likely questions; there might be questions about activities or performance measurements of the model or about the relationship between activities. Furthermore, there are two different approaches for conducting the questions, the formal and informal approach. The informal way concerns about techniques to improve the problem situation. The most famous formal way is referring to the creation of a chart matrix.

The following figure summarizes the role of models in SSM.
The purpose of the models is to identify the real situation and to find ways to improve it by viewing people’s perceptions. [Reynolds M. and Holwell S. (2010)]

**Stage 4: Defining ‘Action to Improve’**

As it was discussed in the previous chapter, the final action analyses the actions which will improve the problem situation. However, due to the fact that people have different experiences, different opinions and worldviews will be heard. As Reynolds M. and Holwell S. (2010) said, these viewpoints “are a source of strong feelings, energy, motivation and creativity”. They support that system analysts should create a new radical Root Definition if the debate is not energetic. System analysts should make changes for analytical reasons in three parts of human situation in order to improve the problem situation. These parts consist of structures, processes or procedures and attitudes. [Reynolds M. and Holwell S. (2010)]
5. Applying Soft Systems Methodology

My dissertation consists of three main parts. The first step was the literature review which was presented earlier and the analysis of the next steps presented in the following figure:

![Figure 11: Research Method](image)

5.1 Step 2 - Finding out

In the beginning, I used MACS website ([www.macs.hw.ac.uk](http://www.macs.hw.ac.uk)) and tried to identify the stakeholders of Master Programmes and to think how they influence the Master Programmes of Heriot-Watt University. The following figure shows the stakeholders that I identified.
Analysing more of the MAC school, I found the key people within MACS who can help me with an overall and in depth picture of the situation.

Finally, I analysed the Master Programmes of Computer Science department in order to have an overall view of whom am I concerned with.
All this contributes to a better understanding of how I will obtain more information about the people who interact with problematic situations. It will also focus my research on specific questions and topics. For that reason, I created some questionnaires for current and potential master students in MACS school, for lecturers and for employers. (Appendix 1-4)

5.1.2 Questionnaires

I designed four different questionnaires for four different groups of people which are presented below. These questionnaires will help us generate an overall view of the situation of MSc Programmes of CS department and to understand what people's concerns, expectations and problems are. The information that I will gather will help me proceed to the next stage in which I will have to design the rich picture of the situation.

Unfortunately, I did not receive a significant amount of responses in relation to the large amount of people surveyed. However, I tried to gather as many responses as I could by sending it two or three times by e-mail to the respectively groups of people, by posting them on social media pages (Facebook) of HWU and by sending it to my classmates separately.

5.1.2.1 Potential Master Students’ Questionnaire

This questionnaire (Appendix 1) was sent to potential master students and was posted on social media (Facebook) of HWU with the purpose to get their weltanschauung in order to have a better understanding of their point of view. The questionnaire sent via e-mail to all years’ undergraduate
students of CS school and was designed to find out what an important factor in choosing a master programme is and how they learned about the postgraduate programmes of HWU.

The questionnaire was completed by 25 potential master students. (See appendix 5)

The following figure answers the question of where potential students heard about the Master Programmes of Heriot-Watt University and what is important for them when choosing a university.

![Figure 15: Where did you here for MSc programmes of Heriot Watt University?](image)

The people who selected “Other” specified that they heard about the MSc programmes of HWU in UCAS, in a Foundation programme, in Prospectus, in Erasmus programme and one person did a MEng as an integral part of his/her undergraduate degree.

The results show that a big amount of people were informed about the master programmes through the University’s website. That means that the website should continuously be updated and the information should be clear and easy to be find as well as user-friendly. Moreover, some people heard about the University in a lecture or in a career fare or from a friend. However, only a few learned about the University from a search machine like “Google” or from the rankings.

The next question was about the essential reasons for choosing a University to do their master degree. See the results in the figure 16.
Figure 16: What is important to you for choosing a university?

The person, who selected “Other”, specified that an essential part for choosing a University is the “Good support for students with disabilities”.

The questionnaire had space allowing people to write their comments about the things that are important for them. One person wrote that “It's mostly about if I can afford it now and if the benefits outweigh the costs of the course”.

The results show that the most important for choosing a University is University’s Reputation which must be kept good through the years either by being “The Scottish University of the Year” as it has been the last two years, or by having a good position in rankings or by hearing about a student’s experience through word of mouth. However, an interesting master programme has an important role to play in their decision for choosing this university which means that master programmes should be up-to-date and in touch with modern trends and topics.

5.1.2.2 Current Master Students’ Questionnaire

This questionnaire was sent via e-mail to current MSc students of CS department and was posted on social media (Facebook) of HWU to get their weltanschauung with the intention to have a better understanding of the situation. The questionnaire was designed in order to understand students’ opinion about different aspects of MSc programmes such as, what they think about their programme, if it was
interesting, what they liked and what they did not, what improvements they would like to suggest and aspects of why they chose the specific degree and what they were expecting to gain. Finally it analyses if MSc covers what employers are looking for.

The questionnaire completed from 14 master students, from which 9 were male, 4 were female and 1 did not specify. (See details of the sample on Appendix 6) Most of the students are international, they are taking part in a full-time master programme and they are in the age range 24-34 years old.

It was asked from students to rank their MSc programme concerning how interesting it was. As the graph shows, most people were satisfied with their programme. Only a few were neutral but no one was negative which is very good for the reputation of HWU.

![Figure 17: How interesting do you find the MSc programme of Heriot-Watt University?](image)

Students expressed their opinion on this open question about what they liked on their MSc programme. They underlined that subjects were interesting and well structured, there was a good quality of teaching and in a challenging level, lecturers were responsive and professionals. Moreover, some of them noticed that the environment was excellent as far as it was multicultural and they met new people. Also, the usability, adaptability and flexibility of courses as well as coursework were some parts that they liked.

On the other hand, they did not like the limited number of modules that they had to choose as well as some bad organizations. Some students supported that semesters were too short (3 months per semester), they had many pieces of coursework with short deadlines, limited time for exam revision and too much time pressure. Some others commented that the programme was extremely expensive and sometimes boring and with no motivation. Finally, a person wrote that “Some students don’t like to share their experiences about topics and work experience.”
Furthermore, students rank the help that they received from the academic staff such as professors and lecturers as well as the help that they received from the University staff such as IT help, secretary, career service, library etc. The average number of results ranks them as “Very Good” but there were also some negative and neutral answers. (See figure 18-19)

In the question, “why they chose this MSc programme”, they supported that the subject was interesting, practical, well specified and in line with their career objectives. Also, some of them commented that they chose it in order to excel their professional skills or because there was an available funding.

In addition, the following figure shows what they want to gain from the MSc programme.
As results shows, students hope to increase their knowledge and also to gain qualifications for a job. The person who voted “Other” commented that “Organising some practical courses enable students take advantage of future acceptance of employment”.

Additionally, students were expecting from their MSc to learn about new technologies and to gain valuable background for further research. The most of them wanted to improve their knowledge, to get a job and finally to be positive and effective to future challenges.

Concerning the question about what employers look for, the responses were mixed. The numbers of current students’ responses were both positive and negative in equal terms; however some of the current students' responses were neutral. One person commented that “It covers what big companies ask for, which gives some perspective for jobs”. However, another person mentioned it is “Hard to say - depends on the specific employer and job. I think you get a good grounding, so probably OK for entry level post.”

Finally, students proposed some improvements, such as better scheduling (lectures, exams, assignment deadlines), less material, less expensive and better co-operation with employers and the IT profession. Moreover, one response noted that “Encouraging students to share experiences would be a good thing because many people come from different cultures and it might help if students interact better” and another one commented that “It might be a good idea that Msc programmes can imitate some practical developing or developed programmes from previous events by the competitive companies”.

**Figure 20: What do you want to gain from the MSc programme?**

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### 5.1.2.3 Academic Staff Questionnaire

This questionnaire was sent via e-mail to the academic staff of Computer Science department of MACS school with the help of my supervisor, Rob Pooley, and I sent it via e-mail to the academic staff that I had communication with throughout the year. The questionnaire was designed in order to understand academic staffs’ Weltanschauung about the MSc programmes, such as what they are expecting from master students, what are the problems with the MSc programmes, what they think employers are looking for MSc students and finally to let them make suggestions for MSc programmes’ improvements.

The questionnaire was completed by 3 people, from which 1 was Master Director and 2 were professors from Computer Science department of MACS school. Questionnaire’s results showed that academic staff are expecting due diligence, hardworking students with a good level of written and spoken English. Moreover, students should have an interest and enthusiasm in the field, to be honest and patience and finally to have the ability to work independently or with an international cohort in order to produce a prototype piece of work (e.g. software) or a substantial survey type document.

Concerning the question of what employers are looking from a MSc student, the results were similar with what academic staff requires from them, adding the strong technical and communication skills as well as to link competences form different areas of computer science together in order to build or analyse significant pieces of work. However, there were different responses concerning the question of how much MSc programmes cover what employers are looking for. One reply was “A lot”, another one “Enough” and the last was “Neutral”.

In addition, academic staffs concerns were that the English skills of some students’ are not in line with prior learning and university’s programmes. Also, some of them have weak programming skills.

Finally, academic staffs propose some improvements that will help MSc programmes to improve and eliminate current or potential problems. A professor wrote that “there is a need for constant reflection and keeping up with industry standards”. Moreover, professors suggested to the admission team, to require evidence for programming skills and to provide pre-semester programming courses for weak programmers. Also, there was a suggestion of having a video or telephone interview with the potential students before the acceptance in order to check their English level.
5.1.2.4 Employer’s Questionnaire

This questionnaire was sent via e-mail to the Industrial steering committee with the help of my supervisor, Rob Pooley. The aim of the questionnaire was to understand what employers’ are looking for from MSc students and to make suggestions to the University on how they can better prepare students to cope with the working environment.

Only one company replied, from the Electronics/Software sector and specified that Master students should be enthusiastic and to have good communication and teamwork skills. The company consists of 1-20% master students which means that they employ every year a sufficient number of master students. For the specific company, a master student should have followed lessons on Software, Programming & Scripting, Mathematics, Linear Algebra, Analysis and Optimization. Unfortunately, we do not have data from other companies in order to compare master programmes modules with what the company asks.

However, the company suggested that a university should better qualify a master student by developing their ability in problem solving, analyzing and verbal communication. It clarifies that the nature of the problems does not matter. Finally, it gives advice to the students, “Do your company research. Follow what excites or motivates you. Talk their language when you apply.”

5.1.3 Interview with Academic Staff

An e-mail was sent to a number of professors who have a responsibility (Director, head of school) at MACS school but only Hamish Taylor, director of Postgraduate studies, was able to help me develop an overall picture of the master programmes and their problems.

5.1.3.1 Interview with Prof. Hamish Taylor

Professor Hamish Taylor is a lecturer and Director of Postgraduate Studies in Computer Science department. I asked him a number of questions in order to understand his weltanschauung concerning the current Postgraduate studies, the current or potential students, about what employers are looking for and finally to learn about the current problems and their future plans for improvements.

Professor Hamish referred that HWU expects a MSc student to fulfill the setup of the master programme, to have the required level of knowledge and skills, to study 40 hours per week, to attend the class and on the exams, to meet his/her supervisor and finally to raise any issues that they have with the programme director. Further to his opinion, employers are looking for students who have communication and team working skills, abilities to learn and adapt new knowledge and finally to apply knowledge and skills that they have learned particularly to computer science MSc.
The educational objectives of MSc programmes are to deliver incomes, to provide a pool of potential research students and research assistants, to assist activities and to contribute to the prestige of the institution.

There was a discussion about the English language level of MSc students as far as lecturers mentioned that they had problems with students with low level of English language. Professor Hamish Taylor supported that it would be easy to put admissions requirements higher and it would be easier for students to study whose English level is good but that the English level the University sets is also critical in sense of recruitment. In the questions of “Have you thought to check student’s English abilities by a telephone or skype interview before accepting them?”, Pr. Hamish Taylor supported that University assess English language abilities with public tests like IELTS, which have speaking, listening and writing exams. Occasionally, they had some issues with students with low English level but it was too late to reject them as they had already paid tuition fees. Therefore, in the past, the English language department used to provide English classes for free. Unfortunately, nowadays, only a few students take advantage of these lessons as they have to pay and they are expensive.

Professor Hamish Taylor mentioned that there are a limited number of scholarships for UK and EU students. However, some overseas students get fee reductions or scholarships from their government or their institutions.

As we analysed earlier, the most important thing for potential MSc students in choosing a university is the University’s reputation. Professor Hamish Taylor mentioned that the University increases its reputation every year and everyone can check it through the Research Assessment Exercise (RAE) 2008 and the National Students Survey (NSS) which are available on the HWU’s website. Another way that is to check HWU’s reputation is the Times Ranking. However, the most successful way for University’s reputation is by ‘word of mouth’. As he said, reported experiences of people who are at the University is far more important and efficient than third hand accounts.

Professor Hamish Taylor revealed that they developed a new MSc Programme in Business Information Management which will be on the market as soon as it is approved. Furthermore, they will improve the induction week by presenting to the students what assessments each lesson requires, the proportion of the mark and the deadlines. This way, students would be able to choose the modules that they want.

Current MSc students asked for a better schedule of exams and assignments deadlines. The professor noted that the assessments are designed to assess learning during the course. Therefore, some assessments cannot be schedules before half of the semester has passed. However, as far as students asking for qualifications for a job, it is good practice for them to work with short deadlines and to meet work pressures.

Concerning the usual problem of the reading list for each lesson, students are asking for the reading list in advance which is quite difficult as lecturers have multiple responsibilities and it is a low priority for
them. Also, they cannot really be sure what they will teach because they do not decide/construct it so early.

Another problem that they face is how to adjust the difficulties of courses. Some courses are easier than others and that can be revealed from students feedback at the end of the course or on how well students’ marks were on particular courses. Courses with low average marks have high failure rate and as a consequence they are not easy. Although they are putting a greater effort to bring marks to the average level, there are courses with more than 10% students’ failure. These courses have to submit a written explanation of the reasons that drove students to this failure. As a consequence, students come up with the dilemma of whether they should choose a course with the purpose to gain more qualifications or a better mark. It is difficult for students to get a distinction if they are choosing difficult courses.

5.1.4 Making the rich picture

I gathered all the key information from questionnaires and interviews and I created the initial "Rich Picture" of the Master Programmes of Computer Science department. As it was discussed in the first part of my dissertation, Rich picture shows the overall picture of the situation under investigation and helps us to focus on the parts which need further analysis and discussion. It does not have a formal structure; therefore, I decided to design it on the computer by using pictures and different colours in order to make it as attractive and as clear as I could.

After careful consideration, I chose the most important information and designed a draft for the Rich Picture of the MSc Programmes of CS. This picture was sent via e-mail to all the potential and current students of Computer Science and it was published on social media of HWU, such as the group of ‘Computer Science MSc Applicants 2012-13’ on Facebook. My Rich picture was accompanied by a text explaining what the specific image represents, what exactly I am trying to do and what by asking them to evaluate it. My purpose was to gather feedback from undergraduate (potential MSc students), postgraduate students and academic staff on whether the rich picture that I designed reflects their thoughts and suggests to me what I should change, add or delete.

Also, I had some meetings with the academic staff of Computer Science department which as a result had a number of suggestions on how I can improve my rich picture depending on their Weltanshauung.

See Appendix 7 for the table which shows the comments that I got by discussing the rich picture with the Stakeholders of Computer Science department.

There were different options which helped me to improve my rich picture. However, there was an opinion from an academic staff member which was controversial. Therefore, I modified my initial rich picture to two new pictures. You can see them on figure 21 and 22. As you can notice, the only
difference is that they have the position of the ‘Supervisor’. Some people believe that the supervisor is part of the Computer Science department, which is symbolised with the bubble, and others think that it can be inside and outside the University, so they asked me to put him/her outside the bubble.

See below Rich Pictures of MSc Programmes of HWU and the table with further details on what each symbol represent in the end.
Figure 21: Rich Picture with the Supervisor in the MACS school.
Figure 22: Rich Picture with the Supervisor outside of the MACS school.
The explanation of the above diagrams is as follow:

**Figure 23: Explanation of Rich Pictures diagrams**

From these pictures, I chose some issues which seem to be important and need further analysis, such as:

- Academic staff have problems with student’s level of English language and that problem starts with the Admissions process. The question generated is; ‘How can we ensure a basis level of English language skills from a student or how can we support them in order to become more effective?’
- Students worry about getting a master degree but at the same time, they worry about getting the appropriate qualifications for a job or further study and finally getting a job or being accepted for further study. The question posed is; ‘How can we make these experiences more efficient?’

After having examined the rich picture and identified some key issues of the situation under investigation, we can start thinking in soft systems terms as to how we can improve or solve these problems.

### 5.1.5 Analysis One (the Intervention Itself)

Analysis One considers the roles of people who play an essential part in the investigation of the MSc Programmes of CS department of HWU as it was presented in the first stage of SSM. More specifically, in the role of ‘Client’ is the dissertation supervisor, Rob Pooley, as far as he proposed this investigation and he is responsible for the completion of this project. Also, in the role of the ‘Practitioner’ is myself, Angeliki Panagiotidou, because I am the person who executes the analysis of
the MSc Programmes of CS department. Finally, in the role of ‘Issue Owner’ are the students and the academic staff from Computer Science department as they will be directly affected by the changes and the final outcome of this investigation.

5.1.6 Analysis Two (Social)

This is the social analysis of the problematic situation which consists of roles, norms and values. As Reynolds M. and Holwell S. (2010) discussed, there are different social positions which represent the ‘roles’, such as lecturers, professors, supervisors, directors, students and university staff, who have different opinions within MACS schools. This analysis helped me understand better the different positions-roles within the MACS school, their relationship and the way that they interact. In addition, ‘norms’ helped me understand what behaviour I should expect from each role individually and finally, in ‘values’, I had to consider the criteria with which I can judge individual’s behaviour in each role. In general, it is clear that roles, norms and values interact with each other in a dynamic way.

5.1.7 Analysis Three (Political)

This analysis helped me to develop an understanding of the stakeholder’s political aspect of the problematic situation. Moreover, I find out about the disposition of power, which in our situation can be knowledge, and the different viewpoints and interests between the stakeholders of the Computer Science department.

As it was discussed in the literature review and it was observed in questionnaires, interviews and rich picture evaluation, all the people who interact within the same environment, MACS school of HWU in our situation, have different interests, experiences and worldviews. However, all the people work and interact with each other within the same environment; and their interests and worldviews have been compromised.
5.2 Making Purposeful Activity Models

The aim of the second stage of SSM is to create the models which will develop our new system. The information that has been gathered at the ‘Finding out’ section will help me to make the Purposeful Activity Model by following SSM steps and designing the PQR formula, Root Definition and Mnemonic (CATWOE analysis).

**PQR Formula**

This step helps us to easily remember what our purpose is, how to perform it and what we hope to gain in the end-final aim. Specifically, each letter of the PQR Formula symbolizes the following:

- **P** - To do a master programme
- **Q** - By taught modules
- **R** - In order to contribute in achieving qualifications for further study or/and for a job or/and simply to increase knowledge.

**Root Definition**

Root Definition will help us make the transition from the ‘real’ world of the university, to the developed, theoretic system. As Williams Campbell Mark (2000), Reynolds M. and Holwell S. (2010), Williams Bob (2005) supported, there can be more than one Root Definition as a result of different worldviews. In our situation, the MSc programmes of Heriot-Watt University is a degree offered by the MACS school and operated by the academic staff which satisfies the needs of students for achieving a master degree through a well-structured programme with the purpose to achieve qualifications for further study or/and for a job or/and simply to increase knowledge.

**Mnemonic (CATWOE analysis)**

The Mnemonic CATWOE consists of six elements which contribute to a better SSM structure. It is actually a short and easy read representation of the system which will help us later to design the criteria for measuring system performance. Find below the initials with their representation in our situation.

- **C** - Students
- **A** - University Administration and Academic Staff, Employers
- **T** - Taught modules, coursework, exams, presentations
- **W** - Student’s and Academic’s staff Worldviews about the MSc programmes of CS department
- **O** - Heriot-Watt University
Soft systems model of the MSc Programme of Heriot-Watt University

E- The constraints of the learning environment such as availability of staff, computer labs, printers, classrooms etc., graduate recruiters' policies, cost of tuition fees and maintenance

Three E’s

Three E's are the criteria that Checkland used to help us to specify the criteria that contribute to monitor and control the transformation process of our system. These criteria are analysed in the literature review and there is an analysis on how these three E’s contribute to our situation below.

Efficacy- The transformation is always essential until our purpose is completed. Our aim is for students to achieve their master degree and to gain qualifications for a job or further study or/and simply to increase knowledge. Our position involves a continuous flow of new students every year who should graduate and find a job or be accepted for further study at a university.

Effectiveness- The aim of the designed system is to help students to get their master degree by examining student’s evaluation of the module, student’s attendance and performance and at the same time to gain qualifications for a job or further study or/and simply to increase knowledge.

Efficiency- The transformation efficiently uses the available resources as far as we are using the minimum number of lecturers with the maximum number of students with the aim not to increase the generated outcome (graduate students).

Conceptual Model

Having developed the root definition, I have to construct a conceptual model for the MSc programmes of HWU which is a theoretical model that describes the number of activities that must occur in order to monitor and control the system. The numbered squares represent the activities that take place in our situation which are linked together with arrows in order to show the row of the activities. By doing this, I tried to investigate what needs to happen can occur in order to improve the situation that we are focusing on.
As Figure 24 shows, we monitor the activities 1-8 and define the measures depending on the performance criteria that have been achieved simultaneously and then we take control actions. This is happening because in our situation, the criteria of performance change every year as far as new students are concerned. The activities of monitoring and controlling are usually referred to as three E’s; efficacy, efficiency and effectiveness which were presented above.

5.3 Step 3 - Using Models to structure Debate

In this stage, we should structure a debate and discussion among the stakeholders of MSc Programmes of CS department in order to identify stakeholder’s suggestions for feasible and desirable changes to two main problematic situations that I identified previously from the Rich Pictures. As it was discussed earlier, the first problematic situation was referred to student’s low level of English, as academic staff mentioned on the questionnaires. For that reason, we should focus on how the Admission team could better check student’s level of English before they accept their application for studying an MSc Programme to CS department or on how they can enhance their English abilities. The question for the second problematic situation referred to how we can enhance student’s qualification for a job or further study through the MSc Programme.
In order to achieve a discussion, I tried to have an interview with some people that I met in the University and I used a chat room on social media (Facebook) in which I invited some students of CS department to ask for their suggestions on how the problematic situations can be improved.

I managed to have an interview with two PhD (PhD 1, PhD 2) students and 3 MSc students of MACS school. All the discussed suggestions have advantages and disadvantages, which will be presented below. Concerning the problematic situation of students’ low level of English, the PhD 1 proposed to use a GRE General Test which examines verbal reasoning, quantitative reasoning and analytical writing. It is used by graduate schools in United States but as the PhD 1 noticed, it is hard to get a high score because it has a strict time limit. However, the PhD 1 proposed to set the score lower in order more students to be able to pass the admission requirements.

Concerning the same subject, I had a discussion/debate with the PhD 2 who suggested an online test with questions and text in which the potential student should film (image and voice) his/her answers and submit it electronically. However, it would be quite stressful and awkward, which might cause unreal results. Another idea that was discussed was referred to the sending of a recorded DVD with a recorded message from the potential student, aiming to examine the level of verbal English. However, this would not be representative as far as students would have prepared and practiced their answers earlier. Moreover, another admission requirement could have been a reference letter from a person with certified qualifications in English (e.g. an English teacher) which will verify the ability of the student to speak, understand and write English at the appropriate level in order to cope with the increased difficulty of a master programme. Though, this might be unreal as far as this person might be paid or might be a relative or close friend. Furthermore, another idea was about a skype or telephone interview. However, this would have been costly since there will be a need for extra human resources and extra telephone charges whereas Skype might face connections problems. Also, there might be a problem with the time difference from country to country. Finally, the PhD 2 proposed exams centers in different countries in which potential students would have an interview. Based on that idea, I remembered that a person from the Recruitment team mentioned that HWU sends professors to universities abroad with the purpose to talk and persuade new students. In some other countries, they have agents who persuade and assist with the whole admission process for HWU. This way, it would be easier and more efficient for the university to send professors to the capitals of each country and to arrange two days of face-to-face interviews. This suggestion needs a big budget but as far as I am concern, HWU has the resources for this kind of recruitment/ has had a growing expense budget over the last few years.

Concerning the discussion that I had with three current master students, we considered skype or telephone interview which was mentioned earlier, requirement of higher score on English exam (IELTS, TOEFL) and an adjustment period for all the students whose first language is not English, before the start of the semester which will consist of English lessons in order to enhance students’ English knowledge.
Further to the second problematic situation that I identified, the suggestions from the PhD 1 were based on the curriculum. PhD 1 supported that current students should be able to choose the modules that they prefer from the whole department, in order to drive their career in the way that they like. Also, each student should have a specific Tutor, usually the director of their degree, who will be responsible for helping them choose the most appropriate courses, depending on what they want to do with their lives. Tutors will be responsible for giving advice and finally signing the final form with the curriculum that they chose.

The PhD 2 separated the problematic situation into two parts. The first part concerns gaining qualifications - information for a job and finally getting a job and the second part is about gaining knowledge for further study. For the first part, PhD 2 proposed companies’ presentations in the University, introducing the company and detailing any potential open vacancies as well as daytrips to companies to gain an insight into the working environment. Another idea was based on compulsory or at least well-advertised extra hours during each semester in which the Careers Advisory Service could give some guidelines on how students can create their CV and cover letter, how to search for jobs, on which sites, how they can get prepared for the online tests and interviews and, finally, how they can become competitive in the market. In addition, PhD 2 mentioned that the modules should be updated to ensure a good connection with the working world. For example, HWU should have taught modules about programmes that companies currently use. In order to make sure that modules are updated, they should have an internal evaluation of each course every 3-5 years from academic staff from the same department or other universities. The evaluation will also provide a good advertisement for HWU as they can write on the website that they use procedures which ensure the best connection with the industry.

Regarding the part about getting information for further study, the PhD 2 proposed to have a speech from academic staff at the end of the first semester. This speech will answer to the following questions: ‘What is a PhD? Why should someone do a PhD? What opportunities they will have in the end of the PhD? What do PhD students do and how hard is it to study for a PhD? What projects exist at HWU and by whom is it supervised? How and when will they have the opportunity to apply?’ Furthermore, HWU should organize and advertise a seminar on how students can write a good application and how they can find funding.

The three current master students suggested well-advertised events from the Careers Advisory Service. Moreover, they should organize ‘Careers day Workshops’ at the end of the first semester and the second semester in which companies can come into the University and talk with the potential employees. In addition, they noted that HWU should cooperate with other universities in order to advertise and make a big event for advertising their PhD studies to the students.

In reference to the social group that I designed on facebook, only one undergraduate student replied who mentioned ‘I know that the university runs some courses in summer for students to learn and
improve English. Maybe students could be informed of these before they start. It might help an English language type of test when applying for the course to indicate if the student should attend a course to improve their English before beginning the Masters course’.

With regard to gaining qualifications for a job, the student proposed ‘more practical work to gain practical skills which can be transferred and used in employment. Or maybe the Masters course could include some work experience or opportunities to meet with employers’.

Having collected all this information, I wrote a list of all the suggestions and I sent it to the current MSc students and the academic staff. I asked them for feedback on whether they agree or not with the way that I pictured the MSc Programmes of Computer Science department to the Rich Picture and the Conceptual model. Additionally, I asked them for their opinion on whether they agree with these solutions, whether these solutions can improve the problematic situations and if they have other suggestions.

Five current master students replied and their answers are presenting bellow. I ranked the students as s1, s2, s3, s4 and s5.

The replies that I had, s1 mentioned ‘Your suggestions are very good and well-organized and I think that rich picture is really good’. Moreover, s1 had some ideas on how we can check if the level of the student’s English is good enough. S1 inscribed ‘the university can make its own English evaluation test with specific questions that help in deciding the level of the student. Another suggestion is to raise the current minimum marks of IELTS required for registration. This doesn’t necessarily mean that all of the four sections of IELTS, i.e., reading, speaking, listening and writing, should be raised. One or more of those sections can allocate higher marks based on a feedback or a survey filled in by the university academic staff to show which ones of those four are the weakest points of non-English speaker students. In addition, they can go through their courses, performing interviews and holding even short conversations between the stuff and students will be helpful.’

Regarding the problem of gaining qualifications for a job, s1 noted that there will be a difference if HWU increase the amount of practical courses and create discussion groups with experienced people in each field. Another idea that was mentioned was to require a compulsory work for one month in summer. As s1 wrote, ‘The course is mainly to make the students work for a company for free (as a training course). In my opinion, this experience will help the students to understand jobs' atmosphere, provide them with few communication skills, and vanish or at least mitigate their fear of work.’

Furthermore, s2 stated that ‘I think two main solutions for checking the English level of students could be - making interviews (by the chosen program of study, so not just a conversation, but the specific interview, so that tutors will be aware of the level of their background knowledge in the particular program as well) and increasing IELTS scores. But it should be very strong reason to do so.’
As for gaining knowledge for further study, s2 suggested meetings with current PhD students. In addition, s2 mentioned that ‘Staff can organise a meeting with potential PhDs at the beginning of the year, then students will be clearly aware of what they need to do at Masters to enter PhD then (inc. gaining scholarships).’.

The s3 wrote ‘The Rich Pictures look good, as do your solutions for problems’. Also, s4 stated that ‘The work you are doing might be very useful for future MSc programs improvement and overall, I think your solutions and rich picture are well structured’. Moreover, s4 made some general suggestions about the MSc programmes such as ‘the open option of choosing at least one subject would help to improve the master level, where the student, as an adult person, chooses the knowledge he feels would help him in the future to find a good job. It would make the MSc more personalized’. In addition, s4 wrote ‘In my opinion, the only part that is missing is internship possibilities during MSc program. I would say that the MSc might last not one year but one year and a half, where the last 6 months is training in the real world companies. That would be very helpful to find an appropriate job once the master has been terminated since often job employers require experience’. Finally, s4 cited, ‘Speaking about language problems, you are right. I would say that solutions you proposed require university’s additional commitment, where more human resources would be involved, that increases the cost of student selection, and as the result, the final MSc fee. Since the MSc fee is one of the selection factors, in my opinion the most reliable way is to increase required external qualification, such as IELTS, entry level.’

The s5 thinks that the Rich Pictures are great. However, s5 had an idea on gaining a qualification for a job. He/she wrote ‘It would be great if the University organized some kinds of workshops for students in regards to a particular job role. For example, web developer - the workshop could cover everything related to this role, like what technologies need to be known, what is a career path of such a role, what skills are essential, how to write a good CV when applying for such role, etc. The University could invite few people from industry who currently work as web developers so they can share their experiences with students’.

The outcomes of this stage provide me with valuable ideas on how I can solve the problematic situation of MSc Programmes of Computer Science and proceed to the next stage, as well as the different worldviews.
5.4 Defining ‘Action to Improve’

After careful consideration of the different Weltanschauung and the extensive research on the MSc Programmes of Computer Science with the SSM methodology in the previous pages, I came up with the following suggestions for improving the problematic situation.

**Problem: Student’s Low level of English**

Possible solutions:

1) Higher score on English exam (IELTS, TOEFL)

2) DVD with a recorded message from the potential student

3) Skype or telephone interview

4) Online test with questions and text in which the potential student should film (image and voice) his/her answers and submit it electronically

5) Reference letter from a person with certified qualifications in English (e.g. an English teacher)

6) Exam centres in different countries. The university can send professors to the capitals of each country to arrange two days of interviews.

7) GRE General Test exams(examines verbal reasoning, quantitative reasoning and analytical writing)

8) Adjustment period for all the students with English lessons

9) English evaluation test by HWU to indicate the level of students and if they should attend a course before beginning the MSc Programme.

**Concern: Gain Qualification for a job**

Possible solutions:

1) Each student should have a specific Tutor, who will be responsible for helping them to choose the most appropriate courses, depending on what they want to do with their lives

2) Compulsory or at least well-advertised extra hours during each semester in which the Careers Advisory Service could give some guidelines on how students can create their CV and cover
letter, how to search for jobs, in which sites, how they can get prepared for the online tests and interviews and, finally, how they can become competitive in the marketplace

3) Modules should be updated to ensure a good connection with the working environment (internal evaluation of each course every 3 years from academic staff from the same department or other university)

4) Practical courses to gain practical skills and experience

5) Compulsory work for one month in summer for free (as a training course).

6) One semester work experience in the real world companies (internships)

Concern: Getting a job

Possible solutions:

1) Companies’ presentations in the University, introducing the company and detailing any potential open vacancies

2) Daytrips to companies to gain an insight into the working environment.

3) ‘Career day Workshops’, organized and advertised by the Careers Advisory Service

4) Make discussion groups with experienced people on each field

Concern: Gain Qualification for further study

Possible solutions:

1) A speech from academic staff, at the end of the first semester. This speech will answer the following questions: What is a PhD? Why should someone do a PhD? What opportunities they will have at the end of the PhD? What PhD should students do and how hard is it to study for a PhD?

2) Seminar on how students can write a good application and how they can find funding.

3) HWU should cooperate with other universities to create a big event for introducing their PhD projects.
6. Critical Account of SSM

The analysis of the literature review helped me gain further knowledge on the hard and soft systems and some of the methodologies that exist within them. Moreover, I understand which methodology is suitable for each occasion and I learned their differences. However, my final decision to use SSM has provided me with extended knowledge of this methodology which is very beneficial when analyzing situations like the one that I did. However, SSM can become more efficient in our lives with some modifications that I will propose in the next chapter.

The dissertation gave me the opportunity to work on a real unstructured problematic situation which provided me with a broad knowledge of Information systems and an in-depth knowledge of SSM. I had the chance to investigate, understand and identify the problematic situations of the MSc Programmes of Computer Science department and to try to structure SSM’s stages in order to gain a better understanding of the situation and to enable me to propose possible solutions for improvements.

Soft System Methodology is based on people’s perspective and cannot identify and provide solutions to random problems. For that reason, the Finding out is the most critical stage as it provides a big amount of information which gives the analyst an overall picture of the environment studied and helps him to identify the problematic situations. The ‘Finding out’ stage helped me identify a wide range of problems and the different weltanschauung among people of the same or different group. (e.g. potential MSc students, current students, Academic staff, Employers) It was an essential part of my research because it gave me the necessary information to structure a big picture to my mind and later to construct the Rich Picture.

Concerning the Rich Picture, I had to put my thoughts and the key pieces of information that I gathered from the questionnaires, in a good order and then to try a couple of times to design the Rich Picture as clear as I could. Rich Picture usually has a lot of information which may cause confusions which worried me. My second anxiety was about how to explain to students what exactly the Rich Picture is and what it delegates. I am not sure if I was entirely, as I had a response from a student, asking me for better explanation.

Furthermore, Analysis one, two and three were hard to define. Especially the analysis third analysis, it was the hardest as do not have the knowledge to set the criteria of how academic’s staffs’ behavior can be evaluated. I believe that each person is different and their reactions are based on their experience, character and their role; therefore I created some general criteria in my mind with which I can evaluate people’s behaviour in each role. However, the meetings that I had with academic staff, students and university’s staff concerning the rich picture, were very useful in order to get a better understanding of this analysis.

There was confusion at the stage of ‘Making a Purposeful Activity Model’, because I was not sure if I need to have one or more Root Definitions and as an extension more than one Conceptual Model. The
confusion came after reading some papers, such as "A case study Using Soft Systems Methodology in the Evolution of a Mathematics Module" from Warwich Jon (2008), who was using more than one Root Definitions and Conceptual Models. However, after having a meeting with my supervisor, Rob Pooley, we decided that there is no need for more than one Root Definition and as a consequence Conceptual Model. Furthermore, I found difficult to define the three E’s in detail as to be clear to someone who is not aware of what they mean.

Finally at the penultimate stage, I faced some difficulties with structuring a debate due to the fact that a big amount of academic staff were on vacation and current MSc students were not checking their university e-mail. However, after discussing my problem with my supervisor, Rob Pooley, I was advised to make some suggestions on my own and then send an e-mail to all the current students and academic staff of CS department with my suggestions accompanied with the Rich Picture and the Conceptual model. This way, I would be able to get their views on whether or not the designed pictures were a real demonstration of the MSc Programmes and my suggestions for improving the problematic situations were feasible and similar to their point of view.

Nevertheless, I tried to have an interview with some people that I met in the University and I used a chat room on social media (Facebook) with some students of CS department in order to ask for their suggestions on how the problematic situations can be improved. Both ways were really successful and thankfully I got some answers via e-mails that I sent. Unfortunately, I found only one lecturer at the University to give me feedback because most of them were on vacation and no one replied to the e-mail, although my supervisor Rob Pooley, sent it twice.

In conclusion, I believe that Soft System Methodology is the most appropriate methodology for unstructured and complex situation, in which the human factor plays the most important role and there are no specific objectives and goals. However, it can be difficult if the practitioners are not willing to participate and help investigate the situation or if they are manipulated by the crowd and we do not have a real Weltanschauung view.

I found SSM’s steps easy to follow and the fact that I could complete each stage in a way that it was convenient for my situations was very helpful. However, I was very anxious with stakeholders’ participation as I do not like to pressure people or bother them during their work. I knew that the academic staff were very busy and current master students were working on their dissertation, therefore, I did not want to send each e-mail more than twice.

Another fact that caused some difficulties was the fact that academic staff did not reply to the e-mails that had been sent by my supervisor Rob Pooley, and I had to bother them at their offices. Furthermore, I could not find a large number of academic staff because they were on vacation, and about the rest, I was not sure whether they were professors or PhD students in Computer Science department or in another department of MACS school.
However, SSM identifies and proposes solutions based on people’s opinion but does not solve problems. Furthermore, it does not test whether these solutions would have been effective at improving or solving the problems. Also, SSM requires knowledge and experience from the analyst and it would have been beneficial to have a basis understanding from the stakeholders as well. As I noticed earlier, it would have been easier if the practitioner (academic staff and students) had knowledge of information systems methodologies as it would have been easier for them to understand what I am trying to do and what the Rich Picture represents. I noted that people who attended the Information Systems course, could easier evaluate my work compared to the others that did not have knowledge of Information Systems.

To conclude, SSM is a suitable methodology for ill-structured situations, like the one that I investigated. SSM was the right methodology for investigating the MSc Programmes of CS department as it guided me step by step to achieve my goals and objectives. My purpose was to identify the problematic situation, evaluate the situation and finally suggest ways to solve or improve upon the issues. I managed to identify two essential problem situations, analyse them and finally suggest possible solutions or improvements as to what stakeholders ask for. I managed to understand how people are thinking and the most important was how people’s opinions change during the process, especially when they see the overall picture of their suggestions (e.g. Rich Picture).

However, SSM can be improved based on today’s world with the future work that I will propose in the next chapter.
7. Future Work

Soft System Methodology is a good methodology with steps that can be easily followed, as it was discussed earlier. However, it has some limitations concerning time management because it requires a lot of time to gather as much information as possible and to scrutinize the problematic situation that needs attention. Unfortunately, I did not have time and I could not find many people who were able or willing to help me.

I believe that some problems took arose due to the fact that the second part (investigation) of my dissertation started after the second semester finished. I suggest that the most appropriate time to start this investigation is in February because all the students (master and potential) are there during their second semester. As a consequence, they will attend University at least a couple of times during the week and they will check their e-mails daily. Furthermore, another fact that enhances my suggestion is based on academic staff who have office hours every week in which students can have a meeting with them. In my opinion, in February, current master students already have the knowledge of what they are getting from their Master compared to what they were expecting. Also, although they have lessons and assignments to finish during that period, they can afford to spend 5-10 minutes after or before their class on a survey.

In addition, Soft System Methodology supports face to face communication and requires the physical presence of people in order to achieve better results. However, nowadays people are using technology in order to communicate with each other as it is a quick way of communicating where there is no for extra time required for going and coming back from the place that participants will meet. This kind of communication can take place via e-mail, chat room, video conference tools and social media. In the last few years, social media has become part of people’s lives and they are the new way of people’s communication and interaction.

In my dissertation, I used social media and e-mail technology in order to persuade and inform people of what I am doing and what I would like them to do in order to help me. Social media can be used by creating a group in which you invite all the stakeholders to participate. By doing this the investigator has all the people who are involved in his research together. The investigator can write on group’s wall with the intention that all the stakeholders get informed. Most people check their social media account a couple of times during the day; therefore, the information, concerning the process of the investigation, travels very quickly.

E-mail technology works in a similar way. More specifically, if the stakeholders are a group of people in a company or at the University, there should be an e-mail address which corresponds to a big group of people. This way, the investigator can send an e-mail to all the stakeholders by typing only one e-mail address, without the need to find and write the e-mail address of all the stakeholders separately.
Both ways can be used in the ‘Finding out’ stage in order to send the questionnaires to all the stakeholders, instead of printing them and trying to get each one separately. Moreover, the Rich Picture can be evaluated this way. Furthermore, social media can work as a chat room; therefore, it can be a very effective way for structuring a debate for suggesting actions to improve the situation as far as it is impossible to achieve the physical presence of all the stakeholders in the same place. However, I managed to get more valuable information concerning my Rich Pictures by having meetings with the academic staff.

The nature of people is to communicate and interact with others but as far as time is limited nowadays; there is a need for different kind of interaction. This can take place with the help of technology.
8. Conclusion

In conclusion, the purpose of this project was to find the most appropriate methodology for investigating the MSc Programmes of Computer Science department of MACS school, to identify the most essential problems and finally to propose improvements. The best approach for this situation was the Soft System Methodology because it is used in unstructured situations which do not have specific objectives and takes into account the human factor.

The project focused on two basic problematic situations which referred to the low level of English of Master students and secondly to the student’s concern of getting qualifications for a job or/and further study and finally getting a job or being accepted to a university for further study.

After careful consideration of the situation and evaluating each phase of SSM methodology, we came up with a number of ways which can improve the problem situations. All the suggestions came from the people who are involved to MSc Programmes of Computer Science department directly (master students, academic staff) or indirectly (employers); therefore, the solutions are more reliable because these people have exposure to the issues first-hand or indirectly by being involved in the industry.

The most popular solution concerning the way that the Admission team can check student’s English level is to increase the required score in English exam (IELTS, TOEFL) and to implement Skype or telephone interviews. Regarding gaining further qualifications for a job, it was suggested that practical and updated courses which can ensure a good connection with the working environment are very important. Another suggestion was about working in a real world company for either one month before the master or for one semester after completing the exams. In addition, in order to help students to get a job, companies’ presentations were proposed in the University as well as ‘Career day Workshops’ organized and advertised by the Careers Advisory Service. Finally, a big event from HWU and other universities would be beneficial for introducing the PhD studies and projects. Moreover, a speech from academic staff about what a PhD is, what opportunities they will have at the end of the PhD and what PhD students do, would have been very effective and costless.

Soft System Methodology was an appropriate methodology for the situation that it was investigating but it should be modified in order to be more applicable in the current world.

However, SSM is not appropriate for all situations and there might be a better methodology for the situation that I examined. SSM is an effective methodology but it has a number of limitations. SSM take into account stakeholders’ viewpoint and as a consequence, cannot have a time limit or restriction. Moreover, one of the biggest problems is that SSM proposes ways for improvements but does not give the final solution to the problem. SSM does not have a step for evaluating and checking whether or not the proposed solutions are efficient. Furthermore, it has the risk of not getting the appropriate amount of responses or not presenting the real stakeholder’s viewpoint. Stakeholders might not want to
participate to the investigation or they might say what they think that you want to hear and not their real opinion.

To conclude, Soft System Methodology is a very good methodology which focuses on effectiveness and efficiency. The project owner can get valuable information about the situation and a number of possible improvements. However, it is important for all the stakeholders, to have a strong will to adapt and evaluate the most essential solutions.

Finally, I would like to mention that I enjoyed the investigation as I worked in a real world situation and I gained knowledge that I can use in the future. This project enabled my problem solving skills and increased my knowledge on Information Systems and specifically, on SSM.
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Checkland P. and Scholes J (1990), “Soft Systems Methodology in Action”, West Sussex: John Wiley & Sons Ltd


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Khoshroo M. and Bahreininejad A., “Toward An Approach for SOA Methodology”


Maqsood Tayyab, Finegan D. Andrew and Walker H.t. Derek, “Five case studies applying Soft Systems Methodology to Knowledge Management”


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Appendices

Appendix A – Potential Student’s Questionnaire

1. What is your gender?

☐ Female
☐ Male

2. What is your age?

☐ 18 to 24   ☐ 25 to 34   ☐ 35 to 44   ☐ 45 to 54   ☐ 55 to 64

3. Where did you hear for MSc programmes of Heriot Watt University?

☐ Rankings
☐ Search Machines
☐ Brochure
☐ Talk in a lecture
☐ Other (please specify)

4. What is important to you for choosing a university? Choose as many as appropriate

☐ University’s Reputation
☐ Interesting MSc programme
☐ Tuition Fees or scholarship
☐ Country and town of University
☐ Other (please specify)

☐ University’s facilities(e.g.sports)
☐ Academic Staff
☐ Family member went or go there
☐ Friend going there
5. Any Comments:

Thank you very much for your help and I wish you good luck with your studies!

All your answers are subject to Heriot-Watt's ethical policy and details will be kept anonymous.
Appendix B- MSc Student’s Questionnaire

1) Studies:
   _____ Full time
   _____ Part time

2) Where are you coming from?
   _____ UK
   _____ EU
   _____ International

3) What is your gender?
   _____ Male
   _____ Female

4) What is your age?
   _____ 18 to 23
   _____ 24 to 34
   _____ 35 to 44
   _____ 55 to 64

5) How interesting do you find the MSc programme of Heriot-Watt University?
   _____ Very interesting
   _____ Interesting
   _____ Neutral
   _____ Little interest
   _____ No interest

6) What do you want to gain from the MSc programme? Choose as many as appropriate
   [ ] Qualifications for a job
   [ ] Increase knowledge
   [ ] Qualifications for further study
   [ ] Other: Please Specify

7) What do you like about the MSc Programme?
8) What don’t you like about the MSc Programme?

9) What did you expect from your MSc?

10) How do you rank the help you received from the academic staff (Professors, Lecturers etc.)?
     - Excellent
     - Very Good
     - Neutral
     - Not Good
     - Bad

11) How do you rank the help you received from University staff (IT Help, Secretary, Career Service etc)?
     - Excellent
     - Very Good
     - Neutral
     - Not Good
     - Bad

12) Why did you choose this MSc programme?
13) Do you think that your MSc covers what employers look for in your discipline?

14) How MSc programmes can be improved?

Thank you very much for your help and I wish you good luck with your studies!

All your answers are subject to Heriot-Watt's ethical policy and details will be kept anonymous.
Appendix C- Academic Staff Questionnaire

1. What department do you work in?

☐ Actuarial Mathematical & Statistics
☐ Computer Science
☐ Mathematics

2. What is your role in Mathematics and Computer Science school?

☐ Head of MACS
☐ Head of a Department in MACS
☐ Master Director
☐ Professor
☐ Research Association
☐ Other (please specify)

3. What do you expect from MSc students?

4. What do you think employers are looking for MSc students in your field?

5. Please rank how much the MSc Programme that you are part in, covers what employers are looking for?

☐ A lot  ☐ Enough  ☐ Neutral  ☐ Little  ☐ Any
6. What are the problems of MSc programmes from your point of view?

7. How MSc programmes can be improved?

8. Other Comments

Thank you very much for your help!

All your answers are subject to Heriot-Watt's ethical policy and details will be kept anonymous.
Appendix D- Employer’s Questionnaire

1. Which sector does your organization represent?

2. Describe the abilities/skills of master students who thrive in your company or what you expect from a Master student?

3. What courses a master student should have follow for a career in your company?

- IT
- Software
- Programming & Scripting
- Artificial Intelligence & Intelligent Agents
- Management
- Databases
- Network Applications
- 3D Modelling & Animation
- Project Management
- Network Security
- Information Systems Methodologies
- Mathematics
- Linear Algebra
- Statistical Methods
- Analysis
- Geometry
- Modelling and Tools
- Dynamical Systems
- Optimization
- Dynamical Systems
- Modern Portfolio Theory
- Corporate Finance
- Investment and Finance
- Derivatives Markets and Pricing
- Enterprise Risk Management
- Life Insurance Maths
- Risk Theory
- Economics
- Financial Mathematics
- Credit Risk Modelling
- Time Series Analysis and Financial Econometrics
- Bayesian Inference & Computational Methods

Other (please specify)
4. How can the University better prepare Master students for the world of work?

5. What specific advice should Career service provide to Graduate students who are looking for a Job?

6. What percentage of your company consists of Master students?

   - 0%
   - 1-20%
   - 21-40%
   - 41-60%
   - 61-80%
   - 81-100%

7. Any comments

   Thank you very much for your help!

   All your answers are subject to Heriot-Watt's ethical policy and details will be kept anonymous.
Appendix E– Participation of Potential Student’s Questionnaire

The following figures represent details of the sample who replied.

**Figure 25:** Gender of the sample

**Figure 26:** Age of the sample
Appendix F- Participation of Current Student’s Questionnaire

The following figures represent details of the sample.

**Figure 27:** Gender of the sample

**Figure 28:** Studies of the sample

**Figure 29:** Country of the sample

**Figure 30:** Age of the sample
## Appendix G - Meeting/Discussions

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic Staff 1</strong></td>
<td>I should consider the learning Environment, such as the atmosphere, technology, vision, learning material, learning method, labs, coursework, activities, support etc.</td>
</tr>
<tr>
<td><strong>Academic Staff 2</strong></td>
<td>Academic staffs instead of Professors, some comments were going to institution’s expectations, to explain the connections.</td>
</tr>
<tr>
<td><strong>Academic Staff 3</strong></td>
<td>To add rankings to Potential MSc Student. Supervisor concerns about ‘Unique Project’ and to ‘Rich-Maximum Potential’</td>
</tr>
<tr>
<td><strong>Academic Staff 4</strong></td>
<td>Head of Computer Science instead of Head of MACS school. To add more women pictures. Change ‘Scholarships-Low Tuition Fees’ with the word ‘Cost’. To put the Supervisor out of the MACS school bubble as far as he/she can be inside or outside. Supervisor also looks for a student with the skills that an employer looks for. To add the ‘Admissions Team’ after the potential MSc student and their concerns about students with ‘qualifications’, ‘A-level written &amp; Spoken English’ and finally about ‘Money’, meaning the money they will get from the students.</td>
</tr>
<tr>
<td><strong>Academic Staff 5</strong></td>
<td>To change some adjectives such as ‘Good’, ‘Better’ etc. as far as they are not specific and every person can imagine differently what ‘Good quality of teaching’ means.</td>
</tr>
<tr>
<td><strong>Recruitment staff</strong></td>
<td>To delete ‘UCAS’ because it is about undergraduate studies and not postgraduate. The recruitment staff explained me that they are using ‘Direct Applications’, ‘Leaflets’, ‘Newsletters’, ‘Social Media’, ‘Alumni’, ‘Promotion material’, ‘Academic staff’ visit overseas universities’ and that they have agents in some countries that they find the students.</td>
</tr>
</tbody>
</table>
### Soft systems model of the MSc Programme of Heriot-Watt University

<table>
<thead>
<tr>
<th>Student 1</th>
<th>‘Very good job. Congratulations!’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student 2</td>
<td>‘I think the picture is very good and don’t want to add anything.’</td>
</tr>
<tr>
<td>Student 3</td>
<td>‘I have reviewed your Rich Picture and I think it is a great representation of what our MSc programme should contain, offer and deliver. You included all the dependencies I could think of and the picture itself is clear and understandable.’</td>
</tr>
</tbody>
</table>
## Tasks and Timetable

<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Research &amp; Literature Review</strong></td>
<td>150 days</td>
<td>Fri 25/1/13</td>
<td>Thu 22/8/13</td>
</tr>
<tr>
<td><strong>2. Literature Review</strong></td>
<td>48 days</td>
<td>Fri 25/1/13</td>
<td>Tue 2/4/13</td>
</tr>
<tr>
<td>2.1 Methodology Research-Read Articles</td>
<td>32 days</td>
<td>Fri 25/1/13</td>
<td>Sun 10/3/13</td>
</tr>
<tr>
<td>2.2 Write Literature Review</td>
<td>16 days</td>
<td>Mon 11/3/13</td>
<td>Mon 1/4/13</td>
</tr>
<tr>
<td>2.3 Submission of Literature Review</td>
<td>1 day</td>
<td>Tue 2/4/13</td>
<td>Tue 2/4/13</td>
</tr>
<tr>
<td><strong>3. Research on Dissertation</strong></td>
<td>72 days</td>
<td>Wed 8/5/13</td>
<td>Thu 15/8/13</td>
</tr>
<tr>
<td>3.1 Identify Stakeholders</td>
<td>4 days</td>
<td>Wed 8/5/13</td>
<td>Mon 13/5/13</td>
</tr>
<tr>
<td>3.2 Questionnaires Sent Out</td>
<td>14 days</td>
<td>Tue 14/5/13</td>
<td>Fri 31/5/13</td>
</tr>
<tr>
<td>3.3 Interviews carried</td>
<td>24 days</td>
<td>Tue 28/5/13</td>
<td>Fri 28/6/13</td>
</tr>
<tr>
<td>3.4 Analysis of questionnaires' and interviews' results</td>
<td>6 days</td>
<td>Wed 29/5/13</td>
<td>Wed 5/6/13</td>
</tr>
<tr>
<td>3.5 Write-up Stakeholders, questionnaires' and interviews' results</td>
<td>5 days</td>
<td>Thu 6/6/13</td>
<td>Wed 12/6/13</td>
</tr>
<tr>
<td>3.6 Generate the Rich Picture</td>
<td>6 days</td>
<td>Thu 6/6/13</td>
<td>Thu 13/6/13</td>
</tr>
<tr>
<td>3.7 Evaluation and Recreation of Rich Picture</td>
<td>6 days</td>
<td>Fri 14/6/13</td>
<td>Fri 21/6/13</td>
</tr>
<tr>
<td>3.8 Create and write-up of the Purposeful Activity Model</td>
<td>5 days</td>
<td>Mon 1/7/13</td>
<td>Fri 5/7/13</td>
</tr>
<tr>
<td>3.9 Interviews and discussion for actions to improve</td>
<td>5 days</td>
<td>Fri 28/6/13</td>
<td>Thu 4/7/13</td>
</tr>
<tr>
<td>3.10 Evaluation of Rich Picture, Conceptual Model and Actions to improve</td>
<td>4 days</td>
<td>Mon 12/8/13</td>
<td>Thu 15/8/13</td>
</tr>
<tr>
<td>3.11 Define Actions to Improve</td>
<td>3 days</td>
<td>Tue 16/7/13</td>
<td>Thu 18/7/13</td>
</tr>
<tr>
<td>3.12 Thesis write-up</td>
<td>9 days</td>
<td>Wed 10/7/13</td>
<td>Mon 22/7/13</td>
</tr>
<tr>
<td>3.13 Critical Analysis of SSM</td>
<td>1 day</td>
<td>Tue 23/7/13</td>
<td>Tue 23/7/13</td>
</tr>
<tr>
<td>3.14 Comments for Future Research</td>
<td>1 day</td>
<td>Thu 25/7/13</td>
<td>Thu 25/7/13</td>
</tr>
<tr>
<td>3.15 Draft Dissertation</td>
<td>1 day</td>
<td>Mon 29/7/13</td>
<td>Mon 29/7/13</td>
</tr>
<tr>
<td>3.16 Final Submission of Dissertation</td>
<td>1 day</td>
<td>Thu 15/8/13</td>
<td>Thu 15/8/13</td>
</tr>
<tr>
<td><strong>4. Poster</strong></td>
<td>14 days</td>
<td>Mon 5/8/13</td>
<td>Thu 22/8/13</td>
</tr>
<tr>
<td>4.1 Poster Preparation and design</td>
<td>5 days</td>
<td>Mon 5/8/13</td>
<td>Fri 9/8/13</td>
</tr>
<tr>
<td>4.2 Draft Poster</td>
<td>1 day</td>
<td>Fri 9/8/13</td>
<td>Fri 9/8/13</td>
</tr>
<tr>
<td>4.3 Final Poster</td>
<td>1 day</td>
<td>Fri 16/8/13</td>
<td>Fri 16/8/13</td>
</tr>
<tr>
<td>4.4 Poster Presentation</td>
<td>1 day</td>
<td>Thu 22/8/13</td>
<td>Thu 22/8/13</td>
</tr>
</tbody>
</table>
The Gantt chart of the Project is:
# Soft systems model of the MSc Programme of Heriot-Watt University

## Appendix I - MACS Risk Assessment Form (Project)

<table>
<thead>
<tr>
<th>Risk</th>
<th>Present (give details)</th>
<th>Control Measures and/or Protection</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage 1: Finding Out</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do not have enough information from questionnaires</td>
<td>Current and potential students will not reply to my questionnaires</td>
<td>To send questionnaires two or three times to current or potential students of MSc Programmes of Computer Science, in order to maximise the results.</td>
</tr>
</tbody>
</table>
| Do not have enough information from interviews | Professors and directors will not accept an interview with me or will not reply to my question for an interview. | ● To ask for an interview from as many professors and directors that I can in order to maximise the number of interviews.  
● To go to their office personally to ask for an interview, instead of sending an e-mail. |
| Do not have true-real Weltanschauung view | Students do not reply concerning their viewpoint of the MSc Programme or think about what they are supposed to answer | Careful Structure of questionnaires- no direct or technical questions |
| Miss important information in the Rich Picture | If I forget to interview or to send questionnaires to vital stakeholders | Try different ways of find all the stakeholders of MSc Programmes in order to take everyone under consideration and to design a Rich Picture as close to the real world as possible |

## Stage 2: Making Purposeful Activity Models

| Cannot design Purpose Activity models | Not enough materials for designing Purpose Activity models | To make sure that I will gather enough information in the first stage in order to avoid the lack of information. |
## Stage 3: Using Models to Structure Debate

<table>
<thead>
<tr>
<th><strong>Cannot structure a debate</strong></th>
<th>People do not want to participate in the debate and as a result, there were not enough people for the groups</th>
<th>If people do not reply via e-mail, I can use social media to persuade more people to take part in the discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Not interactive debate</strong></td>
<td>The participants in the debate are not interacting with the others and they are too shy to state their opinion.</td>
<td>Persuade people who are aware of the MSc Programme situation and make sure they feel comfortable enough to express their views.</td>
</tr>
</tbody>
</table>

## Stage 4: Defining ‘Action to Improve’

| **Do not write the objective view of the situation** | That I will be influenced by my subjective view instead of considering all the perspectives. | I should be open minded so as to see the whole picture of the problem and to use all the available tools in order to suggest ways to improve it. |