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Real World "Messes": Possibilities for Teaching IT through a Soft Systems viewpoint.

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ABSTRACT

As Polytechnics offer more degree and post-graduate programmes in Information Technology and staff are pursuing research in this area, a greater awareness of the wider areas of systems, systems theory and soft systems could enhance our teaching and research. This paper explains Soft Systems Methodology (SSM) as an example of a soft systems approach, overviews the use of SSM in a specific case and explores how it could be integrated into the teaching of various IT subjects, such as Systems Analysis and Network Management. SSM is seen to be more holistic than traditional IS analysis and design. Feedback from teaching staff and practitioners introduced to this methodology report that SSM often matches their own 'mental model' when analysing situations. One interesting feature of SSM is the use of a 'Rich Picture', a cartoon-like mural of an organisation's processes and people.

1. INTRODUCTION

Traditionally, Polytechnics have specialised in the delivery of practical business computing skills within various programmes. More recently, the delivery of degree programmes in Information Technology and Information Systems, combined with the up-skilling of teaching staff has changed the scope of the field in terms of teaching and research. Information Systems, as a more conceptual field, is perhaps more removed from the practical hands-on nature of business computing, but may have an increasing influence in the future (Land 1992). This paper places SSM within the context of systems thinking and soft systems approaches and explains how these are an influence that may affect IT/IS degrees in the tertiary education sector.

Included in the paper is a summarised Case Study illustrating the use of SSM. Some suggestions are offered on how soft systems could influence our curriculum and delivery. Several current IT subjects, such as Systems Analysis and Network Administration could be taught with cases that are more representative of real world situations with this soft systems approach. Proponents of soft systems thinking would argue that approaches like SSM broaden a student's outlook and more realistically introduce the learner to the complexities of real world situations.

2. SSM EXPLAINED

SSM applies a system engineering approach to the solution of real-world problems in action research settings (Lyytinen 1987). The methodology takes a holistic approach taking into account the political realities of an organisation and uses rich pictures to express problem situations. Through further processes, the methodology defines feasible and desirable changes or potential systems

to be built. Soft Systems Methodology is a systemic approach to problem solving and is illustrated in Figure 1 below. The several stages commence with an unstructured investigation into a problem situation without presumptions. The second stage expresses problems and illustrates the problem situation using a 'rich picture' which is a cartoon-like picture showing all current processes and key people. The third stage sets out definitions of primary tasks and issues leading to a formal definition of 'relevant systems'. Relevant systems are selected as the most important ones to focus on out of the original issues and primary tasks. The relevant systems are further refined as root definitions. Conceptual models are then drawn from the root definitions. A comparison is done between the conceptual model/s and the original 'rich picture' which lead to a definition of desirable changes that has filtered through a debate with involved people. Finally, action is recommended to solve or improve the problem situation. An SSM project is ideally done by the people in the organisation, with the consultant acting as a facilitator. An SSM investigation could be undertaken before an analysis and design of a particular information system. However, it does not replace the more concrete system analysis of data modelling, system flow diagrams and other system models.

3. THE PURPOSE OF SSM

The purpose of SSM is to better understand human situations that are problem scenarios and where improvements are required. SSM can be used as a pre-technical analysis phase to help sort out which business system/s are most likely to benefit the organisation the most. Other potential systems may be tagged for investigation at a later stage. This helps confirm the importance of the selected system to build. SSM does bear some similarities to a full Case Study in terms of the richness of data that is drawn from the organisational setting. However, it does maintain its own peculiar approach. SSM can be used purely to learn more about an organisation without any prejudice about the need for any particular system. The 'rich picture' pictorially represents a snapshot

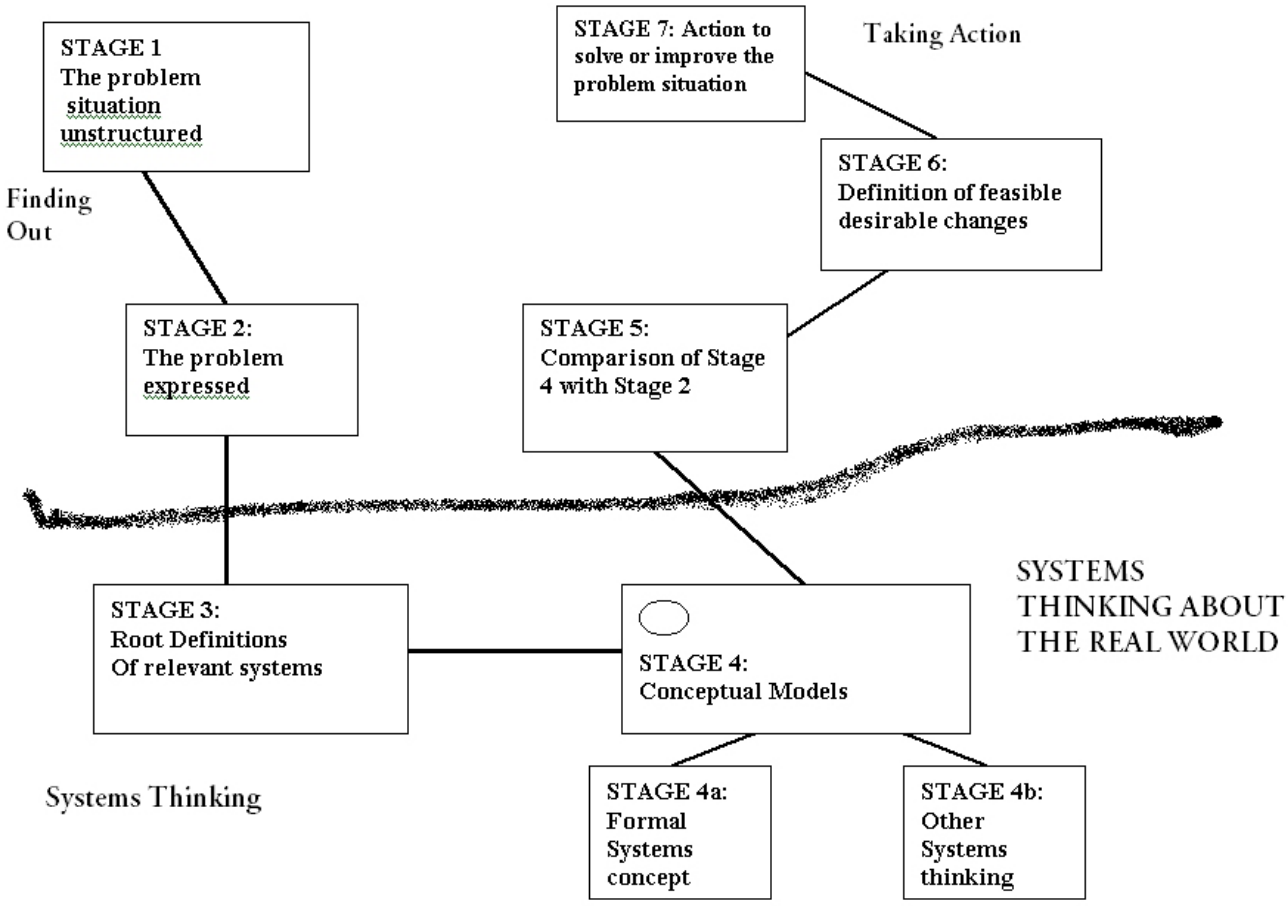

Figure 1: The SSM diagram. (adapted from Checkland 1981).

Historically	Current awareness
Reductionism and Repeatability	Systemic Thinking
Assumes well-defined problem	Uncertainty and confusion about the problem
Assumes problem exists alone	Explores the context of the problem
Problem is 'done with'	Solutions are 'unique' to situations

Table 1: Systems Analysis Change in Perspective (adapted from Wallis 1999)

of any organisation under investigation and this in itself allows wide thinking about itself and its problems. SSM generally produces a wide range of possible systems that could help to overcome problems. If any one of these systems is deemed important, then more technical tools will be required. SSM focuses on human activity systems and stresses the need to take into account different subjective interpretations of what is going on in a particular situation.

Arising from a SSM study are current and proposed systems each of which have a 'point of view', known as a 'Weltanshauung' or worldview (Checkland 1990). SSM attempts to make explicit the subjective mental models of participants in the process and applies theoretically derived models as a support for improving understanding.

4. ORIGINS OF SSM

SSM was developed in the 1960's by Peter Checkland at Lancaster University. Jenkins and Checkland were instrumental in developing SSM as an outcome of the System Engineering departments' work at Lancaster University and an industry liaison with ICI, a large UK chemical company. Real-World case studies also lent credibility to the methodology. The failure of systems engineering to cope with anything apart from well-structured problem situations led to the rethink of the fundamentals of systems thinking. This lead to a 'system of enquiry' that is outlined in SSM (Checkland 1981). Checkland is seen by many to be one of the original thinkers in the IS field and he has tackled both the philosophical and the practical differences between 'real world' thinking and IS modelling/analytical thinking. He also draws attention to the multiple, often conflicting, definitions of an information system, which constitute a systems design and suggests a method of dealing with these.

5. THE NATURE OF SYSTEMS THINKING

In order to properly explain the SSM process some understanding of the backdrop to systems thinking in general is helpful. The core idea is that a complex whole may have properties that refer to the whole and are meaningless in terms of the parts, which make up the whole. In systems thinking, accounts of whole entities are set out as "holons", and these can be checked out against the real world environment. All the problem situations encountered by the developers of SSM featured humans in social roles trying to take purposeful action. This type of thinking highlights deficiencies in looking at problems solely in terms of technical constructs. The example of the New Zealand INCIS project failure poses the question: what went wrong? The application of technology with Data Modelling, Process Flows, Coding, Database Design or the management of the issue as a whole? This is known as the 'Hard' versus 'Soft' issue and has been evident in the development of information systems and management science (see Table 1 below). Historically, computing technology concentrated on the 'hard' issues, but 'soft' system approaches are now more accepted, particularly within information systems and even within more traditional analysis and design frameworks.

6. A SUMMARISED CASE STUDY ILLUSTRATING SSM

Soft Systems Methodology can be demonstrated in the following case of Parkside School, a small primary school with around 100 students. This SSM study was undertaken as part of a Master of Information Systems project for Massey University in 1999 by the writer. Details are summarised for brevity. See Figure 2: Rich Picture 1 of Parkside School (overpage)

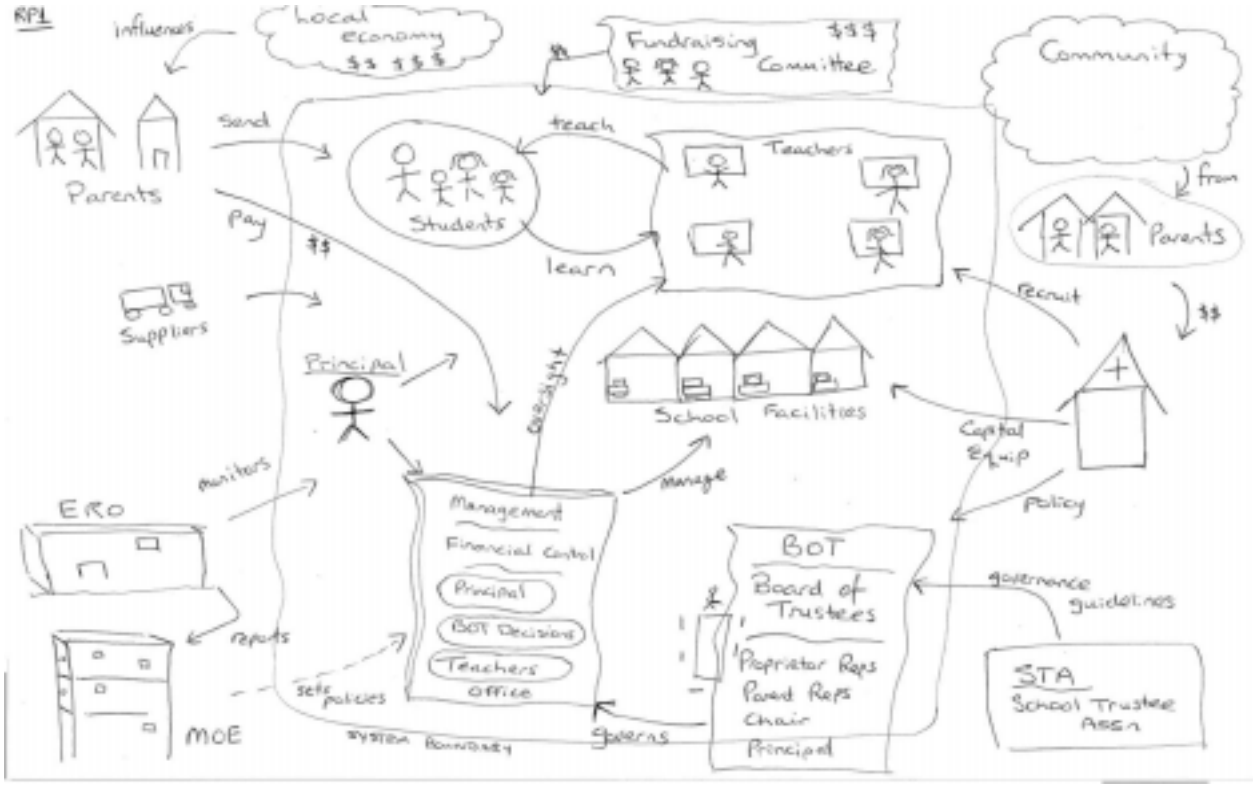

Figure 2: Rich Picture 1 of Parkside School

From consideration of the Rich Picture shown in figure 2 came several Primary Tasks and Issues:

Primary Task - 1

The provision and maintenance of high quality teaching and learning experiences for the students from Year 1 to Year 8.

Primary Task - 2

To provide a holistic education for students including social, academic, sporting and spiritual growth.

Primary Task - 3

Maintain and slowly grow the enrolled student numbers. This includes all prospective families in the community.

Primary Task - 4

To provide technology and computing facilities and weave these into the wider curriculum.

Issue - 1

A tension between the Proprietor's ownership and exclusive management of the school and the many streams of churches represented by the students.

Issue - 2

The principal is juggling between teaching (nearly full-time) and managing an EFT of approximately 100 students. There is little economy of scale with a small school.

Issue -3

An issue of general parent complacency. Support for events etc are by the same few families. There is perhaps a feeling that once the fees are paid that all obligations are released.

Relevant System - 1

A marketing and family liaison system.

This stems from Primary Task 3. The school requires slow but sure growth in enrolments and consolidation of numbers. Most customers should remain for 8 years in order for school to maintain stable numbers. Issue 1 & 3 may be related to this. Possibly there are two relevant systems in this RS statement. The school is different from a Sales oriented company environment in that there are several success factors and that the main goal is not to maximise profit.

CATWOE test for: A Marketing and Family Liaison System

The CATWOE test is an acronym which helps to group people and concepts within the Relevant System. So, "C" accounts for the customers of the system, "A" describes the actors (involved people), "T" describes the main transformation that takes place. "W" represents the weltanshauung or main worldview that views this system, while "O" describes the owners and "E" sets out the environment in which the system would operate.

C - Parents, potential parents

A - School Management: Principal/Admin may include all: teachers, BOT,

T - communicates schools services to community and current parents to increase and keep enrolments

W - a belief that there is greater demand for such a school as Parkside and that greater customer commitment can be achieved.

O - BOT / Principal / Church

E - MOE viability & guidelines, other local school offerings, Church policy, general Christian community, socio-economic neighbourhood

Root Definition - 1

A system serving parents and the community which communicates persuasively the school's services and programmes, operated by the schools management, staff and BOT within the constraints of MOE and Church policy and the constraints of other local schools in the local community.

Relevant System - 2

A technology platform for using computing technology within teaching programs.

Root Definition - 2

A system for students which provides convenient computer technology tools to perform enhanced work

Conceptual Model (2)

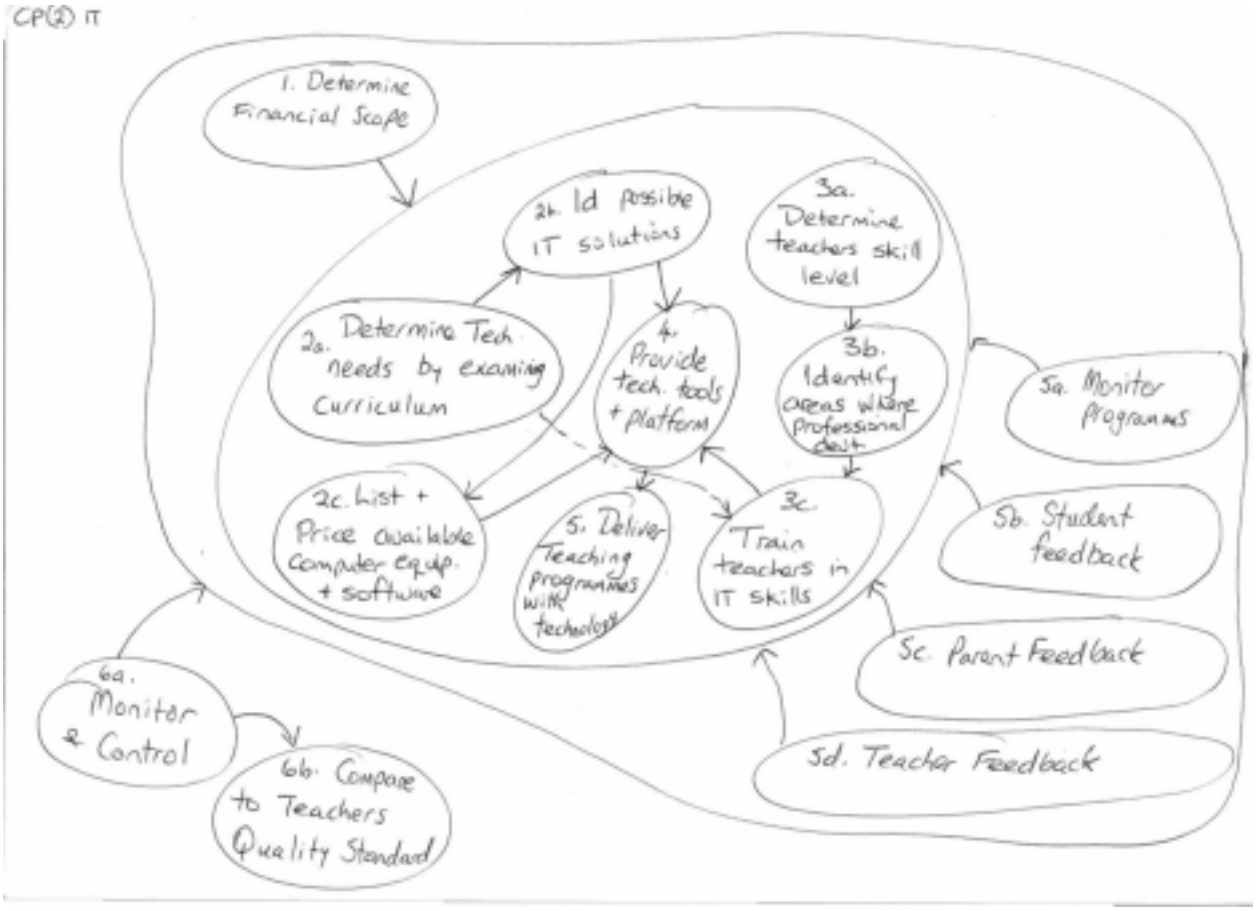

Figure 3: Conceptual Model for the IT Teaching

throughout all subject areas, facilitated by teachers, within the constraints of financial resources and within the initial constraint of the teachers skill level.

Applying the CATWOE to Root Definition 2

C - Students (parents - indirectly)

A - Teachers, Computer suppliers

T - allows the use of IT in all subject areas and upskills students in the use of computer technology

W - a belief that the integration of IT into teaching programs will enhance learners and satisfy parents

O - School Staff

E - Financial constraints, MOE ICT guidelines, Teacher skill level

The feasability of Root Definition 1 and 2 is then discussed including comparing the conceptual model with the rich picture. Only one conceptual model among many possible is illustrated.

Rationale and Justification for the structure and strategy of elements of this Soft Systems Methodology Study of Parkside Christian School.

Issues and Primary Tasks

There are probably more Issues and Primary Tasks that could be listed (even if many of these are not developed further). To list more issues one would need to interview each of the staff and perhaps some of the parents at the school.

Two key systems were developed with a root definition. They were not necessarily chosen as the most important ones. The IT system was a good example of a practical IT system which may have emerged from several IS methodologies. The Marketing/Communication system was one that was more suited to coming out of an SSM study because of several soft issues.

The above Case Study displays key features of a typical SSM study. It is not complete but does illustrate some of the major processes.

7. DEGREE COURSE BENEFITS FROM SSM

A soft systems approach could be introduced to students as an option at the start of a systems analysis phase (Crinnion 1999). When looking at a standard Systems Analysis and Design paper, the business systems problem is presented on the premise that solving the problem will result in resolving most existing deficiencies. In some cases, the business, the players and the political realities could be overviewed in a broader way before the narrower data and informational issues are examined. This is not to say that some broader aspects of organisational analysis are not already dealt with in many SAD programmes.

8. SSM AND THE LEARNING ENVIRONMENT

As others have noted, we often take for granted that the case studies used within IT courses are actually representative and will 'fix' the problem scenario. As Plimmer (1999, p.210) notes, "we know that this world does not conform well to our models. It is messy, chaotic and constantly changing." And, Ledington & Ledington (1999, p.55) explains how the application of Soft Systems thinking has highlighted the problem of deciding which information systems, of the many possible information systems that could be developed in any situation, to actually develop. This could be considered the problem of strategic requirements analysis. Tertiary students may know how to read tailored artificial cases and design 'hard' systems for them but may never encounter the pre-analysis decisions in real life scenarios as to which are the best systems to build during their studies. Many of the case studies in project management, systems analysis and network planning have already 'solved' many of the issues that would be dealt with in the real world. The task then of the student is often to somewhat mechanically apply the "hard" methodology to the key issues outlined and then produce an output that is skewed to the particular course objectives. The following table displays some soft systems considerations alongside some traditional SAD course objectives.

SeeTable 2: A typical SAD paper and Soft System possibilities

Another example where the use of a soft systems approach can influence a paper is in the way a small case study is presented. The following is a comparison between two different approaches in presenting a case within a Network Management subject.

Typical Case Study:

An organisation requires a small network installed in an office situation with 12 PC's involved. A File Server based system is envisaged with appropriate UTP cabling in a star topology. Three levels of user access are required with 2 personnel at a supervisory level access.

"Messy" Case Study

An organisation invites you as a network consultant to provide advice for possible systems. There are currently 12 office personnel who would benefit from sharing resources. People in the organisation have tasks that require 3 levels of access to information. With your technical

Traditional SAD outline	Soft Systems adaptations
explain the concepts of the Systems Life Cycle	
identify and evaluate methods used in the Systems Life Cycle.	
compare and contrast a range of tools and techniques used in the Systems Life Cycle methods.	Evaluate **which** business system problem to solve
solve a business systems problem by choosing a method and applying the development techniques.	Holistic analysis of organisations with human players
conduct cross cycle activities	Evaluation of possible systems and comparison to the Real World
conduct systems analysis to produce a complete requirements definition.	Rich Picture drawn of the organisation
design a system from a requirements definition	Comparison to the Real World during the analysis phase
produce system documentation using a CASE tool.	
produce a technical specification.	
prototype a systems solution from a requirements definition and design documentation.	Evaluation of the efficacy of the developed system

Table 2: A Typical SAD Paper and Soft System Possibilities

knowledge in mind, propose 3 possible small network systems with some networking infrastructure outlined.

Bearing in mind this is a simple, exaggerated contrast to illustrate differences between a prescribed approach with a less defined one, the student will need to think deeper in the second example. In fact, students will probably not appreciate dealing with the second case as the parameters are less defined and each student may arrive at different conclusions. This also may have repercussions for a marking schedule.

However, the second scenario does expose the student to a more representative problem situation and, if trained to deal with this will emerge more flexible in applying any particular technology.

As well as influencing existing papers, some university IS degrees include a Systems Analysis and Design: Issues and Philosophy paper (Crinnion, 1999). This approach looks at systems theory in general, the historical development of systems analysis, and the problems inherent in hard methodology. This also would include a comparison of analysis tools, humans as users and analysts with a coverage of SSM (or similar) and investigations of system failures. Some may argue that this approach is not practical or applied enough. However what could be more 'applied' than encouraging students to think through the complexity of human organisations and to arm them with a range of tools and thinking methodologies to cope with the 'real world'?

9. SSM'S INFLUENCE

Information systems courses in the university sector have specific papers on SSM and on Systems Theory and its influence on humanly designed systems. Some tertiary

providers have soft systems topics within analysis and design papers. Probably United Kingdom and Australian educators have been the most influenced by SSM but the general soft systems approach is widely embedded in IS theory and practice. For example, Massey University has a 4th year paper on SSM within their IS department. Deakin University has a systems study group within the Management Information Systems School with research on SSM including developing a CASE tool to support practitioners of SSM (Systems Study Group, 1998). Finegan, at the Royal Melbourne Institute of Technology, used SSM for developing a systems model of technology transfer for applications of remote sensing in Australia (Finegan, 1994). The ideas espoused in this methodology have had quite an influence in the theory and practice of the development process being used as a platform for bargaining and discussion amongst the players within an organisation and the IS people involved. There are many case studies documented where SSM has been used effectively.

10. CHANGES FOR STUDENTS

One effect of students being exposed to soft approaches may be to highlight for them the limitations of the belief that IT systems will always benefit human activity and organisation. Students will already be aware of a high system failure rate in industry and this field may help them to see weaknesses in narrow modelling techniques.

Often we receive feedback from IT students resisting communications and general business papers but applying SSM methods may help persuade them of the pluralistic nature of IS and IT. If case studies can be created to reflect a truer reflection of the Real World, then we may have better prepared our students to deal with complexity and 'messiness'. Lecturers who have come from industry will not need convincing that our text book cases often bear little relation to problem situations they have worked amongst.

Further, this approach may influence some students to practice more reflective holistic thinking as they embark on professional IT careers. Vigden, Wood-Harper and Wood (1993) contend that the quality of an Information System can be enhanced with SSM as quality is not simply judged as 'production' quality, but also as a 'use view' of quality. This is illustrated in Figure 4 opposite. Tertiary students ability to judge quality in an IS can be improved through this type of approach. See Figure 4: A Soft Systems Approach to IS Quality (Vigden et al 1993).

11. WEAKNESSES OF SSM

Critics would point out that SSM does not actually provide the specific analysis data needed to build a real system. Traditional analysts may agree with the need to go through a similar process of dialogue and securing agreement within a problem domain but do not see the need for another process such as SSM.

From a management perspective, SSM is criticised for being an open-ended process that is difficult to manage and judge whether success has been achieved. The sociological view of human participants in an organisational change process may also criticise the approach as ignoring issues of political power and having a somewhat utopian view of human nature and behaviour. Notwithstanding these criticisms, the use of this type of socially aware methodology is gaining acceptance particularly as more people throughout our society, not just IS professionals and managers, discover the unsuccessful outcomes of "hard" system approaches (Underwood, 1996). Paradoxically, although SSM was developed to bring a greater consensus amongst system players and help sort out the many different worldviews, it has been subject to some conflict between major researchers and practitioners over details of using the methodology itself.

12. CONCLUSIONS

Soft systems approaches that exist within information systems such as SSM have had an influence on the IT and IS world. Such approaches are likely to continue to change our models of understanding in the future. There are deficiencies in reductionism and 'neat and tidy' models that we present to our students through various case studies and applied IT subjects. Systems thinking and soft systems approaches can help to more realistically present cases and organisational scenarios to tertiary students in IT courses. Information Systems, as a wider, more conceptual field than Information Technology, has much to offer in terms of providing a richer framework for applied computing. Teaching applied IT has the potential weakness of producing 'technicians' rather than strategic IT practitioners who may be well skilled but lacking in ability to deal with real world "messy" organisational situations. We can be open to influence from soft approaches without necessarily embracing the entire

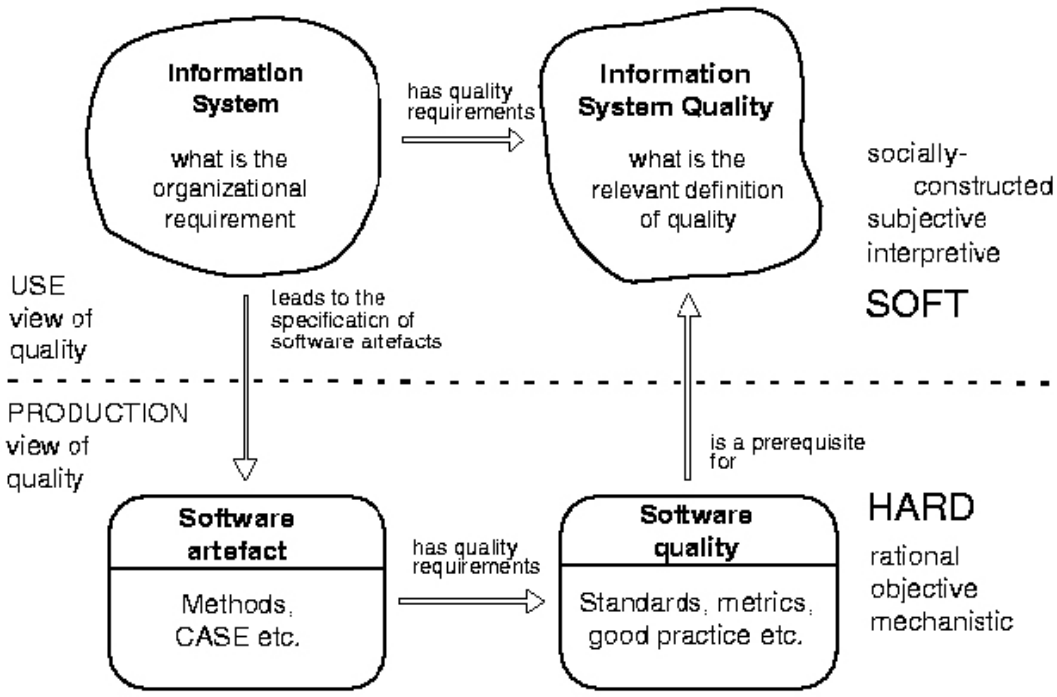

Figure 4: A Soft Systems approach to IS quality (Vigden et al 1993)

methodology, by changing the nature of our case studies to reflect realistic situations and holistic thinking.

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