# Ch 3 Specific Techniques 1: Organisational Requirements

## Objectives

- To introduce techniques which consider human and organisation needs as an integral part of the requirements process
- To contrast an 'organisational learning' approach with business process redesign
- To illustrate the key features of soft systems methodology and to discuss it's role in requirements engineering
- To describe socio-technical approaches and discuss their contribution to requirements engineering
- To introduce ten principles for user-centred design
- To present some practical techniques for cost-benefit assessment of the organisational impact of a technical system proposal

### Introduction

The aim of this chapter is to introduce techniques which place the investigation of information system requirements in wider context. That is to say those techniques which consider that requirements should be defined in such a way as to satisfy human and organisational needs as well as technical (system) needs.

### 3.1 Organisational Requirements

Organisational requirements are those which come out of a system being placed in a social context. Organisational requirements will have their source not only in organisational structures and the activities of individuals and groups but also in power structures, obligations and responsibilities, control and autonomy, values and ethics. (Harker et al. 1990)

Recent research has focused on identification and expression of organisational requirements. For example the aim of the ORDIT project (Dobson et al., 1994) is to develop a methodology that will enable systems designers to reason about organisational goals, policies and structures, and the work roles of intended end users.
To some extent ORDIT includes aspects of both soft systems and the socio-technical approach while at the same time attempts to develop more formal models.The components of the ORDIT methodology include: a process model; an enterprise modelling language; an information modelling language; a role reference model and supporting tools. (see Dobson et al., 1994 for a fuller description)

In general terms, the aim of enterprise modelling is to describe an organisation as a social structure in such a way that it helps in the understanding of the complex interactions

between people and organisations. See Loucopoulos and Karakostos, 1995, for a fuller introduction to enterprise modelling. *say more here...........?*

Organisational requirements can be derived by using the soft systems approach of Checkland (see section 3.2 below) and the socio-technical approach of Mumford (see section 3.3 below) in as much as both methods consider the operation of the proposed system within the broad context of the organisation and the people within the organisation.

## 3.2 Soft Systems Methodology

*What is it?*

The soft systems approach (Checkland, 1991) considers humans as components of the work system. The soft systems methodology (SSM) recommends an investigation into the effectiveness of the 'human activity system' prior to identifying the need for an IT based solution. The assumption being that reorganisation of the human activities may in itself be sufficient to solve the business problem. If it is not sufficient then the investigation will lead to identifying the source of the problem and a solution which includes a human and organisation component and (possibly, but not necessarily) a technical IT component.

Dobbin and Bustard (1994) suggest that soft system methodology (SSM) offers a number of features not explicitly addressed in other 'hard' methodologies, the section below is reproduced from their paper:

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Treatment of the Problem Situation
SSM is concerned with analysing the entire problem situation, by considering the wider system environment as well as the system under investigation. SSM does not examine a problem but the situation in which there is perceived to be a problem.

Emphasis on Behaviour
SSM focuses on identifying the purpose (or purposes) of a system and the activities necessary to achieve those purposes. It explicitly avoids a consideration of system structure initially.

Emphasis on Change
SSM is a methodology which is based on the idea of bringing about change in a problem situation. The proposed system model is compared to the actual system in order to determine the necessary changes.

Multiple Perspectives
The essence of SSM is its analysis of the problem situation from a number of different perspectives or viewpoints. Systems usually serve a number of different purposes and an

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ackowledgement of the multiple viewpoints provides SSM with a mechanism for identifying and resolving conflicts.

Goal-driven
SSM is a goal-driven approach; in other words, it focuses on a desirable system and how to reach it, rather than starting with the current situation and considering how to improve it.

Emphasis on Control and Monitoring
SSM explicitly recognises the importance of control in any system, by requiring the presence of a monitoring and control activity.

*How is it used?*
The methodology is summarised in figure 3.1, it has seven distinct stages: (Wilson, 1984)

1.      Finding out about the problem situation.
2.      Expressing the problem situation (rich picture of the real world).
3.      Selection i.e. selecting how to view the situation to produce insights and
        producing root definitions.
4.      Building conceptual models of what the system must do for each root definition.
5.      Comparison of the conceptual model with the real world.
6.      Identifying feasible and desirable changes.
7.      Recommendations for taking action to improve the problem situation.

.......figure 3.1 here.........


It is possible to start the methodology at any stage and iteration and backtracking are recommended.  It is also recommended that the stages above the line (see diagram 1) are expressed in a language that is readily understood by the people involved with the problem situation. The stages below the line require a specialised systems language.

Stage 1: The problem situation: unstructured

The intention is to find out the problem situation within thinking about solutions. Information is gathered about who is involved, what their perceptions of the situation are; what the organisation structures are; and what processes are going on.

An example of a problem situation is given in Vidgen, 1994:

*The scenario is a vehicle rental company (VCR plc). VCR rents cars and light vans to private and business users. They have noticed that there has been a significant rise in the level of business rentals - market research predicts that business rentals will be the fastest growing market sector over the next five years. VCR believe that growth in business rentals is fuelled by the following factors:*

- *due to the recession organisations no longer need to offer company cars to attract and retain employees;*
- *inland revenue taxation of company cars as a benefit in kind is thought to become increasingly punitive (VCR attribute this to pressure from environmentalists and the government's need to riase revenue);*
- *a desire to come into line with the company policies of other EC countries (company cars are virtually unheard of outside the UK)*

*VRC is considering whether it should establish a separate corporate services operation to target medium to large organisations. VRC's strategy is to become sole supplier of vehicle rentals to corporate customers.*

Stage 2: The problem situation: expressed

The important features of the problem situation are expressed in a way which helps "relevant systems" to be chosen in stage 3. Pictorial formats are recommended - the phrase 'Building a Rich Picture' is often used to describe stages 1 and 2. Greater detail may be added later to the rich picture to support stage 5. The rich picture should show the main structures e.g. power structure, power hierarchy, reporting structure, and the pattern of formal and informal communications. It should also show elements of process, thus forming a view of how structure and process relate to each other in the situation being investigated.

Vidgen provides an excellent example of a rich picture for the vehicle rental company, figure 3.2 below.

...........figure 3.2 here..........

Rich pictures are helpful in gaining an understanding of a situation and provide the requirements engineer or the requirements team with a basis for developing a common understanding of the situation. However, as Vidgen (1994) points out the rich picture is not intended to be an objective representation of the problem situation: "...in preparing a rich picture the analyst is making an interpretation. Consequently there is no single correct rich picture and in one sense a 'good' rich picture is one that people recognize as being representative of the situation they find themselves in..."

Stage 3: Root Definitions of relevant systems

The aim is to define notional systems which are relevant to the problem situation. This can be done by choosing an issue or a primary task from the Rich Picture; then stepping back from the real world and defining a system which addresses that issue or carries out that task. A relevant system must incorporate a particular Weltanschauung (i.e., a particular view of the world), which may or may not seem desirable to the definer. each relevant system will have a Root Definition. Guidelines are provided for checking that a Root Definition is well formulated. These are summarised in the mnemonic CATWOE; i.e., a Root Definition should include:

| **C** | **C**ustomers who are beneficiaries or victims of the system. |
|---|---|
| **A** | **A**ctors who carry out the defined activities. |
| **T** | **T**ransformations of inputs to outputs. |
| **W** | a **W**eltanschauung i.e., a view of the world. |
| **O** | an **O**wner, who has the power to authorise or dismantle the system. |
| **E** | **E**nvironmental Constraints i.e. elements outside the system which it takes as given |

It is recommended that a variety of Root Definitions are explored, incorporating different Weltanschauung.

Below is an example of a root definition for the vehicle rental company:

*" A rental company owned, staff operated system to meet all of a corporate customer's requirements for staff mobility by supplying appropriate rental vehicles when requested, subject to competition from other rental companies, personal taxation of company car users, and an adequate return on capital employed, in order to secure the survival of the rental company."* Vidgen, 1994

From this root definition the following CATWOE is derived:

| *C* | *corporate customers' management* |
|---|---|
| *A* | *VCR corporate services* |
| *T* | *corporate customers' need for staff mobility satisfied* |
| *W* | *the survival of the rental company can be secured by supplying vehicles to companies that have a need for staff mobility* |
| *O* | *VCR management* |
| *E* | *competitors' activity; Inland Revenue taxation policy on company cars; an acceptable return on capital employed* |

This root definition contains a particular W or view of the world, an alternative view might be that corporate employees prefer to use their own cars, in which case the CATWOE would be:

| *C* | *corporate customers' employees* |
|---|---|
| *A* | *corporate customers' employees* |
| *T* | *use of private car on company business ----> that use increased* |
| *W* | *employees without company cars believe that they can subsidize their private motoring through mileage claims* |
| *O* | *corporate customers' management* |
| *E* | *private car mileage rate* |

The purpose of considering alternative worldviews is to identify how the view might impact the choice of primary task model developed for VCR. If the system is developed on the assumption that the W in the first CATWOE prevails when in practice corporate

employees prefer to use their own cars (the W in the second CATWOE) then it is possible that the system will not succeed.

A number of other views (W) might be considered, for example, in Vidgen's paper he (she) also considers the view of the environmentalist and of the competitors. Each view leads to a different root definition.

Stage 4: Conceptual Models

In this methodology, a conceptual model is a human activity model which rigorously matches a root definition. The activities can be derived from the verbs in the root definition, and the model shows the dependencies between these activities. The inputs and outputs implied by the Transformation are also shown. Guidelines are provided for checking that a conceptual model represents a viable human activity system, as defined in the "Formal System Model" i.e., a human activity system **S** is a 'formal system' (i.e. valid) if, and only if:

a.      **S** has an on-going purpose or mission.
b.      **S** has a measure of performance.
c.      **S** contains a decision making process.
d.      **S** has components which are themselves systems having all the properties of **S** (i.e., subsystems).
e.      **S** has components which interact such that effects and actions can be transmitted through the system.
f.      **S** exists in wider systems and/or environments with which it interacts.
g.      **S** has a boundary, separating it from the wider system or environment which is formally defined by the area within which the decision making process has power to cause action to be taken.
h.      **S** has resources, physical and, through human participants, abstract which re at the disposal of the decision-taking process.
i.      **S** has some guarantee of continuity, i.e., has some 'long term stability' or will recover stability after some degree of disturbance.

It is also suggested that conceptual models could be validated against other systems thinking.

It usually requires considerable iteration between stages 3 and 4 to produce a matching root definition and conceptual model.

Stage 5: Comparison

The activities in the conceptual model are now compared with what happens in the real world. For each activity, questions are asked such as:

-      is this activity carried out in the real world?
-      how is it done?

- how is performance measured?
- is the activity carried out effectively?

*--give example--------*

Stages 6 & 7: Implementing Feasible and Desirable changes

The intention at this stage is to investigate which activities are both desirable and culturally feasible.  This may involve: exploring the feasibility of moving from the current situation to the situation implied by the conceptual model: bringing people together to share understanding of their different perceptions of the situation; and getting the people concerned to judge the desirability of the activities.   This may lead to reiteration of stages 3 and 4.

It is only in the later stages that solutions are considered.  The information gathered by the methodology may be used as a basis for designing or choosing a solution, and for planning an acceptable implementation.

***How does it contribute to Requirements Engineering?***
- a way of thinking about the current organisation and identifying potential for change
- helps to identify key stakeholders and their objectives
- helps to identify key workgroups and their objectives
- helps to identify which work roles should be supported and why
- helps develop descriptions of work roles
- helps to develop visions and design proposals
- can support communication between people
- can help to identify conflicts between user groups

***Where to get further information***
Theory ---Checkland, Practice & Case studies........Wilson

Specific applications include information systems supporting port operations in Australia (Watson and Smith, 1988); procuring warship systems for the UK Ministry of Defence ( Strain, 1990); improving tree crop agrotechnology processes in Hawaii (Mills-Packo et al. 1991) and information systems for primary health care in the Aegean Islands (Darzentas and Spyrou, 1993).

### 3.3 ETHICS (Effective Technical and Human Implementation of Computer-based Systems)

***What is it?***
ETHICS (Effective Technical and Human Implementation of Computer-based Systems) is a socio-technical methodology i.e. it places as much emphasis on user job satisfaction

and good organisational design as it does on good technical design. ETHICS has some similarities with SSM in as much as it involves comparing an ideal situation with the actual situation. In SSM the real world situation as described in the rich picture is compared against the conceptual (systems) model. In ETHICS the work mission (the ideal) is compared with the actual work done and the level of job satisfaction of the staff. Comparison of 'ideal' against 'actual' leads to identification of what needs to be changed and why.

*How is it used?*
The methodology is designed for use by designers, managers and users of new technology ...expand on different modes of use ..end user computing..by management consultants.......

ETHICS has twelve main steps: (Mumford, 19..), these are:

1)  Specify Work Mission.
2)  Describe present work activities and needs.
3)  Consider Job Satisfaction.
4)  Decide what needs to be changed.
5)  Set efficiency, effectiveness and job satisfaction objectives.
6)  Consider Organisational Options.
7)  Reorganise.
8)  Choose Computer System.
9)  Train Staff.
10) Redesign Jobs.
11) Implement.
12) Evaluate.

In the description which follows we assume that the manager of a small company is applying the methodology to his (her) own organisation.

Step 1: Specify Work Mission & Identify why change is needed
The manager is asked to specify his (her) personal work mission and the work mission of his (her) business.  He (she)  is asked to think carefully about the business, the reason for its existence and the things it is trying to achieve.  These are the fundamental objectives that he (she)  and his (her) staff are striving to attain through their work. His (her) personal work mission will normally be different from the work mission of his (her) business.

Next he (she)  is asked to state the principle activities required to achieve the work mission, and to examine whether there is a good fit between the principle activities required to achieve the work mission of the business and the activities which are now taking place.

He (she) is then asked to examine ways of improving, for example, the possibility of becoming more efficient, effective and satisfied with work. In essence he (she) is asked to identify why there is a need to change the present method of working.

Step 2: Describe Present Work Activities and needs.
He (she) is asked to provide a broad picture of the activities of the business, of himself and his (her) staff as they are at present.

The analysis should describe the following:

1)    *day-to-day tasks, indicating which tasks take up most time,*
2)    *the most frequent or more serious work problems that have to be solved,*
3)    *those aspects of work which require coordination*
4)    *those aspects of work where new developments are taking place.  These may be new procedures or new products or services.  Describe new ideas being developed,*
5)    *how work is controlled.  The kinds of targets that are set and how these are monitored.  Indicate which are the most important control procedures. (Mumford, 19...)*

He (she) is then asked to identify: the most important tasks, what most time is spent on; the most serious problems; where good co-ordination between activities is required; new methods or ideas that are being developed; the most important control procedures. He (she) is also asked to identify his (her) most important activities and those of the business as a whole.

Step 3: Consider Job Satisfaction
At this stage the manager is asked to examine his (her) personal job satisfaction and that of his (her) staff.

The assumption here ( Mumford, 19...) is that if people enjoy what they are doing then their morale and motivation will be high and they are probably efficient and effective as well as satisfied.  If however, their morale is low and they experience feelings of frustration, then they are unlikely to work at high efficiency and they may derive little pleasure from their jobs.

The job satisfaction questionnaire is used on the manager and on all of his (her) staff in order to ascertain which aspects of their work they particularly like and those which they dislike.

*Underlying assumptions of the questionnaire:*

Job satisfaction is defined as a good fit between what a person does and has in his (her) or her job and what he (she) or she ideally wants.  Most people want the following: to use the knowledge which they possess and to increase this; to get a sense of achievement from work; to have access to resources that enable them to work efficiently and

effectively; to have an element of personal control so that they can make decisions and make choices, and to have a well designed job that provides the right mix of interest, variety and challenge.

The manager and his (her) staff are asked to complete the questionnaire and to analyse the results and to collate comments on the use of skills etc.; what people like doing most; what people like least; aspects of work that staff are most satisfied with and those they are least satisfied with.

Step 4: Decide what needs to change
Compare the results from step 1 with those of steps 2 & 3.  Identify which tasks carried out at present are unnecessary and could be removed.  Identify which tasks on the list from step 1 are not actually carried out and should be, i.e. identify any new tasks which will help achieve the work mission.

Having decided what key changes are needed, the manager is then asked to identify the following:

- *Changes which could help him (her) achieve the business work mission and his (her) personal work mission by improving his (her) efficiency.*
- *Changes which would help the business as a whole to improve it's efficiency.*
- *Changes which would improve his (her) personal effectiveness.*
- *Changes which would improve the effectiveness of the business as a whole.*
- *Changes which would improve job satisfaction.*
- *Future changes.*

Step 5: Set Efficiency, Effectiveness and Job Satisfaction Objectives
A clear set of objectives for the manager, his (her) staff and the business as a whole which are directed towards the achievement of work missions will enable the manager to:

- *Understand exactly what he (she)  wants to get from any reorganisation of work and new technology, before any changes are made.*
- *Evaluate the success of any reorganisation of work or new technology once it is introduced, by checking how well it is contributing towards the objectives. (Mumford 19...)*

The manager is asked to set objectives relating to: efficiency, job satisfaction, effectiveness and future change

Step 6: Consider Organisational Options
Before introducing new technology it is important to ensure that the business is organised and managed in the best possible way to achieve increased efficiency, greater

effectiveness and higher job satisfaction.  There is considerable evidence that computer systems introduced into badly organised work situations tend to be failures, whereas, computers introduced into well organised situations provide many benefits.

Mumford advises that if the answer to any of the following questions is YES then the manager should consider some reorganisation:

- *Would reorganisation help him to achieve his (her) personal efficiency objectives or those of the business as a whole?*
- *Could he (she) eliminate some of his (her) work problems altogether, and get faster and more effective control over the remainder?*
- *Would reorganisation enable him to become more personally effective in critical business areas, and enable the business as a whole to become more effective?*
- *Would reorganisation remove frustrations an enable improvements in job satisfaction?*
- *Would reorganisation make the business more flexible and enable it to cope more easily with change in the future?*

Step 7: Reorganise
i.e. How to change:

An incremental approach is recommended.  The manager is encouraged to take account of the following principles for good organisational design:

a)      People work best in groups of six to eight or less.

b)      Giving a group responsibility for part of a business rather than a single function increases work interest, responsibility and motivation.

c)      Let a group identify and correct its own mistakes,  rather than have another group do it.  This prevents mistakes being made.

d)      Try to ensure that information goes directly to the group that has to act on it. This avoids delay in taking action.

e)      Give each group clear work objectives but leave it to them to decide how to achieve these objectives.  This encourages responsibility and stimulates initiative.

f)      Make sure each group knows exactly what it is responsible for and which other groups it needs to co-ordinate effectively with.

g)      Give each group some development opportunities.  For example introducing new methods of working or new activities.

h)      Involve staff in deciding what organisational changes to introduce.

i)      Keep organisational structure flexible so that it can easily be altered.

Any reorganisation must be linked to the business mission and objectives.

Step 8: Choose a Computer System
Having a clear statement of what he (she) is trying to achieve should help the manager in deciding which hardware/software to choose.  No real guidance is given here.

Step 9: Train Staff
The introduction of new technology will change work practices, it is therefore necessary to plan the training needs of staff.  All staff should be trained to some extent in he (she) use of the new technology even if they are not likely to work with it. If a 'champion' of the new technology appears among the staff then this should be encouraged.  It is important to plan the training activity of staff since many systems are under-utilised through lack of knowledge.

Step 10; Redesign Jobs
It is also necessary to consider the job of each staff member.  Some good job design principles are: Each job should provide the following:

*a)      a good fit with the needs of the person doing the job.  It should not be so    routine as to cause boredom, nor so demanding as to cause stress.*
*b)      Work variety and the opportunity to use a number of different skills.*
*c)      The opportunity to use judgement and made decisions.*
*d)      The opportunity to do a complete job. See a set of tasks through from start to finish.*
*e)      The opportunity to learn and go on learning.*
*f)      A feeling that the work is important and seen by others as important. (Mumford, 19...)*

Step 11: Implementation
Staff participation throughout the process of planning the change is very much encouraged since they are the people who will make implementation a success or a failure.  It is important that they 'own' the change.

At the implementation stage the manager is encouraged to plan timing of and phasing the introduction of the new technology and to consider how the process should be monitored.

Step 12: Evaluation
Once the system has settled own, its ability to contribute to the efficiency and effectiveness of the business, to job satisfaction and to the objectives must be carefully evaluated. Ask staff to complete the job satisfaction questionnaire again and assess

whether objectives set earlier have been achieved. Part of the evaluation will be to identify future change.

### How does it contribute to Requirements Engineering?
- provides a systematic step by step approach
- supports communication between people
- develops knowledge of the current organisation and the potential for change
- helps identify organisational objectives
- helps identify work roles to be supported and why
- helps to describe user characterstics
- helps identify quality attributes of efficiency, effectiveness and satisfaction

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### Where to get further information
The main references are:
1)      Designing Human Systems, The ETHICS Method. (year....)
2)      Using Computers for Business Success, The ETHICS Method.
3)      Designing Participatively.
4)      Designing for Secretaries.
These are all Manchester Business School Publications and are written by Enid Mumford.

## 3.4 Organisational learning versus business process redesign

brief review of BPR and explanation of the issues associated with 'big bang' style change versus incremental learning....half page....leading into an introduction of Easons approach..................

## 3.5 Eason's Approach to Organisational Change and Socio-Technical Design

### What is it?
specifically addresses change and evolution of systems

socio-technical design......explain what it is using fig on page 52 (IT&OC)

explain the 'gap'....using p4 (autumn school)

user-centred design.diagram .......p3 (inaugural lecture)

10 principles and typical supporting methods/ techniques

### How is it used?

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*How does it contribute to Requirements Engineering?*

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*Where to get further information*
**.....................**


### 3.6 Eason's Techniques for Cost Benefit Assessment of the Organisational Impact of a Technical System Proposal

As indicated above there are many techniques which can be used in support of a user centred approach. Only one technique is described here. It can be used in support of principle six: user requirements and values. The technique has been chosen because it supports the early assessment of the organisational impact of a proposed technical system. The five main stages are shown in fig....... The section which follows is Eason's own description of the technique, Eason 19...., and is reporoduced with permission.


### Summary