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Applying Soft Systems Methodology to Multimedia Systems Requirements Analysis

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Abstract

The Soft Systems Methodology (SSM) was used to identify requirements for the development of one or more information systems for a local company. The outcome of using this methodology was the development of three multimedia information systems. This paper discusses the use of the SSM when developing for multimedia environments. Namely, this paper covers the problems with traditional methods of requirements analysis (which the SSM addresses), how the SSM can be used to elicit multimedia information system requirements, and our personal experience of the method. Our personal experience is discussed in terms of the systems we developed using the SSM.

1. INTRODUCTION

Towards the end of 1995, the Multimedia Systems Research Laboratory (MSRL) at the University of Otago was approached by a local manufacturing firm to address the problem of disseminating technical and product information throughout the organisation. In addition to textual data, technical and product information often include engineering drawings, assembly and repair illustrations. Due to the large size of the organisation and the complexity of the environment in which it operated, the MSRL adopted the Soft Systems Methodology, or SSM (Checkland and Scholes 1990) to requirements analysis. Furthermore, we were also interested in determining whether it could be used to identify a need for multimedia.

With traditional methods, the system's developer tends to push a certain type of solution which is usually within the bounds of the developer's expertise. The outputs of requirements analysis " .. too often contain elements that are designs rather than essential requirements" (Booch 1994), p. 5). While focus has shifted to getting the requirements right in the early stages of systems definition and new methods for requirements gathering have been created, there are still some fundamental problems inherent in both the new and traditional approaches. The focus is on modelling the system to be developed rather than trying to understand the problem and its relationship within the organisational environment. Without this understanding, solutions are only partially defined and in some cases may confound the problem. According to (Avison 1985, p9) inadequate systems:

- do not account for a natural change in user requirements over time, and incur heavy maintenance costs,
- require the user to change their behaviour to accommodate the system, rather than the reverse, and
- reflect the data captured by the organisation instead of the information people need.

The traditional system development life cycle, and the new methods for requirements analysis which are based on it, explicitly refer to only one system (Winter, Brown et al. 1995) p. 140). In real world situations, more than one system is usually required to meet user needs. It is for this reason that we attempted to see if the SSM approach might be beneficial in addressing these shortcomings.

Furthermore when using new technologies like multimedia there is always the tendency to incorporate more features than is necessary. For example:

- users may be inadvertently lured into using unnecessary 'bells and whistles' which complicate communication between the system and users, rather than enhance it,
- conventional approaches to requirements gathering (i.e. the data base approach) may lack the robustness to include new forms of information (such as video) and in effect be tied to 'captured' data (which in turn relies on prior technology), and
- there may not necessarily be a need for a 'high-tech' or computer based solution at all.

It was envisaged that through the use of SSM, we would be able to identify the needs in context and hence the features of the system that will enhance the delivery of information. Therefore in order to achieve more complete solutions we need to address the "problem of how to expand our understanding ... of the environments and activities of system use" (Suchman 1995) p. 33). The Soft Systems Methodology (SSM) is a set of "principles of method" (Winter, Brown et al. 1995) which facilitates understanding of the problem and its domain.

2. USING THE SSM IN A MULTIMEDIA DEVELOPMENT ENVIRONMENT

At the start of this project, a meeting was arranged with a manager and a systems engineer of a local whiteware manufacturing firm. The firm designs, produces, and distributes the products it manufactures. The meeting took place in a room which had a large whiteboard which was used to draw rich pictures as part of the analysis. The atmosphere was uninhibited and all members participated freely in the analysis. One member of the MSRL, with experience using the SSM, guided the meeting and ensured that the steps described in the last section were followed. To complete the SSM process and evaluate the model, subsequent meetings were held with individual actors identified during the CATWOE analysis.

2.1. The relevant systems

The identification of relevant systems begun by discussing the primary tasks. A division of the organisation was broken up into subdivisions which interacted with one another. The primary tasks that identified the relevant systems are collection, preparation, and the delivery of technical and product information between the organisational subdivisions. Through this analysis, our understanding of the issues influenced our view of how the relevant systems were defined. The following two characteristics were included in our definition of relevant systems: 'a system to produce technical information easily and unobtrusively' and 'a system to communicate directly to a subdivision about a problem or change'.

2.2. The root definition

The next step was to define a root definition. This was done by naming the activities conducted by, and understanding the relationships between, the relevant systems. CATWOE was used. Again, the iterative nature of SSM became apparent, entities within CATWOE were added as our understanding of the current situation increased. The analysis identified the following Customers, Actors, Transformations, Weltanschauung, Owners and Environmental Constraints. Each entity was tagged with additional information, giving us a quick reference to the reasons they were there.

The *Customers* of the system were identified as:

- Service Centre. They benefited through cost savings by reducing inefficiencies in the system.
- Consumer. The consumer needs a problem resolved.
- The Organisation, consisting of the Engineering Design, Plant and Tooling, Product Servicing, and Product Improvement Departments. They benefitted by reducing the cost of disseminating information, get product to market more quickly, and reduced warranty servicing costs.

The *Actors* were:

- Service Centre. The service centres co-ordinate repair jobs and pass on warranty information Service Technicians to the Quality Department.
- Service Technician. They service one or many products and provide warranty information to the Service Centres from.
- Technical Representatives. They train and update Service Technicians with hints and service procedure.
- Engineering Designers. Engineering designers enter initial Computer Aided Design (CAD) models and other relevant design information.
- Plant and Tooling Designers. They enter CAD models for the design of plants and tool equipment.
- Assembly Line Management. They receive training information and plant and tools specification. They also train workers. Assembly line management are part of the Plant and Tooling department.
- Product Improvement Designers. They enter changes to CAD designs and other relevant design information.
- Store Technician. Store Technicians provide spare parts and pass warranty information to the Service Centre.
- Telephone Staff at place of purchase. They handle initial customer queries and complaints.
- Customer Care Centre. A centralised telephone service staffed by trained technicians with good interpersonal skills to answer customer queries.
- Printery. The Printery prints and distributes information such as training manuals and publicity material.

Two *Transformations* were identified. The first transformed product technical information into technical manuals, technical bulletins, magazines, marketing information, tool list, and training information for assembly and maintenance of the various products. The transformation extracted structured knowledge by the specific sub-divisions of the organisation. In the second transformation, marketing and industrial design recommendations, product costing information, warrantee information, and component information were transformed into new or modified product specification information.

The *Weltanschauung* or world view, was stated as 'better collection, preparation, and dissemination of technical information will result in better product design, assembly, and maintenance'.

The *Owners* of the system were identified as:

- Top Management
- The Technical Information Group
- The Project Champion

A number of *Environmental* constraints were also identified. They were:

- Time. Technical information must be released before actual produce releases, revised information must be released before changes take effect.
- Resources. Limited resources are available for the documentation of technical information.
- Quality control. Industry standards for quality control need to be adhered to.

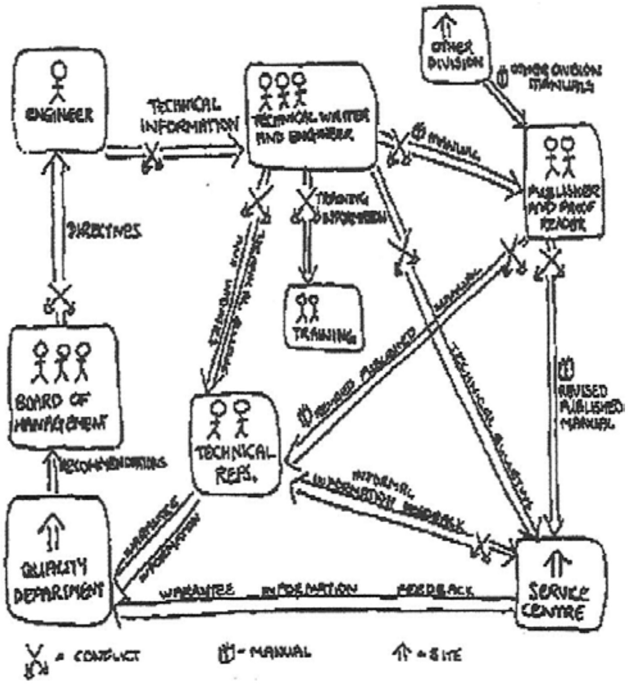

Figure 1: The current system

A rich picture was drawn and modified to clarify our understanding of CATWOE and the current system. What evolved is shown in Figure 1.

As our understanding of the system became clearer through the CATWOE analysis, the root definition of the system crystallised and is summarised below:

> "A system to improve the existing process of collection, preparation, and delivery of accurate technical information in an efficient, timely, and effective manner by, and for the use of, Product Design, Plant and Tooling Design, Product Servicing, and Product Improvement."

2.3. The relevant system

The final model of the relevant system was created iteratively by performing steps three and four of the SSM. The final model of the system is represented in figure 2.

The model was compared with 'perceived reality' by conducting twenty informal interviews with a cross section of the individuals or groups identified in CATWOE. Over time, the model was revised to include the interests of all parties; namely, Engineers from Plant and Tooling, Product Design, Product Servicing and Product Improvement.

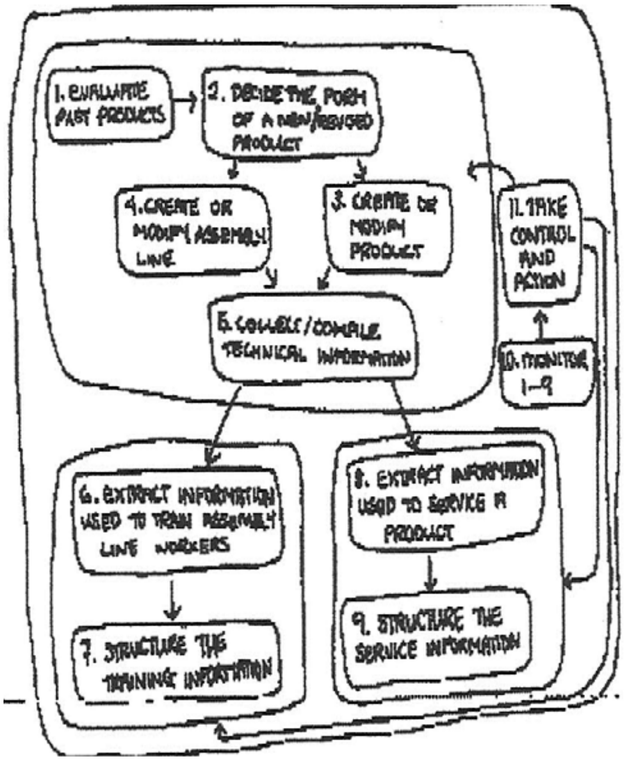

Figure 2: A model of the relevant system

There was a marked difference between the model of the present situation (Figure 1) and the model of the relevant system (Figure 2). As the relevant system emerged, it became clear that the focus of this system needed to focus more on the initial collection, capture and structuring of information, rather than on transforming the source data as is the case with the current system. In the current system, technical information had to undergo two separate transformations before it was distributed to service personnel. This was in addition to the initial preparation of the information by the engineers. Line workers were less fortunate. The information with which they learned to assemble products was reviewed and corrected only once. Hence there were often errors in their manuals. On the other hand, the model of the relevant system indicates that the collection and compilation of technical data should be encapsulated as one system. Rather than being transformed and heavily revised, information relevant to product assembly and servicing should be extracted from the core system into peripheral training and mobile service support systems. Once the information is extracted, it is then presented to those who need it, e.g. training and service personnel, in a structure that is useful to them. Further analysis of our relevant system suggests that the information could only be multimedia in nature.

2.4. The identification of multimedia systems through the SSM

After constructing a model of the relevant systems, the model was then subject to further evaluation based on the 3Es, Efficacy, Efficiency, and Effectiveness. It was during this stage that identified the need for multimedia systems. Based on the relevant system (Figure 2) three information systems were identified. They were 1) a system for the collection, initial preparation, and storage and retrieval of technical information, 2) a mobile service support system, and 3) an assembly line training system. The three systems are currently in their prototype phases.

2.5. The collection system

The Collection System will use intranet technology to tie the other systems together. Its aim is to facilitate the capture and storage of relevant technical information created by product design engineers, product improvement engineers, plant and tooling engineers, and service personnel. This information system will also reflect the natural workflow of each party. It will automatically place shared technical information in context for users; e.g. when a plant and tooling person needs to re-design a tool, his starting point will be CAD models of the product. The system will also extract relevant technical information for training and service 'on the fly'. It will rapidly disseminate notification of product changes via the equivalent of technical bulletins to the other information systems and users.

This system will meet the long-term efficacy goal of an improved process of collection, preparation, and dissemination of accurate technical information in several ways. First, the system provides a unified and structured approach to entering technical information into a corporate 'database'. At present, no such unified system exists. Secondly, the system will collect all relevant technical information relating to a product. At present, information is stored in filing cabinets, on disk, and in several stand-alone databases. Third, the system provides a consistent entry point and method (a web browser) for the storage and modification of information across the board. Fourth, the system will allow ease of sharing technical information to those who need it. Finally, the system administers greater centralised control over the quality and structure of information to be stored.

Compared to the current system, there are less steps needed to collect, prepare, and disseminate technical information. An example of this is the process of collecting CAD drawings, a form of technical information, from the product designers, and its subsequent transformation into a manual for service personnel. In the current situation, this process passed through many steps and many hands, from engineer to technical writer, to publisher and proof readers elsewhere in the country, before finally reaching service personnel. The information system identified by SSM does away with the 'middlemen'. As stated above, the emphasis was on extraction rather than transformation. In this way, the new relevant system would be more efficient than the current system.

As the required technical information would be extracted rather than transformed, there would be benefits if the information remained as close as possible to its original form, e.g. CAD models and designs, mock-ups of products and components. Thus the most expedient way to capture and transmit this sort of information would be via multimedia technology which would increase the bandwidth of communication, rather than lose valuable information by transforming the original work into written documents.

2.6. The mobile service support system

The second information system provides service information and procedures to service personnel in the field. It is envisaged to utilise web technology, and is expected to provide a means of communicating feedback directly between service personnel and design engineers, product improvement engineers and plant and tooling engineers.

In order to remain efficient and effective, the information system would use the same multimedia information captured by the Collection System. The information would only be restructured to suit service personnel. Additionally, as the repair of products is mostly done at the customers residence, and the service person works in 'eyes busy, hands busy' situations, written manuals are not effective. Manuals are difficult to manage. It is difficult to search quickly for specific information, the service person doesn't have a free hand to keep his place, and frequent visual movement between the document and the product wastes valuable time. A solution to this is the use of non-textual multimedia methods of communication, i.e. video, animation and sound. The service personnel think in terms of the physical object they see before them. By using video, for example, they are *shown* rather than *told* how a product is repaired. Additionally, it is envisaged that service personnel would be able to communicate problems directly to engineers through the use of video conferencing, voice mail, or electronic mail to which original product information relating to a specific problem can be readily tagged. These changes alone would meet the long term goal to improve the collection, presentation, and dissemination of technical information to service personnel.

2.7. The assembly line training system

The third system deals with communicating manufacturing and training procedures from product designers to line workers. The system will show them how to piece together a product as they work on the assembly line or during training. This system would be more efficient than the current method of training. At present, assembly line workers use a physical mock up of the product and technical specifications and diagrams to learn to assemble the product. There are several problems with this approach. More often than not the physical mock up is not available, or it takes too long to modify, or is being used elsewhere. As such many line workers end up learning the assembly on the factory floor instead. A high number of errors result, causing frequent delays in the assembly line and high warranty costs.

As with the service personnel, the most appropriate way to present information on how to assemble the products, which is procedural knowledge, is to show rather than tell. This can be done through the use of voice and video, voice and graphics, or video alone. As a training system there was a need to incorporate practice as well. The prototype that was built incorporated a module which allowed the user to graphically and interactively assemble a product on screen. The module provides auditory feedback such as a fan starting up, and graphical feedback e.g. number of errors vs. number correct, and the cooking elements 'lighting' up. The use of this feedback gives deeper meaning to the assembly of the product. It is no longer a matter of connecting Wire A to Slot B. It becomes 'attaching the power source so the element will work'. It was the line workers which identified the need for and asked for this deeper meaning.

The system would also keep track of general scores (not individual's scores) which would identify problem areas within the individual assembly of products. This would open a statistically backed dialogue between line workers and engineers. We recognise that line workers are not entirely at fault for poor assembly. In this manner, and by being more efficient and effective, the training system would help meet the long term goals of improving the capture, preparation and dissemination of information for training.

3. CONCLUSION

The reported work indicates that the Soft Systems Methodology was useful in identifying multimedia requirements for information systems as demonstrated by the development of the three prototype multimedia information systems. More research is underway to evaluate the suitability of this approach in developing other systems.

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