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EXPLORING POSSIBILITIES FOR CHANGE IN RAINFED LOWLAND RICE FARMING SYSTEM

Action Researching among Cambodian Farmers

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Abstract

The introduction of technical innovations to rainfed lowland rice (RLR) farming systems in Cambodia has traditionally been attempted through technology transfer and a researcher-centered approach. This approach has been generally limited in effecting at agricultural change, particularly in the complex RLR system. This paper reports on an attempt to apply a more holistic research process which integrates "action" (practice) and "research" (theory) with emphasis on systems thinking and acting.

Reflections on field experiences in Cambodia suggest that action research has potential for helping both farmers and researchers looking at possibilities for a sustainable improvement in RLR farming.

Introduction

Rainfed lowland rice (RLR) accounts for the largest area (80 %) of Cambodia's cultivated rice land and involves most farmers of whom 60 % are women (UNICEF, 1990). But farming is becoming more difficult and production varies considerably due to poor soil, erratic rainfall, unsuitable techniques and cropping management, and moreover the complexity of the RLR system as a whole. Innovations for improvement of rainfed rice production and the life of the farmers involved are of major concern for agricultural researchers, extensionists and policy makers. However, solutions attempted to date have not been the most appropriate as expected for achieving a sustainable improvement.

The following are some of the characteristics of the situation:

(a) RLR farming is characterised by the ever-changing and complex interaction between physical (rainfall, soil, climate, drought, flood, geography), social (culture, religion, social order, organization of labour, poverty), economic (trading, food exchange, credit and indebtedness, family economy, transport) and political factors (land tenure, price of food, development, political situation, power relations, social service).

http://ro.ecu.edu.au/ecuworks/6866
(b) Farming is becoming more difficult as change hastens, and adequate production of rice for subsistence continually failed to be achieved. Farmers increasingly feel that support is declining and think there is no hope for any improvement.

(c) The relationships between farmers, government and policy seems relatively loose due to consecutive political events, social change in the country, and failure by the government to address farmers' problems.

(d) Funds and government staffing levels are inadequate to conduct worthwhile programs.

(e) The political situation is continuously unstable.

(f) The extension approaches of NGOs and international organizations are either extremely theoretical or extremely practical. In both cases the effectiveness is limited.

The underlying theme of this paper is that the relatively limited achievement in RLR change and improvement stems from the fact that policies are: a) based on a reductionist viewpoint, which shows the gap between theory and practice, and neglects the diversity, complexity and recursiveness of different dimensions of RLR farmers lives; b) developed on the basis of agency perceptions of the nature of the problems confronting RLR farmers rather than on the shared concerns with the RLR farmers; c) lacking in meaningful interactions with local people (Fujisaka, 1989), although a need for farmer participation has been acknowledged.

It is argued that the current approach to agricultural change needs to shift from conventional empiricism, with its linear logic and power relationships, to models which endeavor to establish systemic and mutual recognition and accommodation of change among farmers (clients) and the researchers.

Exploring Action Research for Agricultural Change

This paper reports on research carried out in collaboration with the Cambodia-IRRI-Australia Project (CIAP) as part of PhD program in the School of Agriculture and Rural Development at the University of Western Sydney, Hawkesbury.

The research explores possibilities for change in RLR farming using different approaches to critical inquiry that culminate in an holistic approach called “action researching”. The essence of this approach is the attempt to introduce “systems thinking and acting” to the range of stakeholders who are involved in a situation where the matter of what actually constitutes improvement is questionable. In this case the stakeholders were the researcher, RLR farmers and village leaders who are engaging with the RLR community to identify problems and look
for improvement. Bawden and Packham (1991) suggest that new approaches to improvement in agriculture relies on specialised knowledge and the ability to help all concerned people to work in group in the learning process.

Research Procedure

The study followed two phases of inquiry:

(i) Phase One: Ethnographic

This phase comprised an ethnographic study of the RLR farming system focusing on agricultural change in the system. Participant observation was used to obtain insights about the RLR system and aspects such as indigenous knowledge, coping with food shortage, problems in RLR farming, 'grassroots rural development' and the whole RLR system. Semi-structured and structured interviews were used to obtain an understanding of indigenous agricultural knowledge from farmers of different age, class and gender, and an understanding of the farming approach in each individual farming context. Data were also collected on seasonal activities, farmer traditions/practices, labour exchange and farmer household culture.

Critical reflection on this phase from the researcher confirmed: 1) the problems of farmers and of RLR farming as perceived by farmers themselves; 2) the need to have clear understanding of indigenous systems on the part of researchers/policy makers; and 3) the lack of assistance for problem improvement and the need to look at possibilities for change in the system.

(ii) Phase Two: Action Research

Reflection on the first phase research outcomes led to the conclusion that a more action-oriented approach to the research would represent a potent innovation in the situation being faced by farmers which seems irresolvable. The complementarity of ethnographic and action research approaches echoes a similar idea posited by Chambers (1994:264) that the most important contributions of academic research come from those who engage in practice and who find things to do and ways to do them that work. Another important purpose of action research method is the potential for understanding reality "by stirring up the pot" as Father Volken and his Indian collaborators suggested:

*It is said that if you want to know reality, you must try to change it.*

Henry Volken, Ajoy Kumar and Sara Kaithathara (1982)

This action research attempted to be explorative, using OFAT as a tool to see how action research fits and works in the Cambodian RLR farming context. As it proceeded, action research became an approach to assess learning.
The problem encountered was the difficulty in getting farmers together and getting open discussion from individual farmers in a group. So I initially approached farmers one by one, or on the family basis, or in friendship groups in which members had high confidence in each other, before attempting to discuss in the big group. This approach generated meaningful interaction between farmers and myself as researcher, because it involved us all in shared reflection and critical thinking.

Two action research groups formed themselves and work relationships continued with the two village leaders and with the girl who acted as my assistant. My role was that of a researcher; at the same time I acted as group facilitator and as an "extensionist". The process comprised 5 stages: 1) identification of the problematical situation; 2) discussion and design of an action plan; 3) implementation of the action plan; 4) monitoring and evaluating outcomes; and 5) judging and discussing the second action plan for the next cycle.

The action phase of the research included action to broaden the perception of the farmers, action to develop understanding and a communication process between farmers and researcher, as well as action to practice researching approaches to improvement. The data sets collected were analysed and interpreted under the following headings:

(a) OFAT and its Conventional Approach

Generally the National Agricultural Research Systems (NARS) involves farmers once technologies are ‘proven’. Fujisaka and Garrity (1991) by their experience concluded that many of IRRI’s partners have preferred to set up more top-down demonstrations after lengthy on-station testing rather than involving farmers from the onset of the research.

At CIAP’s rice research program, the primary objective of OFAT is to adapt technical innovations which had been successfully conducted at the research station and at the same time to attempt to transfer the technical innovations to farmers. Generally the proposal is designed by the CIAP’s researchers. Then, through the collaborators from different provinces, the negotiation to conduct the trials with the farmers are presented. The negotiation consists of discussing the proposal with the farmers and making a contract which normally is the compensation through the trial output. Once the farmers agree with the conditions the trial is set up. Farmers implement trials; the researchers are in charge of doing trial observations and necessary data collection which mainly involve plant and yield measurement. The result of the trial will be contrasted with the farmer’s normal crop production as the trial plot is located in the rice field. With the result obtained farmers will decide whether to adopt new technology or not. It is expected that, if the result is impressive, the innovation will be spread to the other farmers through the farmer trial cooperators, but in case of inappropriate result, farmers provide the reasons for non-adoption and that is the end.
In the case of green manuring with *sesbania*, for example, after 3-4 of years OFAT, experience from CIAP showed that most farmers did not adopt this innovation because of labour demands in the context of labour force shortage, cattle problems, seed multiplication problems, and constraints to *sesbania* cropping to produce good crop and enough green mass. For these reasons green manuring was discarded from the research programs. Another viewpoint raised by farmers is the slow effect of *sesbania* compared to inorganic fertiliser.

Through the above process of OFAT, a number of limitations can be observed:

(a) The policy of the OFAT emphasises "doing for" (involving technical operation and quantitative appreciation), rather than "thinking for doing/ learning for doing" which concerns thinking/learning about actions. Thus the learning outcome --attitude changing-- is difficult to achieve, because extension agents and farmers are not aware of errors committed in the past.

(b) The focus of the approach is extremely practical and concentrates on a technical problem with a solution perceived by the researchers. Thus it does not cover to address other problems confronted by the farmers. In addition technical solutions can involve conflict with other factors and create new problems for the farmers.

(c) The researchers and farmers use different frames of reference when thinking about agriculture. Conditions where research is conducted is highly controllable. Their thinking is "out of time" (context). By contrast, the farmer’s performances can occur only “in time”, where they are embedded in a particular agroecological and sociocultural context which gives rise to dynamic changing conditions to which they must make a series of rolling adjustments (Scoones and Thompson, 1993).

(d) Generally what counts for researchers is replication and comparison, while for the farmers, what counts is fitting available resources to changing circumstances well enough to make it through the season (Scoones and Thompson, 1993).

Fujisaka (1994) stated that if IRRI is to move ‘upstream’, some way must be found to increase the efforts of national rice research institutes - including universities and NGOs - to incorporate farmers in agricultural problems solving.

(b) OFAT through Exploration of Action Research

In this study the researcher was a facilitator who helps farmers learn and understand innovation. Farmers understand innovations then decide whether to conduct the trial or not without it being imposed. They design how innovation is going to operate in their own conditions and situation by addressing possible problems identified by themselves. Then innovation is implemented in conditions where they attentively explore their own knowledge.
and skills to look at possibilities to apply innovation. At the end they express why they failed or succeeded and what they will do next.

Research Outcomes

(i) About change

Out of 53 households 20 tried the "green Manuring" and 2 (10%) succeeded despite drought problems, 6 (30%) abandoned the trial but 6 new families jointed. Thus the same number of farmers jointed the following year's trial. Despite crop failure, farmers learned by their experience that green manuring improves the soil compaction problem. The diversity of the farmer's household situations indicates that it might ultimately be possible to develop strategies for each group of household situations. Although change is not visible, a great deal of understanding and learning occured.

(ii) On Learning

The research has identified how farmers are thinking about their cropping. To know "how" they are thinking, and why they are thinking in certain ways, put me as researcher, facilitator, in position to play a part in their learning. Learning is seen as an ongoing process. Adapting the teaching-learning theory of Kitchener (1983) and Salner (1986), learning was introduced through "triple loop facilitated learning" (loop because there was feedback). The loops were: Cognition - when the farmers thought about ways to address constraints for conducting sesbania trial; Meta cognition - once trials were over they thought about what they had done, why they acted as they did that; Epistemic cognition - some farmers expressed why they misunderstood or why they thought like they had believed. The researcher analysed and reflected on farmer thinking and at the same time, when interviewing individual farmers she helped the farmers to rethink and re-understand the facts of sesbania cropping.

Conclusion and Recommendation

The essence of problem management is the capacity of a participant to experience, integrate learning and take decisions to persist or move on - this is human choice. Participation is very important. As it proceeds, the participant will persist, understand the cause of failure, refine the problems, then become more adaptive and try to work with real wanted structures.

Reflections on experience in Cambodia with RLR farmers, suggests that OFAT through action research is an innovative approach that help farmers, rice researchers, and extension workers in searching for possibilities for change for improvement of RLR farming and the farmer's food security.
A third phase of the research is recommended to: a) critically review the progress of the learning system; b) facilitate ongoing development; c) develop a theory of action research that supports need for review and replanning.

References:


Abstract

At the University of Canberra, an innovative approach to solving student appeals was introduced at the end of semester 2, 1994. Formal appeals at the Faculty level were replaced by a two-stage procedure. Most of appeals have been resolved at the first stage, mediation, while only a small percentage of appeals has proceeded to the second stage which is a formal appeal at the University level.

There were a number of concerns in the previous procedure, including non-uniformity of appeals procedures across Faculties. This gave rise to confusion over procedures for both students and staff. Another problem was that while students had a right of appeal in reviewing unit results, there was no such right for staff members involved.

Mediation provides the opportunity for both staff and students involved in an appeal to explore the issues and to look for a mutually-acceptable solution in the presence of a mediator who has been trained to remain neutral, empathetic, and focussed on the issue at hand, and who has the necessary skills to find a solution. Control of the mediation process rests with the mediator who also directs the style of interaction and communication between the participants. The mediator also ensures that the participants work with each other. In setting the scene for a mutually-acceptable solution to emerge, a mediator models the behaviour pattern required. Mediation is directed by the mediator, constrained within a set of University rules and has represented a successful change in appeals procedures in the first instance.

Feedback meetings and conversations between University mediators provided data to fine-tune the procedure for subsequent semesters. Emerging from adopting a campus-wide approach to mediation is a changed culture, one in which staff and students alike are happier with negotiated, rather than adversarial, solutions. This is a major cultural change in a strictly-controlled hierarchical community.
What is Mediation?

Tillett (1991) states that:

"Mediation is a process in which a third party intervenes in a conflict, usually with the consent of the parties, to facilitate a mutually acceptable resolution which requires the agreement of the participants for implementation. In a sense it is facilitated collaborative problem-solving."

While there are many ways to resolve conflict, mediation is distinct because it is controlled by a neutral third party. In any conflict there will always be core issues at stake, triggering events, conflict or conflict resolution and the consequences (Walton, 1987). Tillett (1991) also maintains that the key variable in mediation is not the nature of the conflict or its participants but the mediator, who must possess appropriate personal and process skills.

While mediation at the University of Canberra is envisioned as a collaborative problem-solving process for all types of conflicts, in the first instance it has been used for unit reviews for fail or P* grades. The previous procedure was centred around formal appeals within the faculty. The new procedure focuses on mediation rather than on formal appeal, with any dispute not resolved at mediation going to a University-wide formal appeal.

The Mediator's Role

The mediator's role is to control the mediation process by directing how the participants requiring mediation should interact. Personal qualities required by anyone who wishes to help other people reach resolution by mediation include clear, rational and innovative thinking. More importantly, the mediator must be able to show empathy, humour and flexibility, as well as assertiveness. To be effective the mediator needs to be goal-oriented, even when the process appears to be stuck, or is wandering. Self awareness, creativity, self-control and self-motivation are equally important. The mediator also requires basic organisational skills, and an ability to analyse objectively. Process-related skills include interpersonal skills in communication, listening and building trust and rapport. These personal characteristics apply regardless of the sort of mediation to be undertaken. Wertheim, Love, Littlefield & Peck (1992) maintain that the mediator characteristics are that there is low power over outcomes and high control over process.

Semester 2, 1994, was the first time for this procedure to be implemented. As one of the newly-trained volunteer University mediators it seemed important to me to explain what my role as a mediator was at the start of each mediation session. I also talked about desirable ways to achieve a satisfactory outcome from both parties' point of view. What I have discovered is that if I talk with each participant separately before a joint meeting I can devote my attention to one point of view at a time. Each person has the opportunity to voice her or his feelings, frustrations, sense of power or powerlessness with the situation as well as the facts from her or his point of view. Each person has my complete attention in exploring the problem. So far, the students who have sought mediation are invariably angry, upset, frustrated and extremely disappointed. They may be aggressive, depressed or tearful. My most important task at this
stage is to listen to their story. When each person has expressed her or himself, and the emotional outpouring has subsided, then we can start exploring the options available.

From the staff members' point of view, being confronted with yet another change of procedure that has been imposed on them causes anger and frustration. When the student appears to be challenging academic judgement (which is an expression of positional power for academics) in their claim for a change of results then the staff member involved feels threatened.

The first stage of the mediation process is for the student to meet with the lecturer-in-charge of the unit. In the third mediation that I facilitated, the student was frustrated because the lecturer was unavailable for the initial interview. There was a good reason why this should be - the lecturer was on annual leave - but this was viewed as yet another source of irritation by the student.

How was the mediation procedure set up and implemented?

As far as the academic community of the University of Canberra was concerned, the changed unit review procedure was imposed on them. The procedure was chosen by the administrative staff, and academics were informed of the changed procedure in November, 1994. It appears to me that there is a clash here between the mediation process and the way in which the procedure was put in place. Mediation is about negotiating solutions to problems collaboratively, not imposing changed procedures. Mediation in this situation is made more difficult by the difference in positional power between the participants. Wertheim et al (1992) maintain that an imbalance in positional power will affect the course of the dialogue by undermining trust and inhibiting participants. Students who have not completed their course are going to be very careful about what they say about any academic.

Timeline for Mediation

Mediation was in place early in December, 1994, for a review of unit results from semester 2, 1994. While mediators were given basic training in November, just two weeks before unit results were released to students, the most important learning for mediators happened during the first round of mediations. While an email list was set up for all mediators, there is still technical difficulties and not all mediators are receiving information on the list. At a followup meeting late in December, mediators shared their experiences with the academic registrar to consider modifying the hastily-set up procedure.

A systemic approach to mediation

A systemic approach means that the human activity system of mediation is looked at as a process to arrive at an overview and to look at the system as a whole. This whole is adaptive and flexible and while there are rules and guidelines to control the process there is flexibility within the overall structure.
People Involved in Mediation

As a human activity system, which manifests itself only as perceptions and therefore in many world views, the people who are involved directly in mediation are:

(i) The academic in charge of the unit in which the student result is being queried. The staff member's point of view is influenced by the culture within the Faculty and to a lesser extent within the University. Everybody has his or her own personal perceptions of student/staff relations. Some academics are very understanding about other influences on a student's life that may have had a bearing on the final result in a unit, while others adopt a very narrow view and will only consider the academic result.

(ii) The student making the request for a change of result. Students may be influenced by their peers in requesting a review. They may also be influenced by the Students' Association. Historically, advice and support from the Student's Association has been in the form of a fight for everything that it can get, which may mean that a student presenting for mediation comes with an inappropriate attitude. Students may also be influenced by the myths about units and Faculties that circulate through the student population. For instance, unit A in Faculty B may be regarded as a hard unit where very few students pass first time. This builds up fear and expectations about failure and difficulty.

(iii) The mediators, who leave their normal role aside when they facilitate a mediation. Mediators may or may not be involved in their own personal development (I have been involved in a variety of personal development courses both at work and privately). Training as a mediator means that I continue to explore the way in which I relate to people in the world, particularly in my work place. During the training session we took part in a number of role-playing exercises. I observed myself reacting out of role to an aggressive situation and subsequently did a workshop privately on how to handle anger. As a mediator it is my aim to create a common emotional climate in which an acceptable solution can be found for both academic and student.

Emergence

Emergent properties only manifest when the system is considered as a whole. They are often viewed as unusual outcomes.

Some emergent properties from the changed procedures for unit reviews are:

(i) Attitudinal problems from staff affected by procedural changes.

(ii) The commitment of the mediators. University administrators were surprised with the level of commitment of volunteer mediators. Mediation is an extra duty for already over-worked
staff members. The commitment and enthusiasm contributed to the overall success to this change in procedure. My experience is that there is a sense of personal power in acting as a mediator. I believe that one of the traps of mediating is to develop any ego-attachment to the final outcome.

(iii) The necessity to go outside the guidelines to reach a satisfactory outcome for both parties. I think this is necessary to set up a common emotional climate. When both parties realise that the mediator is interested in them as a person and is willing to help with any other issues that are worrying them at present - like a staff member worried about maintaining unit standards, finding temporary accommodation for a student who has to come to town especially for a mediation session, considering a personality clash, giving course advice, then a satisfactory outcome is more likely.

The four core properties of systems and the mediation process

"The mediator controls the mediation process by directing how participants interact, controls the content and provides the motivational control. The mediator ensures that participants work with each other." (Mediation training notes, November 1994)

One of the core properties of systems (Checkland 1984) is control. Here we see that the directions for mediators state the control mechanisms explicitly with respect to interactive style, motivational control and content.

From my experience the above statement about the mediation process is extremely autocratic. While I do indeed direct the process and maintain the focus on the desired outcomes, I don't do this in an autocratic manner. This is illustrated below in the case histories discussed.

I think that the ultimate key to successful mediation is open and clear communication and this needs to take place in a mutually-acceptable emotional climate. The purpose of my initial meeting with each participant separately is not only to hear their story but also to defuse the emotional situation. Maturana(1993) states that we exist in multiple realities when the emotional situation is different. It is only when both parties are calmer that we can have a sensible discussion about the situation. I also ask each participant to restate their point of view at the joint mediation meeting. I suggest the participants remain calm during this meeting, pointing out to them that we are more likely to reach a satisfactory outcome for both parties if everybody stays calm.

Case Study Number 1

The student involved came knocking on my door just after results had been released. She came straight from the Students' Association. They had told her that she had a case for appealing and she was all fired up and angry about "the man" who had failed her. She was not going to talk to him. He was not available on the day that had been set aside for discussing unit results (Monday 12 December) so that she could view her examination paper and she had come
especially from Sydney and she had to find somewhere to stay and her parents were very particular and she couldn't stay just anywhere.

She had rung from Sydney and she had been told that the lecturer would be unavailable until Tuesday 13 December - but she came on Monday anyway. She was also given a time when she could view her examination paper on the Tuesday when she phoned from Sydney.

So, I had one very angry, very frustrated student to deal with. She assured me that she was right and she couldn't possibly have failed the examination. She knew that she was right and therefore the lecturer must have marked the paper wrong. She had managed to get herself into a very agitated state - and I suspect that the Students' Association had helped with the agitation.

There was also some confusion over resubmission of assignment work. She claimed that she had done the assignment work with a friend in another tutorial and her friend had not had to resubmit and that her friend's assignment was marked "satisfactory" and she had had to resubmit. Also she had not had a resubmission of the final assignment marked and this was not fair, in her opinion.

I found it very difficult to get the facts about the assignment work from her because she was so angry about what had happened.

I learnt from the lecturer and the tutor that resubmissions of the final assignment were only marked if the student passed the examination, or if they were on the borderline of passing. So her final resubmission was not marked because she did not pass the examination.

So, I had a lengthy meeting with her, where I tried to calm her, and where I advised her on how to get some cheap accommodation that would possibly meet with her parents' approval. I also arranged the joint mediation meeting for the next afternoon - because she did not want to stay another night in Canberra.

On Tuesday morning I had a conversation with the lecturer who was very defensive to start with, which I found quite surprising. I repeated to him what the process was about and I also assured him that I was not there to take sides. So, we then got to talk about what the rules of the unit were, the assignment work and how the examination was marked, and we also agreed on the meeting time for the afternoon. The lecturer agreed to go through the paper with the student and to spend some time beforehand looking at and making comments on the paper.

I started the meeting in the afternoon by explaining what mediation was about to both participants. I cautioned the student about staying calm and then we started the detailed analysis of the paper. The student quibbled about every detail. The lecturer found 3 1/2 marks for her, but this was still insufficient to reach a pass grade. During the process I advised the lecturer to change his use of negative language. Remarks like, "This is very poor arithmetic" or "You don't know what you are doing with this question" were a trigger for the student to get
angry and to erupt with statements like, "This isn't getting me anywhere" and I am going to leave and I am going to appeal." So, each time that this happened I suggested to the lecturer that he express himself positively. After I had intervened for the third time, the lecturer apologised and reframed his comment. I was really pleased that he had acted on my advice. The meeting went on for one and a half hours. As time passed, I reminded both participants about possible outcomes - that the student could indeed go to a University appeal, or that she could accept the lecturer's final decision on a re-mark of one question which had received very few marks. At this stage she noted that this was work she had done with a friend and that the solutions were probably identical. Finally, the agreement was that the student would accept the mark of the other student if the solution to the question was the same, whatever that was. If it was different, another lecturer would mark that question, again, on her paper.

When the lecturer checked the paper of the other student it turned out that the answer was the same, and there was a difference of only half a mark, so the mark that the student received remained unchanged.

Reflections

My reflections on mediation include:

(i) At least one member of the Students' Association needs mediation training to help to combat the adversarial attitude and the anger that was fuelled by assuming that mediation was the same sort of process as an appeal;

(ii) Mediators need further training in learning how to defuse emotionally-charged situations;

(iii) Mediators need to be debriefed;

(iv) Academic staff in general need more education about the mediation process;

(v) Because the changed procedure was put in place with little time to publicise the changes, there was a great deal of uncertainty about what should take place. And the phenomenon of sudden and unheralded changes caused stress and anxiety for those academics who were involved in having their unit results reviewed.

As a result of a third mediation (not documented here) I came to the following conclusions:

(vi) Include the possibility of a cooling-off period in the mediation procedures. (There was a period of five weeks between the initial phone conversations and the joint mediation);

and,
Take care to set the emotional climate initially. Allow both parties to air their emotional turmoil before coming to any decisions, and especially before a joint meeting between the parties takes place. (The initial phone calls were very important in setting the emotional tone.)

Conclusion

Mediation for unit results at the University of Canberra is the first step towards a major cultural change where problems are solved systemically and cooperatively, and where all parties involved in the conflict have the opportunity to present their point of view. While, at present, mediation is for review of unit results, it is envisaged that mediation will be used for any dispute that occurs over any issue across the whole University campus. University Administrators viewed mediation at the unit review level as a pilot study for introducing mediation to the wider community. For this to be implemented efficiently and effectively it will be necessary to provide mediators with further training, especially training in handling highly-charged, emotional situations which is the usual case when disputes are being discussed. It is also necessary to create a cooperative environment by adopting a participative implementation strategy to put any expanded mediation procedure in place.

References


A DESIGN DECISION SUPPORT SYSTEM FOR HELICOPTER MULTI-MISSION MODIFICATION

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ABSTRACT

Helicopters are presently designed exclusively for singular customised missions. New or expanded missions are not easily accommodated unless a new design or some modifications to existing ones are made. Between the two, the latter is economically more attractive. This alternative, however, warrants a tradeoff between mission requirements, costs and performance, demanding an optimisation framework with which to search for a compromise solution.

Because the parameters involved in modifying a helicopter for multi-mission purposes vary significantly from mission to mission, an optimisation program is considered too restrictive a methodology. A more flexible approach is needed whereby the commonality of several missions can be simultaneously assessed.

This paper uses systems thinking to derive a design decision support system for helicopter multi-mission modifications. By exploring the inter-relationships between system components and attributes, the disparate mission commonalities could be identified through an appraisal of the capabilities of various modification packages. And by organising these packages into a hierarchical multi-mission system, a series of commonality matrices indicating the inter- and intra- functional relationships between components and attributes could then be established.

The number of mission commonalities a component or attribute possesses signifies its relative importance in the overall system. By normalising the commonality numbers into percentages, a design support system (DSS) prioritising the components according to their relative importance in the system is established. The DSS empowers the designer to appreciate the extent to which various mission requirements under consideration could be met.

For a given mission, a number of alternative modifications may be derived from the DSS. The cost associated with each together with its corresponding drop in helicopter flight performance (due to modification) could then be evaluated against its needs-fulfilment capability to arrive at a cost-effective option.

As an illustration of the methodology, a military-cum-medical multi-mission modification is considered. The results show that system thinking offers a promising outlet in establishing a design decision support system for helicopter multi-mission modifications.
Introduction

With its inherent vertical take-off and landing capability, the helicopter is a highly versatile machine. Since its invention, its usefulness has been proven in a wide range of fields, including military operations, fire fighting, search and rescue, reconnaissance surveys, news gathering and a host of other civilian uses. However, for all its uses, the design of a helicopter is predicated very much on the pre-determined functions that it is set to perform. This invariably means that a helicopter designed for one purpose, say, military operations, may not be suited to an alternative mission, such as a medical rescue task, without appropriate modification. The design of a multi-mission helicopter is both a costly venture and a design nightmare, since the types and number of functions to cater for is open-ended. An obvious and, most likely, cheaper solution is to modify an existing helicopter based on the missions it has to carry out (Hieden 1990; Osmond 1994). This paper outlines a systems methodology to develop a design decision support system for helicopter multi-mission modifications.

Overview of System Methodology

The approach begins with a holistic view of the problem. The multi-mission modification system (MMMS), the focus of the study, represents the transformation process in a conventional input-process-output system configuration. The operational needs of the different missions (ie, military, medical, police or civilian) to which the MMMS has to cater constitute the key inputs; the environmental conditions (eg, mountainous terrain and adverse weather) within which the MMMS has to operate make up another input dimension. The output of the MMMS is the mission capabilities, which are geared to meeting the mission requirements arising from the operational needs. A holistic view of the problem involving two missions - military and medical - is diagrammatically illustrated in Figure 1.

FIGURE 1: MILITARY MEDICAL MULTI-MISSION MODIFICATION SYSTEM AND ITS ENVIRONMENT

With the problem set in a systems perspective, the next step in the process is to identify the operational needs and translate them into mission requirements. These mission requirements are the functional attributes the MMMS is supposed to fulfill through its hardware (or modification packages), the structural components of the system. By arraying the modification packages into a hierarchical structure, the necessary hardware to be included for the mission, together with their functional attributes, could be systematically examined. As the objective of the MMMS is to match as much of the mission requirements as possible through its modification packages, the main task, therefore, becomes one of finding i) which of the hardware component (of the various modification packages) can perform what functions; and ii) where the functional redundancies are. This is achieved by identifying the inter- and intra- relationships between the individual structural
components and their attributes in a commonality matrix to determine the number of links each component and attribute has with others in the MMMS arising from:

i) the interdependence between components (ie, component-to-component) due to their common operational capabilities (ie, concept of the whole);

ii) the operational capabilities that bind a component to various attributes (ie, component-to attribute) due to the functional characteristics the former exhibits; and

iii) the common characteristics that exist between attributes (ie, attribute-to-attribute) which proffer them a comparable capability to fulfill certain mission requirements.

The number of links each component and attribute has with others in the system is called the mission commonality number. Indirectly, the commonality number is a measure of the relative importance of components and attributes in the system. By normalising it into a percent weight, the relative importance of each component and attribute within each hierarchical level as well as within the system as a whole could thus be quantitatively defined. With the relative importance of individual component and attribute established, a design support system predicated on a precedence order for mission modification could then be developed. The function of the design support system is to help ensure that the mission requirements under consideration could be prioritised according to their relative ability in fulfilling the operational needs of the missions.

For a given mission, a number of alternative modification packages may be generated from the design support system. The cost associated with each together with its corresponding drop in flight performance (due to modification) could then be compared to arrive at a cost-effective option. Figure 2 outlines the major steps involved in deriving the design decision support system of a MMMS.

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**FIGURE 2: OVERVIEW OF SYSTEMS METHODOLOGY**
Case Illustration

To illustrate the application of the methodology, a military-cum-medical helicopter MMMS is considered. The operational needs, the environmental conditions and the corresponding mission requirements the MMMS in question has to fulfill are presented in Table 1. And the procedure involved in adapting the system methodology of Figure 1 to deal with the intended modification is displayed in the flow diagram of Figure 3.

TABLE 1: OVERVIEW OF SYSTEMS INPUTS AND OUTPUTS

| SYSTEM OPERATIONAL MISSION CAPABILITIES |
| ENVIRONMENT | NEEDS (INPUTS) | Aggressive | Supportive | Administrative |
| Military (Customer) | - Offensive - Air to air attack of hostile helicopters | - | - | - |
| | - Air to ground attack of tanks, guns, bunkers | - | - | - |
| | - Combat assault by commandos | - | - | - |
| | - Airborne assault by para troopers | - | - | - |
| | - Defensive | - | - | - |
| Medical (Customer) | - Logistics | - | - | - |
| | - First aid | - | - | - |
| | - Patient stabilisation | - | - | - |
| | - Transport patients | - | - | - |
| Natural & man-made environment | - Weather | - | - | - |
| | - Threat | - | - | - |

The manner in which the needed modification packages are arrayed into a hierarchy for the proposed MMMS is partially illustrated in Figure 4. Note that the total system consists of three levels. Figure 4 shows only the first two levels together with the attributes (excluding the medical modification packages) of the components of Level II.

The commonality matrix depicting the inter- and intra-relationships between the components and attributes of Level II (excluding the medical modification packages) in Figure 4 is represented in Figure 5.
The total commonality number arrived at for each component and attribute is normalised into a percent weight in Table 2 and the way in which the weights of these components and attributes are arrayed in the system hierarchy is illustrated in Figure 6.

### TABLE 2: MISSION COMMONALITY PERCENT WEIGHT (LEVELS II AND III ONLY)

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**FIGURE 6: SYSTEM ELEMENTS PERCENT WEIGHT ARRAYED IN PARTIAL SYSTEM HIERARCHY**
Based on the weightage arrived at for each of the components and attributes, a decision support system (DSS) prioritising the components and attributes in order of their relative importance for modification is developed. As an illustration of a typical DSS, only those components (ie, operator and hardware) pertaining to the modification based on an armed package is displayed in Figure 7.

Assuming that an armed modification package is selected for a particular helicopter (ie, with a specific airframe), the DSS will provide an indication of the adequacy of the modification which could be accomplished. Figure 8 shows the degree of operational needs (ie, military or medical or both) met by modifying the helicopter based on an armed package. The three curves suggest that a complete armed package is expected to fulfil about 80% of the military needs, 55% of the military-cum-medical needs and 30% of the medical needs. Any package that is less than a full armed package will fulfill less of the various mission needs.
Using the cost for a fully armed package as the datum (ie, cost index = 100) for cost comparison and the flight performance of a helicopter without modification as the yardstick (ie, flight preformance drop index = 0) for performance evaluation, the relative reduction in cost as well as the associated increase in flight performance drop with respect to different modification packages may be discerned from the relationship between the two, as Figure 9 illustrates. Any modification package may be appraised for its cost and flight performance drop by reading off the graph.

Conclusion

The need to find a trade-off between mission requirements, costs and flight performance drop when modifying helicopters for multi-mission operations warrants the use of an optimisation framework to search for a compromise solution. Because the parameters involved and the constraints to be considered in designing a helicopter for multi-mission purposes vary from mission to mission, an optimisation program is considered too restrictive a methodology. The use of as a unifying concept to simultaneously assess the commonality of a range of mission requirements offers a simple and yet rigorous approach to finding a pragmatic solution. The case illustration above shows that the method derived based on systems thinking offers a promising leverage in establishing a design decision support system for helicopter multi-mission modifications.

References


CREATIVITY AND SOFT SYSTEMS RICH PICTURES IN UNIVERSITY EDUCATION

Mark Campbell Williams
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"Two roads diverged in a wood
.. I took the one less travelled by,
And that has made all the difference"...
(Robert Frost)

Abstract

Can teachers and students use soft systems rich pictures and creative expression to enrich teaching-learning in university classes? I have found that incorporating these into learning journals can be a way of balancing the technicism that so often dominates technologically oriented disciplines.

Introduction

In what ways can teachers and students use creative approaches to enrich teaching-learning in university business computing classes? Instead of the tired old technicism that seems to dog computing education, can students and teachers alike move towards what Marcuse calls a liberating rationality? Since 1992, I have been conducting interpretive, autobiographical, action-research to explore this area. Students and teachers have been encouraged to work together in a dialogical way using open discourse to reflect on aspects of information systems beyond mere hardware and software. The teaching-learning process has included group personal introductions; the writing of personal learning journals; encouraging group work; encouraging dialogue in lectures and laboratories; highlights of humour; times of values clarification and goal setting; deciding on motivational metaphors; clarifying world-views; drawing rich pictures of the unit; the telling of stories and alternative myths; relaxation exercises with guided visualisations; and including unconscious wellsprings of knowledge in the research process.

In this paper I will briefly discuss the idea of metaphors and rich pictures as part of learning journals in university business computing classes. I will then give examples of how two mature age students used these concepts in their education.

Learning Journals

The form that I currently use is that in the second lab students submit a sheet listing their beginning competency level in computing, their previous experience and their expectations for the unit. On the back of the sheet, students paste a recent newspaper clipping about IS and write some comments. Every second laboratory, students submit further sheets with the following headings:
a. **Reflective examination of your learning progress in the laboratories:** You will describe what you are learning and how you are progressing in your ability to use computers for your present or future work. This has to be in a creative, artistic format using stories, autobiography, metaphors, rich pictures, doodles, poems, stuck-on pictures or the like. (The philosophy behind this is that computing education is generally narrowly technicist and should be balanced by creative approaches in education and professional training.)

c. **Newspaper clippings** (relevant to IS and up to date) with comments - to be stuck on the back of the sheet.

The learning journals are ranked to give a score of ten percent of the total assessment. I give a practical test in the last computer laboratory to enable students to verify the learning outcomes described in their journals.

**Soft Systems Rich Pictures**

A rich picture is a drawing of a system that can assist in better planning or understanding. The term springs from what is known as soft systems methodology (Checkland and Scholes, 1990). This is a widely used technique for better understanding the cultural and political context of organisations in management consulting or in computer software development.

For example, the rich picture below (figure 1) was drawn by a first year student at the end of the foundation unit (Information Systems I - MIS1100) to help her understand the various elements of the unit and how she made sense of it to achieve her goals. She used an Apple Macintosh computer for the first time for 20 minutes to create this simple rich picture.

![Rich Picture of MIS1100](image)

**Figure 1:** Rich picture of MIS1100

The rich picture can have an IN (or input), an area filled with relevant pictures of important areas, an ON GOING (or output), a WASTE (or wastage from the system) and REFLECTIONS (or feedback to the system). This student sees that she entered the course as a small bird and went on from the course as a powerful eagle. The learning journal provided a form of feedback in the unit and stress was the waste in the system. The icons
Application of Systems Methodologies

in the rich picture are metaphors used for creating rapport and for communicating the nature of shared and unshared experiences (Lakoff & Johnson, 1980).

Creative Expression

Bowers asserts that all human thinking is both cultural and metaphorical in essence (1993, p.60). The essence of metaphorical thinking is understanding a new concept or experience by relating it in something else. Profitable ways to harness this is to avoid inappropriate generative metaphors such as the mind as "computer," mental fatigue as "burnout," curriculum as "input," and student behaviour as 'output" (based on student-as-machine metaphor). A better way would be to explain dissimilarities between what is being compared and by placing metaphors in historical context (Bowers and Flinders, 1991, pp.34-35).

He is very concerned that educators be aware of their moral responsibility to use language in a way which helps students become part of communities and cultural and natural ecologies. For example, in critiquing the work of a computing expert, he asserts that: "The metaphor of an "Information Age", which is the most recent expression of liberal ideology, serves to hide the moral/spiritual nature of the ecological crisis." (1993, p.93). Bowers understands that the metaphors used in education are of crucial importance - do they point to technicism or to something else? He sees current computing education as dominated by a nineteenth century mechanistic root metaphor.

Bowers (1987) understands that a much more morally responsible way as placing teaching and learning within an historical and linguistic context that assists the process of cultural-communicative competence which involves bio-regional and ecological sensitivity and self-reflexivity. In his book, The Promise of Theory (1984), he explored in detail the way in which classroom socialisation and cultural/communicative competence are interwoven. Teachers largely control whether the students gain the language to be able to reflect on life on culture in a mature way within a community and a social and cultural and bioregional ecology. If the students do not gain this cultural-communicative competence they continue to unknowingly live by the exhausted and inappropriate assumptions from previous times.

Susan's Story

"I have given up a section of my life for the last 12 weeks to MIS1100. I have given my time, energy, frustrations, tears and laughter, a minute fraction of my life's travel and I have been rewarded twenty fold. Regardless of the mark on a piece of paper at the conclusion of this unit, I have passed. I have gained knowledge and confidence in the area of computers. When I look back I was panicked in the early parts of the course, not in the lectures, but in the unfamiliar areas of word processing, setting up files, all the everyday things I employ others to do. I had a string of adventures, and I have become friendly with the systems maintenance people across two campuses. My job is to make people feel good by filling up their otherwise boring evenings getting me out of scrapes. I wish to heap accolades on these people, and suggest if all students had some real interaction with them the knowledge would flow, and the campus would be a much friendlier place to work and study in. I no longer inwardly panic, I take pride in getting into a mess and fighting my way out, and if there are

Mark Williams
people to help me along the way, how much richer is the experience." (learning journal, 12 November, 1993).

A mature age student working as the head of an accounting section, Susan was a hard-working person with a very positive view of life. She took up the challenge of university study balancing this with a rich family and community life in addition to her responsible career position. As she commented in an interview: "I have come from a stage of panic to non-panic - this is a big step for me. It is not really competent yet but non-panic is a real gain. I'm not panicked by computing and computers anymore." (interview, 23 October, 1993). In this quote and the quote above, note the metaphors of "stage of panic to non-panic"; "a big step"; "a minute fraction of my life's travel"; "a string of adventures"; "heap accolades"; "I take pride in getting in a mess and fighting my way out"; and "knowledge would flow". Let us look at the rich picture Susan created at the end of the unit.

![Figure 2: Susan's Rich Picture of MIS1100](image)

The laboratory group of which Susan was a part developed a lively and friendly community camaraderie giving each other nicknames - hers was the self-styled nickname "the little old dinosaur". We see how she sees herself entering the course as a slow moving turtle with "lack of confidence" and, although time was seen as waste from the system, she emerges as a strong dinosaur. This is a curious metaphor and could easily been seen in a negative light. However, in Susan's case I think it represents a humorous was of expressing personal strength and growth in the context of a rich learning community.
Nigel's Story

Michael was a mature age student returning to formal education after a number of years away. His background was in accounting and he had rather limited contact with modern microcomputer usage and information technology. He had a very positive approach to the unit. In his learning journal he developed a metaphor for his expanding knowledge based around 'The Wizard of Oz':

...So I used this metaphor about going down the yellow brick road and the castle, it's a bit corny but it seemed to be what he [the lecturer] wanted so I let go, I started to do a lot of creative writing and a lot of landscapes and people coming in so it's turned into a novella. ... I found it good to do although doing it over 14 weeks it becomes harder to bring in new characters and it gets a bit corny but I actually have enjoyed doing it that way..... If people are allowed that sort of scope then you can write it as a novel, you can put into any sort of format you want. It's something I wasn't aware of. Because as I said you have to do structured things in other subjects I only sort of moved the margins a bit so that slowly I filled them out. (interview, October 21, 1993)

The above metaphors are legion. Nigel's creative talents found expression in this way of educating. His positive approach to life is reflected in a comment made in one of his learning journals about Robert Frost's poem which heads this paper: "This poem is about not being one of the sheep in life". That said, he stated that with his background in systems installation much of the benefit of the unit was in the actual technical knowledge gained. He saw himself as "a pirate in the high seas of IT and picking the gems"(interview, October 21, 1993). This is mirrored in his rich picture (figure 3 below).

Figure 3: Nigel's rich picture of MIS1100
Discussion
In this paper I have not discussed my motivational and guiding theoretical frameworks which include the notions of cultural and communicative competence in the educational thinking of C. A. Bowers (1988, 1993); critical social theory notions of what is equitable, fair and good (Adorno and Horkheimer, 1990; Marcuse, 1964; Habermas, 1972, 1984, 1987); the holistic elements of soft systems methodology (Checkland and Scholes, 1990); and the Jungian psychological notions of the unconscious and individuation (Jung, 1953-76). Suffice to say that a certain theme of recent literature on computing education from Joseph Weizenbaum (1977) through to C. A. Bowers (1993) has warned of a dominance of technicism - an over-emphasis on technique to the detriment of meaning or purpose. The concern is with an overly narrow emphasis on hardware and software computing techniques and an undue trust in technical solutions to human problems. This way of thinking is sometimes referred to as an instrumental rationality (Adorno and Horkheimer, 1990; Habermas, 1972; Dryzek, 1990), a technocratic consciousness or technocratic rationality (Habermas, 1972; Bowers, 1988, 1993; Ellul, 1990) or, more simply, as technicism (Bowers, 1988, 1993).

By incorporating metaphorical language and rich pictures in learning journals in university business computing, I have observed considerable numbers of students and teachers express themselves in ways that are unusual for this discipline. In this process I suggest that their has been a kind of educational wholeness, a blossoming towards balanced attitudes, a balancing of the technical with the artistic. In our more poetic moments, I see this as hints of human splendour within an otherwise instrumentally rational and technocratic milieu.

References
WHAT AM I DOING HERE AND WHY ARE THESE PEOPLE TALKING AT ME?
-- The Negotiation of Expert Status in Conferences (Such as this One)

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Abstract

Are conference presentations mainly to convey information or to convince the audience that the presenter is to be viewed -- for the moment at least -- as an expert? Our lectures and conversations have both an informational part and a relational part. The latter part concerns issues of status, believability, friendliness or distance, etc. This talk and discussion introduces the relational element in conference presentations and in expert–nonexpert communication in general, i.e., the negotiation of expert status. Video clips illustrate how we perform in order to get people to listen to us and heed what we say, to treat us like experts. Discussion will enable us to analyse this conference as a social system within which statuses and alliances are negotiated.

This conference paper/discussion builds on an interpretation of communication between technical and nontechnical people as the negotiation of expert status (Rifkin, 1994, Technology Studies, vol.1, no.1). The paper draws on the rhetoric of science and technology (Waddell, Downey, and Miller, for example), the work of Tannen in sociolinguistics, of Colson on traditional African divining, and of Feldman and March on organizational decisionmaking. Illustrations come from three years of ethnographic observation and from anecdotal material on technology-based organizations.

Introduction

How many times have you listened to a specialist in a conference session discuss a technical point that you could not fathom? How about the challenging question from an audience member that you could not understand either? If we cannot gain an understanding of what the presenters discuss at a conference -- despite our interest in a topic -- why are we there, and why do they (and we) persist in this style of presentation?

Consider an interchange from my observations of public hearings. A consultant working for a polluting company debates with a member of the technical staff of a water pollution control agency. Presiding at the hearing are members of a politically appointed water board, individuals who sit as judge and jury. What can we tell from the dynamics of such a conversation just by analysing who talks when? From our analysis of who gets to talk in a single episode in a unique setting, such as in water board hearings, what can we say about conference presentations and the general issue of decisionmaking that involves experts? What questions can we raise about how we view experts and experts' roles in our organisations and in our culture?
In addressing these questions, this paper draws heavily on a recently published article -- "Who Need Not be Heard: Deciding Who is Not an Expert" (Technology Studies, vol.1, no.1). The research approach and theoretical perspective that underlies the discussion here are described in more detail in this article.

What is Expert Status?

The concept of expert status serves as a foundation for my analysis. Expert status represents a measure of authority over a conversation. When we decide to grant expert status, we tend to rationalise that we defer due to the relevant knowledge, skill, and experience. These judgements we base on evidence. We see something in the performance that a speaker gives in a conversation that lends that speaker an air of authority.

As relatively nontechnical listeners, we can rarely gauge with certainty whether the expert has the insight claimed. In many instances, when experts compete, only time can reveal which expert has pointed to the most desirable choice. During a conversation, however, expert ability is hard to judge conclusively. Yet, even when we, relative nonexperts, fathom only a fraction of what the expert says, we do make such judgements of ability. Nonexperts seem to rely on prior knowledge, on expectations, and on cues to make such decisions.

At the moment of interaction, the candidate for expert status must be able to evince recognizable cues, the cues to which the client will respond. The nonexpert interprets -- or misinterprets -- such cues and responds to the question, "How well does this person fit my model of the kind of person whom I would like to view as an expert in this situation?" The nonexpert gauges expert ability by a process of reading socially recognized indicators of that ability and of its relevance. This evaluation process leads to an assignment -- or non-assignment -- of expert status.

Expert status derives from Goffman's concept of participation status. Goffman (1983:3) states, "When a word is spoken, all those who happen to be in perceptual range of the event will have some sort of participation status relative to it." Expert status connotes a high participation status, the ability to contribute to a conversation and be heeded. Being granted privilege in a conversation is different from -- though not entirely disconnected with -- the status of the expert/professional in society.

Expert status differs from the status of the professional in society in that expert status is a provisional status in that it represents the authority granted by a particular listener in a particular conversation. Expert status is in the eye of the beholder. This provisional character makes expert status a negotiated status.

What Does a Negotiated Status Mean in a Social System?

The concept of a negotiated status has roots in social anthropology in studies of villages (Strathern, 1982) and Native American groups (Clifford, 1988). Mitchell's study (1969) of urban Africans is particularly illustrative. Mitchell explains how the assignment of a
negotiated status by others whom one meets hinges on one's public, social identity (as opposed to one's private, personal identity). Mitchell found that status categorizations are particularly important in interactions between members of different ethnic groups. In these insider-outsider interactions, the social identity tells others whether they see friend or foe. Social identity also helps an observer to distinguish whether the other is from a group higher or lower in status. Such indicators of alliance or enmity and of power or lack of power emerge not only in Mitchell's urban African but in expert-nonexpert, technical-nontechnical interaction, such as in a conference.

Consider an example of how the concepts of social identity and negotiated status apply to experts. Jane Smith identifies herself as a specialist in hydrogeology working as a consultant for a chemical company. Her specialty and her alignment with the chemical company contribute to Ms. Smith's social identity. However, not everyone whom she encounters will grant her expert status. With her social identity, Ms. Smith will probably be viewed as a voice of authority by her clients at the chemical company. Ms. Smith will probably not be viewed as a voice of authority by members of an environmental group concerned with pollution caused by the company. Ms. Smith's expert status is a negotiated status in that she would gain expert status from one audience -- company executives -- but not from another audience -- environmental group representatives. She would be given an opportunity to speak at length and would probably be heeded by chemical company executives. She would probably not earn the same privileges -- at least not so readily -- in conversations with members of the environmental group. Though her social identity may be clear to both groups, the authority that she wields with each is different. In particular, her participation status in conversations that are seen as relevant to her specialty -- her expert status -- with each group will differ. In addition, she will probably not be granted expert status by either group in conversations about finance, local politics, or other issues not relevant to her specialty.

This provisional nature of expert status makes an organisation employing people with a variety of specialties similar to the multi-ethnic city on which Mitchell reports. In both social systems, there are many flavours of social identity, in one case specialties, in the other, ethnicity or clan identity. In both social systems, there are varying relationships of authority and alliance among individuals from different groups. Individuals in such arenas listen to a person speak and look for signals indicating where the speaker belongs. As a result, in both arenas as in conference presentations, an individual's authority can fluctuate depending on the nature of the question involved -- the relevance issue -- and the nature of the audience at that moment.

How Do These Status Negotiations Occur?

What indicators of the negotiation of status can we see and study? The evaluation of identity signals can be seen in conversations. Within the conversation, we interpret identity signals to decide who deserves our attention and to whom we should defer, to whom we should yield the floor. We try to determine what difference in power and what social distance we should acknowledge. Often, we question or listen at length to gain evidence. The iterative and interactive nature of this evaluation is what makes it a negotiation. The attempt (1) to understand and (2) to evaluate the speaker in a conversation is known in the subfield of linguistics called pragmatics as the negotiation of meaning and identity (Haslett,
1987). In the discussion of technical matters, this concurrent negotiation of meaning and identity means that participants attempt to understand one another and to negotiate about expert status.

The importance not just of meaning but of rank in a conversation -- such as the rank of expert -- derives from an emphasis in the fields of pragmatics, sociolinguistics, and conversation analysis on the relationship aspects of communication. Linde (1988) cites referential and relational components of any utterance. Lyons (1977) uses, respectively, the terms descriptive and interpersonal aspects. Bateson (1975) also refers to such distinctions. Speech-act theory, which is usually traced to Austin (1962), has this relational component as a primary element. The linguist Tannen (Coughlin, 1990: A9) claims that there is a misconception about language, that language is to communicate ideas in the most efficient way. It is not. Language is to negotiate social relationships, and the meanings of the words are quite minor in that whole thing.

Habermas (1984) makes a breakdown similar to the linguists in his use of the concepts purposive-rational/instrumental action and communicative action. Molotch and Boden (1985) share Tannen's perspective on the use of language and Habermas's and Foucault's emphasis on the ties of language and power. Molotch and Boden (1985: 285) conclude from their microscopic, ethnomethodological study of testimony that conversations are used to play out power relationships -- we take it that access to the procedures of talk is a significant resource for accomplishing power in face-to-face interaction, power which is thereby potentially reproduced within and across interactions.

Downey (1988), an anthropologist who studies engineers, notes that such social influence can derive from our hunger for information. Feldman and March (1981), in their studies of organisations, concur that individuals in organisations see information as having symbolic power. They describe how members of organisations gather information to a far greater extent than is justified by its practical use in decisionmaking. This symbolic value means that command of information and information sources enhances perceived competence and inspires confidence. (Feldman and March, 1981: 177-178). Organisation theorists conclude that this high symbolic value placed on information and the promise of a reduction in uncertainty mean that an individual who offers information can gain a measure of influence (Pfeffer, Salancik, and Leblebici, 1976). So, a social system that is hungry for informed decisionmaking can be seen as primed for negotiations of expert status.

In such social systems -- as in a conference, which many seem to treat as an information bazaar -- one who gives the appearance in a conversation of the ability to supply information becomes able to secure influential relationships, such as the relationship of expert to client. Someone deemed an expert can exert influence not only over the future actions of the client but over the present conduct of the conversation itself.

How do Experts Affect Decisionmaking?

A focus on the relational aspects of communication and on information as a source of symbolic power are complementary in analysis of decisionmaking. Emphasis can be shifted away from a view of decisionmaking as a process by which information is simply sorted into categories supporting one option or another. Convincing us of the logical action
to take need not be seen as the root of the expert's power. The expert uses information -- and we listeners use that information as evidence -- to construct a relationship of influence, an expert-client relationship. The information that we gather can no longer be seen merely to contribute to rational calculation. It serves a symbolic function and a selection function. We need to select an expert actor for our decisionmaking ritual to become comfortable with our choices (see Colson, 1973, for more on decisionmaking rituals). The selection of what to do can be seen as a byproduct. For the nonexpert, assignment of expert status can be seen as a means to an end -- a way to gain assistance in making a decision -- or as an end in itself -- a comforting relationship. Our decisions can become a choice of whom to heed rather than simply of what to do.

For the expert a similar question arises about means and ends. The expert influence in the moment of decision is part of what may be, or may become, an ongoing relationship. For the expert which is the goal -- to influence the decision or to secure the relationship (see Jackall, 1988, chapter 6, on how management consultants preserve their relationships with executives in large corporations)? This relationship is something on which the expert draws to sustain and extend expert status. The client/decisionmaker's satisfaction helps to secure that relationship.

What are Implications for Conferences?

Are conferences about conveying information or are they about status negotiations? Or both? The perspective described in this paper can leave one with the impression that conference presenters are mainly talking about themselves. Presenters seem to act as though they are having their identities evaluated and not just their arguments evaluated. Audience members, too, can negotiate for expert status by asking the clever question, pointing out the obscure technical point, or laughing in concert with high-status figures.

Both form and content of a presentation tell the audience much about who is presenting. Command of air time, as in speaking for a long time and to a large audience, signals authority. Speaking slowly signals authority, in part at least, because it displays a sense of security, a sense that the speaker does not fear having his/her air time taken away. Interrupting successfully can take status away from the one who is interrupted. Changing the topic of discussion is a privilege of one with status. Telling about personal experiences in an engaging way is part of a performance that gets one to be viewed as an expert. Such cues abound.

The negotiation of expert status can be seen not only in the individual cues but in their orchestration and in the recognition of the audience. What results is that a conference presentation, or any conversation, can be seen as a performance. From this perspective, what a presenter says that one understands in a conference talk and what is said that one fails to understand are both part of a performance. Making statements that listeners cannot fathom is as important a part of the performance as any other. The very breakdown in communication that can frustrate a listener conveys a message in and of itself about status, or rather, about the status that the speaker may desire.
Interpretation and Open Questions

Extended observation and analysis convinces me to visualize the expert and listener (conference presenter and audience member) as a couple on a dance floor. A questioner at a conference can be viewed as someone who tries to cut in on the dancers. Such cutting in to replace a conference presenter and dance with audience members may frequently prove to be unsuccessful. Yet, the attempt to cut in causes the dancers to alter their steps. The presenter sidesteps. The dance varies, but the couple -- presenter and rapt member of the audience -- often remains together at the end of the song. To offer another metaphor, vying for a dance may be likened to mating displays where beasts engage in combat to impress current and prospective mates, current and future clients, employers, or followers.

One might ask what benefits might be gained from interpreting conference presentations and decisionmaking debates as rife with expert performances and negotiations of expert status? On the other hand, one could ask what benefits might be gained from ignoring this relational aspect of communication in our analysis of decisionmaking? Which question makes the reader/listener of this piece view this presenter -- me -- as more of an expert?

References


SECTION 6

PHILOSOPHY
SYSTEMS MODELS AND ENGINEERING DESIGN THEORY

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Abstract

In this paper some of the philosophical considerations of the use of systems models in engineering design theory are discussed. The paper begins with an exposition of the role of systems models as an historical basis for engineering design theory and design methodologies. The widespread underlying presence of a ‘systems’ based paradigm in design theory is noted and some of the implications of this are explicated. The paper concludes with suggestions as to the philosophical appropriateness of the future application of systems modelling techniques to different areas of engineering design theory.

Preamble

The study of designing and the processes of design is relatively recent. Although a small handful of texts were published in the 1950s, it is generally acknowledged that design became recognised as a subject of study in the mid 1960s (Cross (1993)). Research into design and the development of new systematic design methods became well established during the 1970s. The main focus of design research was the creation of methods to improve the output of designers. Four other identifiable streams in design research were; the consideration of the philosophical aspects of designing (trying to identify the underlying basis of design), attempts to unravel the details of designers’ internal creative processes (usually from a viewpoint of cognitive psychology), the study of the problem-solution relationship, and the modelling or optimising of the management of design activities. Cross (1984) identified four different overlapping themes in design research which he maintains also represent the chronological development of research into design and theories about design to that time. These differences can be attributed to Cross’ focus on design research as design methodology. He lists the themes as:

1. Management of the design process
2. The Structure of Design Problems.
3. The nature of Design Activities
4. "Reflection“ on the fundamental concepts of design

Although this list of themes represents both the main preoccupations of design researchers and theorists, it must be emphasised that at all times from the 60’s to the present there has been a diversity in subject matter within the literature.

The main focus of design research is and has been research into methods and techniques (Cross (1993). Past and present research and theory development in the field of engineering design is aimed at improving the output of designers by the use of systematic methods. In most cases, what is being attempted is the routinisation of design activity. This has been supported by the increasing availability of computers over this time. This, in its turn, has led to the development of an extensive range of computer based aids for designers. An
underlying theme in much of this side of design research is that of attempting to totally automate the design process, so that the ‘intelligence’ and ‘expertise’ would become located in machines and processes external to the human designer.

**Systems Models as a Basis for Engineering Design Theories and Methodologies**

There are two strands in the historical development of design theory which reinforce the dependence of design theory on systems methods. The first strand is the externalisation of design: trying to make designing more visible and less mysterious. The second strand, is that of automating design. This reduction of design to an externalised automatic process has been one goal of design research, theorising and method generation. For theorists and researchers with this perspective, the Taylorisation of designing is straightforward: consider designing as a process, model this process using systems methods, then find means to emulate and automate it.

It can be seen from a cursory examination of the literature that these outlooks have been dominant from the earliest conferences (see for example; Jones and Thornley (1962) and Gregory (1966)) on design research to the present. Perhaps the most seminal publication was that of J C Jones on design methods (Jones (1970). In it he collected together and classified the main methods of design available in the late 1960s. This book offered a new vision of design as a rational process that would remove the mystery from the activity of designing and enable design to be managed as easily as managing any other industrial process. Jones’ outlook and most of the design methods which he collected together were based on the newly emerging theories and techniques developed for managing complex activities, such as; General Systems Theory, Operational Research and Linear programming. Prior to this, Alexander (1964) had proposed and demonstrated his computer based, decompositional method for designing. This method was based on a systematic analysis of the ‘fit’ or ‘misfit’ between different functional aspects of form and context. The method reduced design problems and their solutions to an hierarchical system of misfit relationships. Newall and Simon (1972) and Simon (1984) used systems based models of information management to represent human creative problem solving and designing. More abstract aspects of designing, such as the analysis of interrelationships between functions (Matchett (1962) in Gregory), were developed as design methods based on systems analysis.

Designing came to be seen as a process akin to the industrial manufacturing process. General Systems Theory provided a simple visual and symbolic representation which was applied to design. As systems models became more widely used in the 1950s, they provided a tool not only for designing complex engineering artefacts (by then seen as systems of interrelated functions), but also for managing design activities. From the 1960s onward, systems models of designing became commonplace, to the extent that many writers defined the activity of designing and design process as a ‘design system’ unconsciously conferring ‘privilege’ on this one conceptualisation of designing and the design process.

The development of system models of design may be seen in the visual representations of design process. Perhaps the simplest early systems model of designing is that of Jones (1970) in his ‘glass box’ view of a designer,
Other writers and theorists, seeing the shortfalls of such a model, increased the complexity of their descriptions. An example of a recent version of this model is that proffered by Ertas and Jones (1993) in a text aimed at engineering design students in America.

Fig 2. Steps in the engineering design process - Ertas and Jones (1993)
Other researchers have concluded that the design process includes much more than what designers do. They propose that design permeates every part of a profit generating process based on making artefacts. Perhaps the most complex system based model of design from this viewpoint is the multi-dimensional model of ‘Total Design’ proposed by Pugh (1990).

The systems outlook has become the most prevalent outlook in design theory. Critical analysis of the writings of design theorists and design methodologists indicates that (whether stated explicitly or not) the designing of technologically based artefacts is almost exclusively seen from within a ‘paradigm’ of General Systems Theory (in the sense of paradigm as used by Kuhn (1970)). My purpose here is to identify some of the problems which arise from this position.
Criticism of Systems Models of Design

There are several elements that are commonly considered to be essential parts of the process of producing an engineering design\(^1\).

These essential elements are:
- Definition of 'needs'
- Creation of solutions
- Evaluation of Solutions
- Decision making
- Feedback

Simple system models of design attempt to portray these in a defined sequential manner. Several writers, however, appear to be uncomfortable with rigid systematic theories of design by noting that the sequence in which the above elements occur is fluid and depends on many factors such as the organisation, the individual designers and the problems in hand. Ullman (1992) reports on research by Hales and Ullman which concludes that it is not possible to follow a design in progress using such models. French (1970) has suggested that block diagrams representing design process may be drawn in many different ways. All design theories, models and methodologies have ontological and epistemological bases. Technological design is almost universally grounded in a positivist, scientistic, value-neutral framework where concepts and facts have fixed meanings which are objectively verifiable (in theory at least!). It appears that these ontological and epistemological assumptions are essential for the sensible modelling of designing as a system.

Coyne (1990) challenge this paradigm of design conceptualisation by arguing, from a hermeneutic perspective, that positivism and scientism and the assumptions on which they are based are an inappropriate foundation for design theory and method. Christians (1989) argues against the assumed neutrality of technology and its associated activities and artefacts. It is obvious that systems theory has some role to play in the development of engineering design theories and methods, but rather than systems theory being a useful tool of design research it appears that the activity of designing and its interpretation has been forced into a 'systems' perspective.

Design theory exists at many levels of conceptual abstraction. To use the terminology of Coyne and Newton (1992) of metaphoric theory of design - 'Systems models of design process' is a conceptual metaphor that has been given an unusual amount of privilege (Coyne, R and Newton, S (1992), Coyne, R, Snodgrass, A and Martin, D (1992)). The metaphoric representation of designing as a system has been widely adopted but in doing so it has shaped what is understood by design. To test whether such privilege is justified it is necessary to look again at the activity of designing and the theorising about it. This must be done so that theorising becomes the object of study. This is what Stegmuller (1976) calls a second level rational analysis or meta-theoretical study, or what in philosophy is known as

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\(^1\) Where 'design' is used as a noun to mean the drawings and specification of an artefact to be manufactured, as distinct from the physical artefact itself.
meta-analysis. What is being considered here is a further step in abstraction, i.e., the theorising about design theory and the use of systems theory in it. Looking at design theory as a subject, the main issue of design research might be expressed as,

The study of how ideas might be influenced before they are conceived.

There is general consensus that the creative aspect of design is the activity which differentiates design from other activities involved in the production of artefacts. The identification of designing with creativity leads to a definition of 'design process' along the lines of 'any process which includes the activity of designing'. Thus, a design process may also consist of other activities besides designing. In the research to date, much has been made of these peripheral processes of design as 'design activities' ignoring the fact that the academic and practical study of many of these peripheral activities is well developed in other disciplines. To give examples: the analysis of 'needs' is dealt with by sociologists and philosophers, the choice between potential design options is more appropriately part of the study of decisionmaking (and hence, politics, business economics or ethics) rather than design itself. A simple test for whether an activity must be included in design research is whether the activity is unique to designing or whether it is simply an instance of an activity which occurs in other circumstances and is investigated generically in other disciplines. By deconstructing design in this manner it is clearer where systems methods are more usefully applied.

The challenge then, for design researchers is to derive a systematic representation for the essentially creative part of the design process. If it is not possible to do this and to adequately represent creative activity using systems theory, then it calls into question the assumption of validity of a systematic representation of the whole design process.

There appear to be several difficulties in representing creative designing using systems theory. Some of these are:

- The fundamental inclusion of the variability in an individual designer (or design team) of human values and the meanings ascribed to 'facts'.
- The apparently universal psychological use of 'design worlds'—where a designer creates an internalised representation of potential solutions or part solutions and their environmental contexts.
- The temporal nature of partial conceptualisation, i.e., the transitional nature of the values, meanings and conceptualisations inherent in the use of design worlds.
- The dependency of partial solution evaluation and choice by 'feeling' mechanisms.
- The 'reflective' development of both the artefact specification and the designer (see Schon(1983, 1992)).

These are the difficulties that are immediately apparent and there are others which arise from the interpretive, praxical and value-laden nature of designing. All of them lead to two questions:

1. How can systems theory be used to portray a process which includes a need to select and modify creative thoughts before they are known?

Perhaps it is appropriate to note again, that design theory is theory about designing not the theories which designers use which are pertinent to the domain which they are working in or the artefact being designed is created in.
2. How can systems theory be used to describe a process where meaning is fundamental to the process and is not necessarily factual, i.e., it is a qualitative, value-laden element, dependent not only on the participants but also on the geographic, historic, cultural and religious placement of the process?

Conclusions

Design theory and design research has been shaped by its use of a paradigm of systems analysis. There are questions and difficulties which have not been addressed and which must be addressed for the intelligent development and use of systematic models of design activities. Taking a meta-theoretical overview there are three sides to the use of systems models in design theory. Firstly, it seems obvious that systems analysis may be applied to many parts of the overall process of creating products (as described by Pugh for example). Secondly, it appears to be very difficult to model creative human activities using a general systems approach unless ontological and epistemological considerations are ignored. Finally, there must be some question over the validity of modelling the total design process as a system if the creative elements cannot be adequately modelled but are an essential part of the system model. Therefore, I conclude that systems theory can provide useful tools in the realisation of aspects of the design process, but is incomplete as a model or description of the design process as a whole.

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Since the rise of scientific rationality, philosophy has been relegated to the dustbin as a quaint and obsolescent academic exercise. This is not to say that new philosophical discourse does not take place in various disguises. Cyberneticians, theoretical physicists, and cosmologists claim philosophical ground from time to time, as do those engaged in “modernist” and “post-modernist” sociological debates. Still, there is a dearth of good, gutsy philosophy in which people think hard together about how they think. Even rarer are the artworks which help us to enrich and to clarify our discourse through illustrations. One reason for this is that philosophies founded on empty paradigms produce little more than the same old quarrels, and those are dull in every sense. A philosophy implied by the conventional interpretation of “general systems theory” is not exempt from this criticism.

We are right to doubt that we will have much of a future if we cannot re-invigorate philosophy itself and develop a systemology -- an applied philosophy -- which enlightens our worldviews. This paper offers some suggestions as to how we might re-cognize systemicity and better appreciate its philosophical ramifications.

Keywords: general systems, systemology, complementarity, heterarchy, homeokinesis

Introduction

We hold everything we know in light of our paradigms. We cannot think without them or, indeed, think of being without them. All of our perceptions are refracted through paradigms. Paradigms serve as references, as mnemonics, as standards. In its role as a mental model, a paradigm provides a structure for inter-relating concepts, but it must do more: it must admit of a relevant substance for values.

We often hold two or more different paradigms, albeit with some internal conflicts and contradictions. Paradigmatic integrity has often been considered to be a hallmark of good character, yet it is a rarity, for paradigms are garnered eclectically and therefore their contents may be as varied as their sources. Attempts to hold together incompatible paradigms is a
stressful schismatic factor for individuals and for cultures alike.

If we were better able to appreciate our paradigms in perspective, we would see them as fragmentary, whether they be the jumbled precipitates of contingencies or the desultory cropings of a bigger coherent picture. Our finite minds can only assimilate what has been reduced somehow to fit. Moreover, for a given application the instrumental cropings of a limited paradigm are usually the most practical, e.g., the plumbing and the wiring of a house are ordinarily separate. Nonetheless, generalization can be as valid and as pragmatic a method of reduction as analytical particularization can be. Every paradigm, however specialized, is itself a generalization. Ever since the expression of the need for a general theory of systems, there has been a quest for a paradigm which embraces paradigms, i.e., a generalization about generalizations. As it turns out, the answer to this riddle is embedded in its very articulation.

Where We’ve Been

The limitations inherent in all of our perceptions dictate that we can at best frame our paradigms as instrumental cropings of a larger “reality.” If a subject matter has strong and enduring compellers interwoven through weak and temporary relations, the conventional scientific framing of rationality works frighteningly well for analysis, prediction, and control. Our popular paradigms for daily living then tend to take on the characteristics of the dominant scientific paradigm, albeit in a bastardized form, and we may erroneously assume that such a worldview will accommodate all phenomena sooner or later. After three centuries of indoctrination in the particular rationality of a techno-scientific mindset, it now seems that we have forgotten that the universe is not really comprised of “sets” of “objects” in mechanical “relationships.” Instead we have reified a (partly misunderstood) abstraction into a worldview.

It is true that where applicable, point-to-point linear progressions and scalar quantitative measurements do provide satisfactory approximations, especially under environment-free laboratory conditions. There are appropriate places for treating the world as if it were constructed of rigid structures, modular assemblies, crystalline forms, clearcut boundaries, mechanical interconnections. Sometimes it is even desirable to assume that time comes neatly bundled in “frames.” When the billiard ball version of the universe proves inappropriate, however, where shall we turn? Perhaps we should try newer science.

Good scientists are the first to challenge their own received paradigms, whether or not laymen keep up. So called “relativistic” and “quantum” physics have long since blurred the hard edges of technological exactitude, asserting a world comprised of gradient fields and probability waves and unresolved uncertainties. More important for ordinary affairs, cyberneticians have articulated how “circularity” is an inevitable and ubiquitous supplement to every linear progression, both in theory and in practice. While these ideas may free our imaginations from the stultifying notion that everything is a pre-determined machine, they are still not enough to put mechano-morphic paradigms in their place as sometimes useful approximations for a
limited range of phenomena. With newer scientific paradigms the balls may be fuzzy and they may bounce back, but it is still a billiard ball universe nonetheless.

Why Didn’t Somebody Tell Me?

The received paradigms in force nowadays stand as infelicitous insofar as they stand in conflict with one another, inadequate insofar as they don’t accommodate the range of experiences which we have, and empty insofar as they don’t mean much to us. Wherever we turn there is another “scale” of achievement or “hierarchy” of values which is alleged to be a standard to be met. Nonsensical preachments about “total quality management” notwithstanding, we live in an age obsessed with quantitative measures, linear scales, material progress, competition, gamesmanship, and productivity. Every such measure as emerges from this scalar quantitative predilection suggests a different monothematic paradigm, so each one necessarily collides with every other.

Thoughtful and caring people have known for a long while where to look for some reconciliation for our empty paradigms. One of them, cybernetic philosopher Warren McCulloch, pointed out fifty years ago that our theories of value remain “notably inferior to intuition in inferring the outcome of an untried choice.” [4] He went on to show how even those human values which are subject to quantitative measure cannot be reduced to a single common scale but rather require two (or more) complementary, cointantaneous, and circular evaluation schemes: a heterarchy of values. His successors have further reminded us that our every action represents a coordination of coordination of behavior [3]. Heterarchies of dynamical complements are inherent an every social systemicity. Our very selfness is constituted of at least a cyclical ordering of a cyclical order which no amount of analysis can reduce. Furthermore, the prototype for such a systemicity is the tore such as Figure 1, whereupon the meridial and the annular lines respectively represent a cyclical ordering of a cyclical order in a heterarchical array.

Figure 1
Starting Over

Whatever paradigms we adopt, we would be well advised that they be "natural," i.e., modelled upon ways in which phenomena unfold without human intervention, especially if long term viability is what we seek. From a perspective we can recognize that nature does not construct itself out of stationary points, lines, and planes but rather that concepts such as these are the illusory artifacts of underlying dynamics. Not a point nor a line nor a plane nor any other figure in less than three dimensions is realizable in nature, and nothing is without some rate of change.

Since no "thing" can exist in less than three dimensions, the first models for idealized actuality must somehow fill or enclose a volume. Crystalline shapes are attractive and they do occur naturally, but their stasis and geometrical regularities which are so apparent to an observer are not indicative of their inner dynamics which are whirligigs of subatomic homeokinesis. A smoother shape such as a sphere offers a better model; it is indeed the contour which encloses the largest volume within a minimum of surface area, and its symmetry is attractive also. The sphere, or any deformation thereof, lacks a course for dynamics, however, and can therefore represent at best a stasis, at worst a degenerative entropy. The simplest topology which offers both a generative but stable asymmetry and a natural course for repetitive dynamics is again the tore, a cyclical ordering of a cyclical order. It is the topology of the gyre and the eddy, of the interplay of electricity and magnetism, of nervous and hematological circulations, of the living plant, and of the corporeal bodies of animals. It is ubiquitous in nature. As such, it is the paragon of natural topologies.

Some Effects of Illusions

Although the toroidality is common among our artifacts, e.g., as rings, links, wheels, tubes, spools, sieves, pipes, canals, etc., it is not well acknowledged among our mental constructs, and we are the more conceptually impoverished thereby. The philosophical ramifications of the illusion of stasis have confused us with a legacy of false ideals which infect our sciences, our politics, and our attitudes. Impossible and ridiculous notions such as closed systems, foolproof controls, environment-free laboratories, hermetic seals, perfect isolation, maximum payoffs, highest scores, spheres of influence, final analyses, total solutions, complete independence, and absolute freedom have long been commonplace in western cultures and are increasingly popular nowadays. Indeed, we can trace false idealism such as this to Platonic and to Euclidean philosophies.

Combined with a truculent reductionism, false idealisms have proved to be as toxic as they are potent. We have become so proficient in chopping and hacking that we have reduced our habitats to shards, even as we have alienated ourselves from habitats and societies. The antidote to this poisoned apple is not a simplistic reaction in favor of complete connectedness,
for that too is infeasible. What would be the more helpful, if humans value their continued tenure on Earth, is a perspect of realizations together with a respect for imaginations which appreciates these together as heterarchical complements in a whole picture.

**Moving Onward**

To let go of underdimensioned reifications and to accept continual variational change puts us in a more natural state of mind. The next consideration is how we might expect to obtain structural stasis at an echelon of order where three-dimensional fluxation is everywhere. One answer is to try to arrange streams of flux into oppositions so as to produce relatively stationary wavefronts, arcs, and fountains. These formations, arising as they do in conflictual interference, tend to be unpredictable and unstable. More representative, however, would be the formation which emerges where a three-dimensional current and cross-current co-penetrate to produce a vortex. Here forms a dynamical hole in the ambient fluxes, a toroidal center which can itself move along a stream as a whole. Once organized, it is stable over a range of different fluxations and remains ordered by the feedback of its cyclicity. Cyclonic patterns of weather and eddies in a stream provide common examples of this phenomenon. Where the kinesis is slow relative to the percipient, it may be less apparent but the underlying activity remains similar. Whether it be the persistence of a hurricane, the gyre of a whirlpool, the metabolism and cell replacement of a living creature or the life cycles of the members of a society, the paradigm of the ever changing yet ever toroidally similar whole is to be found at every known echelon of natural order as suggested by the illustration in Figure 2.

![Figure 2](image)

**Homeokinesis** is the word for persistent similarity with continual change. Although it can be produced by a variety of dynamical interactions, the simplest, most predictable, and most stable of these is through the complementarity of a current and cross-current. The controls manifest in the resulting toroidal fluxion are *volutionary* and *heterarchical*, i.e., constituted of a cyclical ordering of a cyclical order which are inherently self-controlling. The very existence of a toroidal formation is induced by and introduces a channeling of fluxes, a mutual creation of and dependency upon a polarized potential gradient. The maintenance of imbalances amidst a sustained flux provides the *homeorheosis* to power other currents and cross-currents. Thus do
homeokinesis and homeorheosis produce one another mutually wherever there is a non-uniform stream of fluxion of any kind whatsoever.

Systemologically, a paradigm in which entities emerge in the dynamics of current and cross-current helps us to recapture the ancient notion of system as *syn-histanai*: a bringing together to cause to stand. In practice, where dynamics don’t matter for the purposes of a particular situation, the objects we see and manipulate remain as before, albeit recognized as special quasi-static cases of the larger kinetics.

From this perspective we can see where we have gone wrong in our own conceptualizations as well as in our indoctrination whenever we have taken systemic dynamics to be merely a changing stasis and systems to be constructed out of “components.” Thus have reification of abstractions and generalization of special cases made conventional paradigms topsy-turvy at best, intractable and nonsensical — even dangerous — at worst.

And So What?

A dynamical, heterarchical, complementary, homeokinetic, volitional and toroidal paradigm for systemicity is not merely a theoretical ploy nor a convenience for visualizing fluidic flux and reconciling wave/particle dualities. Mechanical puzzles ought still to be approached mechanically, billiards is still a collision of spheres, and quantum physics will do what it must in order to make sense of its arcanities. Where systemological paradigms matter is at the echelon of order of human societies and of their habitats, polities and ecologies. It is here that dynamics are consequential all the time, that the mechanical and the programmatic interact continually with the imaginary and the purposeful. Very ethereal and very ephemeral dynamics working amidst very concrete and very enduring or long-lasting ones are at best very difficult to apprehend, but they are surely impossible to appreciate if they are approached on an inappropriate premise.

It is beyond the scope of this paper, or indeed of any one treatise, to consider the implications of a competent systemological paradigm for the future. There are a few salient messages which come out of a wholesome systemological worldview nonetheless:

- It would be timely for us to let go of the particulate “things” indicated at the left in Figure 3 and reach instead for a grasp of vorticulate systems such as those suggested at right.
• To see the universe whole is impossible for our limited perceptivities. Therefore, our every conception is inevitably a cropping. If each of us is not to come a cropper, however, we will all need to use more enlightened paradigms as standards for choosing where we cut and where we puncture the big picture.

• No systemic understanding is possible without an appreciation of dynamics. Systems — properly so called — emerge from self-stabilizing complementary fluxes and are homeokinetic. It is never enough to know only the form or structure of a system. Its functionality, its contents, and its controls are also essential, along with the timings of its kinetics.

• How big is the big-enough systemic picture? Pragmatically, it is an instrumental cropping which is big enough for the purposes of a definitive percipient. Systemologically, it is not less than a perspective that embraces at least one dynamical heterarchical complement which forms a toroidal whole. In particular, no hierarchical description of a system is even half the story.

• When might we begin to understand any system? Not merely when we have mastered a logical description but rather when we have a topological perspective of it in its environment.

• The persistent imbalance of homeorheosis is necessary to provide the sustaining and the powering fluxes for systemicity. Compellors, i.e., attractors and repellers and saddles, are to be found at every toroidal center. Among the compellors which must be acknowledged are the teleological ones, those arising in human purposefulness, where a repeated thought provides an intended end as a goal or standard for reference.

• System and environment are themselves complementary. There can be no healthy system without a healthy environment [7].

• The archetypal image for systemicity which will surely serve us best in the foreseeable future is the open, dynamic, toroidal heterarchy suggested by the illustration in Figure 4:
Conclusions

The young human is open to paradigms; older heads cling to paradigms which they already have. Difficulty notwithstanding, it behooves us now to look again at nature and our natures, to re-cognize what we have misconstrued, to envision with new eyes what we have failed to respect, to think once again about what we have thought, to let go what is inadequate, to apprehend what we have failed to grasp, and to reconstitute our paradigms accordingly. Such a project will be systemological: a work of applied philosophy. It will be terrifying and exciting and, with a little luck, very enlightening.

References

Platonic assumptions about what all things, including inanimate objects, "strive for." wisdom

machine works

(Note here that obstacles introduced from other echelons of order count as cross-currents.)

topology - tore+

confluences and divergences

general system for GST is not an assembly but rather a co-volution

In these formations will be manifest the results of colliding and coalescing streams, though neutral or unstable equilibrium

how toroidal
how a cropping thereof or has a role within

taking control requires accepting accountability/responsibility

domination of nature
conquest in opposition
hierarchy
prediction and control
ideal forms
ultimate reduction
truncated linear logics
instrumental pragmatics
mechanization
coercive socio-politics
omnipotence, omniscience, immortality
reification of abstractions and approximations
generalizations from special cases
"open loop" controls (without complements)
separating the inseparable
equi-initial "causality"
not all cultures have been so naive
analyticity, ultimate particle, reduction
@have tried to make rules out of special cases and approximations and illusions
given ... then ...

retrospect on purpose
absolutivity

monothematic and monotheistic
perfect structure has true statements not included [Goedel]
fluctuating, imperfect and temporary
linear and truncated scale can be pegged but not actuality ... overshoot, saddles, extrema, reversals
idealization, belief in ideals
perfect containedness and isolation are rare, connectedness is the rule
electron in a box, poison in a hermetically sealed container
corners, edges, surfaces
compellors

perspective, enlightened, correspondence principle, conveniences, expediencies, purpose as simplifier

@logical => topological

"random"
gears, levers

as nature does it
philosophy ... aesthetic as well as logical, praxiology as well as epistemology, axiology as well as teleology
linear order, complementary linear order, cyclical order, complementary (co-)cyclical order [pix]
Orderings
human
religious ... administered in mysticism
military/police
natural ... growing, eating, dying
geographical ... maps
civil
encyclopedic/dictionary
mechanical ... chugging state-to-state
billiard ... elastic collisions
mathematical ... perfectly rigid and provable
geometrical ... idealized
circuit
field
political
business
gyroscopic
chemical
atomic
cosmological
economic
chrematistic
market
athletic/competitive
game
biological
ecological
taxonomical
scalar
vector
matrix
logical
thermodynamic
fluidic
algorithmic
systematic ... hierarchical, integrated
systemic

instrumental croppings ... lever and fulcrum
sections, slices
What makes us to think of ourselves so simplemindedly? Laziness, perhaps, and a desire for quick and easy answers, but most certainly it is plain misindoctrination.

Before anyone can tell us about the world, we construct our paradigms around what we can feel and see and hear and smell and taste for ourselves. Children are natural-born
philosophers who want to know everything and are quick to generalize from their experiences. The infant learns about people by manipulating them with smiles and wails; the toddler gets hands into everything and puts whatever will fit into its mouth; the young child spins a top and throws a ball and splashes water and tries new combinations of words. Purpose and intention are taken for granted, as is caring about things and about other creatures. In the thriving youngster, there is a richly interwoven humane dynamic, an amorphous paradigm centered upon an unconditional personal interdependency which often seems the more beautiful even as it is more mysterious.

As soon as the age of rationality is reached, however, things begin to change. Discipline, order, and control become very important, at least to the child’s “care-givers,” and promises, threats, requirements, and proscriptions establish an increasingly rigid paradigm. Shared times must be scheduled, shared events must be planned, activities must follow the rules, serendipity is banished, and the impromptu is too dangerous to allow. In most cultures the formalities of religion are imposed at this time, along with schoolish organization for learning. What a child might be eager to learn about counting and reading is reduced to rigor, sterilized, and warmed over for force-feeding. Leaving aside the question of how much misinformation may be present in any particular cultural curriculum, it is clear nonetheless that numerous mistakes are being made. Not the least of these is to give children too little credit for their abilities to philosophize. Their “naturally” learned paradigms are often closer to “the truth” than are their lessons, e.g., when they draw pictures with sweeping, circular scribbles rather than with draftsmanlike precision of lines from point to point. If there is one misindoctrination which dominates all of the others, it is surely the geometrical idealization which has been taught for so many millennia and its extension to the mechanical paradigm which prevails today. As practical as geometrical conceptualization is where it applies, as when laying out plots of ground, it constitutes at best a simplistic misindoctrination when the metaphor it represents is taken as a paradigm for living.
ETHICS AND HUMAN SYSTEMS

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Abstract
Many developments in human-systems and soft-systems also address the concerns of the Business Ethics (BE) movement. Like ethicists, leading systems thinkers have campaigned against the "sweeping out" of social and human factors from managerial and economic decisions, or the uncritical military-style acceptance of given objective(s). Accordingly, an opposing process, that of sweeping in social and human factors to management theories and methodologies is now well and truly underway.

In fact, many major themes of BE (eg. caring for others, concerns for justice, devotion to self-knowledge and reflective thinking) may readily be "swept in" to complement traditional analytic treatments of managerial problems. Two simple illustrations are offered in the paper, one involving a logging decision, the other a dividend decision. Various methodological adaptations and conceptual revisions are then discussed. The first is from decision analysis to meta-decision analysis, involving problem-structuring and decision-errors at the meta-level. Next, following Zeleny (1994), traditional maximality is expanded to multiple optimalities and linked directly to business ethics. Finally, an adaptation of formal game theory to the conceptual model of an Ultragame is explained and linked to a more fundamental ideological transition. Ultragames assume plurally rational players and synergies amongst elements of the rationality-set of multiple strategic entities. In sum, systems-thinking can inform business-ethics, and vice-versa.

Introduction

30-40 years ago, rational-decision-making was generally understood as utility maximisation, with optimisation (profit-maximisation, cost-minimisation) being sought within given problem contexts. There used to be a consensus that business (and engineering) decisions should sweep out the messy problems of human-systems, social-systems, strategy and policy (eg. Checkland 1989). The same spirit was captured in Milton Freidman's (1970) prescription concerning the proper goals for corporate management: the powerful idea that "The social responsibility of business is to increase its profits". Today, this prescription continues to be supported and followed by many, despite its having been systematically and thoroughly refuted (eg. Goldman, 1980; Buchanan, 1985; Grant 1991).
Now, however, as the influence of formal economic theory on business practices has receded (eg. Kay, 1991; Kuhn, 1992), the level of interest in theoretical alternatives has grown. This is particularly the case with Philosophy, which, until around 1980 had become "the absent center of Anglo-American management theory" (Burrell, 1989). It is no coincidence that the post-1980 push for alternatives to hard systems exactly coincided with the flourishing of the Business Ethics (BE) movement. (The journal Human Systems Management and the Journal of Business Ethics both date back to the very same year: 1981.

As business ethicists and systems thinkers alike have campaigned against the "sweeping out" of social concerns from management decisions, an opposing process, that of sweeping in social and human factors, has become established. Old techniques are being steadily discarded and replaced with new ones (eg. Mason & Mitroff, 1981; Linstone, 1984; Rosenhead, 1989) or else augmented, or adapted (eg. Singer, 1994a) in ways that reflect the growing ethical imperatives.

Illustrations

The major themes of BE (eg. caring for others, concerns for justice, devotion to self-knowledge and reflective thinking) may be quite readily "swept in" as augmentations to traditional analytic solutions. In the two simple illustrations that follow, solutions based upon utility maximisation are augmented with a pluralistic, ethical approach. The latter incorporates plural forms of rationality and ethics, as well as the creation or design of alternatives, the search for wisdom and self-knowledge, with a commitment to collective human betterment (eg. Boulding 1985).

A logging decision

Many business decisions simply involve one-off profit opportunities. For example, a manager in a forestry business faced a decision about purchasing an area of developed woodland, with the intention of logging. The manager knew that for various reasons (environmental, recreational, aesthetic and spiritual) the trees should stay. He also knew that "if he were to refrain from felling these trees, someone else would do it", because there was undoubtedly a profit to be made. This is the commonly understood reality: the "facts and logic" of countless similar situations (as well as countless justifications to the media). A simple traditional decision analysis (DA) of this situation is set out in Figure 1.
This DA gives a clear unambiguous prescription, a solution to the given problem: start the chainsaws! That ethos (and its legislative underpinnings) are currently changing, in many parts of the World, resulting in changes to the utilities in the DA. (eg. as fines are increased, the inequality \(-f >> 0\) becomes reversed). At the same time, however, in newer forms of decision analysis, such as Multicriteria Decision Making (MCDM), Ethical Decision Making (EDM), and Meta-Decision-Analysis (MDA) there is less emphasis upon aggregated utilities and probabilities.

In the new decision analysis, the focus has shifted to (a) the creation or design of alternatives, and (b) the structuring of reflective inquiry. Accordingly, these approaches vigorously sweep in BE; in particular, they inform the manager that he should:

* Understand that "If I don't do it others will.." is not a valid reason for action.
* Set an example..remembering not to underestimate the influence that your own behavior has on others.
* Lobby governments, to pass laws with sufficient penalties and effective enforcement.
* Enlist support from pressure groups (Greenpeace, etc.)
* Cultivate an image of social responsibility to win over customers (Green marketing)
* Develop new businesses and retrain employees (Green strategy).
Creating and selecting these strategic options, the designed objects of rational choice, then requires moral courage, or moral character (eg. Solomon, 1992). Put differently, strategic thinking becomes nothing other than moral-philosophical reflection (Singer 1994b).

A dividend decision
In recent years, decisions have been taken to invest in setting up national lotteries (eg. LOTTO, in NZ & UK, etc.). The decision process for these large investments interacted with the dividend decision. However, the understood interaction was very far removed from that found in many finance texts (eg. Brealey & Myers, 1981).

Traditional OR-MS (statistical analysis, central-limit-theorem, etc.) informs us that the game, once set up, will almost certainly produce very high ROI, but will also contribute to an increase in economic inequality in society. Pareto-optimality in the market, associated with utility maximization prescribes that the investment is indeed "worthwhile", it should go ahead; moreover, the profits from LOTTO should be returned to the providers of the capital, as with any other capital project.

This analysis may be complemented, with one based upon deliberative rationality, associated with the veil-of-ignorance approach to ethical decision making (Rawls, 1972). The latter prescribes that resource allocations in society should conform to the following principle: Inequalities of wealth in society are OK so long as they arise in a way that also benefits the least advantaged member(s) of society.

According to this principle, the investment in LOTTO is "worthwhile" if and only if the least advantaged members of society can be expected to receive net benefits. It could be argued (at the right fringe) that these "net benefits" are adequately delivered as the utility (ie. psychic pleasure) of checking LOTTO coupons, or watching the draw on TV. But if that seems doubtful compensation, it then becomes necessary to ensure that some part of the profit from the LOTTO goes directly to "benefit the least advantaged".

In every actual case of such lottery investments, the deliberative form has in fact been chosen over the utility maximizing form, as significant dividend payments are being forwarded to charities, hospitals, social agencies, as well as the providers of the capital. This empirical choice lies in the meta-rational or meta-ethical arena (eg. Singer 1991 et seq; Van Gigch, 1991). Accordingly, one must now ask: why should any other commercial investment & dividend decision be any different? This is not a trivial question.

From Decision-Analysis To Meta-Decisions

The extension of economic rationality concepts implied in the above illustrations is certainly nothing new to the BE discipline! For example, plural forms of rationality are already quite cleary manifest in the available published techniques of Ethical Decision
Making (EDM) (eg. Hosmer, 1991; Mathews et al, 1988; Murphy, 1988; Singer 1994c). There appears to be a consensus about the appropriate scope of EDM techniques: managers should engage in structured inquiry. Others, in Management Science and Human Systems agree. For more than a decade, they have also advocated inquiry-based, multi-principled and non-optimising approaches to problem solving (eg. Mason & Mitroff, 1981; Linstone, 1984; Ackoff, 1994).

Problem structuring
In addition to EDM and the other multiple-perspective checklists, the need for different forms of "rational analysis" has also been widely recognised. Various problem-structuring methodologies (Rosenhead, 1989; Jackson, 1991) have been developed. Such methods enrich the description of strategic alternatives and, especially, improve the conceptual models of managerial problems (eg Oral & Kettani, 1993). Yet, all such approaches foster a better understanding and a clearer vision of the world as it really is, so they become identified with ethical decision making. For moral agents must always strive for the greatest possible clarity of perception (eg. Murdoch, 1970).

Figure 2 A Meta-Decision-Analysis Of A Strategic-Decision Meta- Decisions Strategic Decision

Meta-decision analysis
The progression from DA through to EDM and problem-structuring can be subsumed into a meta-decision analysis (eg. Singer, 1994b). MDA recognises that all decisions have an archetype structure (Figure 2) a project-set, however vaguely the "projects" may be perceived. MDA then steps backwards...into the domain of three inter-related meta-decisions: about descriptions, rationalities and models. MDA also involves an idea, familiar in BE (eg. Rawls, 1972; Rossouw, 1994) that all decisions must ultimately be made by processes of reflection and discussion. Conflicts that arise at the meta-level...and these surely
will arise as meanings clash...must be managed through conversation, until they become resolved, settled or dissolved, over time (eg. Zeleny, 1989; Singer, 1994a).

**Decision errors**

With MDA in mind, it becomes quite apparent that the concept of decision-error, as it is commonly used in DA and behavioural -decision-theory, can no longer be confined to experimentally demonstrated phenomena, such as misapplied cognitive heuristics (cf. Cohen, 1981). Such a narrow definition of "error" must now be radically expanded, to include the entire spectrum of improvable or sub-optimal choices, at the meta level. The wrong choices here inevitably create poverty, resentment and confusion.

**From Maximality To Optimalities**

Each of the checklists and structuring techniques appear to invite managers, implicitly or explicitly, to select an optimum solution to their problem. But none say how. No procedure for making tradeoffs is specified. The reason for this is quite simple: EDM and inquiry techniques do not require tradeoffs. The intention is simply to encourage users to actively pursue all the objectives to the best of their ability. Such management-without-tradeoffs involves strategic and political action, to change the constraints, the system, or the wider environment (eg. Zeleny, 1994a) Balance amongst the criteria must then come from within the user, as a sense of harmony, or cognitive equilibrium (Zeleny, 1989).

So what, then, has happened to the core concept of optimisation (profit-maximisation, cost-minimisation, etc.)? Well, according to Mason (1994, p70), optimality "is a far more profound and elusive state of affairs than can be derived from the most powerful mathematical proofs." Moreover, according to Zeleny (1994b, p2) "there can be no absolute definition of optimality". One can, however, identify and formalise multiple optimalities. Zeleny (1994) has classified these on the basis of (i) single vs multiple criteria (eg. cost and safety), and (ii) whether or not, in any expressed problem: (a) alternatives and criteria are given, (b) only the criteria are given, so that the alternatives must be designed or (c) neither alternatives nor criteria are given. In the latter case, a value-complex is needed, consisting of "mostly qualitative and difficult to measure principles, ethics and rules, best articulated in (natural) language." Put differently "optimum" has come to incorporate plural-rationalities (Singer, 1994d).

**From Games To Ultra-Games**

Formal game theory (GT) has never once solved a real managerial problem (eg. Singer & Brodie 1990). On the other hand, if one looks to the natural language meta-theory or the conceptual models of Game Theory, a strikingly different picture is revealed. If one accepts, pragmatically, that meta-theory and conceptual-models, can properly be termed "useful", then the same can surely be said of a conceptual model of a strategic interaction...
between plurally-rational entities (rather than utility maximising players). Such a conceptual model, an Ultragame, has indeed been elaborated in Singer (1993 & 1995). The idea here, to paraphrase Solomon (1992, p56) is simply to get people to think differently about strategy. Empirically successful recipes flow from the extended conceptual model (eg. Uphoff, 1994; Ritzer & LeMoyne, 1991; Maruyama, 1992)

Conclusion

In management theory and systems thinking, the principle of complementarity manifestly applies, for we most surely need scientific and ethical approaches to management. As this article hints, there are many potential synergies yet to be realised amongst traditional knowledge domains. Much remains to be done. For example, at this moment, trainee financial analysts somewhere in the world, are being indoctrinated in "old" ideology: commanded from the hierarchy to deliberately and consciously sweep out social concerns from their "professional" judgements. Thus, the post-1970's struggle (eg. Churchman, 1971) to sweep such concerns back in to all commercial practices and education has really only just begun! Perhaps in another 25 years or so, the great financial myopia will again be seen for what it really is: a "passing of the buck" on a truly Global scale.

Reference


A Singer


SECTION 7

MANAGEMENT
QUALITY ASSURANCE IS A SYSTEM

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Abstract
Quality assurance (and other related terms like total quality management, world best practice and benchmarking) are four current concepts that are being used, and abused, both in technical and in everyday contexts.

Two of the reasons for this use and abuse are: First, the alternatively perceived simplicity or complexity of the problem and of the solution to quality assurance; and Second, the varying number of stakeholders, the range of expectations and the mixed success that the implementation of quality assurance has had in various walks of life.

Systems skills and knowledge can make a worthwhile contribution to quality assurance, by providing a framework both for study and for improved communication.

With a framework discussion can be focused more on the intent of quality assurance and less on the way that quality assurance has been successfully implemented in manufacturing industry. This focus is needed because of the special or at least different characteristics, in terms of quality assurance, of various walks of life.

Four aspects of quality assurance noted in the paper are:

- Quality assurance driven for transformation and innovation and quality assurance driven for accountability;

- Quality assurance by reduction in areas of most waste, over the total process;

- Quality assurance by an increased ability to express skills more as generic skills and less as context specific skills;

- Quality assurance of an agreed management process to deliver agreed outcomes and quality assurance of a visionary leadership to identify new outcomes and to facilitate improvements in the management process.

Keywords: Learning, problem formulation, problem solution, decision support.
Introduction
Quality assurance is currently an issue for many workplaces in many walks of life. The problems encountered, with quality assurance, are in part caused by the complexity of the issues and of the decision support required (Monypenny, 1991, 1992, 1994). Systems thinking has a long experience with complex issues. There are many systems methodologies that could be used (Monypenny and Peeno, 1994). I have chosen Systems Engineering Methodology (Sage 1977, 1983) because of its attention to institutional or organizational aspects of systems. The main contribution of systems methodology is to provide a framework and a terminology distinct from the subject of analysis, in this case, quality assurance. This is equivalent to saying that the framework and terminology are largely generic rather than largely context specific to quality assurance. The need or reason to be generic is to increase the clarity of the perception of the relative importance of the many aspects of the issues related to quality assurance. The paper will first outline systems engineering methodology and then look at four aspects of quality assurance from a systems perspective.

Systems Engineering Methodology
A central purpose of the systems engineering methodology (Sage, 1977, 1983) is to assist clients in the organization of knowledge by providing a framework for the formulation, analysis, and interpretation of issues and problems of large scale and scope. It is most appropriate for use when one or more of the following is the case (with respect to the problem or issue under consideration):

a. There are many considerations and interrelations;
b. There are far-reaching and controversial value judgments;
c. There are multidisciplinary and interdisciplinary considerations;
d. Future events are difficult to predict;
e. Structural and institutional considerations play an important role.

A.- The systems engineering methodology involves three fundamental steps:
1. Formulation of the issue or problem. The issue formulation step of the systems engineering methodology is subdivided into three more specific steps:
   a. Problem definition A descriptive account of the issue or problem under consideration, the identification and structuring of problem elements, which typically include the identification of needs, alterables, constraints, stakeholders, relevant societal sectors or institutions, relevant fields of knowledge.
   b. Value system design The objectives of the needed policy or plan are identified and structured, and objectives measures or attributes of desirable states or outcomes are specified. These will serve as sensors or indicators or instrumental measures of the degree to which alternatives satisfy the objectives.
   c. System synthesis Identification of potential alternatives, policies, controls, or complete systems that are believed capable of needs satisfaction.
Methods used in the formulation of the issue. Typically, idea generation and collection methods are very helpful to identify the various needs, stakeholders, alterables, alternatives, constraints, etc. Among the idea generation and collection methods are brainstorming, nominal group techniques, Delphi, and very important approaches based on surveys, interviews, and questionnaires. Also useful are methods for structuring the elements identified, such as interaction matrices, cognitive maps, causal loop diagrams, and other forms of structural models.

2. Analysis of the impacts of alternatives. The analysis step of the methodology is subdivided into:

   d. Systems analysis and modeling (impact assessment). The various feasible alternative systems, designs, or action alternatives are analyzed more closely to assess their feasibility, and/or the expected impacts and possible consequences of their realization or implementation. This activity is often referred to as "impact assessment".

   e. Optimization or refinement of alternatives. A refinement or fine tuning of alternatives and adjusting of policy parameters, typically by means of various optimization-based approaches, such that each proposed policy is the best one possible in terms of expected satisfaction of the value system.

Methods used in the analysis of the impact of alternatives. The forecasting or assessment of impacts and the analysis of alternatives generally require more precise analytical tools than used in issue formulation. However, when data or theory are insufficient, and/or time and resources are lacking, qualitative, expert opinion-based impact assessments and forecasting methods may be appropriate, possibly in conjunction with more precise quantitative techniques.

After the issue has been formulated and analyzed, such that there exists a set of alternatives and some knowledge of the impacts of the alternative courses of action in terms of the objectives one desires to satisfy in order to fulfill needs, it becomes possible to implement the final of the three fundamental steps of systems engineering methodology: interpretation.

3. Interpretation of results leading to the evaluation and prioritization of alternatives as well as the selection and implementation of selected alternative(s). This step may be subdivided into:

   f. Decision making. This implies an evaluation of the alternatives in terms of how their impacts result in need fulfilment, the prioritization of alternatives, the selection of one or more alternatives, and the implementation of action plans. In interpreting alternative courses of action, systems or policy options are evaluated and ranked in importance with respect to need satisfaction as indicated by the associated objectives measures. This evaluation is made to determine whether one or more policies or systems are worthy of further consideration or implementation.

   g. Planning for action. A plan or schedule for implementation, including resource allocation.
Methods used in interpretation. Various decision aids have been developed to assist decision makers in the evaluation and prioritization of alternatives. Among these are various approaches to decision analysis and decision support.

B.- The systems engineering process, involves a number of phases. A number of efforts have been made to describe the systems engineering process in a number of phases, such as program planning, project planning, development, and implementation. The underlying idea is that each of these phases represents an important choice-making task in which the formulation, analysis, and interpretation steps are accomplished. When the (logical) steps of systems engineering methodology are listed along one axis and the phases along another, a table or matrix results in which each individual entry represents a specific activity corresponding to one of the steps and one of the phases of a systems engineering effort.

C.- There are several points about systems engineering which merit further discussion. First of all, systems engineering efforts are not processed in a sequenced linear way but rather as a process. In this context a process is the interaction of a method, or methodology, with human judgment, in which iteration plays a central part. Insights obtained from one part of the effort might lead to a revision of approaches taken earlier, making iteration and feedback necessary. Second, the steps in the systems engineering methodology (outlined above) are intended to be helpful as a guide, not as a restrictive format. Flexibility in the procedures and methods used is a central feature of systems engineering. It should be noted, however, that each of the steps outlined above represents an important ingredient in a systems engineering effort, and omission or neglect of any step increases the risks of failure. Third, since systems engineering is a process in which people work together to realize the various steps of the effort, the selection of an appropriate combination of capable analysts, experts, or other participants, and methods or aids in the process, is at least as important as adherence to the several steps of the systems engineering methodology.

Transformation and innovation and accountability

Quality assurance can be driven for, or by, different motives or objectives. Two of these are for transformation and innovation and for accountability. Quality assurance driven for transformation and innovation has been in place for many years in manufacturing industry. It is well understood and relatively widespread. There are well developed procedures to estimate costs and returns, and for implementation. In this context quality is relatively easy to define and to measure and is easily accepted by all stakeholders. In this context quality assurance is output driven. An example of very successful quality assurance driven for transformation and innovation, is the supply of air-conditioners for
cars that do not contain green house gases. Given this sort of experience in
manufacturing industry efforts are being made to extend quality assurance
(driven for transformation and innovation) to mainly service industries, with
some success.

Quality assurance driven mainly for accountability is a relative newcomer. A good
example is quality assurance in universities, for example see Lindsey, 1994. In
this case the Commonwealth is driving the quality assurance agenda mainly to
facilitate allocation of funds using a standard formula and to maintain financial
accountability. In this context quality is very difficult to define and to measure
and there is a wide range of views on the many aspects of quality assurance
among the many stakeholders. Thus considerable effort has been allocated to
seeking, documenting and validating measurable proxies for quality with only
limited real success. To date there have been significant difficulties in taking the
successful experience of quality assurance driven for transformation and
innovation in manufacturing industry, and developing quality assurance driven
mainly for accountability in universities.

In systems terms the difference between quality assurance driven for transformation
and innovation and quality assurance driven for accountability can be expressed
as differences in value system (what are the objectives or what is important) and
in system synthesis (what are potential alternatives). Experience to date
suggests that the procedures for and implementation of quality assurance are for
more value system (objectives) and system synthesis (alternatives) dependant
than has been generally acknowledged.

Reduction in waste

One aspect of quality assurance is about reduction of waste. Significant effort has
been placed on reduction of waste in given sections of the total process with
considerable success, as for example in demand pull production in
manufacturing. As quality assurance is extended there needs to be more focus on
reduction in areas of most waste, over the total process. This is specially the
case as quality assurance is extended from the relatively low risk and low
variability situation of manufacturing industry, to the higher risk and higher
variability situation of service industry. In this context there needs to be a clear
distinction between reduction in waste and appropriate steps to manage risk and
variability. In Australia, management of risk and variability due to exchange
rates, terms of trade, commodity prices, drought, trade wars etc are acquiring
increased importance.

In systems terms, the reduction of waste is a question of systems synthesis (of
identification of potential alternatives).

Ability to express skills

The organizational environment in which quality assurance is undertaken can range
from stable to turbulent. As the turbulence increases so does the returns to
Management and leadership

Attempts are being made to extend the success of output driven quality assurance in manufacturing industry to quality assurance of processes in mainly service organizations like for example organizations that do research and development in agriculture. In this context there can be quality assurance of an agreed management process to deliver agreed outcomes and there can be quality assurance of a visionary leadership to identify new outcomes and to facilitate improvements in the management process.

The need for distinction between the two stems from the difference in their degree of dependence on individuals for success; required skills and resources; preferred organizational structure; preference for stable or turbulent times; etc.

In systems terms, the difference between management and leadership is one of problem definition.

The Challenge

The challenge for quality assurance covers both new efforts to extend quality assurance and current efforts that are experiencing difficulties.

New efforts to extend quality assurance need to be proceeded by clear statements related to problem definition, value system design and of systems synthesis rather than to be proceeded by statements on systems analysis and modeling and optimization or refinement of alternatives. The statements need to be made either by the dominant stakeholder or by consensus of all stakeholders. Neglect in preparing such statements or major differences between stakeholders, will increase the risk of both failure of the effort and of the effort being derailed or redirected.

Current quality assurance efforts that are experiencing difficulty or failing to make expected progress, need to review their statements related to problem definition, value system design and to systems synthesis. This review will help determine expected impact and likely consequences of implementation and help refocus and prioritize allocation of organizational resources.
In general, now is the time to apply quality assurance to the quality assurance agenda. Systems skills and knowledge can make a worthwhile contribution by providing a framework both for analysis and for improved communication.

References


THE APPLICATION OF SOFT SYSTEMS METHODOLOGY IN
TELSTRA: A CASE STUDY

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Abstract

The Australian telecommunication industry is undergoing rapid and continuous technological change and organisational restructuring in a vigorous competitive environment. A critical success factor for managers is the ability to achieve the 'right' balance of sociological, psychological, and technological factors. In this complex setting, the systems professional needs appropriate skills and tools to manage the challenge of change.

This study addresses the need to adopt a holistic approach to the management of organisational change in a technological environment. It focuses on the particular requirements of the systems professional as a manager of change and a developer of information systems. In this context an examination is made of the suitability of Soft Systems Methodology (SSM).

The investigation is supported by a case study in progress of the application of Soft Systems Methodology in a business unit of Telstra. This case study seeks to identify the benefits of adoption of Soft Systems Methodology as an approach for managing change and developing better systems. It also seeks to provide a framework and guidelines for the adoption of the methodology in Telstra.
SYSTHEMICITY AND OBJECT-ORIENTED APPROACHES TO
BUSINESS PROCESS RE-ENGINEERING

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Abstract:
Jacobson et al. have recently proposed the use of object-oriented modelling techniques as a
means of providing a formal basis to Business Process Re-engineering (BPR). The present
paper argues that such an approach is rooted in the reductionist, scientific paradigm,
concentrating upon the 'technology' of redesigning processes, but not situating that activity
within an understanding of the 'soft factors' surrounding the change process (eg,
motivation, management commitment, leadership, the need for expert guidance). This paper
explores the suggestion that a recently developed object-oriented approach to information
systems analysis, termed State-Behaviour Modelling (SBM), which incorporates explicitly
application of systems principles in the analysis of problem situations and construction of
models, might be adapted and applied to BPR. It is argued that SBM might provide an
object-oriented based method with the power of Jacobson's approach, but situated in a
systemically sound framework.

Introduction

Corporate restructuring, referred to in many circles as 'Business Process Re-engineering' (BPR) has become arguably the management buzzword of the 1990's. Hammer and Champy [1] define it as 'the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed'. BPR requires that enterprises take a comprehensive review of their entire existing operation and try to redesign it in a way that uses new technology to serve customers better [2].

Jacobson et al. [2] acknowledge that 50 to 70 percent of companies that try BPR fail. The risks which lead to failure fall broadly into two categories: those associated with the change process and those associated with the technology used. It has been estimated [2] that 80 percent of the failures are caused by 'soft factors' surrounding the change process, such as motivation, management commitment, leadership, the need for expert guidance etc..

The number of 'how to' texts, which ostensibly instruct the would-be practitioner, continues to increase (see for example, [1, 3, 4]). Scrutiny of these texts, however, leads one to conclude that whilst they enable the reader to understand the meaning of re-engineering, the importance of re-engineering and a handful of the principles underpinning re-engineering, they do not describe how one can, in practice, redesign a business according to those principles. In response, Jacobson et al. [2] have recently suggested that BPR's success rate could be dramatically increased if its methods offered more concrete guidance. A similar point has been made by Martin [5]. Both Martin and Jacobson et al. have attempted to provide such concrete guidance: Martin has used an 'integrated engineering approach', whilst Jacobson et al. have developed what they term an 'object-oriented method based upon the notion of 'use cases'.

In terms of the risk items listed above, most books and methods on BPR [1, 3, 4] tackle the soft factors (ie, attempt to take a systemic view, emphasising management of change), whilst Jacobson et al. [2] and Martin [5] tackle the technology (ie, an approach which is rooted in the reductionist, scientific approach and concentrates upon the redesign of process). One might question whether what is really required is a unified approach, which attempts to provide concrete analysis methods within a framework which addresses the soft factors.

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Recently Younessi et al. [6, 7] have presented an approach to information system analysis which they term State-Behaviour Modelling (SBM). The approach:

a. incorporates explicitly the application of systems principles in the analysis of the problem situation and construction of models;

b. includes methods for considering the cultural, social and political dimensions of an organisation;

c. generates models which are consistent with the object-oriented paradigm in that they use explicitly the notions of object, class and inheritance.

The present paper explores the suggestion that SBM might be adapted and applied to BPR, and that it might provide an object-oriented based method with the power of Jacobson's approach, but situated in a systemically sound framework which allows the model building to be informed by study of the 'soft factors'.

The paper first establishes, in section 2, the rationale for an object-oriented approach to BPR, with the candidate object-oriented approaches of Jacobson et al. (use cases) and Younessi et al. (SBM) being presented, in outline, in sections 3 and 4 respectively. Section 5 then compares the two approaches, indicating that whilst both make constructive use of object-oriented concepts, SBM also addresses a number of systemic issues not handled by Jacobson. Finally, section 6 summarises progress and indicates the direction of planned future work.

The Rationale for an Object-Oriented Approach to Business Process Re-engineering

If one is to take a formal approach to BPR, at a minimum one might expect an approach to include:

a. a notation that allows every activity and deliverable of the enterprise to be specified. The deliverables from the analysis, in the form of business models, should capture both the structures of the organisation and the dynamics. As noted by Jacobson et al. [2], these are different from traditional business models which tend to model the organisation as a computer with a database and a program that manipulates the database;

b. models presented in a language which allows the 'actors' in the enterprise (the CEO, executives, process owners/managers/operators etc) to engage in debate leading to change; and

c. a process for the development of an information system that is integrated with the re-engineered organisation. One would hope for a tight relationship between the process that develops the business model that underpins the redesign of business processes, and the process that develops the information system.

Object orientation is an approach to modelling in which complex systems are viewed as sets of interacting objects (where an object is an entity that is meaningful to an enterprise in its environment). The relations between these entities are seen as associations between objects; the properties of the entities are attributes of the objects; and the 'tools' that other objects can use when they want to interact with an entity are the operations of the object. If one entity affects another when a certain event takes place this is represented as communication between the objects. The association that expresses that one object is a compound (ie. consists of) other objects is called aggregation. In addition, object-oriented notations group objects with the same attributes and operations into classes, where a class might be considered to be a template for that set of objects. Finally, often introduced although arguably not essential to object-oriented approaches, is the notion of inheritance whereby classes are structured in a hierarchy with an instance of a class lower on the hierarchy obtaining all of the operations and attributes of its parent class in the hierarchy. Readers are referred to the plethora of texts on object-oriented approaches for further detail (eg, [8]).
Jacobson et al. [2] have suggested that an object-oriented approach might meet the
expectations above of a formal approach to BPR. Specifically:

a. object-oriented concepts and notations allow one to represent and clarify the inner
workings of an enterprise, capturing its structures, products, services, resources and
processes, and how those things depend on each other;

b. if coupled with simple, natural ways of enacting those models, the 'actors' in the
enterprise can engage in debate leading to change (for example, Jacobson adapts his
idea of 'use cases' (see section 3) to this purpose whilst Younessi et al. suggest
various means within SBM (see section 4) of aligning the models with options for
change); and

c. the pairing of object-oriented business engineering and object-oriented systems
analysis offers a relatively seamless transition from redefined process to the
requirements for the information system. (Note that the object-oriented approaches
of both Jacobson and Younessi et al. have their origins in approaches designed to
support information systems development).

We now present in outline, and subsequently compare, the candidate object-oriented
approaches to BPR of Jacobson et al. and Younessi et al.. Both have been described in
detail elsewhere (ie. Jacobson et al. [2] and Younessi et al. [6, 7]).

Jacobson's Object-Oriented Approach to Business Process Re-engineering

Jacobson et al. [2] represent business process re-engineering as four primary activities,
some of which are at least partially parallel, and some of which are iterated. The main
activities of a re-engineering project, according to Jacobson, are shown as in Figure 1.

![Figure 1: An Overview of the Main Activities in a Business Process Re-engineering
Project (adapted from [2])](image)

The re-engineering project can start in many ways, broadly represented in Figure 1 as a 'Re-
engineering Directive' which explains why something must change and what the project is
expected to achieve. The Directive triggers an activity termed 'Envisioning' in which the
new business enterprise or new processes are visualised. In order to achieve this, Jacobson
argues that one must know the company's strategy and understand the existing business.
Thus 'Envisioning' triggers the 'Reversing the Existing Business' activity which produces a
model of the existing business. It is argued that one cannot visualise the new company until
you understand the existing one. Paradoxically, you need a vision of what is to be done to
know what you must understand about the existing company. The tightly iterative
Reversing/Envisioning activities result in an 'Objective Specification', a vision of future
business.

The 'Objective Specification' is an input to the work of 'Engineering the New Business'
which involves creating one or more new processes, designing them, developing a
supporting information system, possibly simulating and iterating the models until a model
of the redesigned company emerges. Finally, the re-engineering project will require
'Installing the New Business', where the redesigned company is implemented in the real organisation.

Jacobson et al. [2] provide guidelines for all four activities. Underpinning the activities of 'Reversing the Existing Business' and 'Engineering the New Business' is formal modelling built around the notion of use cases and object models. To establish an understanding of what the business is meant to accomplish, one builds a use-case model consisting of actors and use cases. An actor is a representation of something that interacts with the business, whereas a use case specifies the flow of events that a particular actor wants to perform in the business. Use cases are a simple, natural way to identify business processes. A customer is a user of a company and uses the company through a business process. Each such way of using the company is a use case. When the use cases have been elaborated one is ready to make a complete object model of the business. For each use case the objects that are needed to execute that particular use case are identified. Jacobson et al. find it useful to recognise three types of objects: interface objects which represent a set of operations in the business, each of which should be performed by one and the same resource; control objects which also represent a set of operations in the business but involving tasks that do not imply taking direct responsibility for contacts with the business environment; and entity objects which represent products and other things handled in the business. Subsequently various associations between objects and their classes are recognised (ie. aggregates of objects, communication between objects, and inheritance between classes of objects).

Worked exemplars of the method are available in Reference [2].

A State-Behaviour Modelling Approach to Business Process Re-engineering

Younessi et al. [6, 7] represent business process re-engineering as a five stage process, which follows a structure, and adopts a number of the techniques of the Soft Systems Methodology (SSM) [9]. SSM is a systems-based problem solving methodology with a rich base of techniques for supporting the initial analysis of ill-structured enterprises, including the investigation of cultural issues. SSM advocates that the analyst should propose multiple relevant systems, each of which, when modelled, will support debate on the various perceptions that stakeholders have of the primary tasks and issues surrounding the operation of the enterprise. Further, the work of Wilson [10] has provided insights into the means by which one might develop a model which accommodates various stakeholder views of the primary tasks which take place.

The five stages of SBM are presented schematically in Figure 2. As shown, the organisation is investigated in Stage 1, using ideas such as those described by Checkland and Scholes [9] under the headings of 'analysis of the intervention', 'social system analysis' and 'political system analysis'. The insights so established allow the naming, in Stage 2, of systems relevant to the tasks and issues considered by various participants as important to the organisation's future operation. It is important to note that these are not present real world systems, but named systems which participants believe may be relevant to understanding possible future processes of the organisation. There may be many such system names. SBM prescribes the representation of each named relevant system as a 'State-Behaviour Definition' [7], a concise textural statement of the roles, states and behaviours, purpose and environment of each relevant system, somewhat akin the SSM's Root Definition with its CATWOE elements [9].

At Stage 3, SBM provides a series of heuristics [7] which support the extraction of classes, attributes, operations, and the associations, aggregations and inheritance structures required to construct an object model based upon each named relevant system (ie. based upon the State-Behaviour Definition). The models so constructed, termed 'State-Behaviour Models', can be represented in any class oriented 'object model first' notation (eg, that of Rumbaugh et al. [8]).
At Stage 4, SBM takes an approach similar to that advocated by Wilson [10] for arriving at a model which accommodates the various views of the primary tasks. Specifically, the various object models developed at Stage 3 are reviewed to identify classes which are common to all. Those about which there is not 100% consensus are then questioned as to desirability, determined by debate between the various stakeholders. Additional classes, agreed by this process, together with those common to all models, form a tentative 'consensus' model. In order to improve the coherence of what is really only a collection of classes 'glued' together, it is useful to utilise the pairing of the State-Behaviour Definition and the State-Behaviour Model, by developing a new State-Behaviour Definition which attempts to be consistent with the tentative consensus model. From the new Definition, one can develop a model which should be coherent, by recovering Stage 3 starting with the new SBM Definition.

Finally, in Stage 5 one formally aligns the model with the real world, to identify the scope of procedural change required to migrate to the re-engineered processes. In undertaking this comparison, SBM adapts various comparison techniques from SSM [9], specifically: informal discussion; formal questioning; and scenario writing. It is interesting to note that scenario writing is in many ways analogous to the 'use case' approach of Jacobson et al [2], but in SBM it appears late in the methodology as a means of identifying the impact of moving from the present to the future improved system, rather than as a trigger to envisioning the future processes.

A worked exemplar of the approach is available in Reference [7].

Figure 2: A Schematic Representation of the State-Behaviour Modelling Framework

Systemicity and the Jacobson and State-Behaviour Modelling Approaches

It has been proposed in the introduction to this paper that SBM might provide an object-oriented based method with the power of Jacobson's approach, but situated in a systemically sound framework which allows the model building to be informed by study of
the 'soft factors'. To display the extent to which SBM meets the perceived need to place a powerful object-oriented notation within a systemically sound framework, we first propose a set of criteria for assessing whether an analysis approach can be considered systemic. We then formally align both Jacobson's approach (section 3) and SBM (section 4) against this framework of expectations.

In a previous paper Younessi et al. [6] argued that an approach could be deemed systemic if any of the following activities could be demonstrated to have taken place:

a. **Systems Analysis** - with an emphasis on collecting a multiplicity of views from many stakeholders with the conflicts inherent within them highlighted rather than suppressed. A participative and democratic approach to groupwork is encouraged to assist in evaluation of complex and politically sensitive situations.

b. **Conceptualising and Modelling** - with an emphasis that models developed must support debate of feasibility and desirability. Modelling usually requires also parallel investigation of alternatives.

c. **Testing** - Options for change are discussed and explored with a wide range of stakeholders.

d. **Choice** - Group decision and consensus are encouraged. Models are often superimposed and reconciled to arrive at a consensus model.

e. **Implementation** - Implementation is normally based on individual/collective agreements to perform and support the model. This is much assisted by the consensus arrived at in the previous phase.

Such considerations might be viewed as the requirements of systems practice. To be fully systemic, one might also expect the explicit use of at least a core set of concepts from the systems literature (what Checkland [11] would term 'systems thinking') including at least:

f. **Emergence** - This is the notion that the whole is greater than the sum of the parts, i.e. entities when put together from component parts, may demonstrate properties that the individual components do not possess or demonstrate (or indeed properties which have no meaning at all in terms of the component parts).

g. **Hierarchy** - This is 'the principle according to which entities meaningfully treated as wholes are built up of smaller entities which are themselves wholes. In a hierarchy, emergent properties denote the levels' [11].

h. **Communication** - Communication refers to transfer of information from one entity to another. This transfer often denotes temporal precedence.

i. **Control** - This is the process, mechanism or tendency through which an entity preserves its stability. Checkland [11] defines control as: 'the process by means of which a whole entity retains its identity and/or performance under changing circumstances'.

| Table 1: An evaluation of the conformance of Jacobson's approach and SBM's approach to Business Process Re-engineering to features expected of a Systemic Approach |
|-----------------|-----------------|-----------------|
| a. Systems Analysis | Multiple use cases investigated, but issues/conflicts not highlighted | Allows multiple views to be expressed through multiple state-behaviour definitions, some of which may be issue-based rather than primary-task |
| b. Modelling | Models support debate, but do not stress explicitly parallel investigation of alternatives | Explicit handling of multiple models |
| c. Testing | Use cases support testing of the model | Three methods of aligning models with the real world proposed in Stage 5 |
| d. Choice | Involvement of the business community in consideration of models is promoted | Technique for achieving accommodation of views is explicit in Stage 4 |
| e. Implementation | Explicit in 'Installing the New Business' step | Not explicitly acknowledged in the approach |

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Beyond these four concepts, the recent writings of Checkland and Scholes [9] stress that in parallel with the development of systems-based models which might be used to investigate tasks and issues, a 'systems intervention' demands the investigation of 'the situation as a culture'. It is suggested that this must address initially:

### j. An Analysis of the Intervention
- This is a formal process of determining the person or persons who hold the roles of clients, problem solver, and problem owner.

### K. Social System Analysis
- Social system analysis seeks to understand the continually changing interactions between the elements: roles (social positions recognised as significant by people in the problem situation); norms (the accepted behaviours which characterise roles); and values (the local standards against which actual performance of a role will be judged).

### L. Political System Analysis
- Political System Analysis includes techniques for characterising the processes used in a problem situation by which differing interests reach accommodation

Jacobson's approach and SBM are aligned with the above expectations in Table 1. Highlighted in columns 2 and 3 are the components of each approach relevant to the twelve systemic features discussed above, which are listed in column 1. Conformance to features f.-i. is not discussed further herein. Younessi et al. [6] have previously argued that object-oriented concepts and notations utilise implicitly many of the core systems thinking concepts (Emergence, Hierarchy, Communication, Control) and so both the Jacobson and SBM approaches, to various degrees, make use of those concepts. Of note however, is the explicit inclusion of cultural system analysis features (see features j.-l. in Table 1) in the SBM approach, and the extent to which SBM makes explicit the representation of issues, and their accommodation (features a. and d. in Table 1).

### Summary and Outlook

In this paper we have examined the proposal of Jacobson et al. [2] to use object-oriented modelling techniques as a means of providing a formal basis to Business Process Re-engineering (BPR). The present paper has argued that Jacobson's approach is rooted in the reductionist, scientific paradigm, concentrating upon the 'technology' of redesigning processes, but not situating that activity within an understanding of the 'soft factors' surrounding the change process. The paper has explored the suggestion that a recently developed object-oriented approach to information systems analysis, termed State-Behaviour Modelling (SBM) [6, 7], which incorporates explicitly the application of systems principles in the analysis of problem situations and construction of models, might be adapted and applied to BPR. Such an SBM-based approach has been outlined, and it has

### Table 1: Features of the Proposed Approaches

<table>
<thead>
<tr>
<th>Feature</th>
<th>Jacobson</th>
<th>SBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergence</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Hierarchy</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Presence</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Construct</td>
<td>Class/Object</td>
<td>Class/Object</td>
</tr>
<tr>
<td>Nature</td>
<td>Functional/Reductionist</td>
<td>Systemic</td>
</tr>
<tr>
<td>Type</td>
<td>Inheritance, Aggregation</td>
<td></td>
</tr>
<tr>
<td>Communication</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Presence</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Construct</td>
<td>Communication between objects</td>
<td>Messages</td>
</tr>
<tr>
<td>Intra-Object Control</td>
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<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Presence</td>
<td>Yes (Implicit)</td>
<td>Yes (Explicit)</td>
</tr>
<tr>
<td>Construct</td>
<td>Class invariant, pre- and post-conditions</td>
<td>Class invariant, pre- and post-conditions</td>
</tr>
<tr>
<td>Inter-Object Control</td>
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</tr>
<tr>
<td>Presence</td>
<td>Yes (Explicit)</td>
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</tr>
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<td>Construct</td>
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<td>Intervention Analysis</td>
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</tr>
<tr>
<td>Social System Analysis</td>
<td>No</td>
<td>Yes - Stage 1</td>
</tr>
<tr>
<td>Political System Analysis</td>
<td>No</td>
<td>Yes - Stage 1</td>
</tr>
</tbody>
</table>
been demonstrated that SBM not only possesses many of the desirable features inherent in an object-oriented formal BPR approach, but includes also cultural system analysis and makes explicit the representation of issues and their accommodation. Work in progress now seeks to apply SBM to a selection of process re-engineering problem situations with a view to formally evaluating and further refining the approach.

References:


THE TOPOLOGICAL CONCEPTUALISATION OF THE MANAGEMENT
SYSTEM-SYSTEMS APPROACH TO MANAGEMENT

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Abstract
The paper presents theoretical considerations leading to the topological conceptualisation of the formal management system that includes such categories as: organisation, goals, organisational cells, management organisation and organisational links. Presented are basic relationships between such philosophic disciplines as: ontology, axiology, epistemology and methodology used then to derive the following categories of contemporary philosophy's instrumentarium: things, processes, events, relations, attributes and sets. These categories are used to attempt to define such general abstracts as: structure, a whole, compliment, system and interrelationships. As a consequence presented is a topological conceptualisation of organisation, its characteristics and a formal and real organisational structure i.e. the extended definition of organisation. Supplemented with functions of management the definition is a basis for determining a management system, as a triple including mereological sets of formal rules of management and of really used methods as well as and ordered set of relations between the rules and the methods.

Introduction
The present paper is an attempt to conceptualise the management science proposed by L. Krzyzanowski [4] on the basis of topology. However the full presentation of all his theoretical considerations and results obtained goes beyond the scope of the present publication and therefore we will discuss only, in our view, the most essential definitions and implications which could enrich the present knowledge of management.

This is not easy to sort out what are foundations of some scientific discipline and what are its developments. Leaving this question open here we agree that these foundations should contain some basic (primary) notions and assertions having the nature of general philosophic assumptions. Among them of particular importance are ontological assumptions which express the researcher's viewpoint, thus resulting in taking definite epistemological assumptions which will then be used for developing and objective knowledge about the world that surrounds us. In the epistemology assumptions exert and influence on research principles and methods applied i.e. on the methodological approach and instruments. Moreover the interrelationships between the ontological, epistemological and methodological assumptions are not one-way, yet they can do appear in the opposite direction. Furthermore the above mentioned philosophic disciplines may be set to compliment one the others, figure 1.

Selected ontological categories
The contemporary philosophy usually distinguishes as fundamental the following categories: things, r, processes, p, relations, r, attributes, A, and sets, S. All these (and other unmentioned here eg. phenomena, facts, status quo) categories as well as purely intentional constructs of human thought (whole, part, element, structure, system) may be treated as
objects in the epistemological sense if they are separable as such by proper acts of cognition and if we can distinguish them from other objects and if we can indicate something of them and if they are indicators for something else.

However the status of an object in the ontological sense may be bestowed upon some of this categories namely upon those which have an ontic reference i.e. to some objective elements of real (material) existence. The object in the ontological meaning is such part of real universum which not only can be distinguished as a single (unit)

![Diagram of interrelationships between the philosophic disciplines](image)

In spite of all we distinguish the two basic types of relations:

I. **Relationships**, T, indicated as those observed between two or more objects in the epistemological sense.

II. **Interactions**, Q, occurring in reality between two or more things.

III. **Attributes**, A, (properties relative) are exponents of products of the above relations and used to value subjectively the relations in reference to their arguments.

IV. **Sets**, S, may either be constructed as:

- **distributive sets**, S_d, also called topological sets, being collections (classes, families, types) of objects-elements distinguished and classified to these sets on the basis of sharing by them at least one joint attributes, **collective sets**, S_c.
named also mereological sets \[6\] such as a whole (compliment aggregate) composed of things which are its parts.

**Selected epistemological categories**

The term structure is one of the most fundamental epistemological category. Though it is widely used and gives name to a number of structure-related terms such as structural, structuralisation, structuring etc. and perhaps because of that it is still ambiguous and vague. In the present paper we adopt the following definition: terms such as structural, structuralisation, structuring etc. and perhaps because of that it is still ambiguous and vague. In the present paper we adopt the following definition:

by a structure, \( \text{STR} \), of the object \( P \) we mean a set of relations determined on the set of elements of the objects:

\[
\text{STR}(P) = \{R_b, \{e(P)\}\}_d
\]

considered as a distributive set.

<table>
<thead>
<tr>
<th>Category Name and Symbol</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>thing, ( r )</td>
<td>real objects</td>
</tr>
<tr>
<td></td>
<td>(ontological category)</td>
</tr>
<tr>
<td>process, ( p )</td>
<td>real non-objects</td>
</tr>
<tr>
<td>event, ( o )</td>
<td>real non-objects</td>
</tr>
<tr>
<td>relationships, ( T )</td>
<td>intentional objects</td>
</tr>
<tr>
<td>interactions, ( Q )</td>
<td>real objects</td>
</tr>
<tr>
<td></td>
<td>(ontological category)</td>
</tr>
<tr>
<td>attributes, ( A )</td>
<td>relative attributes</td>
</tr>
<tr>
<td>properties, ( D )</td>
<td>real non-objects</td>
</tr>
<tr>
<td>distributive sets, ( S_d )</td>
<td>intentional objects</td>
</tr>
<tr>
<td>collective sets, ( S_c )</td>
<td>high-rank objects</td>
</tr>
<tr>
<td></td>
<td>(real, if real components)</td>
</tr>
</tbody>
</table>
Another structure related notion is a concept of a whole which maybe put as:
A whole, H, is any object, P, composed of elements (parts, components), e, related with the object by inclusion links ie. a collective set of elements which constitute the object:

\[ H = \{e(P), R_{in}\} = \{e(P)\}_c \]

where the subscript c stands for collective.
In the literature we may come across the term complement which is somewhat different than the whole:
A complement, CPL, is any object, P, composed of elements, e, ie. the set of elements interrelated by complementary links, \(R_{cpl}\):

\[ CPL = \{e(P), R_{cpl}\} \]

However the focal term in management theory is a system which in the topological sense can be defined as a pair:

\[ SYS = \{e(P), R_{ord}\} \]

which is a set of elements, e, distinguished within any object P with respect ordering relations \(R_{ord}\) and that express a sort of ordering.

The above mentioned objects are a necessary condition to define any organisation ie. it will always be some object in the form of a whole or a compliment either a system, however, it will also contain some new quality ie. cooperation links.

By an organisation ORG we mean a goal-targeted real object P which is an ordered collective set of elements, e, which cooperate one with the others:

\[ ORG = [G, \{e(P), V\} \]

where: G is a cluster of goals, V-cooperation links.

The cooperation links contribute to the appearance of the synergy effect, \(EF_{syn}\), defined as a difference between the effect, \(EF\), gained by the real object, P, consisting of elements, e, related by the cooperation links, \(V\), and the sum of effects gained by the same elements, e, acting on the non-cooperation basis:

\[ \mu( EF_{syn} ) = \mu[EF(e(P)), V] - \sum_{e} ef(e) \]

where \(\mu\) is some measure of the effect.

If the difference is positive we deal with synergy if not we have dissynergy. So attaining the synergy effect is a sine qua non condition for setting up, existence and development of any organisation.
Organisational categories
In organisation theory much attention is devoted to the issue of goal. Though the question is widely discussed by any management book e.g. [2] or [7] the goal category turns out too general, ambiguous to be operationally used. In the English literature this concept is identified with the seven categories: ideal, aim, purpose, objective, goal, target which are given quite different meanings and interpretations. In this paper we accept the following definition of the goal. The **goal** is a future desired state or outcome of the organisation (system) determined in terms of objects and subjects, which is reachable and to reach by some date or over the period within some planning interval. Each organisation simultaneously strives for a number of goals which form a “cluster”. Dependent on the organisation the clusters may include various often competing goals. Narrowing the class of organisations to economic organisations, strictly, enterprises, we may distinguish in their cluster of goals at least the three sorts of goals: production goals, financial goals and social goals.

The performance of the goals runs in the, organisational cells which are components of the organisation and defined as:

the organisational cell, $k_o$, is the least unit, capable of independent realising a definite job, which is a collective ordered set of human and equipment carriers, in which one of the human carriers acts as a controller:

$$k_o = \{\text{nd}_{hc}, \text{nd}_{eq}\}, R_{in}, R_{ord}$$

where $R_{in}$ stands for inclusion relations between the carriers, and $R_{ord}$ ordering relations. Contemporary enterprises are usually made of several, at least, up to hundred of organisational cells. Hence the management of such an enterprise may be defined as a set of controllers $K$, located on a number of levels over the real sphere of the organisation fig.2.

![Management levels](image)

fig.2 Multilevel structure of the management, decisions, performance information, D decision makers, SC service cells, TC staff cells.
Management System

The organisational cells in the real sphere together with multilevel controllers build over them K, constitute widely understood material components of the organisation. On their set the following relations may be distinguished:

I. Inclusion, $R_{in}$
II. Membership,
III. Ordering links: horizontal, vertical and slant,
IV. Hierarchy and subjectivity, and finally
V. Cooperation.

The above mentioned and other various organisational relations $R_{org}$ stretched over material components of the organisation together with their attributes usually described as organisational charts represent a formal organisational structure:

By a formal organisational structure $\text{STR}_{\text{form}}$ we mean a set of organisational relationships $R_{org}$ defined on the set of organisational cells in the real sphere and under management:

$$\text{STR}_{\text{org}}^{\text{form}} = R_{org} (C_{Or}, A_{P_{\text{man}}})$$

So the organisational structure is rather a collection of predicates ie. indicators, regulations and rules determining formal and potential relationships between the organisation components.

The formal structure reflects a postulated organisational communication network. Defining the term of an organisational link as postulated formal organisational relationships $R_{org}$ and real interaction filling channels of the communication network:

$$V = [R_{org}, Q]$$

we are able to determine a real organisational structure $\text{STR}_{\text{org}}^{\text{real}}$ as:

$$\text{STR}_{\text{org}}^{\text{real}} = R_{org} (C_{Or}, A_{P_{\text{man}}})$$

where $C_{Or}$ and $A_{P_{\text{man}}}$ are defined as before.

The above considerations allow us to attempt to synthesise a definition of a management process in its preparatory stage as:

$$\text{MAN}_{\text{prep}}^{\text{stage}} = [A_{P_{\text{man}}}]Q_{\text{org}}^{\text{plan}}[G, Q_{me}^{f}, R_{org}(C_{Or})] \xrightarrow{\text{EN}}$$

and in its realisation stage as:

$$\text{MAN}_{\text{real}}^{\text{stage}} = [A_{P_{\text{man}}}]Q_{\text{con}}^{\text{mot}}(C_{Or}) \leftrightarrow \text{EN}$$
Management

where: G - a cluster of goals, $Q_{\text{org}}^{\text{plan}}$ - planning and organisational decisions, $Q_{\text{org}}^{\text{f}}$ - future material and energy interactions, EN - environment, SS - social system, $Q_{\text{con}}^{\text{mot}}$ motivation and control interactions.

The management is an integral part of a management system of an organisation and hence maybe defined as an ordered (coherent, mutually consistent) set of formal rules (principles, patterns) and a set of really used methods (ways, techniques, procedures) for planning, organising, motivation, and control:

$$SYS_{\text{man}} = [RUL_{\text{form}}^{\text{man}}, MET_{\text{real}}^{\text{man}}, R_{\text{ord}}]$$

where: $RUL_{\text{form}}^{\text{man}}$ is a set of formal managerial rules and $MET_{\text{real}}^{\text{man}}$ contains really used managerial styles, technologies, techniques and procedures as well.

Conclusions

It seems that the above presented theoretical proposals of formal definitions of the basic notions constituting management science are a significant step toward the establishment of a general system management theory. Solidly based upon formal system and control theories it would become a starting point for the automatic designing of the management system for any organization.

References

THE ESTABLISHMENT OF A “SYSTEMS THINKING” USER GROUP.
The need for a networking forum to enable the business community to be aware of methods to address critical business problems through participative problem solving based on a systems thinking approach.

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Abstract.
Almost everyone at times feels the need to have a way to discuss their ideas, doubts and problems with others with similar interests. The need for a forum where practitioners and theorists of “Systems Thinking” ideas could discuss items of interest in a non threatening, non competitive way has been realised for a number of years. In 1988 the Professor and Head of School at Curtin University convened the “Machiavellian Society” which met regularly for a few years. A subsequent initiative has been a group of interested individuals introducing the idea of a “tipple” lunch, with TIPPLE standing for The Information Professional’s Pleasant Lunch Experience.

It would seem from these two initiatives that there is an ongoing need for some contact between people interested in this area, but that this need seems to be met by a fairly cyclic response from people prepared to organise a forum for such contact and interaction. This paper addresses the stimulus for a new initiative for such an interest group, describing progress to date and some of the factors which can be seen to influence the perception of success.
THE ESTABLISHMENT OF A “SYSTEMS THINKING” USER GROUP

Introduction

All common interest groups at times feel the need to have a way to communicate their ideas, doubts and problems with others of similar interest. The Australian Computer Society, for example, supports and encourages a number of Special Interest Groups (SIG’s) which provide people with forums in which they can meet and address common interests. These interests can be physical (Women in Information Systems, Young ACS), product oriented (WA Unix Systems Group), or methodological (Object Oriented SIG). This Australian Systems Conference recognises this need in its theme, where the conference aims to “provide a forum to allow practitioners and theorists of systems thinking to come together and share their skills and knowledge.”

The Western Australian business community is one of the most physically remote business communities in the world. It is over 1500 kilometres from any city with a comparable population (approx one million people), and 3000 kilometres from any national capital city. There are very limited opportunities for business people to “network” with others involved in similar areas of problem solving, business application, approach and methodology, partly because of the isolation, and partly because the people involved in some cases see themselves as competitors for a small market share. The excellent availability of communications in Australia with phones, video conferencing and Internet access worldwide does not appear to completely fill the need for this “networking” and there appears to be an ongoing need for personal contact between people involved in common interest areas.

This need seems to be met by a fairly cyclic response from people prepared to organise a forum for such contact and interaction. This paper addresses the stimulus for a new initiative for such an interest group in the field of Systems Thinking, describing progress to date and some of the factors which can be seen to influence the perception of success.

History

The “Systems Thinking” approach was probably first brought to Perth by Professor Bob Galliers in the early to mid 1980’s. Bob had studied under Peter Checkland at Lancaster and subsequently conducted a number of consultancies in Europe. He introduced the Soft Systems Methodology into postgraduate programs at Curtin University and into a number of business and government organisations. Graduates from the courses and the organisations found of use this Methodology and other variants of the systems thinking approach, and were interested in discussing its application further. In 1988 Professor Galliers convened a meeting of interested people who had a background in the “Soft Systems Methodology”. This group called itself the “Machiavellian Society” and met regularly for a few years. When Bob Galliers took up a post at an English university, there was no immediate successor to carry it on and the Society ceased having meetings.
A subsequent initiative has been a group of interested individuals participating in a “tipple” lunch, with TIPPLE standing for “The Information Professional’s Pleasant Lunch Experience”. This more social version of the Machiavellian Society filled the need for some contact between interested parties, but the delights of Western Australian wines sometimes made the excellent interchange of academic and practical ideas less clear in the memory than is desired.

Curtin University’s School of Information Systems continued to include Systems Thinking approaches in its courses and staff at Curtin made contact with some graduates from Hawkesbury Agriculture College near Sydney. Hawkesbury had for some years adopted Checkland’s SSM approach in its teaching, research and consulting in the agricultural field and had contacted Curtin for assistance to some of its postgraduate students who were working in Western Australia. This contact developed and the two groups found much common ground which they had not previously been aware of, between the applications of the approach to information systems and agricultural applications.

Conception

From this relationship, an informal group of Hawkesbury and Curtin graduates and students established a forum where they would run a session with postgraduate students from Curtin to discuss applications of the approach within and beyond Information Systems. This was so successful that it became a regular part of the syllabus in units in the Postgraduate Diploma of Information Systems at Curtin. A number of other unofficial activities such as lunches and dinners developed on a very informal irregular basis. Developing from a very successful one of these on the Thursday before Easter in 1994 came the suggestion that something more formal and regular be established to take the benefits of such discussions to a wider audience. The quality of the wines from an unspecified Western Australian vineyard have been claimed to have had some influence on this rash suggestion, but nonetheless it was taken further.

Implementation

A number of formative meetings were held with the aim of agreeing a goal, a format and target audience. The Soft Systems methodology was used to help agree the purpose of the group and where the members wanted to get to. Two firm requirements were agreed early on in the process. One was that the group wanted to be seen as a group of practitioners, and as such did not want to be too closely associated with a University with the danger of being labelled too academic in their approach (this in spite of the fact that a number of academics were members of the formative group). The second was that the group wanted to maintain the breadth of interest which had been created by the contribution from the Hawkesbury Agriculture College graduates and did not want to become a special interest group of a society such as the Australian Computer Society, despite the considerable financial and organisational benefits available from such sources.
Achievements

From these formative meetings a number of activities were agreed and held. All formal sessions ran from 5.30pm to 7pm and were followed by periods of up to two hours of socialising and networking.

The inaugural meeting at Hollywood Hospital in August 1994 commenced with a short presentation on approaches and techniques which may be included in the term “Systems Thinking”. The group then divided into three separate discussion groups to address the question: “What are the essential components of any Problem Solving Situation?” These groups were facilitated by formative members of the group. Following these group discussions the results were collated and discussed by a panel.

The second meeting was held a month later at the Health Department theatrette, near the Central Business District (CBD). A member gave a presentation of the business applications of the Soft Systems Methodology (SSM), particularly in the field of agriculture and irrigation in primary industry and water usage in country towns. The group went through a case study which addressed the problems of water usage in a country town in WA and showed some of the SSM models and definitions from that study. The change of venue, parking problems near the CBD, and a clash with a Computer Society activity, caused a number people to arrive late. While this was not a problem to the presentation and discussion, it was agreed that the Hollywood hospital venue, away from the CBD was preferable. Following the presentation, a written survey was conducted of attendee’s reactions to activities so far, and their wishes for further activities. The results of this survey are discussed in the section Survey and Evaluation in this paper.

At the October meeting at Hollywood hospital, a consulting principal with the DMR Group presented an outline of DMR’s Business Process Redesign approach. This meeting was attended by about twenty five people, and was a very lively discussion both during and following the presentation, on the common factors in “successful” interventions of the BPR type, and in the definition of “success”.

In November, two Workplace Change Consultants from the WA government’s Department of Land Administration (DOLA) presented their experiences in piloting Quality Customer Service in the Client Services Branch of DOLA. This presentation attracted a very participative group of about thirty attendees. The audience response was interesting with a lot of discussion about the terminology, particularly TQM, QA and BPR.

It was agreed that there would be no more business sessions for the year and that the formative members of the group would have a pre Christmas dinner. At that and during the Christmas period members discussed appropriate formats for 1995 activities. The group decided that it would address a suitable business problem which would give participants the opportunity to see methods and techniques in use, to share practical hints and ideas, and to experience a number of different approaches. It was agreed that a forum of attempting to assist an organisation with a business problem would be an opportunity to achieve this.
The Small Business Development Corporation (SBDC) is a WA state government funded organisation. At the March 1995 meeting, an SBDC consultant presented the problem that “There is a feeling of unease about the number of small businesses in Western Australia which fail soon after their commencement”. This problem had been brought to the Systems Thinking group’s attention by three formative members of the group. These three facilitated the session as a single group participation session to address the stated problem. With the consultant on hand to clarify the problem boundary, and a lot of animated discussion about a suitable technique, the evening resulted in a “fishbone” style diagram of factors, relationships and commonalities inherent in the problem. It was agreed that there should be a follow up session to take this further, and that there would be benefit in applying the “Strategic Choice” methodology, partly since it was known that John Friend from the UK, the author of books on this approach, would be in Perth later in the year.

The results of the March meeting were sent out to all members and a follow up session scheduled for early May at Hollywood Hospital. Again the SBDC consultant attended, but this time the participation was led by a lecturer with Curtin University Graduate School of Business. The lecturer introduced the Strategic Choice approach and applied aspects of it to the small business problem area defined at the March meeting. While the full application of the approach was not possible in the time frame allowed, the thirty or so participants agreed that enough had been covered in the evening to make attendance at the next scheduled event, a lunch with John Friend presenting his approach, more meaningful.

At the time of writing this paper the events scheduled for the rest of the year are:

- **Dinner**: a Systems Thinking dinner on a Saturday - a social, not a business event.
- **August meeting**: An evening meeting on a topic yet to be defined, hoped to be related to practical experiences in commercial application of approaches.
- **Meeting with Keith Ellis**: A keynote speaker at this conference, Keith has agreed to spend an evening with the group in September.
- **Agriculture Workshop**: A full morning workshop on Systems Agriculture with some staff from Hawkesbury Agriculture College who are planning to be in Perth attending the Systems Thinking Conference.
- **September Systems Thinking meeting**: A full afternoon comprising a presentation and discussion with staff of Hawkesbury about Systems Thinking and how it has been applied in their teaching, research and international consulting activities.

**Participant Survey And Evaluation**

During the formative meetings held to establish the Systems Thinking group, the potentially diverse nature of the group of participants was recognised. It was agreed that to cater for such a group it would be essential to obtain structured feedback from participants at meetings. The intention was that this would form part of an overall evaluation framework.

A questionnaire survey was conducted at the end of the second formal meeting of the Systems Thinking group in August 1994. Feedback was largely encouraging. In terms of “likes”, people got most out of the group participation, panel question and answer sessions, and the networking opportunities. Fortunately “dislikes” were significantly lower in number.
than likes. Complaints included, “not enough time”, “too much direction in the question and answer session”, “group participation not well facilitated” and “presentation succinct (which is good), but too short”.

When asked about the structure of future sessions there were no takers for more formality. The general view was that there should be less formality, shorter presentations, and more discussion and interaction. These views were, however, underpinned by comments which basically supported the approach and structure taken in the first two sessions. In terms of frequency, there was overwhelming support for the monthly to six weekly get togethers. There was general support for mixing more formal sessions, such as a presentation followed by a panel discussion, with more social events. There was a strong view that the group should start to tackle a real topical social/political problem and involve chief executive officers in talking about how they implement change.

The results of the survey were compiled and contributed towards a discussion paper. This was forwarded to the formative members of the Systems Thinking group in preparation for a meeting to plan the future program for the group. At the meeting there was some fairly intense exploration of several key issues that could be used as a case study; for example, the group could explore the “native forest logging problem” in the South West of Western Australia.

In conclusion it was agreed that the initial survey provided some extremely useful advice and the program was changed to reflect the activities which matched the comments made by participants.

Organisation

The development of the group has depended upon a number of essential organisational and administrative opportunities that are felt to have had a considerable effect on the success of the group meetings. Firstly, the venue is important. The one found most popular has the attributes of being a tiered lecture theatre facility which is appropriate for formal presentations, but small enough to encourage participation. It has sophisticated presentation and recording facilities which make it easy for facilitators to switch between methods of presentation and has excellent ante rooms for breaking into group discussion or for refreshments and open discussions during breaks or at the conclusion of meetings. Location is within ten minutes drive of the City with ample hassle free parking.

Timing of meetings is crucial, after work on a normal work day seems to be the most popular, with breakfast, lunch and weekend meetings being alternatives that are more likely to be overtaken by other priorities. There needs to be careful scheduling to avoid clashes with other interests, but it is impossible to avoid all clashes because of the wide range of interests of participants.

A major factor is communications with group members. The “floating” nature of attendance means that announcements at group meetings can not be relied on to get messages to all interested parties. FAX transmissions were used when the membership of the group was small but as this has grown to about 60, a simple “sticky label” mailing
system has been used. The administration overhead and costs of mailing are being covered by one member and one organisation, and this is likely to become an issue as membership continues to grow. It was decided at the commencement of the group that the production of formal membership, constitution, office bearers and payment for membership would be postponed for as long as possible, and this is still the aim.

Participation

It is useful to speculate on why special interest groups go through cycles and why membership is unstable. Examination of the activity and interest patterns of the people involved in the Systems Thinking Group, the School of Information Systems, and the Graduate School of Business reveals a phenomenon that could be worthy of further study: the rise of the individual. We look at two issues: increasing lack of tenure, and membership of multiple work and social groups.

The new style of organisation is a reality for many people. Organisations shed peripheral functions to focus on core business, remove layers of middle management, discourage tenure in favour of limited term work-place agreements, and seek to employ only post-secondary educated people with current qualifications and relevant experience. There can be seen to be an increasingly clear dichotomy between the interests of the organisation and the individuals who comprise its membership. The organisation demands team-work, commitment, and focus, and works for adherence to a compromise strategy set of core values, mission, objectives, and focused key strategies. The individual knows that the organisation’s future is in the hands of its owners, competitors, chief executive, executive managers, and the legislature and society; the life of a business or government department can be very short in a rapidly changing social and business environment. Individuals are risking much if they rely on continued employment in their present position or even the present organisation; to fully commit to present structures is to open oneself to disappointment at the very least, to probable unemployment, and to possible psychological damage.

Over the period during which management theory and practice has led to the focused, short term organisation, individuals have had opened up to them a vast range of roles, professions, subjects and special-interest groups in which they might immerse themselves. Thus a person in a profession could simultaneously be a member of all of the kinds of groups identified in the diagram below. We have excluded consideration of those focused on the home, religion, and recreation.
Other current and emerging circumstances will reinforce these pressures: the Internet has opened up new opportunities for the formation of “virtual” organisations to pursue matters of special and short-term interest - the use of the term “common interest” becomes redundant.

A similar multi-focus role emerges when we look at the concept of multi-disciplinary interests. There is an increasing demand for professional services to be applied in a manner that is sensitive to culture, ethics, moral and social values, legal constraints, and “best practice” in the industry, as well as the purely commercial drivers.

Thus, when we seek to attract membership for a special interest group, we are in competition with a huge range of other interests that the potential membership base might have. These competing interests will be managed by people having the same problems as the convenors of the Systems Thinking Group - if the organisers choose to compete head-on.

Lessons

It is felt that factors which have contributed to the success of this group have been:

- The obvious need for professional contact, networking and support.
- The establishment of a dialogue between professional systems thinkers (academics and practitioners) and their business community.
Management

• Support for problems of methodology and approach.
• Administrative matters such as availability of a suitable venue, parking, food with volunteers to arrange these on a semi regular basis.
• Availability of good, interesting, entertaining speakers prepared to be involved in participative sessions.
• Collegiality and cooperation between members.
• Lack of formal membership, payment, constitution etc. which would require an infrastructure.
• Evidence of diversity and richness of interest in the area.
• Interstate and international speakers
• Non-competitive independence from any other interest groups.

Factors which are threatening the success and ongoing existence of the group.

• Interest without participation.
• Participants and organisers fully employed (overcommitted).
• Lack of formal charter/ sponsor/ constitution - lack of formal direction statements.
• Need for wider participation from the business community - to ensure relevance.
• Threat of the “Down” side of the cycle being imminent.
• Possibility of “Factions” and Vested interests being seen to dominate.

Conclusions

From experiences so far with his interest group it would seem that the following lessons are applicable:

• On any occasion, we may be unable to understand why we have had an exceptionally good or poor turn-out - because we would have to know the array of interests of each participant and the priorities on that day.
• If we focus on applications of the theme, we have a much wider array of topics in total to draw upon.
• We are unlikely to succeed in gaining support from all of the people all of the time, and hence in attracting a large group to all our meetings.
• There will be a relatively small cohort interested in actually running the special interest group; it will consist of those people for whom the subject area has (and can maintain for a period) a higher relative priority than other interests.
• The organising group will also change over time, because the members’ relative priorities will change over time. There will be times when most, if not all, of the organisers lower the priority to such an extent that they are not able to continue, and the group will cease to exist. Hence the cyclic nature of SIG’s.

In continuing with the group activities, the following appear to be the guidelines acceptable to most members:

• Do not attempt to establish a rigid hard format for activities or to narrow the focus in a way which reduces the pool of interested participants,
• Try to resist formality, membership fees, formal affiliations as long as the size of the group permits,
• Be flexible, stay “loose” and try to survive for as long as possible and the group is more likely to be seen as “useful” to a larger group of members.
HUMAN SYSTEMS WORKING WELL: LEARNING ORGANISATIONS

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Abstract

Organisations are human systems and examination of organisational life needs to be systemic and from a human perspective. Readers are introduced to effective organisational learning culture as a critical factor in organisations working well as human systems within society.

Learning and development are increasingly valued and practiced in many organisations. However, the perspectives taken are often too narrow to adequately deal with the demands of operating in a complex and turbulent environment.

People learn most things through experience. What, how much and how well they learn is closely related to the quality of the learning culture in the organisation. A definition of learning is developed to underpin discussion and examination of organisational learning culture. Using that definition as a basis, organisational learning culture is defined.

Developing organisational learning culture is about developing optimum conditions for effective learning within agencies, at individual, team and organisational levels. Organisational learning culture impacts on and interacts with its structure, work practices and management values. It challenges existing attitudes and practices and leads to individual and organisational change.

Characteristics of effective learning culture, defined and tested through action research, are described. Developing these characteristics in an organisation requires conscious effort to change. A number of starting points and a wide variety of strategies can be used to develop and improve organisational learning culture.

The aim of the starting points and strategies outlined is to create organisational climates that provide context and motivation for continual effective learning by individuals and organisations, and provides formal, informal and incidental opportunities for learning.

Developing effective Organisational Learning Culture is a critical factor for organisations in cultivating their human resources, and in moving beyond survival to growth and the provision of high quality services and products.
Introduction

This paper reports some of the findings to date from work-in-progress on organisational learning culture. The ideas presented arise from work with a range of organisations in the government, private and community sectors, and specific action research within the community services industry. The action research project is reported in detail in Kempin, 1994.

Underlying concepts and principles applied in the paper also draw upon other research and theory in the areas of organisational change and learning.

Many commentators including Dunphy (1981), Kanter (1983), Senge (1990), Pedler, Burgoyne and Boydell (1991 and 1994) and Limerick and Cunnington (1993), have examined innovative practices and structures in organisations. Also, writers such as Argyris (1990), Marsick (1987), Mezirow (1981), Senge (1990) and Senge et al (1994) have presented various ideas about learning and how it occurs in organisational contexts.

A common theme running through these sources is a systemic approach which views peoples’ behaviour, attitudes and needs as critical. In line with this, my view is that organisations are human systems, and examination of organisational life needs to be systemic and from a human perspective.

Learning is increasingly valued within many organisations. However, the perspectives taken are often too narrow to adequately deal with the demands of operating in a complex and turbulent environment. This paper begins to explore some of the issues involved in developing learning cultures that enhance organisations’ capacities to operate well as human systems, achieve quality outcomes and to have a positive role within society.

Learning culture is a major determinant of individual and organisational flexibility. An organisation’s learning culture is also critical to determining how it relates to its social, political and economic environment. Its learning culture impacts on:

- the viability of an organisation,
- the quality of its service and products,
- the quality of work life for its staff, and
- its role in community life and society as a whole.

Following is a description of definitions and principles associated with organisational learning culture, which provide a context for introducing characteristics of effective organisational learning culture and starting points for developing them.
Definitions and Underlying Principles

The following definition of learning has been developed over time from the author’s experience, from the literature and from action research. It incorporates recognition that individual and group values and attitudes impact on learning, and also uses ideas from Victoria Marsick (1987), Peter Senge (1990) and others.

Learning is the way in which individuals and groups acquire, interpret, reorganise, change or assimilate information, skills, values, attitudes and feelings. It is the main way by which people construct meaning in their personal, social and organisational lives, and is often recognisable as an enhanced capacity to act effectively.

This definition places learning in all aspects of individual and group life and, importantly, it does not equate learning with training or education, which are specific delivery systems from which learning can arise. Furthermore, some research which suggests that over 85% of learning, by individuals and groups, occurs through processes and experiences other than formal training - mainly through experience in all settings.

Jack Mezirow (1981) and David Kolb (1984) have developed useful theories and models of how people learn experientially. In many respects Mezirow’s model can be characterised as an expanded, more detailed version of Kolb’s. Both models depict learning cycles that pass between action and reflection, activity and repose, with Mezirow’s having nine stages and Kolb’s four.

Kolb’s (Ibid.) experiential learning cycle involves the following four stages:

- Experience (Action)
- Reflecting (Observing)
- Conceptualising (Theorising)
- Planning (Deciding)

Kolb (op. cit.) also notes that people tend to prefer operating in one or two phases of the learning cycle, and develops a taxonomy of four different learning style preferences that people have.

Senge et al (1994) apply the learning cycle theory to teams, with the four stages in their team experiential learning cycle being:

- Coordinated Action
- Public Reflection
- Shared Meaning
- Joint Planning

It is my view that in the workplace, as in life generally, people learn most things through experience. What, how much and how well they learn individually, as teams and as whole organisations is closely related to the quality of the learning culture in the organisation.
Structures, functions and work roles facilitate team work, enable individual and team learning, and are responsive to service and staff needs, within clear boundaries and relationships.

5. **Reflection on, and review of models and practices are actively facilitated.**

   Individual and team reflection on practices and experience, and organisational review (at all levels) of models and structures occur regularly through a range of established processes.

6. **Learning goals are identified and acted on.**

   Overall organisational learning requirements, based on a broad view of learning, are identified. Individual and team learning and development are planned within that context.

7. **An external perspective is present.**

   Contact by individuals and teams in the organisation with outside individuals, organisations, networks, industries, and the community generally, are valued and occur regularly.

8. **Questioning, experimentation and innovative practices are actively facilitated.**

   Questioning of the status quo, innovation and new ideas in relation to models, structures and practices are encouraged within the bounds of integrity and safety.

9. **The physical environment is conducive to learning.**

   The physical environment in the workplace helps create positive energy, creativity and motivation for everyone.

10. **Openness to change and responsiveness to learning is present at all levels.**

    Change is viewed as normal and necessary for ongoing development of the organisation as an effectively operating human system, and of service and product quality.

The presence of these characteristics in an organisation strongly indicates a culture that supports learning. This is not, however, the same as a culture without disagreement, conflict or personal and organisational pain.

Disagreement and conflict between individuals, teams and areas will occur, for example, where questioning, reflection on practice, true participation and/or flexible work roles exist. In an organisation with an effective learning culture, when difficulties occur they are recognised, acknowledged and positively acted upon in ways that lead to learning and performance improvement.
A working description of organisational learning culture is:

Organisational learning culture (or climate) is determined by the conditions that exist in an organisation that support or hinder learning at individual, team and organisational levels. It is influenced by a combination of many aspects of organisational life such as management models, decision making processes, structure, work practices, organisational principles and values, physical setting, and the external environment. As such the learning culture is a critical facet of overall organisational culture.

The people who constitute the system and the various elements of organisational life combine formally, informally and incidentally to enhance or detract from the operation of the learning cycle and the interplay of individual, team and organisational learning styles.

Creating effective organisational learning culture is about developing optimum conditions for learning within organisations at all levels. A critical aspect of how this is achieved is treating organisations as a human systems, and examining organisational life in systemic ways from a human learning perspective.

The existence of an effective learning culture will challenge existing practices, structures, processes and attitudes at all levels, leading to significant ongoing change.

Characteristics of Effective Organisational Learning Cultures

There are a number of characteristics that appear to be common to organisations that positively and effectively facilitate systemic, dynamic and responsive individual, team and organisational learning. They are:

1. **Clear, shared organisational purpose and direction exist.**
   The purpose, direction and philosophies of the organisation are stated and have been developed with the participation of key stakeholders, who share a commitment to them.

2. **Effective cooperation, communication and sharing of skills are actively facilitated.**
   The organisation is a network, with an integrated, collaborative culture that supports cooperation between individuals and teams, and the open sharing of skills and information.

3. **Participation by all levels in the organisation is valued and practiced.**
   Participation is encouraged and facilitated by the attitudes, structures and processes that exist throughout the organisation.

4. **Structures, functions and work roles are clear but flexible.**
Structures, functions and work roles facilitate team work, enable individual and team learning, and are responsive to service and staff needs, within clear boundaries and relationships.

5. **Reflection on, and review of models and practices are actively facilitated.**

Individual and team reflection on practices and experience, and organisational review (at all levels) of models and structures occur regularly through a range of established processes.

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Disagreement and conflict between individuals, teams and areas will occur, for example, where questioning, reflection on practice, true participation and/or flexible work roles exist. In an organisation with an effective learning culture, when difficulties occur they are recognised, acknowledged and positively acted upon in ways that lead to learning and performance improvement.
As a manager in one organisation undertaking change towards a more effective learning culture commented; “Learning and change generate conflict, and I have learned that the processes of learning and change are often about managing conflict constructively.”

For the above characteristics to create an effective learning culture they must exist systemically throughout an organisation, and not only at the individual level or in a single team. This is not to say that effectively learning individuals or teams do not exist within a disfunctional organisational learning environment, but that they do not by themselves constitute a learning organisation and usually do not have sufficient influence to change the culture systemically.

**Implementation Strategies: Where to Start, What to do ......

Every organisation is different. They have different cultures, structures and practices and there is often no clear starting point for learning and change. My research and experience working with organisations suggests a number of common starting points. These are:

1. **Using a diagnostic process, such as a learning climate analysis, to analyse an organisation’s current learning culture and practices.**

2. **Working with senior management to persuade them to adopt learning structures and practices and to develop policies supporting learning.**

   It is critical to ensure the support and commitment of senior management to drive necessary changes.

3. **Raising the consciousness of staff and management about learning by relating it to current events and felt needs.**

   Participative processes must be used to help to reassure staff and management, and develop ownership by them of the actions, changes and outcomes sought.

4. **Working with senior and middle managers to develop them as change agents.**

5. **Using planning processes as a way to introduce learning structures and practices, and to establish them as goals for the organisation.**

6. **Piloting new learning practices and structures in one area of the organisation, and using the process and outcomes achieved as an example for other parts of the organisation.**

   This is only a selection of possible starting points, and in The Learning Company (1991:50-51) Pedler, Burgoyne and Boydell detail others. Not all of these starting points will be relevant to every situation, but one or more may.
When starting a process of developing more effective organisational learning culture, experience suggests:

- Adequate time, staff and money resources need to be allocated to support and create effective learning and constructive change.
- Clearly articulated goals to work towards, and clear, planned strategies to achieve them are important factors in gaining support from participants in any processes used.
- It is important to be realistic in what one tries to achieve and to be patient in the process of achieving it.
- Not to try to do everything at once. If people feel overwhelmed by the pace of change and feel that they are losing control, they will resist or ignore it.

Conclusion

Organisations are human systems and examination of organisational life needs to be systemic and from a human perspective. Creating effective organisational learning culture is about developing optimum conditions for dynamic learning by individuals, teams and whole organisations.

Learning culture impacts on and interacts with organisational structure, work practices, and management values and practices. It challenges existing attitudes and practices and leads to individual and organisational change.

There are a number of characteristics of effective learning culture in organisations. Developing these characteristics in an organisation requires conscious effort to change. There are also a number of starting points that can lead to the creation of effective learning cultures.

Developing effective learning culture is critical for organisations in cultivating their human resources, and in moving beyond survival to growth and the delivery of high quality services and products.

Bibliography And Selected Reading


The modern System Movement started in the middle of this century. However, these methods have not been adopted in many organisations to become part of their standard practice. It has often been difficult to obtain funds for projects using these methods. In this paper I discuss two aspects: 'do-ability' and accountability. I believe that these have been overlooked by proponents of these methods, including myself. Other barriers to adoption have been discussed elsewhere (Van Beek 1993). The paper is based on five years of experience in trying to extend these methods in Queensland.

Background

In the Department of Primary Industries, Queensland (DPI), systems-based methods were not used consciously until about 1990, except in a few projects. In most of these exceptions the expertise was supplied by consultants from what is now the University of Western Sydney, Hawkesbury campus. However, in practice many officers in the DPI worked from a holistic or 'Big Picture' concept. Interest in the theories supporting such practices has been growing since the mid 1980's. This interest made it possible for me in 1986 to test the concept of what then was called Agricultural Knowledge and Information Systems (Beal et al. 1984, Roling 1988, Van Beek, 1989). Other officers were encouraged to do the same and in 1990 the DPI Systems Study Group was formed. It became a focal point for people from within and outside the DPI with an interest in systems-based methods.

I became full-time convenor of this group till 1993 and my main project became: ‘Extending Systems-based methods to the Department of Primary Industries’. Key activities were:

- producing a small newsletter *Circles* which had a final send list of 350 while it was free of charge;
- arranging seminars with overseas experts such as Professors Peter Checkland, Professor Niels Roling and Dr. Janice Jiggins;
- conducting workshops where key methods were introduced and discussed, involving some 160 people from DPI, other departments, CSIRO, Universities, producer groups and commercial organisations from Australia, Scotland, New Zealand and the Netherlands.
- consulting and
- undertaking numerous projects.

The main aim was to popularise these methods and make them part of the culture of the DPI. We achieved this aim only in some parts of the DPI and of other organisations. I have some
doubt about how long these effects will last. In 1995 I retired from the DPI to return to the same activities, but now on a commercial basis as a trainer and consultant.

This paper is structured as a reflection on my own experiences from the last five years. It is written from my new point of view: having to sell these methods to make a living. This perspective gives substantially different insights than my previous perspective: that of a scholar. The focus then was on the theory and development of these methods, and on questions such as what represents rigour in qualitative methods (Van Beek, 1993 b).

The paper will focus on two aspects: ‘do-ability’ and accountability. ‘Do-ability’ refers to verbs which can be carried out and noticed directly, such as thumping a table, rather than to verbs which obtain effects, such as gaining attention. Accountability is part of a relationship and refers to the aspect of people having to give account of their decisions and actions when asked. These aspects came up regularly in many discussions as important in the decisions to adopt, approve and fund the use of these methods in projects. They are seen by many as problematic when people propose to use systems-based methods.

I believe that these two aspects have been overlooked in past efforts to get systems-based methods widely adopted. My readings of the early literature suggests that the initial extension and promotion of systems-based methods were dominated by a very strong reacting against reductionist methods, for instance Checkland (1984). Little attention was paid to the complementarity between the two philosophies. There was then also no mention of the substantial benefits from using them together when trying to improve many situations, as illustrated in some of the case studies of the Systems Study Group (Van Beek, 1993 c).

I have found distressingly large numbers of very intelligent and influential people who felt, and still feel, attacked by this initial anti-reductionist approach. They thus became detractors in stead of users of systems-based methods. In addition, much past and present writings about systems-based methods is focused on philosophy. This inevitably means the use of many words and difficult concepts. As a result, the detractors can easily dismiss these methods as: useless talk.

My experience suggests that systems-based methods become much more acceptable when the aspects of ‘do-ability ’ and accountability are highlighted rather than the differences between reductionists and system-based science. It encourages the focus of discussion to shift from talk to action to accountability.

Methods

The basic structure used in this reflection is based on the Knowledge Systems Approach (Van Beek 1992). The practical ‘model’ used was developed further for use in stake-holder analysis during a recent consultancy (Van Beek 1995). In this paper the word model means no more than a framework in which to place data in order to structure discussions.
The data used in this paper is drawn from personal experience and notes collected over the last five years. The criteria used for selecting this data was: to illustrate the key people and their relationships who actively participate in making decisions about using or not using systems-based methods.

The model which I suggest as a possible tool for 'monitoring' shifts from talk to action to accountability was developed by Vance and Van Beek (1995) to analyse communications between researchers and graziers.

Reflections

Most applications of systems-based methods in the rural-based situations with which I have been associated were through discreet projects. From here on, the word 'projects' will be used to refer to these situations. Each of these projects had many stake holders. Different stake-holders made their presence felt in each situation, but a number of types are common. They are given in figure 1.

FIGURE 1: Stakeholders in decision making.

This paper concentrates on the people directly involved in, or with influence on, making decisions about using or not using systems-based methods in a project. They are: project officers, their bosses, clients and administrators of funding organisations. Each group has legitimate duties of accountability under the democratic system of administering public...
funds in Australia. They also have legitimate organisational and private goals to pursue. Peers, client representatives from industry groups, and systems scientists often have a strong influence as well, through providing advice and professional endorsement.

Project officers are the people who carry out the project. They may or may not know much about systems-based methods, but invariably they must be seen to take action. They are often accountable in three directions: to bosses, clients and funding authorities.

Bosses may or may not be sympathetically inclined to the philosophy and use of systems-based methods. However, almost invariably they are held accountable by their own superiors for being seen to achieve results. Also looking over the shoulder of every senior boss are auditors and officials from treasury departments as they are accountable to stay within accepted rules, especially financial ones. Budget limits loom large in the minds of bosses, as do pressures to deal with countless details and deadlines, few of them trivial.

Client representatives are the people who, on behalf of all clients, are members of boards, advisory groups or committees, be these of funding organisations or of the project itself. Some representatives are clients, but many are professionals employed by client groups and organisations. Their accountability looks simple, but their own interests, to which they are also accountable, are often complex, diverse and hidden.

Clients are the people who are supposed to benefit from the projects. Mostly they do. Many clients are intuitively attracted to systems-based methods. However, being managers of complex systems, they have to balance investments in this project with other pressing needs in an era of limited money. They thus have a legitimate need for early visible action and products, and for confidence in obtaining benefits within a reasonable time limit.

Administrators of funding organisations are responsible to Boards of Management and / or CEO's of organisations which fund projects in particular areas. Funding can be by the organisation to which the project officer belongs, it can be by clients or organisations of clients, or it can be by specially created organisations such as the Rural Industries Research and Development Corporations and the National Health and Medical Research Council. Some funding is by combinations of these organisations. In an age of accountability, the careers of the fund administrators are seen to depend on their accountability. The administrators thus place a very high value on achieving visible milestones at preset dates. Many believe that this can only be done by specifying the project in fine detail prior to it being approved for funding.

Peers of all the above stakeholders, but especially of the project officers, are amongst the less visible stakeholders. Peers are often invited to comment on the use of systems-based methods, but also often buy into discussions without being asked. Peers have a great influence on the careers of professionals and the social standing of clients. The dominant values in many peer groups in agriculture and rural sciences appear to be based in reductionist science, in philosophies of 'management by control' to achieve pre-set
objectives, and in believes in ‘strong’ leadership based on knowing the ‘right’ answers and not asking doubt-creating questions.

Systems scientists provide theoretical support for many, but by no means all, systems-based methods and techniques. This support is too often in a language which is beyond the understanding of most of the people I have worked with (frequently expressed as: ‘That bl..dy language’). Many systems scientists are strongly influenced by, and accountable to, the academic world. This appears to have set the tone of the literature about systems-based methods in which Journal articles and Masters and PhD’s theses are very visible.

Communication between these stakeholders is complex, as the different groups concentrate on different aspects of project proposals. Some focus on the design and theoretical soundness, while others focus on effects and outcomes.

Looking back at the ‘do-ability’ of many project proposals, we could have benefited from using a model to analyse communication, such as the one given in figure 2 ‘Categories to Analyse Communications’.

FIGURE 2: Categories to Analyse communications

The categories are based on the following differences between utterances:

- Pre-actions refer to things that precede actions, such as observing, describing, monitoring, comparing.
- Actions refer to things that are do-able and visible in the real world such as conduct semi-structured interviews, survey 1000 people, write articles.
- Effects are the result of actions in the real world such as the end of a conflict, funds obtained.
- Restraints/opportunities limit the choice of, or create the opportunity for, decisions to act.
• Goals are long term outcomes of actions and are generally not observable such as achieving sustainability, secure income, harmonious working relations.
• Research is about the design, conduct, communication and management of research.
• Decisions are about the criteria and processes used to make long term decisions.

The categories can be numbered and subdivided further. Many communications can be coded by looking for sets of words which belong together (called an ‘utterance’). These can be counted and tallied. This provides a subjective, but ‘out-in the-open’ and discussable, assessment of where the emphasis of a document or discussion lies. It then becomes easier to balance a draft document such as a project proposal by include ‘utterances’ which serve the needs of other key stake-holders.

In retrospect, many of our statements in early discussions and writings in the Systems Study Group fell into the Research-Goals-Restraints (on our type of research) categories. Much of the systems literature falls into the same categories, with some noticeable and valued exceptions such as Jim Wilson (1988). In many of our project proposals we did not sufficiently balance these with statements in the categories of Preactions-Actions-Effects, where the main and legitimate interests of many key decision makers are.

Conclusion

Common amongst most key stakeholders is a need for early action and visible effects. Therefore, in order to get funds to use systems-based methods, we need to put together proposals (in plain English) that consists of:

• early visible actions
• which will demonstrably help achieve desired effects
• as well as identify suitable follow-up actions, and thus
• are likely to contribute to stated goals,
• given current restraints and opportunities.

We also need to assist these key stake-holders in fulfilling their accountability requirements. This has often required no more than to present time tables based on visible actions, rather than on achieving outcomes. In past projects we also learned the need to include in the proposals dates to re-negotiate project details as we learn from the findings of these early actions.

We claim that systems-based methods are very suitable for use in complex situations. Obtaining funds where there are seven or more decision makers is clearly such a complex situation. Meeting the above requirements should therefore cause no major difficulties.

In retrospect I find it ironic that it took me five years and a change of perspective before I fully realised the importance of these aspects. I hope that this paper will help others to learn faster than I did. My recent experiences suggest that we can indeed make the shifts: from talk to action to accountability.
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USING A STAKEHOLDER APPROACH TO DEFINE SYSTEM BOUNDARIES OF BUILDING PROJECTS

K.A London & W.D McGeorge

Abstract

'Messy' ill-structured problem situations (Checkland, 1990) are prevalent in the building industry. One such dynamic problem situation is the evaluation of building performance after occupation. An emerging trend in the construction industry is the appreciation of project stakeholders and the varying impacts and influence they have on project success. The design, construction and occupancy of each new building project involves numerous and various stakeholder groups of users and producers - who tend to evaluate the building with their own agenda in a disjointed nature. Building evaluations have been an attempt to systematically bridge the gap between the systems of the producer and user groups. Some environmental design researchers in the past when developing models for the Post-Occupancy Evaluation (POE) have advocated a 'systems approach'. Various researchers have suggested that such a holistic approach as this is critical to the future development of the POE. The systems approach has had various interpretations however, many seem to emphasise a problem formulation stage including identification of the various system stakeholders and their objectives. In this way the stakeholder groups and how they view the problem is the starting point in defining the boundaries of the problem. The stakeholder approach advocated is the theoretical framework used to structure and define the boundaries of the building environment evaluation system. Generally POEs have been carried out as an independent activity post construction. Researchers have commented that one of the difficulties experienced when evaluation is seen as an activity independent of the design and construction processes is in trying to compare the expected performance against the actual performance - as in many cases the original set of objectives - if it can be identified is 'blurred'. The proposed paper identifies the major factors affecting the stakeholder approach to building performance evaluation and discusses how these can be accommodated in a practical post-occupation evaluation technique.

Keywords

Systems approach, stakeholder, building, post occupancy evaluation
Introduction

Building projects are characterised by numerous stakeholder groups - those who are affected by and/or who affect building projects performance. Distinct groups within the building construction industry forge project teams - often across organisations and in a non-routine manner to produce buildings. Coupled with this diverse groups - generally outside the building construction environment use a building to ‘house’ their organisational activities. A building project life cycle typically follows a structured sequence of activities of feasibility, design, construction and occupancy, possibly evaluation followed by refurbishment and then further occupancy and finally decommissioning. During this life cycle various stakeholder groups move in and out of this system as the project dictates (London et al, 1995). The dynamic nature of a project's total life cycle whereby numerous stakeholders are involved in making decisions and solving complex problems certainly belies this accepted structured sequential description of activities. Although all buildings in their ‘production’ experience similar phases a project will have a unique set of endogenous and exogenous factors and participants that impact on its success in terms of building performance. As well during occupation building's undergo environmental change as they physically age and deteriorate. Coupled with this, the occupants of buildings and their various organisations undergo functional and cultural change with time which results in changes to their building environment. With such an ever changing system there is little wonder that the evaluation of a building’s performance post occupation is a ‘messy’ and complex problem. Who evaluates...what...and when? Seldom is a classical research evaluation technique of pre-test/post-test of decision making applied rather the key participants often engage in a post rationalising exercise. In so doing often evaluating from the confines of their own ‘world view’. Architects measure success in vastly different terms than clients who in turn perceive the building differently to contractors.

Figure 1: Stakeholders on Building Projects
Systematic Building Performance Measurement

Systematic evaluation of buildings is certainly not a commonplace initiative in the building industry in Australia at the moment. Seemingly it is an activity more suited to large organisations responsible or involved in a repetitive building program, for example government agencies with a property portfolio, organisations who own multiple facilities, large contracting organisations or large architectural consulting firms. In recent times with a global emphasis on the quality assurance concept whereby organisations provide assurance of the quality of their service or product - the measurement of a building’s performance which can represent both service and product may well become a commonplace adjunct to core businesses of design and/or construction. Cultural shifts such as this can alter the building industry environment which in turn affects building performance measurement. Pegrum and Bycroft considered the effect this industry shift has had on building performance evaluation in Australian state and federal government agencies (Pegrum and Bycroft, 1989) and summarised some important assumptions that affect a valid perspective of the building performance evaluation model.

1. The design process is assumed to be open-ended, and the design of buildings must be looked upon as a circular process and not a linear one which ends at the construction of the building.
2. Evaluation to be most effective should be an integral and accepted part of the design decision making process and not an independent invasive activity designed to lay blame.
3. In order to produce worthwhile feedback, the evaluation must look at the total design decision-making process, not just the results of the process, and it must use evaluation criteria that reflects issues which were in fact requirements during that decision making.
4. The results must be presented in a form that is understood and acceptable to the designers or other users of the information.

We might add two others...

5. Feedback from evaluation research is most useful when it is asked for by those intended to use it.
6. Evaluation will be most effective when an environment conducive to evaluation is created.

We contend that the reason for the poor uptake in the application of systematic building performance evaluations has been due to the receptiveness of the key decision makers. Information from the users of buildings about the building’s performance in-use is invaluable to decision makers, such as clients, designers, facilities managers, contractors.
regulating authorities and clients, who are responsible for the design, construction or management of the built environment - but if the stakeholders for a project comprise only the producers and not the users then it is unlikely that information of a behavioural nature will find a receptive audience. A "push pull" type of relationship between users and producers is required, which is likely to lead to both groups demanding better decision support tools to improve building environments (McGeorge et al., 1994).

Various conceptual and procedural models have been devised and implemented over the years (Law, 1981). Many models have concentrated on improving techniques however, the more enduring models have emphasised a holistic view first and the importance of an overall strategy for assessing building performance. The need to determine and capture stakeholders' project objectives at the outset of a project has been identified - although few have managed to carry this through. It is probably opportune to take heed of Eden and Radford's advice for tackling strategic problems such as this. 'In recent years it has become accepted wisdom that strategic issues cannot be dealt with by some form of routine strategic analysis, but rather that they involve the design of a strategic thinking process.' (Eden and Radford, 1990). Therefore instead of prescribing a 'routine strategic analysis' for evaluation of buildings post-occupation we advocate a strategic thinking process with the framework being an explicit exploration of a stakeholder approach to evaluation.

Stakeholder Approach

Although generally an uncommon concept in the building industry the stakeholder approach is not new to management practitioners and theorists. The actual term has been in vogue in literature since at least the early 1960's. There is literature in the fields of organisation theory, strategic management, business ethics and public policy evaluation which discuss the stakeholder approach. These diverse streams are in agreement on the fact that organisations providing/selling a service/product do not function in isolation and that they must consider the influence of specific constituent groups on the attainment of their objectives. However, this is where the common ground ceases to exist and the issue of how to respond and 'manage' these various groups is approached in a varied manner. Strategists have considered stakeholder groups as constraining factors that need management but would not be directly involved in the strategic management process (Gomolka et al., 1990). This has in the past placed an emphasis on the fact that these factors can be predicted and manipulated by a chief decision maker. In more recent years systems theorists have approached problem situations with the view to involving customers, actors or owners in a never-ending enquiry process about the problem situation in order to improve it. (Checkland, 1990). Various public policy (including social welfare
and education) evaluators have approached the problem from a collaborative perspective and directly involved stakeholders in their problem situations. This strategic management vs multifiduciary dilemma to stakeholders has been identified and discussed and it is significant that this dichotomy exists within the construction industry. Decision makers involved in the design and construction of building projects have been making decisions about building performance issues on behalf of users - often with little or no consultation. These decisions can be invalid and arbitrary and may continue to be so unless we listen to those that are left with the legacy of our decision making for years to come. The Building Performance Research Group at the University of Newcastle is currently trialling a unique stakeholder approach.

Factors Affecting Stakeholder Approach
Already we have experienced a number of factors that affect this innovation - factors that will ultimately contribute or negate its effectiveness. The project stakeholders themselves will affect a stakeholder approach to evaluation - their past experiences individually and/or collectively. Linked to this is the stakeholder group synergy or lack thereof which encompasses the commitment of the project team and the users of the facility to the concept. The contractual relationships between the parties and various stakeholders’ organisational factors will contribute to such an initiative as this. Communication and information management systems between project team members is another critical component in this system. The project and its evaluation in turn sits against a backdrop of a range of external or system environment issues. As mentioned previously the culture of the whole building industry can affect initiatives ‘taken’ up within the industry - this can be affected by national and international economics. Factors seemingly more remote like societies expectations/trends can alter the evaluation of a building’s performance. A project specific post occupation evaluation technique is now considered within the context of these constraints.

Project Stakeholder Evaluation Group
Capturing the diversity and commonality of opinions from stakeholders regarding building performance evaluation is critical - albeit difficult. Some post occupancy evaluation programs implemented in the past have attempted this yet when information was captured much of it did not feedback to those most likely to use it. To overcome this and other difficulties outlined previously it is proposed that an identifiable project specific stakeholder objectives evaluation (PSE) group could be formed at inception of a building project rather than when the building is finished. The group is designed explicitly to
evaluate building performance and obtain feedback for future projects thus bringing immediate relevancy to the evaluation process. The identification and involvement of key stakeholders would be critical to its success. One of the key issues is that stakeholders from both the users and the producers group of the specific project would be involved. The problem of building performance evaluation is formulated and defined by the PSE group for the project. In this way stakeholders' project objectives are identified and explicitly stated so that expected performance can be captured and measured against actual performance later on and as well decision makers may be more receptive to feedback if they've been involved in the total evaluative process. During the design and construction of a project changes often occur to the original project objectives resulting from environmental conditions, project specific factors etc. Ideally the project PSE group identifies mechanisms to allow for the monitoring of such dynamics.

At this point there are three main elements of the group to consider: function, process and life cycle. The function of the PSE group is to identify project objectives /conflicts / compromises and assumptions. It is not only critical to capture a set of project objectives but to move on and determine how these are to be evaluated during the building’s life. Indicators of success in achieving project objectives need to be identified by the PSE group. In defining the problem various internal and external factors affecting how such a group would function would be ideally be identified. Various group decision support systems (GDSS) are available for solving strategic decision making processes (Eden and Radford, 1990) that would contribute to the internal functioning of the group. A mapping out of an evaluation implementation plan by the PSE group as they deem appropriate for
the duration of the design and construction phase and importantly the occupation phase would be critical to the success of this approach. At the University of Newcastle a PSE group has been assembled and will be taken through an accelerated simulation of a stakeholder-based evaluation of a project. The group includes stakeholders of public schools in New South Wales, specifically a representative from: the state government education properties agency; an architectural firm responsible for designing schools; a school; the local community and a contracting company responsible for constructing schools.

Conclusion

The stakeholder approach advocated requires that original project objectives formulated at the outset of a project are in evidence in evaluations so that firstly expected performance vs actual performance can be measured and secondly that these objectives can be reassessed. Systematic building evaluation should take heed of the fact that the root word of ‘evaluate’ is ‘value’ and that various values from stakeholder groups need to be reflected in our buildings. Values of those most affected by decisions...users... should be heard and understood in the process of decision making related to building environments. Values that underlie the technical competence of professionals...producers... who build and manage our work and leisure environments must also be in evidence(Shibley, 1982). Without this holistic view of evaluation, design becomes action without reflection and facilities management is either left to those without architectural knowledge or in the hands of professionals uninformed by specific institutional and individual values. For this to be successful the design process must be restructured to allow time for the systematic and explicit management of an evaluation process as too often after the ‘keys’ have been handed over many of the decision makers have moved on to the next project and have little incentive to be involved in a project during its occupancy.

Bibliography


