The Submission Revisited

Systems Practice for Managing Complexity

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Introduction

At the core of our bid to the EPSRC (Engineering and Physical Sciences Research Council) for funding the SPMC research network was a collaboration between the Systems Discipline at the Open University (OU) and staff with an interest in Systems in De Montfort University (DMU). We had worked together successfully in the past to host the 1997 UKSS conference, entitled 'Systems for Sustainability' (see Stowell et al 1997). In formulating our bid we recognised a number of opportunities. We wanted to improve the quality of the relationships we each had with some of our key stakeholders; those people and organisations with whom the two groups had been engaged in some form of joint activity in the recent past. We also saw it as an opportunity to improve the systematic interaction within and between each stakeholder group, i.e. for those who had been involved with either the OU or DMU to meet and possibly do something together. We also wanted to use the design of this process as part of our research.

Based on our experience of the first workshop we now recognise that the participants, who included some of our main stakeholders, were not as familiar with the language of systems as we had perhaps envisaged. One participant said in feedback after the event: *''The tricky balance which has to be sought is between first rate engagement among a small group of cognoscenti, which produces few spreading ripples, and unstructured chat among a large number of people which may, by chance, produce ripples but which will have little coherence'.* This commentator may well be right but the challenge is to provide both meaningful conversation and coherence.

There is a large range of systems concepts and methods and perhaps it is too easy for those familiar with them to take them for granted. One traditional response is to pay attention to defining terms such as in a glossary of the type included as Annex 1. However, in our experience of teaching Systems this is usually inadequate. There are those who argue that Systems can only be taught experientially. But this does not necessarily always mean face-to-face. Our experience of designing supported open learning teaching materials is that it is possible to teach systems thinking and practice via this medium, but it requires the active engagement of the learner through activities, assignments and conversations with tutors and on-line with fellow students. If the need to teach Systems requires experiential learning, or the active engagement of the learner, and we are sympathetic to this view, then it is a challenge for any author who attempts to explicate systems ideas in traditional 'scholarly paper' mode. This gives rise to our first caveat on this paper: it is not an attempt to convey systems concepts, to 'teach systems' in any way. It is an account of the historical circumstances which gave rise to a research project, a discussion, albeit brief, of some of the thinking that underpinned the bid, and an account of the process design we have in mind for managing the project.

Strengthening and building networks

In our bid we proposed a strategy which would strengthen the existing network of stakeholders in the two groups, such as advisory board members, alumni, funders of research and studentships, research partners and consultancy and training clients. We envisaged that the process of strengthening these loose networks might create opportunities for synergies and the emergence of a new 'formal' network, a SPMC network, in which new understandings and joint activities would happen. We proposed to achieve this by:

(i) introducing a number of provocative 'big questions' with the potential to trigger new conversations amongst those participating through engaging in cycles of critique and challenge around issues of common concern. We wanted to start this process before introducing a number of external international participants to our incipient 'formal' network as a means of being open to new perspectives and of creating challenging initial starting conditions for the formal network's emerging 'systems of interest'[1] (see below);

(ii) drawing into conversation our existing research collaborators (especially our NGO and systems education associates) and our extremely large number of users of systems thinking and practice via taught postgraduate project and research work and OU Systems Society (OUSys) Alumni , UKSS (UK Systems Society) and the UKAIS (UK Academy of Information Systems) members. This is premised on the notion that nothing can happen unless you are part of a meaningful conversation.

We proposed to build on the following experiences:

(i) the 30 years of experience of the Open University in teaching Applied Systems to mature students (see Maiteny and Ison 2000; Ison 2001). Not only are these students 'mature' but most are in work or professional contexts in which, as active learners, they can apply what they are learning to their own circumstances, circumstances that are not readily available to 19-23 year old full-time students. For example:
   - between 1983 and 1999, 10795 students successfully studied the OU course 'Complexity Management and Change: a systems approach' (course code T301);
   - by December 1999, one year after its introduction, 1006 students had claimed an OU Undergraduate Diploma in Systems Practice;
   - since its introduction in December 1997, over 300 students (mostly in employment) have studied the module 'Environmental decision making: a systems approach' as part of the Environmental Decision Making postgraduate programme at the OU;
   - a substantial record of achievement in Systems Research and PhD student supervision.

(ii) the network of 'industry' partnerships developed by De Montfort and the Systems Discipline at the OU;

(iii) the large Systems alumni in the OU some of whom (about 300) were members of the OU Systems Society (OUSys).

(iv) Our relationship with, and membership of, the UK Systems Society (also with about 300 members).

(v) the learning that had resulted from initiating and participating in a 'Systems Professor's Group' in the UK over the period 1995-1999;

Proposed objectives for the 'formal' SPMC network

As a first iteration we formulated the objectives of the SPMC network in the following terms:

[1] We refer to a 'system of interest' as the product of distinguishing a system in a situation in which an individual or group has an interest or a stake.

Theoretical:

- developing systems theory and of new forms of systems practice by applying systems thinking to new domains[2]
- facilitating the emergence of new research questions about systems practice and systems theory
- subjecting new theoretical developments and reflections on practice to scrutiny and challenge in industrial, business, public sector, NGO or not-for-profit environments[3];

We argued that these objectives will have been met if fundable research proposals emerge, 'industry' agrees to co-fund or participate in this research and papers in refereed journals, workshop proceedings and a book are produced.

Practice-based:

- initiating and supporting ‘networks of conversation’ between systems thinkers in academia and potential systems thinkers in 'industry';
- identifying and pursuing themes of interest shared between the academic and 'industrial' participants;
- bringing together those involved in, and concerned about failure in the development of information systems (IS);

These objectives will have been met if the relationships generated at the workshops and other network meetings are self-sustaining and lead to further collaborative initiatives.

Management:

- facilitating a wider appreciation of systems thinking and systems ideas in 'industry' and a desire for systems skills and understandings is manifest;
- eliciting new case-study material for research and teaching;
- generating new proposals for shared research activities, for example through the use of CASE or other collaborative studentships;

The objectives will have been met if case studies and research proposals are forthcoming and if requests for further development of skills are received from non-academic participants.

We did not envisage these outcomes as arising deterministically from a blueprint design. Rather we saw our project proposal as offering a set of guidelines for process design which was flexible enough to accommodate new perspectives and to allow cycles of iteration to further specify the nature and type of output. This is consistent with our current theoretical perspective as outlined below.

The conceptual framework for our network proposal

Our espoused purpose for the project was to bring together individuals and groups of diverse perspective including systems theorists, systems practitioners and other interested groups from 'industry' so as to establish a research agenda for systems thinking, systems theory and systems practice. We proposed that the network would initially be organised around five '***big***' questions:

(i) What constrains/enhances the translation of systems thinking into systems practice and new systems thinking?

(ii) To what extent does the reification of current 'first-order' conceptions of knowledge, information and 'effective communication' constrain organizational change, precipitate failure, particularly in IT and IS related

[2] By domain we mean a recognisable arena of practice in which systems thinking is applied e.g. health

[3] Systems practice is relevant across all of these sectors; for the sake of brevity however we shall use the term 'industry' to subsume all of these sectors.

developments and restrict the evolution of new communities of systems practice?

(iii) Is it possible to manage for 'self-organization' and emergence and if so how?

(iv) What constitutes an effective pedagogy for building capacity in systems thinking and practice?

(v) What constitutes ethical systems practice particularly in relation to the issues of global sustainable development and the threats of enclosure of the 'knowledge/information commons'?

Our experience of the first workshop is that these five questions expressed in the above terms did not convey much meaning to most of those present. However, at the end of the day most of those present felt they had participated in a meaningful conversation - one that they expressed interest in continuing. As our design process was to use these questions as a starting point we do not intend to go into battle to preserve them as the basis of our formal network.

The answers to why these questions were important and meaningful to those who proposed them lays in their experiences, the traditions of understanding out of which they think and act. Individuals cannot escape their traditions, literally a network of pre-understandings or prejudices from which they think and act and thus make sense of their world. As human beings all we have at our disposal is our ability to communicate because biologically 'my world is always different from your world'. This is one of the opportunities that a formal network provides - it creates a basis for new conversations in which it is possible to better appreciate different traditions of understanding as well, hopefully, as one's own. Because this paper is an historical account of how the SPMC bid came about, as well as an account of some of the thinking behind it, it is worthwhile attempting to unpack what was meant by each of these questions and to outline why we think they were, or are, important. It is also worth remembering that the main aims of the project are to generate research questions and collaborations that are potentially fundable.

The considerations which are modelled in Figure 1 gave rise to the first 'big' question:

1. What constrains/enhances the translation of systems practice into systems theory and new systems thinking?

It was proposed that the 'formal' network would take its theoretical basis from the learning through 'teaching' experience at the Open University that the development of systems theory can lead to the development of systems practice skills, which in turn, can lead to new systems theory (see Figure 1).

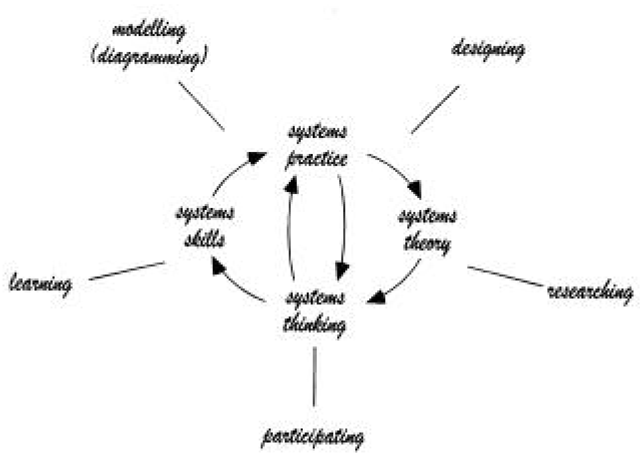

Figure 1
Systems practice informs and renews systems thinking which in turn, renews systems practice. Systems practice also informs and renews systems theory, which stimulates new systems skills by stimulating systems thinking and thus systems practice.
The cycle stimulates researching, participating, learning, modelling and designing activities in the domains in which it is embedded.

Figure 1 has at its core the relationship between systems thinking and systems practice - together they form a duality, a unity or a recursive relationship rather than a dualism (see Ison and Russell 2000b). An example of a duality is the predator-prey model in ecology - in isolation they make little sense, together they constitute a whole. Dualisms are concerned with negation - for example in the practice of science it is often a putdown to label something or someone as subjective rather than objective. The pair subjective/objective form a dualism, a type of thinking that is unhelpful yet too common. We argue that to engage in systems thinking in isolation from systems practice is unhelpful; in other words to treat it as dualism rather than a duality. Our reflection also raises the question of whether it is possible, theoretically and practically, to separate them? In other words if you cannot experience systems practice (as embodied in what someone does) then you can claim that they are not engaged in systems thinking. Or put the other way, thinking is a form of practice and thus can be experienced in what someone does. For someone *thinking* systemically they are at the same time *being* systemic.

However, for academic and teaching purposes it makes sense to refer to a tradition of scholarship in which particular concepts have been devised which we can agree, or not, as being key to systems thinking. The separation of systems thinking from systems practice is something we do to enable sense making but they belong together. For example, Checkland (1981) says (p.4): 'Systems thinking, then makes conscious use of the particular concept of wholeness captured in the word 'system', to order our thoughts. Systems practice' then implies the product of this thinking to initiate and guide actions we take in the world'.

Based on our teaching and research experience we would argue that the process by which people engage in systems thinking and systems practice (as depicted in Figure 1) and which would seem to need to operate to develop further systems thinking and practice is inhibited or constrained in two main ways: (i) situational or (ii) cognitive. An example of a situational constraint is the middle level manager who goes home from an OU systems summer school enthused by her new found abilities in systems thinking and practice only to find that her family or work colleagues are disinterested or actively undermine her enthusiasm in a range of different ways. The end result is that new communities of systems practice - following Wenger (1998) - fail to develop. The cognitive constraints are taken up below.

Figure 1 is an attempt to model some of the process that go on when developing systems thinking and practice skills. It suggests the mutual development of theory and practice can be stimulated by testing systems theory in new contexts and against new problem situations and by grounding the experience of new contexts in broader conceptualisations of systems theory. A number of renewed activities emerge from the dynamic interaction of developing theory and skills. These emergent activities are indicated in Figure 1 (e.g. modelling, researching etc).

There is also another dimension, not included in Figure 1, which concerns the role of technology. Any technology acts as a mediator of human experience (see Ison 2000a). As an example think of what a forklift does - it amplifies our ability to lift, but at the same time it suppresses the development of certain muscles, or the type of collaboration that was needed, say, to move the stones to build Stonehenge. So, for example, influence - modelling software may enhance systemic understanding of positive and negative feedback processes which are counter-intuitive. On the other hand our experience is that the learning that comes from doing Rich Pictures (as part of Soft Systems Methodology - SSM) is far richer if done by hand on paper than with a drawing package using a pre-established menu of icons (see also West and Stowell

2000). There is thus a need to know more about how technology might mediate systems practice.

2. To what extent does the reification of current 'first-order' conceptions of knowledge, information and 'effective communication' constrain organizational change, precipitate failure, particularly in IT and IS related developments and restrict the evolution of new communities of systems practice?

This particular question arises from an awareness of the extent of failure of R&D projects designed to bring benefits to poorer people, or to natural resource or environmental management, particularly, but not exclusively, in the developing world. It also comes from an awareness that 90-95% of IT developments fail in terms of what was expected of them (and many have been spectacular failures). Not surprisingly the reasons for the failures are complex and systemic; they have been explored in many books (e.g. Ison and Russell 2000; Checkland and Holwell, 1998). Our position is that at the core of many of these failures is a set of inappropriate theoretical assumptions associated with theories of knowing (epistemology), information and human communication which have become reified.

Reification literally means 'making into a thing'. It is a process made apparent in Etienne Wenger's theory of situated learning; he uses the term reification to refer to 'the process of giving form to our experiences by producing objects that congeal this experience into 'thingness'. He goes on to say: 'In so doing we create points of focus around which the negotiation of meaning becomes organized'. By using this term we are drawing attention to the making of 'knowledge' and information' into 'things' and human communication into simply 'message transfer'. As an example consider the burgeoning field of 'knowledge management'. As a practice it is organised around this thing called 'knowledge'! From our perspective this is problematic as 'knowledge as thing' hides both the process and relational aspects of the act of 'knowing'.

To further 'unpack' this question it is necessary to appreciate the different sets of influences that have shaped the emergence of particular systems traditions (Figure 2)[4]. One of the distinctions made in this figure is between first-order and second - order cybernetics. Of significance here is the strand of influence of 'information theory' developed by Shannon and Weaver, which has become, we would argue, unhelpfully pervasive. It is becoming increasingly recognised that contemporary use of the term 'information' comes from a semantic mistake made at the time of the Macy conferences[5] when Heinz von Foerster substituted the word 'information' for 'signal transfer' (e.g. see Capra 1996). Prior to this time 'signal transfer' was always used when talking about computer 'communication or the passage of nerve impulses in a nervous system, but almost over night 'signal transfer' became 'information transfer' which also became the dominant metaphor for human communication (see Krippendorf 1993).

An alternative metaphor for human communication achieved by following the Latin roots, *in formare*, is that information is something formed within, it does not come

[4] As mentioned earlier, following Russell & Ison (2000) a tradition is a pervasive network of understanding that is largely taken-for-granted, even unconscious, and which can be looked upon as a 'way of being'. It is the intellectual background within which we interpret and act thus making sense of our experience.

[5] A series of interdisciplinary conferences held over a 10 year period in the USA starting in 1946 and funded by the Josiah Macy Foundation.

from outside in a deterministic or transmitted sense. These issues have become the concerns of second-order cybernetics (the cybernetics of cybernetics, in which the observer has to be accounted for as part of any explanation: see Figure 2). The second-order cybernetic tradition is not well developed in terms of practice. New, second-order cybernetic forms of systems practice are needed which are theoretically grounded (e.g. Winograd and Flores 1987; Open University 2000; Ison and Russell 2000b).

To summarise then, this question is concerned with the way in which we have made 'things' of knowledge, information and messages (in human communication) based on theories associated with what is called the 'first-order' cybernetic tradition. Our argument is that practices which are based either implicitly or explicitly on these 'first order' understandings constrain organizational change and contribute to failures in domains as diverse as rural development and IT projects.

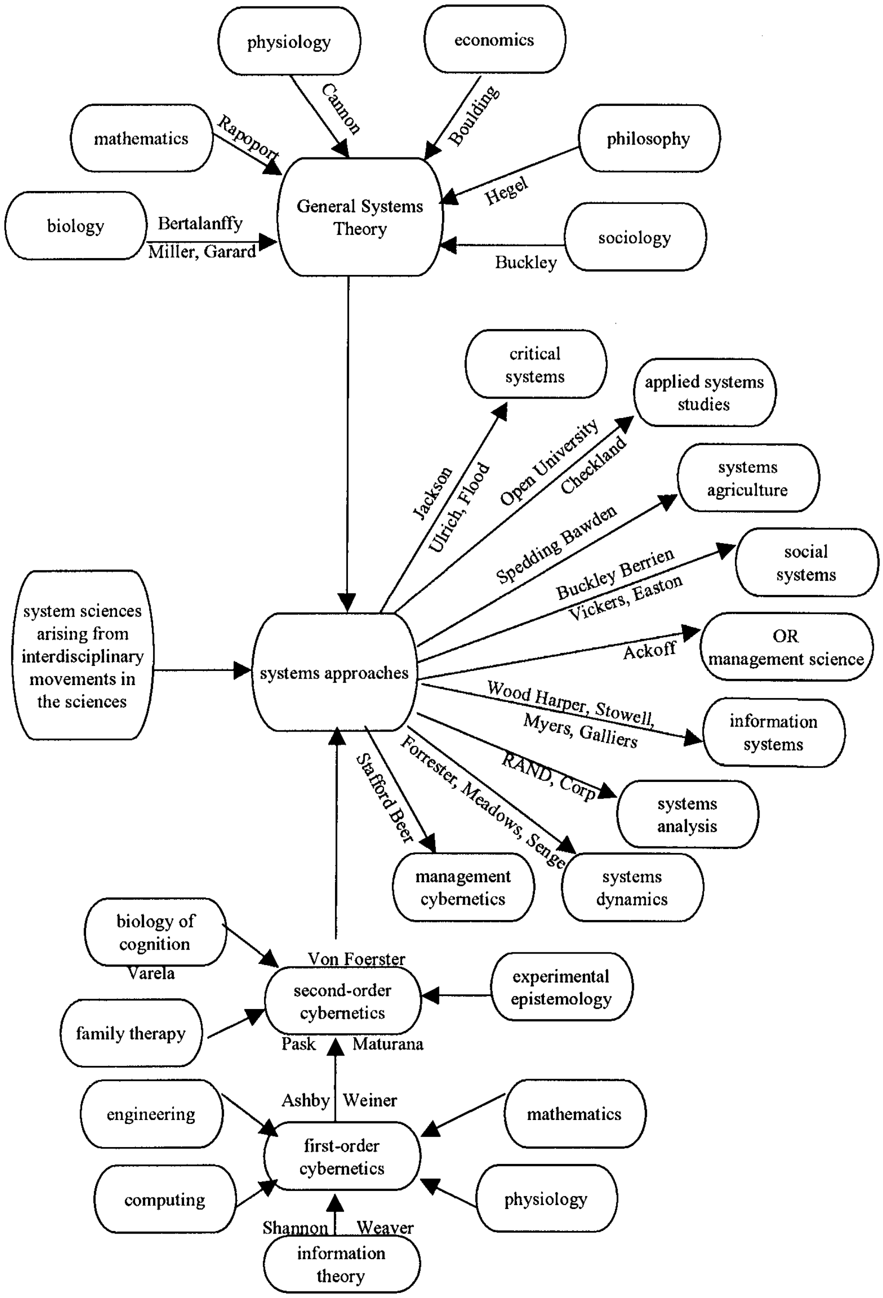

Figure 2. A spray diagram mapping some of the different influences within systems scholarship that have given rise to a range of systems approaches for managing complexity, and some key researchers associated with these influences. (Adpated from Ison, Carr & Maiteny 1997).

The 'thingness' of systems

From Figure 2 it is important to realise that there is no consensus on what constitutes systems thinking or systems practice but that there are different traditions which may share, many or few, concepts and thus practices[6]. We suggest that new opportunities for development and renewal of systems theory are likely to emerge by moving beyond first-order cybernetic models, and what Checkland (2000) calls the 'hard systems tradition', upon which current systems theories-in-use are mostly based.

There is no scope here to discuss the main areas of contention. However, there is one important distinction that needs to be made because without it members of the network are likely be forever talking at crossed purposes[7]. This concerns whether we believe Systems exist (and can therefore be discovered!) or whether someone[8] who uses systems thinking formulates a 'system of interest' by distinguishing a system (an interconnected set of components which can be seen to fulfil a purpose) from a background, called an environment for the purpose of learning about, or changing something[9]. In other words, is there something to be gained by thinking of 'systems' mainly as a practice - a form of purposeful activity rather than just being concerned with the 'thingness' of systems?

Checkland (2000) argues that the position of believing that systems exist is the main characteristic of 'hard systems thinking'. It is also associated with early (first-order) cybernetic thinking - see Figure 2. This form of systems thinking is still pervasive, though perhaps unintentionally so, because of the everyday use of the word 'system' - as when we refer to the train system or education system. In everyday use it perhaps means a set of interconnected elements or activities for most people (connectivity or connexity - to use Geoff Mulgan's, 1998 term). However, as Peter Checkland's scholarship and our own experience with students at the OU has shown, there is a limit to what can be gained from systems practice based on this everyday, or realist, notion of 'system'. What it fails to account for is the different perspectives that exist on just what any 'system' might be - one persons terrorist is another persons freedom fighter (see Checkland 2000 for examples).

The distinctions about the nature of 'system' are not trivial although at first the reasons may not be apparent. The distinctions are both epistemological (concerned with how we know, or what we accept as knowledge) and ontological (the nature of reality). In terms of systems practice the two positions are markedly different - in the realist interpretation one can set out to discover, or describe THE system - what is called systematic practice. The alternative is practice which recognises the uniqueness of each persons experience (perspective) and an awareness that we only have communication (in its many guises) as a basis for collaborative action - what is called systemic practice. Systems practice from this perspective can be see as designing a learning process in which systemic insights are gained.

Whilst it is not possible to explore all the implications of these ideas here - they are the subject of a full year of study in our OU courses (e.g. Open University 1999, 2000, 2001 and Annex 1)[10] we do argue that it is important for the systems

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[6] In making this point we are not arguing the need for consensus (which is an impossible task) but for appreciation of the differences so that some clarity may be gained with regard to any particular use of systems concepts by grounding them in a history or tradition.

[7] For example, this and other confusions, are very apparent in the report that arose from the EPSRC/BT Plc workshop run to initiate the EPSRC programme.

[8] It may be a person or group

[9] We refer to this as taking purposeful action

[10] No claims are being made for which is the better form of systems practice; both in context and carried out with awareness offer opportunities. However when faced with situations experienced as

practitioner to be aware of how they view the 'thingness' of systems. This is because of the impact it can have on practice. In particular we are concerned that a lack of epistemological awareness (i.e. one's own position of the 'thingness' of systems) constrains the development of communities of systems practice. Communities of practice arise in response to particular shared challenges and evolve with their own rhythm and life and whilst community members may come and go the community of practice will live on or perish according to its own inherent dynamics (see High 2001). At this stage little is known about the operational dynamics of particular communities of systems practice nor about how purposeful action can foster, develop and maintain them.

3. Is it possible to manage for 'self-organization' and emergence and if so how?

Anyone who has seen, or participated in, a 'Mexican wave' at a sporting event or concert will know what this question is about. A 'Mexican wave' starts locally with a few members of the crowd urging others on - this activity spreads to other localities and before long a self-organized, perfectly formed wave can circle a football stadium. There is usually a great sense of achievement when the pattern that is the well-formed wave 'emerges' from the activities of all the individuals in the crowd. This phenomenon is well recognised by those in charge of large public spectacles such as the Sydney Olympic Games. These organisers provide accompaniments such as torches, flags, hats etc to enable participation in pre-designed possibilities but also to allow for emergence of novel outcomes. What is important about both these possibilities is that they are not deterministic - they both draw on the willingness of individuals to participate, (to respond to an invitation) and the creativity of all those present. What these organisers recognise is that they can create the possibilities for self-organisation or emergence by setting the initial starting conditions. This is also something a good entertainer can do when they foster active and creative audience participation.

Unfortunately the phenomenon is less well appreciated in management and other aspects of organisational life where centralised command and control models are often those that dominate. It is also not clear what practices foster or inhibit self-organisation and when it is, or is not desirable. For example, when designing an Information System (IS), it is vital to consider the relationship between the environment and its impact upon an enterprise, which are both constantly changing and so affecting policy making and control actions. The IS practitioner cannot hope to encapsulate this fluid situation using traditional deterministic methods of IS definition (Stowell and Champion 2000). To overcome the limitations of rationalistic approaches, many authors have argued for an interpretivist approach to IS design which draws on systemic thinking.

David Robertson, in a presentation to the Society for Research into Higher Education in late 1998 entitled 'What employers really, really want' reported that: " research on employers in a number of English-speaking countries with senior corporate people showed that the traditional skill set doesn't go far enough if graduates want to be employable internationally." (see also his paper earlier in this volume). What's missing, he claimed are 'complexity skills'. "Graduates must understand that the world is not linear (broken play, broken field). They need the ability to manage ambiguity and connectivity and to be comfortable with provisionality (making decisions when you don't really know what is going to happen as for example with e-

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complex when it is not clear what the nature of the problem or opportunity is, then our experience suggests it makes sense to start of systemically rather than systematically.

commerce). He argued that they must also be comfortable with emergence (though did not elaborate on what this really meant nor how it might be achieved).

An argument can be mounted that systems thinking, or what Robertson describes as complexity thinking, is a necessary ingredient of a broad, liberal education. In the context of information systems, Work (1997) argues: "…in short a liberal education has the greatest relevance in that it insists that specialised knowledge be restricted to its own sphere" and that "liberal education then is broad, not narrow. Rather than being in direct opposition to specialist disciplines, its true role is to delimit them. This is one of its chief benefits. It does this by encouraging reflectiveness. The intellectual frame of mind which .. may serve as the basis for an individuals self reliance and for a democratic society".

4. What constitutes an effective pedagogy for building capacity in systems thinking and practice?

This question mainly concerns the cognitive constraints to developing systems practice skills referred to in the first question. Many authors claim that learning is a prerequisite for the emergence and evolution of 'systems which are complex and adaptive'. However, in making this claim they rarely provide an explanation of what they mean by learning. To accept any claim about learning then a theory of learning is required which makes sense of our actions in the world. It is also essential to track current on-going efforts to develop and teach concepts about systemic complexity. This is because it is known (Perry 1981; Salner 1975; 1986) that personal change in epistemic assumptions is absolutely essential to any major breakthroughs in decision making based on understanding and applying systems theories to practical problems. If, as Salner has found, many people are not able to fully grasp relatively simple systemic concepts (such as non-linear processes, or self-reflexive structures), they will not be able to rethink organizational dynamics in terms of "managing" complexity without substantial alteration in the worldviews (their "applied epistemology).

The Centre for Systemic Development (University of Western Sydney, Hawkesbury) (e.g Macadam and Packham 1989; Bawden 1992; 1995) as well as the Systems Discipline at the OU have tried to incorporate what is known about fostering epistemic change. And it has been done with encouraging short-term results as far as we know (e.g. Peters 1979; Clarke, Costello & Wright 1985; Wright 1999; Ison 1994; Blackmore et al 1998; Blackmore and Ison 1998; Maiteny and Ison 1997; 2000). At De Montfort University postgraduate students studying Information Systems Management may chose to use systems ideas to make sense of complex business problems for their final project. Some of the practical outcomes of these projects, particularly in the case of part time studiers, have met with a measure of success in the several cases where they have applied the results of their investigations to their work related problems.

Looking back over the thirty years in which the OU Systems Group has been operating, a particular pedagogical model for teaching Systems through supported open learning can be recognised. It has the following features:

1. Academics learned quite early that systems concepts need to be grounded as much as possible in the student's own experience. For this reason both continuous and examination assessment asks students to relate the systems thinking and practice in the courses to their own professional and personal contexts. This strategy is aided by the fact that most students are working whilst they study and they have a sufficiently rich life experience for the ideas to become meaningful.

2. Case studies of failure (e.g. IT innovations; the UK Child Support Agency etc) have proven to be a way of engaging students' involvement beyond their own

experience. This was a lesson which was learned very early and which continues to be employed.
3. Diagramming (and other modelling) skills are developed and used as a means for students to engage with perceived complexity;
4. Other systems concepts, tools, methods, and methodological approaches are taught so as to develop skills in 'formulating systems of interest…..for purposeful action'.
It is worth noting that in recent courses there it is emphasised that purposeful action has both rational and emotional elements.
What is lacking however, is any longer term (and longitudinal) check on the degree to which learning that we can "see" is being utilized and further developed in practical situation improvement in student's working lives (see also Weil 1999).
Salner (1986) drawing on earlier work by Perry (1970, 1981) and Kitchener (1983) describes the prevailing theory on epistemic learning as involving the deliberate breaking down and restructuring of mental models that support worldviews. Prigogine provides an additional lens on this theory in his discussion of "dissipative structures" (Prigogine and Stengers 1994). This theory provides a model of the dynamics of epistemic learning: each learner goes through a period of chaos, confusion and being overwhelmed by complexity before new conceptual information brings about a spontaneous restructuring of mental models at a higher level of complexity thereby allowing a learner to understand concepts that were formally opaque.
To understand and deliver a pedagogy that enables and provokes students to move across levels of epistemic competence is in itself challenging. To do so requires an awareness on the part of the curriculum designer and personal tutor so that they can facilitate the emergence of these changes. As Salner (1986) points out it is not always clear that academics and tutors have these competencies themselves. What is more, awareness, and curriculum design which flows from this awareness, may still be insufficient to achieve epistemic change in a "learning system" in which students are concurrently members of families and firms. The structural dynamics of these settings may preclude the types of conversations which further trigger the necessary knowledge acquisition and learning that leads to changes in the student's world view[11]. In this sense a course or a curriculum is a macro level response to micro-processes which are carried out in the everyday settings of the students who have studied systems courses. To return to Work (1997) he argues that "once students have acquired an understanding of the benefits and liabilities of information technology by studying those reference disciplines, they may begin to learn the practice of information systems under the guidance of senior professionals, as in other professions". Put another way, is it necessary for a systems educator keen to foster systems practice to address both cognitive constraints to systems thinking and the environment in which the systems thinking/practice is situated. From a theoretical point of view this makes sense. After all the act of formulating a system of interest is the same as formulating a system - boundary-environment relationship i.e. all systems have a boundary and a background or environment in which they are situated so to change one is to change them all.
If both the cognitive and situational constraints to systems practice are better understood, it may be possible to contribute to developing new models of course and curriculum design based around self-organizing principles not dissimilar to that which has occurred in the emergence of Linux, the computer operating software, as an "open system" challenge to the dominant Microsoft "closed system" of software innovation

[11] For the reasons discussed under question 1.

(Open University 2000; Naughton 1999). In the Linux example the product was developed by following some simple rules of co-operation and giving away the source code - the copyleft idea rather than copyright.. To move in this direction however would require an appreciation of, and possible challenges to, prevailing modes of organisation in Universities from which the curriculum is “managed”.
For the reasons outlined above, the fourth 'big' question seems to have been neglected to date; given the emerging discourses around life-long learning, the prevalence of multitasking and the expectation that professionals will have several careers, this seems very unfortunate and is a deficiency we aim to redress. We seem uniquely positioned to do so.

5. What constitutes ethical systems practice particularly in relation to the issues of global sustainable development and the threats of enclosure of the 'knowledge/information commons'?

The fifth and final question has at its heart issues around which there are conflicting perspectives, no clear 'community of discourse' and which, in some circles are hardly yet being spoken about. Education for sustainable development will enter the UK national curriculum in 2001 - it is recognised that managing for sustainable development is a systemic issue, yet it is still unclear how individuals, organisations and nations can embark on this trajectory (e.g. see High 2001). For example, it is claimed that: ‘Education for sustainability is the continual refinement of the knowledge and skills that lead to informed citizenry that is committed to responsible individuals and collaborative actions that will result in an ecologically sound, economically prosperous, and equitable society for present and future generations. The principles underlying education for sustainability include, but are not limited to, strong core academics, understanding the relationships between disciplines, systems thinking, lifelong learning, hands-on experiential learning, community-based learning, technology, partnerships, family involvement, and personal responsibility.’[12] This suggests increased demand for systems thinking and practice.
It was Garrett Hardin who drew attention to what he described as the 'tragedy of the commons'. His parable concerned the management of a common natural resource, the rangeland grazing lands held in common. Whilst his ideas have been both supported and contested the metaphor at least is apposite to the practices of multi-national companies and internationalised Universities who strive to control through patents and other devices genes, germplasm and intellectual property. Threats to the closure of the 'knowledge and information commons' via, possibly regulation of the internet, partnerships with University consortia and international media conglomerates as well as more stringent intellectual property regimes pose ethical and practical problems. For example, what is the ethically defensible social role of the University in such a scenario? (e.g. taking research funds from major tobacco companies etc; see Ison 1999; Gourley 1999). These issues are leading many to consider how to build new global communities of academic practice via the net and other mechanisms informed for example, by the copyleft' (as opposed to copyright) ethic of the open source movement (see Naughton 1999).
It is in this context that the question of what is ethical systems practice needs to be considered. We suggest this does not involve adherence to any particular set of ethical principles but rather emerges in practice (i.e. they are embodied) as described by Varela (1992). In their book, 'Profit Beyond Measure' Johnson and Bröms (2000)

[12] This quote comes from the President’s Council on Sustainable Development, USA, under Bill Clinton in 1996.

provide another example of ethical practice when they argue that: *'Looking at a business as an embodied pattern - as modern scientists now view a life system - would imply that the natural way to manage is not to impose plans and controls in an effort to shape results. Rather the natural way to manage would be to discover and nurture appropriate relationships and wait for results to emerge spontaneously..,'*. At its most basic any concern with sustainable development is also a concern about the nature and quality of the relationships we, as a species, have with our world.

The proposed process design

The process design that is envisaged is described in Figure 3. The process has been designed to commence with a pre-launch workshop with invited stakeholder participation. These proceedings report the outcomes of this workshop. The material includes challenges to our process design assumptions as well as responses to the initial research questions. These outcomes will be used to guide the design of a further stakeholder workshop on December 8^{th}, 2001 for members of OUSys and the UKSS. The outcomes of these stakeholder workshops will be used to design the main launch event or events in early 2002. The launch will include contributions from each of our international network members. We envisage a series of issue based workshops based on the themes which emerge, combined with the needs and enthusiasms of stakeholders in the network. These workshops will be convened with the express intention of formulating researchable projects for the future development of systems theory and the application of systems theory and thinking in a wider set of contexts. The outputs will be new research questions, new material for pedagogic purposes as well as new challenges to existing systems theory.
Of particular importance will be designing a process for challenging our emerging theoretical and practical assumptions by engaging with 'industry'. Industry in this context means: (i) The OU Systems Discipline's network of CASE sponsors (with ESRC co-funding); (ii) The over 600 'mature' OU students who by membership of the OU Systems Society, or completion of the Project assessed MSc module, 'Environmental Decision Making. A systems approach' have been actively engaged in using systems thinking and practice in their professional and personal lives. We would propose to invite these people into our network via one or more workshops and, if funds permitted, by focus groups, supported by a major interactive web-site currently under construction within the Systems Discipline at the OU; (iii) De Montfort University, Milton Keynes have benefited from the support of a Commercial Advisory Board. Senior managers from local business and industry advise on the design of courses, ensuring that graduates are given an education that will meet future business needs. Current participants include a range of national and local firms. (iv) Continue to engage with investigators and collaborators from the EPSRC funded project “Systems Engineering for Business Process Change” (see http://www.ecs.soton.ac.uk/~ph/sebpc) (v) Systems is an intellectual building block in Information Systems and engagement with IS practitioners will be made through the UK Academy for Information Sytems.

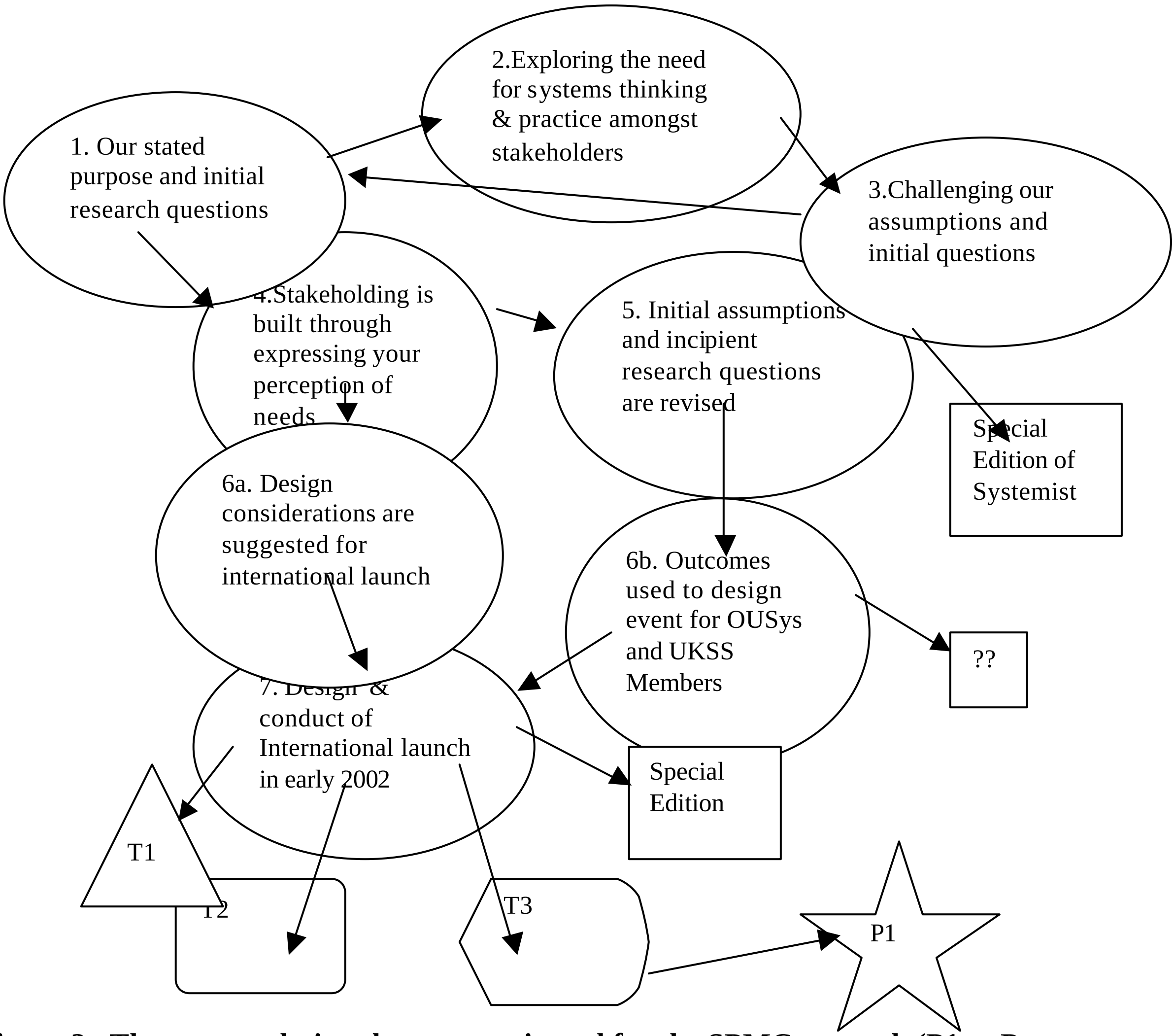

Figure 3. The process design that was envisaged for the SPMC network (P1 to Pn projects arising from emergent themes (T1 to Tn).

Conclusions

The bid that was funded is for £64,200 to cover the costs of setting up and servicing the network, running the workshops and disseminating the workshop proceedings. To reiterate, the core activities in this proposal are

- developing a network that incoprorates the two central participants involved, together with their associated *incipient* internal and external networks of interested individuals and organisations (N.B. in terms of communicative action, no meaningful overall networks yet exist).
- designing and organising six issue-based workshops addressing themes of common interest in systems approaches to situation improvement. One of these workshops will be a public forum.
- publishing outcomes of these workshops in a variety of forms (see below)

It is anticipated that all workshops will be jointly organised but increasingly with stakeholder participation and that workshop themes will be designed around the central five questions but will accommodate the learning that emerges from the interests of participating members. Processes will be designed to elicit and focus on themes. Potential themes might be exemplified by, for example: design for avoiding

failure; managing for emergence; modelling as a learning process and identifying new systemic skills needed by practitioners in Information Systems and Management.
Each workshop will have a dissemination process built into its design. This process will enhance and go beyond the dissemination to a wide and mixed audience inherent in the concept of a large network membership. It is likely that the outcomes from each workshop will include some, or all of the following: papers in refereed journals, proceedings published as working papers, web-based proceedings, teaching materials, training course designs and other materials. A book is anticipated as an outcome from the three-year process.
The workshops and other activities of the network will be managed to foster the emergence of collaborative relationships between participants. The theoretical basis for such management is that network processes can be designed to respond to the enthusiasms of its members for systems thinking and systems practice and that such enthusiasms, appropriately acknowledged, lead to new research questions and new collaborations.[13]
It is anticipated that as the network develops, its activities will become increasingly grounded in the interests and enthusiasms of its non-academic members. It will then become possible to generate the financial and other support needed to make the workshops self-sustaining. It is also anticipated that as the network activities and workshops develop, the range of activities will extend and can be increasingly funded by cost-covering charges for workshops. This design is consistent with the notion that systems practice is the art of orchestrating a particular type of conversation, a conversation[14] based on systems thinking.

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[13] see Russell and Ison (2000) for an explication of the development of a research methodology based on *enthusiasm*.

[14] From the Latin *con versare*, meaning 'to turn together'

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Annex 1 Definitions of some generalized system concepts used in systems practice

Concept	Definition
Boundary	The borders of the system, determined by the observer(s), which define where control action can be taken: a particular area of responsibility to achieve system purposes
Closed system	A system which is closed to inputs from its environment, e.g. a transistor radio is closed to energy. In practice such systems rarely exist, but many systems are treated as if they were closed
Communication	(i) First-order communication is based on simple feedback (as in a thermostat) but should not be confused with human communication, which has a biological basis
	(ii) Second-order communication is understood from a theory of cognition which encompasses language, emotion, perception and behaviour. Amongst human beings this gives rise to new properties in the communicating partners who each have different experiential histories
Connectivity	Logical dependence between components or elements (including sub-systems) within a system
Difficulty	A situation considered as a bounded and well defined problem where it is assumed that it is usually clear who is involved and what would constitute a solution within a given time frame
Emergent properties	Properties which are revealed at a particular level of organization and which are not possessed by constituent sub-systems. Thus these properties emerge from an assembly of sub-systems
Environment	That which is outside the system boundary and which affects the behaviour of the system; alternatively the ‘context’ for a system of interest
Feedback	A form of interconnection, present in a wide range of systems. Feedback may be negative (compensatory or balancing) or positive (exaggerating or reinforcing)
Hierarchy	Layered structure; the location of a particular system within a continuum of levels of organization. This means that any system is at the same time a sub-system of some wider system and is itself a wider system to its sub-systems
Holon	A constructed system, of interest to one or more people, used in a process of inquiry; a term suggested to avoid confusion with the everyday use of the word ‘system’, as in e.g. ‘transport system’ (used synonymously with 'system of interest')
Measure of performance	The criteria against which the system is judged to have achieved its purpose. Data collected according to measures of performance are used to modify the interactions within the system
Mess	A mess is a set of conditions that produces dissatisfaction. It can be conceptualized as a system of problems or opportunities; a problem or an opportunity is an ultimate element abstracted from a mess
Monitoring and control	Data collected and decisions taken in relation to measures of performance are monitored and controlled and action is taken through some avenue of management
Networks	An elaboration of the concept of hierarchy which avoids the human projection of ‘above’ and ‘below’ and recognizes an assemblage of entities in relationship, e.g. organisms in an ecosystem

Open system	A system which is open to its environment such that there are recognizable inputs to the system and outputs to the environment, e.g. an organism is an open system for inputs of food (energy)
Perspective	A way of experiencing which is shaped by our personal and social histories, where experiencing is a cognitive act
Purpose	Objective, goal or mission of the system; the *raison d'être* which in terms of a model developed by people is to achieve the particular transformation that has been defined
Resources	Elements which are available within the system boundary and which enable the transformation to occur
System	An integrated whole whose essential properties arise from the relationships between its parts from the Greek *synhistanai*, meaning 'to place together'
System of interest	The product of distinguishing a system in a situation in which an individual or group has an interest or stake
Systems thinking	The understanding of a phenomenon within the context of a larger whole; to understand things systemically literally means to put them into a context, to establish the nature of their relationships
Tradition	Literally, a network of pre-understandings or prejudices from which we think and act; how we make sense of our world
Transformation	Changes, modelled as an interconnected set of activities which convert an input to an output which may leave the system (a 'product') or become an input to another transformation
Trap	A way of thinking which is inappropriate for the context or issue being explored
Worldview	That view of the world which enables each observer to attribute meaning to what is observed (sometimes the German word *Weltanschauung* is used synonymously)

(Source: adapted from Open University 1999)