WITH A LITTLE HELP FROM OUR FRIENDS:
How third generation system dynamics and the problem structuring techniques of 'soft' OR can learn from each other

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ABSTRACT

At its inception, the paradigm of SD was deliberately made distinct from that of OR. Yet developments in 'soft' OR and systems theory now have much in common with current SD modelling practice. This paper briefly traces the parallel development of SD and soft OR and argues that a dialogue between the two would be mutually rewarding. To support this claim, examples of soft OR tools are described along with some of the field's philosophical grounding and current issues. Potential benefits resulting from a dialogue are proposed, with particular emphasis on the methodological framework of SD. The paper closes with some suggestions on how to begin learning from the links between the two fields.

§1 INTRODUCTION: THE PARTING OF THE WAYS

In 1956, four years after Alfred P. Sloan had donated funding for the establishment of a management school in the technical environment of MIT, Jay Forrester became involved with the enterprise with the planned purpose of looking for linkages between engineering and management (Forrester, 1968a and Keough & Doman, 1992). Although his initial expectation was that operational research[1] would play a role in Sloan's initiative, Forrester's perusal of the field of management science/OR lead him to conclude that it was not a fruitful subject to explore further. As we now know, his subsequent enquiries lead him to study the application of dynamic feedback concepts to social systems and thus to found the field known initially as 'industrial dynamics' and today as 'system dynamics' (SD). However, at the time when the roots of SD were being founded, there was a conscious separation from the subject of OR.

Repeated mentioning of the views of Forrester is not genuflection, nor is it a demonstration of obeisance to the field's Ur-texts. Forrester has described eloquently and convincingly the reasoning behind his decision to disassociate his work from OR. He recognised the need for the practise of management to evolve from being an 'art' (by which he meant a series of disconnected experiences and cases which lacked a framework) but was nevertheless unconvinced regarding the effectiveness of the 'science' of management as it was then constituted, that is, OR (Forrester, 1958, 1960[2], 1961 and 1968a). He believed that OR concentrated on open-loop thinking about specific and often isolated operational or logistical problems or fragments of systems. He found that the quest for 'optimal', analytical solutions lead to problems being unrealistically simplified until they were "devoid of practical interest". The mathematical solutions to such problems he described as being more akin to "exercises in formal logic" than attempts to provide "useful help in real problems". Although willing to concede that it was able to pay its way, Forrester asserted that OR did not deal with managers' most urgent problems, that it did not concern itself with problems which "made the difference between the companies that succeed and those that stagnate or fail".

Forrester had very different and much more ambitious aspirations for SD. These were clear from the very beginning (Forrester, 1958 and 1961) but were perhaps expressed most clearly in a later paper (Forrester, 1968b). Forrester likened OR to the study of the open-loop decisions in a system and management information processing as the provision of information for such decisions. SD would concern itself with the whole assembly of decisions (rates or policies), levels and material and information linkages and, in so doing, would examine the effects of the closed (feedback) loops in the system. Using this method of study, Forrester believed that a more integrative theory of the separate processes of management would become possible, that with such a general theory it would be possible to integrate, store and reinterpret specific cases and experiences and that "(s)uch strides (would) far exceed in importance . . . (the application of) operations research methods to isolated company problems" (Forrester, 1958).

A full understanding of the factors involved in the early days of SD must await the historian's skills but what is clear is that SD deliberately set out on a course that was markedly different from OR[3]. This distinctive course has been held for some three decades. It has reaped considerable rewards. By setting itself apart from OR, SD has attracted a wide and disparate group of practitioners and supporters who might well have been repelled by the traditional OR world-view. It has proposed and practised the use of models as requisite tools at a time when this would have been difficult to do from within the OR paradigm.

However, it is our belief that today the balance of rewards has shifted. Wolstenholme's (1990) description of SD attempts to bring out the connections with other approaches in OR[4] and in his foreword to that book,

Forrester comments approvingly that such a treatment "is long overdue". However, we believe that there is much to be gained from going beyond this contexturalisation. Our specific goal in this paper is to bring to the attention of the SD community some of the tools and methodologies which make up the 'problem structuring techniques' of soft OR and so promulgate the debate about what SD and soft OR can learn from each other.

§2 THE CHALLENGE TO THE 'HARD' OR PARADIGM AND THE ROOTS OF 'SOFT' OR

2.1 - OR RIP?

The problem structuring techniques of 'soft' OR emerged from the fundamental questioning which took place in the OR community of the US and Europe during the 1970s regarding the appropriateness of OR's paradigm. This debate was a response to attempts in the 60s and 70s to apply hard systems thinking to social problems. The widespread failure of these attempts resulted in disillusionment with, and criticism of, 'hyper-rationalism' as an approach. As will become clear, Forrester's distinct paradigm for SD rendered that subject relatively immune to many of the criticisms that emerged. But inside the field of OR the debate was extended, critical and not always well-tempered. Discussions took place over a number of years, in many journals, involving many people[5]. However, one of the key contributors was Ackoff (1979) who pronounced that OR had no future.

Ackoff believed that OR as then practised was too 'hard'. There are many ways of characterising hard OR (or 'classical OR'). One short-hand might be that its paradigm was "predict and prepare". It concerns the identification of problems, their objective, accurate description and optimal solution. The stakeholders were assumed to be passive objects amongst whom a consensus existed, so that is was possible to take a unitary perspective of their objectives. Models were technical, opaque and frequently large. Ackoff attacked all of these assumptions and more. For example, he said that managers did not have independent problems but were confronted with complexes of problems which he called 'messes'. He criticised objectivity as an impossible goal in a specific situation (though admitted that it could be a systemic property of the scientific endeavour as a whole). In a given situation the stakeholders were frequently in conflict because of different values and goals so that any unitary process which suppressed such subjectivity was doomed to miss vital issues. He rejected the concept of optimality as being impractical - due to the exclusion of aesthetics and the emphasis on the utility of ends to the exclusion of means - and irrelevant - due to the rate of change in organisational systems.

(It is interesting to compare these criticisms of optimisation with those of Forrester. Similarly, Forrester's rejection of the predictive function of models and the alternative of using them to "design . . . the kind of system that we desire", sits very comfortably in the debate of the OR world. Generally, in his list of "obvious truths" that he believed to be false (Forrester, 1960), Forrester in many ways successfully foresaw and therefore avoided the criticisms that awaited the paradigm of hard OR. The creation a distinctive paradigm for SD has been of enormous value to the field and deserves much wider recognition in the OR world.)

Ackoff was by no means the only critic of this paradigm of OR. For example, Checkland wrote widely about the hard and soft system view and criticised hard OR for trying to understand 'human activity systems', which involve individuals performing deliberate acts to which they impart subjective meaning, by treating them as if they were 'designed systems', like cuckoo clocks. This is a perspective to which we shall return.

2.2 - OR Resurrected?

What has OR done about this? What has emerged - to a disproportionately high degree, it must be said, in the UK - is a paradigm that we shall loosely term here 'soft OR' and an associated set of tools called 'problem structuring techniques'. We may view this paradigm as following up some of the leads of Ackoff. Rather than trying to "predict and prepare", it aspires to "design a desirable future and invent ways of bringing it about" (Ackoff, 1979). It involves an array of tools for coping with complexity, uncertainty and conflict. It is concerned about stakeholder participation, transparency of the process, the use of 'soft' data and social judgement. Models are understood not as true, objective representations of the world (ontologies) which can then be 'solved'. They are accepted as being subjective intellectual constructs (epistomologies); explanatory devices which can be used to explore, to understand[6]. The purpose of such tools is to 'generate meaning' for the participants; to help them to learn together about their problem area. Hard OR assumes implicitly that it is practitioner-independent and that the problem is defined, the organisational objective clear and known, before technical analysis starts. In contrast, soft OR is consciously contingent, or requisite; involving models tailored for the individuals concerned in each specific project. Soft OR explicitly recognises that a "process of accommodation between participants is necessary before a problem focus can emerge which will carry assent and commitment to . . . action" (Rosenhead, 1989a). (This last consideration has lead to a fascinating and conceptually complex debate about the ideological structures in which OR operates. 'Critical Management Science' has been one of the outcomes of this debate and it will be discussed further in the next section.)

The above statement paints the field of soft OR with a very broad brush (as well as shamelessly including concepts from the 'systems movement'). Other authors characterise the two paradigms in somewhat different ways, though there is much overlap in the core ideas. Hard and soft OR have been characterised respectively as dealing with problems which are 'tame' and 'wicked' (Rittel & Webber, 1973) whilst Ackoff (1979) believes that

the paradigms apply to 'problems' and 'messes'. Rosenhead (1989a) portrays a dichotomy between 'tactical' and 'strategic' problems. Checkland (1981) speaks of classical OR or hard systems analysis as being useful only for dealing with 'designed systems' which can be 'engineered' so that 'solutions' are found to 'problems'. In response he formulated his contribution to soft OR; 'soft systems methodology' (SSM) which was crafted instead to deal with 'human activity systems' which involve 'issues' and 'accommodations'. Some commentators reject the dichotomous view and speak of hard OR as being a special case of soft OR and others have worked on systematising the relationship between different methods (see §3.2). From the particular point of view of the current SD community, perhaps the most interesting characterisation is that whilst hard OR is about finding solutions to problems, soft OR is about the continuing facilitation of learning about situations.

§3 SO WHAT IS SOFT OR?

Our hope is that the general comments of §2.2, when seen in the light of Forrester's paradigm, will themselves capture attention but we feel that the additional material below may be helpful. In the first sub-section we very briefly describe (or simply name) examples of the techniques in question. In the second sub-section we then give a brief account of the methodological setting and debate from which the tools arose and in which they continue to be critically examined and re-crafted. Our specific aims in this broadly drawn section is not to describe fully but rather to whet the appetite of fellow system dynamicists and to map out paths to pursue should they wish to find out more. We also hope to add substance to the claim of links between soft OR and SD.

3.1 - A Taste of Soft OR Problem Structuring Tools

The Strategic Choice Approach - Strategic Choice is a set of methods used with groups to facilitate communication about complex decisions (Friend & Hickling, 1987). It focuses on the interlinked decisions to be made and the uncertainties (doubts or disagreements) involved. It is incremental and highly interactive. There are three 'reference points' for any study. The classification of uncertainty contrasts uncertainties of 'the working environment' (needing analysis), 'guiding values' (needing clarification of objectives and conflict handling) and 'related choices' (needing negotiation and wider collaboration). The four modes of decision making define procedures for 'shaping' (forming an agreed view of a problem structure), 'designing' (identifying courses of action), 'comparing' (evaluating actions against criteria) and 'choosing' (agreeing an incremental process for decision making). The commitment package closes the process and expresses the decisions taken and deferred and the conditionalities on them.

Critical Systems Heuristics - CSH is an approach for studying existing or planned systems by uncovering the interests that the system serves (Ulrich, 1983). The process involves the use of 12 'boundary questions' aimed at the system planners but also at those people affected by the system. The questions seek out sources of motivation, control, expertise and legitimation and can be used by planners and other concerned actors to reveal the underlying value assumptions of the system design. The aim is to free the design from the individual, organisational, cultural, societal and political value assumptions which may be hidden and coercive. Although the process of revealing the true interests and motivations underlying proposals may lead to counter-proposals, CSH has little to say about the formulation of these or how any changes might be effected.

Strategic Options Development and Analysis - SODA is a method for dealing with complex, messy problems (Eden et al., 1983 and Eden, 1989). Equal emphasis is given to the process of the discussion and the content so great importance is attached to the use of 'facilitative devices' (maps). SODA centres on each individual's psychological construction of his/her world rather than the perception of an objective reality. Interest rests on participants' interpretation of events and the meaning that they impart to situations. SODA is based on Kelly's 'theory of personal constructs'. The approach uses 'cognitive mapping' as a language to express personal constructs. Maps are drawn in one-to-one interviews and in workshops in a participative style and display the meaning ascribed to a concept by recording its relationship with other concepts. Other forms of modelling may be suitable to study parts of a map. Maps are used to facilitate team negotiation and the outcome of a workshop is consensus and commitment to action. COPE offers computer-support for cognitive mapping.

Soft Systems Methodology (SSM) - The core notion of SSM is that a real-world problem situation may usefully be viewed as a case of organised purposeful activity or a 'human activity system' (HAS). Since 'purpose' and 'meaning' are imparted by those involved in such a system, SSM accepts subjectivity as a crucial element of human actions. SSM proposes a flexible enquiring process for articulating the meaning imparted by various actors and their understanding of the situation. The enquiry probes the situation using two streams of analysis, one logic-based, the other concerning cultural matters. Word and diagram models using devices such as the 'root definition' and 'rich picture' are used and comparison between such 'ideal type' models (q.v.) and the real world leads to an 'accommodation' amongst relevant actors to implement changes which are both systemically

desirable and culturally feasible. Although its attention to subjectivity means that an SSM study is, in principle, never ending, its attempt to treat the subjectivity in a rigourous way offers a powerful team method of learning about a situation. (see Checkland, 1981 and Checkland & Scholes, 1990).

Strategic Assumption Surfacing and Testing (SAST) - This approach was designed for groups lacking a common set of values and goals. Advanced by Churchman (1979) and developed by Mason and Mitroff (1981), SAST is based on the Hegelian dialectic. Two (or more) sub-groups are formed around positions for which each sub-group does have a consensus. Various techniques are then used to 'surface' (articulate) the assumptions behind the views so that the sub-group is aware of its key assumptions, or *Weltanschauung*. 'Dialectical debate' is then encouraged between sub-groups so that each position is clearly presented, attacked defended etc. This clash of thesis and antithesis is intended to help participants to understand different points of view and so develop a synthesis; a (temporary) consensus or agreement regarding assumptions, which then acts as a basis for decision making or planning.

This short list is already a rich one but we might also mention tools as varied as **hexagon modelling** (Hodgson, 1992), **decision conferencing/analysis** (Phillips, 1990 and Kirkwood, 1992), **robustness analysis** (Rosenhead, 1989b), **metagame and hypergame analysis** (Howard, 1989 and Bennett *et al.*, 1989), **viable system diagnosis** (Beer, 1979, 1981 and 1985), **interactive planning** (Ackoff, 1974 and 1981) and, as Wolstenholme (1985) has observed, many of the qualitative frameworks used in strategic management would not be uncomfortable in the company described here.

3.2 - Methodological Issues of Soft OR

Soft OR: Natural Science or Social Science? - All serious methodologies must be grounded in a philosophy; there must be an epistomology, a theory underlying the knowledge that the methodology claims to impart. Hard OR offers knowledge of the same nature as that of natural science; it claims to be analytical, ontological, value-free, subject to empirical testing, public, repeatable and refutable and its underlying philosophy is 'positivism'. As soft OR engaged increasingly with the subjectivism of its application, its developers looked more towards social science, in particular sociology, for a suitable theory of knowledge. However, sociology offer a complex array of knowledge theories. The tradition of Durkheim has a positivistic-naturalistic approach, conceptualising sociology as the objective study of social facts. This 'functionalist' approach gives accounts of actions deemed to be rational in a given situation; social reality is a concatenation of self-regulating social structures which transcend the individuals who form them. In the social sciences, the term 'systems theory' is generally associated with functionalism.

An alternative view (though it contains different strands) arises from the work of Weber and is known as the 'interpretive' approach. Interpretive sociology, grounded in the philosophy of 'phenomenology', concerns the subjective understanding which individuals ascribe to their social situations. Interpretation takes as its core concept the intentional act; it attempts to illuminate social action by offering an account of the acts of rational people and the subjective meaning that people ascribe to their acts in order to create meaning for their conduct. The form of knowledge on offer is epistomological, experimental repetition can be impossible and disagreements arise concerning criteria for refutation. The need to establish criteria for validating interpretations lead Dilthey, and others, to develop the theory of **hermeneutics** in which the *Verstehen* method is employed to place researchers in the role of the observed individual, in order to retrieve the meaning that he/she imparts to his/her actions. Interpretation is done with reference to 'ideal types', a complex concept which may be read as thinking aids, drawn from real phenomena, which have explanatory value. The social world, viewed from the interpretive perspective, is being constantly created by individuals via processes of dialogue, negotiation and learning; social reality is then an emergent property of the actions of individuals.

The purpose of the above materials is to illustrate that much of the work in soft OR is fundamentally interpretive in nature. For example, the descriptions of SODA and SSM given above reveal the importance attached to subjective understanding and the use of ideal types (cognitive maps and root definitions) to express individual meaning and to negotiate agreed worldviews. Checkland (1981) takes great care in reflecting on the action research which lead to SSM and appeals to a typology of the social sciences proposed by Burrell & Morgan (1979) to describe the social theory implicit in SSM as based on phenomenology. He is also at pains to differentiate SSM and the concept of HAS from other forms of systems thinking which have been identified with the functionalist view. Other soft OR researchers have taken similar pains to establish the underlying theory of their methodologies, Flood and Jackson being particularly attentive in this respect (see below).

Critical Theory and Soft OR - The Critical Theory (CT) of Habermas is overtly political, being a complex, subtle and eclectic theory of communication which draws on Marxist materialism, functionalist systems theory and Piaget's work in developmental psychology. Habermas sees social development as centred on learning, the accumulation of knowledge. He argues that knowledge is never objective but always serves an

interest and that that interest leads to - 'constitutes' - a particular form of knowledge. Habermas then uses this concept of **'knowledge-constitutive interests'** to propose three areas of interest and hence knowledge. **'Technical'** knowledge, arising from the need to control the physical world, is based on a positivistic approach and is viewed as a creation of advanced capitalism, its predictive and controlling purposes being used to manipulate people and coerce them into accepting such 'rational' thinking as the only acceptable form of knowledge. **'Practical'** knowledge arises from the human need to communicate, to discuss in order to make sense of what others mean in order to reach agreement and consensus. Such knowledge is derived from the phenomenological, interpretive view of the social sciences. Habermas finds these two knowledge types insufficient. Technical knowledge, he argues, is applied illegitimately to social issues and puts power in the hands of 'experts', reducing the machinery of democracy to side-shows of actual decision making as the issues which are open to debate and the 'rules' of that debate are subject to the coercive nature of power structures and the ideology of 'instrumental rationality'. Practical knowledge is either transformed erroneously into technical knowledge or 'systematically distorted', undermined by the illusions imposed on people's understanding of themselves because of ideological influences on language and even thought. With CT, Habermas therefore seeks a form of knowledge which he calls **'emancipatory'**. He argues that truth and rationality are phenomena of communication; knowledge arises from free discussion, from debate which is aware of the interests behind contributing views, proceeds with complete freedom and treats all contributors as equal. Such processes will lead to 'enlightenment'; understanding of technical ideology and power structures and personal values and behaviour. They will allow rational consensus via undistorted debate, or **'communicative competence'**.

Mingers (1980) examined the specific connections between SSM and CT and concluded that although there were many similarities, SSM suffered in comparison because it lacked a political stance and because it would tend to conserve and support rather than challenge the status quo. However, CT offers a general challenge to soft OR because of that paradigm's interpretive approach (see Mingers, 1992). Soft OR is conservative in practise. It seeks to elicit subjective viewpoints without considering the distortions that they contain. It aims at free debate and consensus whilst (generally) failing to articulate the power structures which limit that debate and which have the potential to resolve genuine conflicts by the exercise of coercive power. However, there have been attempts by OR practitioners to respond to CT. One of the most striking projects in this regard is the work at the University Hull. Declaring an outright emancipatory interest and working over a considerable period , the Hull group have devoted considerable energies to the creation of a response, an attempt to rehabilitate systems theory within the social sciences by engagement with the ideas of Habermas, Foucault and Derrida. An account of the development of these particular ideas may be found in Flood (1990) whilst Flood & Jackson (1991a) draws on a wide range of authors. The apex of this work may be considered to be 'total systems intervention' (TSI), a methodology which is discussed below.

Systems and Metaphors for the Methodologies - Section 2.2 closed with comments on ways of characterising the different paradigms of OR. As perspectives on approach and actual techniques developed this became an increasingly important enterprise. Rosenhead (1989a) offers two lists of 'characteristics' of the 'dominant' and 'alternative' paradigms in OR whilst Checkland (1981) describes the 'shape of the systems movement'. Considerable work has been done in this area by the Hull group. Across a number of articles (for an example, see Jackson & Keys, 1984) they have developed a **'system of system methodologies'** the aim of which is to "relate in the most general terms systems-based problem-solving methodologies to the contexts in which problems are found". The early form of this work offers two axes: 'nature of system' and 'nature of the decision-makers'. These are subdivided respectively into 'mechanical' and 'systemic' and 'unitary' (agreement on common goals exists) and 'pluralist' (goals can only be formulated if there is compromise or imposition), forming a 2x2 framework. Although this is not the only schema offered by workers at Hull[7], a development of it lies at the heart of TSI. Attempting to offer a practical implementation of the ideas of CT, TSI espouses a clear emancipatory interest (Flood & Jackson, 1991b & c). It offers its framework as a way of helping decision-makers draw on the diverse range of system-based techniques and, in choosing the most appropriate, making a virtue of that diversity. A 2x3 schema uses the axes of 'system' and 'participants' (a reworking of the concept of decision-makers) but now has these divided into 'simple' and 'complex' and unitary, pluralist and 'coercive'. The segmentation of unitary, pluralist and coercive is formulated to be in line with Habermas' technical, practical and emancipatory interests (a mapping with which we have some doubts). Flood & Jackson then place 13 different methodologies into this framework, SD being broadly categorised as 'simple-unitary', along with (hard) OR. A further step involves the re-framing of the schema using 'dominant metaphors': 'machine', 'organism', 'brain', 'culture', 'team', 'coalition', 'prison'. The purpose of this process is to relate each of the 13 methodologies to a cluster of dominant metaphors, the rationale being that this generates a perspective on the methodologies which will help managers think about which is the best to use. TSI consists of the self-reflexive and complementarist selection and use of a technique and Flood & Jackson (1991c) offers an overview of six[8] of them and a critique of its own approach.

The work of the Hull group, and particularly TSI, has been the object of various criticisms. Mingers (1992) questions the appropriateness of the axes of the grouping and challenges its links with Habermas. Taket

(1992b) observes that TSI's assignment of methodologies to problem contexts "is crucially dependent on the particular readings of the methodologies used". In light of the categorisation of SD in TSI, we believe this to be a criticism well made. Most seriously, Taket (1992a) suggests that value-laden words such as 'total' are "at variance with Flood's complementarist vision . . . and with the critical spirit of the whole thesis" and Mingers (1992) wonders whether TSI's goal of enhancing OR is consistent with its espoused emancipatory aims. These criticisms notwithstanding, the advancement of the ideas behind TSI is probably not aided by the unhelpful and confusing use of the dominant metaphors[9], nor by the extraordinary self-confidence of some of the authors' claims for it. Nevertheless, the work of the Hull group remains probably the best conceptualised attempt to provide some form of route-map to the methodologies of soft OR whilst engaging with CT.

§4 WHAT CAN RESULT FROM A DIALOGUE BETWEEN SD AND SOFT OR?

The connections between the problem structuring techniques of soft OR and SD are, we believe, clear. There may be those who view (erroneously, we believe) 'first generation SD' as a traditional, hard OR technique but probably second and most certainly third generation SD unambiguously demonstrate much in common with soft OR with regard to both the philosophy of operation and the aspirations of the work. But what is the value of becoming aware of such ideas? For instance, the field of 'management science' in the USA is some distance from the path taken in the UK[10] and yet there is no widespread concern. Are there reasons why particular benefit could flow from a dialogue between the communities of SD and soft OR? We believe that there are.

In the sub-sections below we discuss three related 'clusters' of benefits. However, we would preface this by commenting that this is a particularly apposite time for such a dialogue to be effective. The advent of new software (iThink and Vensim) and Senge's (1990) clear and popular articulation of the long-standing idea of SD as a learning tool have generated great interest. Today, SD is perhaps at its most confident. At the same time, because it aspires to deliver so much, the field is entering a high risk period in which it risks an 'overshoot and collapse' mode. Parallel with this, we see increased recognition of the array of tools and the variety of approaches that are available. Our clients have certainly become more sophisticated in this regard and academics are describing these linkages loosely (Rosenhead, 1989b) or more formally (Flood & Jackson, 1991c) whilst also generating a wealth of experience in applying the approaches. This is the context which makes us believe that the time is right for a dialogue

4.1 - Making Common (Process) Cause

Many aspects of modern SD are innovative and not easy to convey to clients; modelling for insight not foresight, consultant as process facilitator not problem expert, process as a learning experience etc. Soft OR practitioners have had many of the same problems and fought many of the same battles in these areas. Both sides have emphasised the importance of group processes and valuable reservoirs of experience have been created. Similarly, the tools of soft OR and SD are both being used to try to implement the idea of learning processes. Making common cause with colleagues of similar views and building on the commonalities of process and aims of various approaches with prospective clients can surely only ease our task. Knowledge would flow both ways and such mutual understanding would help us to explain to those outside the field what it is that we are trying to do whilst we simultaneously learn about it faster ourselves. In one aspect of process SD has a distinct advantage and therefore much to offer. The long-standing usage of technological support has produced a great deal of valuable experience. Soft OR has had a tendency to work without technology. As the soft techniques introduce computer support[11], access to the experience of SD could be of enormous value.

In order for such a complementarist activity to begin, it will be necessary for the SD field to acknowledge the existence of these other approaches. In this respect, we believe that the term 'systems thinking' is an obstruction. Usage of this label ranges from the inappropriate to the virtually incoherent. 'General System Theory', critical as it is quite possible to be of it, evolved into some useful modern approaches of 'systems thinking' and the majority of the tools of soft OR would identify with that label. The usage of the term within the SD field is very different (though rather hard to clarify). Is SD an element of systems thinking or vice versa? What is the relationship? Yet usage of this term is spreading with an enthusiasm which verges on the hegemonic. To use such a term to describe our own single methodology is virtually to deny the existence of any other. True systems thinkers will, we hope, be interested in learning from the other approaches discussed here and, in engaging with them, may re-examine the name which they give to the modern form of SD. This need not be a mere semantic squabble but could be a valuable clarification of the methodology of SD (q.v.).

4.2 - Making Available A More Diverse Tool-box for Messes and Learning

No approach is universally applicable. Not all problems can be addressed using SD, whilst soft OR lacks a tool for examining the time-evolutionary behaviour of systems. Many combinations are possible as we wrestle with messes and strive for learning. We can imagine hexagons used to select an issue to model (see Lane, 1993), a SODA process giving rise to an SD model, SSM employed to understand the purpose of a system, robustness used to explore the scenarios, decision analysis to evaluate their desirability (see Gardiner & Ford,

1980 and Reagan-Cirincione *et al.*, 1991) and even a SAST process with two different SD models. Soft OR offers a suite of fascinating tools of a style which most system dynamicist would find attractive. Working knowledge of such tools would doubtless improve our consultancy interventions, whether they are used as conceptualisation devices or as support for the whole project. If we seek to operate in the real world it is surely better to have a range of approaches which draw on the breadth of systems thinking. Soft OR is a good place to start.

The flow is two-way. Rosenhead (1989a) criticises the one-off decision perspective of hard OR since "(e)ach decision situation is unique, because (it) changes the configuration of resources". The field of SD has much to offer soft OR when it comes to powerful tools for learning about feedback effects and dynamic decision making.

A powerful way of engaging with other techniques is to study differences and commonalities; the frameworks and systems of methodologies discussed in §3.2 offer some approaches of this type. Additionally, this debate about the attributes and applicability of various techniques is progressing at present with very little contribution from the SD community. Whilst we take issue with the categorisation of SD made by Flood & Jackson (1991c), we admit that their comments reveal a weakness in the formal methodology of SD as well as indicating that system dynamicists need to be involved with complementarist debates of this kind.

4.3 - Firming-up the Methodological Framework of SD

Knowledge of soft OR would render more vigorous the methodological framework of SD. We propose that this base needs attention for two reasons; firstly, that factors are causing the degradation of the original framework and secondly, the push of SD into new areas has revealed weaknesses in that original. However, readers may find it heartening that similar comments have been made about the systems movement by Checkland (1992).

Practitioners of SD seem to be less certain today of the areas of its applicability. Having stolen a march on OR very convincingly, SD is in danger of committing an error which OR is now well aware of - applying the technique to inappropriate problems. Forrester (1968b) was very clear about the limitations of the technique. However, the conceptualisation tools of SD produce a rapid focussing on, and even bias towards, an SD-type analysis in an intervention (see Meadows, 1980, Wolstenholme, 1985 and Lane, 1993). It does seem legitimate to worry whether SD is being applied inappropriately. One way of ensuring the appropriate application of a technique is to have a view of how fits in with others. This is another reason why the system of system methodologies of Flood & Jackson (1991c) should be of interest: it at least provides one map for making such judgements. However, in engaging with these ideas, we reveal another degradation of the framework of SD: having always aimed at the use of modelling with teams, SD is widely labelled today as suitable only for unitary contexts (*ibid.*). This is not the place for a detailed response to what we view as Flood and Jackson's inappropriate characterisation of SD but what we would say is that their comments have an undoubted strand of truth in them. Wolstenholme (1993), as well as making an excellent job of representing SD thinking to the systems community, observes that the formal, rigourous discipline of SD does seem more suitable to unitary than pluralist contexts. However, SD is no stranger to diverse viewpoints; the point is that whilst SD can handle non-consensual groups, this is less a function of the formal methodology than it is an outcome of the skills of a specific practitioner. Case studies are rare and hence the field's ability to erect a set of clear theories on the use of SD in pluralist contexts has been severely limited.

There seem to be two areas in which the methodological framework of SD has proven weak and connection with soft OR can help in both. The first concerns the knowledge theory underlying SD. Many writers appeal to positivism (see Bell & Senge, 1980). However, Forrester (1961) is less convincingly committed to such 'public knowledge', giving a definition of information-feedback which "encompasses every conscious and subconscious decision" and commenting that "man is most conspicuously separated from the lower animals by this *self-awareness* of why he acts" (italics added). These remarks, and the sub-section on 'assumptions underlying test procedure', seem at least to face in the direction of a more social science contextualisation for SD. Certainly the insistence on 'confidence' as the criterion for model validation (Forrester, 1961 and Forrester & Senge, 1980) is knowingly distanced from the objective knowledge of natural science. Forrester and others (e.g. Meadows, 1980) are very much aware of this distinction and a clear articulation is offered by Barlas & Carpenter (1990) who argue that the epistomology of SD is of the 'social/relativist' type of Quine and Kuhn rather than the 'reductionist/empiricist' type of positivism. However, when Forrester (1990) comments that, "(t)he social sciences have relied too much on measured data. As a consequence, academic studies have failed to make adequate use of the data base on which the world runs - the information gained from living experience, apprenticeships, and participation", he appears to be aligning himself not just with the social sciences but with the interpretive rather than functionalist school. There is a tension here. SD might appear to be grounded in positivism, and many outside observers mis-perceive it as such. Forrester (and others) propose a socially relativistic grounding. Yet there are also clear arguments for underwriting it with a more phenomenological philosophy. This uncertainty has lead to some practices which have not aided the field's reputation. We might argue that Forrester implicitly threw away the 'rule book' of positivism and the result is a riot of untrammelled model building. Some model-builders have ridden the coat-tails of 'validity by confidence' to create extraordinarily subjective models and to make ambitious claims for their efficacy as learning tools. One

wonders how social scientists would react to the research 'method' employed. Our field must confront the fact that we can only swap one set of rules for another, not operate without any rule book; the *Verstehen* method, the subject of hermeneutics etc. are appropriate for such exercises and phenomenology must be their grounding. SD must comprehensively and widely address the issue of its philosophy of knowledge or this confusion will continue to debilitate the field.

There is a second area in which the methodology of SD has proven weak in the face of new developments. Building models to learn about systems is a goal expressed in the earliest Forrester works (Forrester, 1961) and he also proposed that widespread use of the insights of SD in an organisation would offer new freedoms to staff (Forrester, 1965). Whilst, in the past, the field has been no stranger to the political ramifications of its recommendations, its positioning today concerning empowerment in an organisational context is (with significant exceptions) in many ways naive from the point of view of the political system within which it operates. SD takes much for granted in its current belief that learning and freedom can be promoted by SD model building, dialogue and microworlds. System dynamicists might prefer to see themselves as proffering an objective, value-free approach. Or they might claim that the response to coercion/power structure issues is via the process; just as in much of soft OR, the implicit hope here is that the skills of the practitioners can take up this methodological slack. Yet the issues concerning power, ideology, coercion and communication reviewed in §3.2 are just as relevant for the field of SD so that both of the above views would be explicitly disavowed by CT. Can we be certain that the Claim Game is not a device which allows senior staff at Hanover Insurance to coerce subordinates into the world-view of managers? Is the vision that produces Senge's (1990) 'alignment' based on consensus, or coercion? Can 'dialogue' articulate mental models? If so, do they reveal the true nature of the individuals, or the nature of a alienated prisoners? Flood (1993) argues that 'freedom by debate' cannot resolve these problems but that approaches which specifically address systematically distorted communication must be used if freedom by 'disemprisoning', true emancipation of the individual, is to result. One argument might be that the tools and processes of SD are inherently emancipatory. If so, we need to do a great deal more work before we can establish the validity of this view. This is not a barren academic pursuit; it is a vital attempt to clarify our understanding of the work that we aspire to do. Whether the SD community chooses to take up the analysis of, and make common cause with, the critical system thinkers is another matter but the issues that are raised by CT must be engaged with convincingly. We may agree or disagree with the critical systems thinking community but a dialogue would indeed generate meaning and contribute to our understanding of what SD is.

§5 CONCLUSIONS AND PROPOSALS FOR GOING FORWARD

After a justifiable separation of some three decades there is much to be drawn from studying the common ideas of SD and soft OR. Although the SD community can be confident that it has much to bring to such a dialogue it can also expect to benefit from it. **Soft OR** offers a range of tools which can help both in SD projects and in interventions requiring a different **sys**temic approach, whether the goal is to handle a mess or to promote learning. There is also an impressive **body** of work on methodology and theories of knowledge validation in soft OR with which we could usefully engage. Forging links between the ideas of soft OR and SD requires, most of all, motivation. This paper is a modest attempt in that direction[12]. Attempts to move forward by building on those links require three areas of activity; communication, application and research.

There are many ways of beginning communication between the fields. Subject specific books and articles exist already. There are case studies and teaching materials for those who look for them. Some extremely valuable survey books have been published which give an overview of the techniques. Moving away from the printed page, we should try to visit conferences and universities where we can meet practitioners. The 1994 SD conference in Stirling, Scotland provides an excellent opportunity which we know will not be passed up.

Beyond communication lies application. We should experiment with the different tools available to learn more about them, very much in the style of Reagan-Cirincione *et al.*, (1991). The author is currently using a combination of hexagon modelling, SAST and SD with a UK bank. Gary Bell[13] is working with managers from a telecommunications company on the problem of software development. The intention is to use SD and SSM in a participative style. The currently identified research issues concern the use of SSM to frame an SD modelling approach and a theoretical analysis of the type of knowledge which can arise from such an intervention, compared particularly with the work of Abdel-Hamid & Madnick (1990). We hope that developments in both projects will have advanced sufficiently to be reported at the 1994 conference.

This last example demonstrates most readily that 'hybrid modelling' can provide a database of experiences which would then contribute to the final activity, research. By comparing assumptions, techniques and methodologies we would hope to draw higher level conclusions about the relative philosophies of SD and soft OR. Though such an activity may appear rather theoretical, it will be important in informing the practical application of our tool. We can anticipate some complex, subtle and, perhaps, 'robust' debates with our critical systems theory colleagues and others working in soft OR. But if all involved retain an openness to new ideas, we have no doubt that such a dialogue will ultimately prove highly rewarding for all concerned.

With recent refinements in software and philosophy of implementation, SD now has the potential to put into practise widely its long-standing goals. Since it seeks to do this in a way which has many similarities with soft OR, it is surely worthwhile to access the experience in these other fields. We will count this paper a success if, in a small way, it encourages and aids a few of our colleagues to do just that. Such developments will, we believe, minimise the risk that the organisational learning approach will prove to have been a dangerous chimera for the SD field but will instead ensure that the original vision of SD - to provide valuable learning to organisational operators - is achieved successfully and widely.

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NOTES

[1] The abbreviation 'OR' is used for operational research and its American counterpart, operations research.

[2] This paper was first given as a lecture in 1960.

[3] The distance between OR and SD presumably increased with time since Forrester (1960) observes that men (sic.) with an OR training had much less success than others when trying to pick up the ideas of the new field.

[4] Many of Wolstenholme's earlier publications (1982 & 1985) also demonstrate the clear and consistent influence that the UK OR and systems communities have had on his ideas on the use of SD, particularly the importance attached to qualitative SD, or 'QSD', as a distinct subject.

[5] System dynamicists interested in intruding further into the private grief of the OR community will find a readable summary in Rosenhead (1989a) which also contains a detailed set of references.

[6] Checkland (1992) offers a clarification of the distinction between ontologies and epistomologies whilst Eco (1984) describes the latter with "The only truths that are useful are instruments to be thrown away".

[7] Jackson (1991) presents five frameworks which can be used to compare and contrast systems methodologies.

[8] SD, viable system diagnosis, SAST, interactive planning, SSM and CSH.

[9] Flood (1993) relates different methodologies to a much clearer threesome of models of practising freedom.

[10] Hugh Miser comments on Rosenhead (1989) that it "is an important book, especially for American MS/OR workers, who have as yet paid far too little attention to approaches like those it describes." (Miser, 1992).

[11] See, for example, Friend (1992) and Avison, Golder and Shah (1992).

[12] It is only right also to mention Wolstenholme (1985) since this SD conference paper established QSD as a distinct subject but also drew explicit attention to the links between SD and other systems disciplines.

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