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Author(s)	Jennifer, M. Wilby
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Applying a Critical Systematic Review Process to Hierarchy Theory

Jennifer M. Wilby
Centre for Systems Studies
Hull University Business School,
Cottingham Road, Hull HU6 7RX United Kingdom
j.wilby@hull.ac.uk

ABSTRACT

This symposium asks: "If Systems Sciences are to help integrate human efforts and advancement, how will they do so?" This paper addresses this question and reviews the use of general system theory, and in particular, hierarchy theory, as one such way of applying systems science to issues of concern in global systems. The paper further emphasizes the need to investigate systems sciences with a rigorous and systematic procedure.

This report presents an on-going research program to produce a critical systematic review of hierarchy theory and a critical review of the utility of hierarchy theory for addressing issues arising in complex systems. The methodology of systematic review utilizes extensive literature searching and review, the application of pre-determined inclusion and exclusion criteria to the retrieved literature, and the critical evaluation and synthesis of the gathered data on hierarchy theory.

The goal of this paper is to propose a framework for systematic critical review of any systems methodology that can also be specifically applied to hierarchy theory. This will provide theoretical rigor and practical implementation for this area of systems science. It is also useful in this symposium as an underpinning and plea for rigor in addressing the question as to "what really constitutes systems, their development, and their design".

Keywords: general system theory, hierarchy theory, systematic review, critical review.

1. INTRODUCTION

In our zeal to apply systems methodologies and models, failures are sometimes overlooked, or actively avoided. It may be quite some time before the success of a methodology or model undergoes critique, or before it is noticed that the process fails to be successfully applied. Applying rigorous scientific methods is the usual yardstick for measuring such success or failure of research questions. The application of deductive scientific process in social systems, and specifically in problem solving methodologies, is not feasible in that social systems do not stand still, cannot be held stable for the length of experimentation, and any received results are difficult to generalize to even similar problem situations.

To address these drawbacks in investigating social systems using systems sciences, one means of introducing rigor in systems science and its methodologies and models is to incorporate a process of critical systematic review and critique of the systems sciences. While critique is necessary in any discipline for any evolving model or theory, it is especially appropriate in the systems field where feedback and the iterative processes involved in model development are core principles.

This paper proposes such a process that in turn may facilitate increased acceptance and use of systems science in the integration of human effort with the goal of advancement in social sciences. The process has the secondary outcome of addressing "what really constitutes systems, their development, and their design".

2. SYSTEMATIC REVIEW

Systematic reviews are a recent development in the field of medical research, employing a more rigorous, and usually quantitative, approach to the meta-analysis of primary data. This process of review is now found in many areas of social sciences research including education, psychology, criminology, and sociology. In any area, a systematic review addresses the need for additional rigorous investigation where a collection of primary data and studies may offer different conclusions from the same type of intervention, thereby causing uncertainty in decision-making and possible allegations of biased analysis, interpretation and reporting of results.

"Systematic reviews identify, appraise and synthesise research evidence from individual studies and are therefore valuable sources of information. Systematic reviews differ from other types of review in that they follow a strict protocol to ensure that as much of the relevant research base as possible has been considered and that the original studies have been appraised and synthesized in a valid way. These methods minimize the risk of bias and are transparent, thus enabling replication". [1]

According to Mulrow [2] systematic reviews are beneficial for the following reasons:

- Large quantities of information can be reduced to manageable size for decision-making
- The information generated can help to define further research questions
- The process of review is efficient and can reduce the need for large new primary studies
- Reviews can offer a greater generalisability with the increase in data received from many rather than one similar study
- Reviews can address the consistency of relationships among studies with the same intervention
- Reviews can highlight inconsistencies in the data and between studies for further discussion
- Reviews offer a larger sample size and therefore additional sample power
- Following from an increase in sample size, the review can offer greater precision in estimates of effect
- Systematic reviews offer greater accuracy with the specific aim of reducing random and systematic errors.

As drawn from a publication overview of the process of systematic reviews [3], systematic review involves several stages:

1. Defining the research question - this addresses four criteria of the participant (methodology) for the study; the intervention; the outcomes to be measured; and the intervention design. [3]
2. Searching the literature – one of the hallmarks of a systematic review is in how it differs from a traditional literature review. A systematic review, like a traditional literature review, also employs a search of the literature but it is always planned a priori to be an extensive, exhaustive, and strategically determined search pattern. The search strategy is documented, reviewed by peers, and involves not only published, database literature, but also unpublished 'grey' literature such as unpublished reports, contact with other researchers, incomplete

studies and studies that may have been published in languages other than English. [3]
3. Assessing the studies – in a systematic review data are evaluated against inclusion and exclusion criteria to determine whether data should be included or excluded from the review. These criteria are again determined a priori in the protocol designed for that piece of research. Included studies are also assessed using validated quality criteria regarding study intervention and outcomes. All of these procedures are checked by at least one other reviewer and are sometimes entirely duplicated by the second reviewer depending on the resource constraints within the project. [3]
4. Combining the results – in a systematic review the included data are analysed in a form of meta-analysis that may be quantitative (statistical meta-analysis) or qualitative (narrative synthesis). This part of a systematic review most closely matches that of a traditional meta-analysis project. [3]
5. Placing the findings in context – the results of the review have to be discussed and evaluated as to the relevance of the results and whether the results are sensible in light of the possible impacts of heterogeneity, chance and bias introduced in the research process by the choices made by the reviewers. [3]

However, systematic reviews have some drawbacks. Systematic reviews "may be done badly … they may have made an inappropriate aggregation of studies … the results may not be in harmony with the findings form large-scale high quality single trials …"[4].

In addition to this critique however, from a critical systems perspective by Jackson [5], the practical considerations of intervention also involve the issues of:

- The understanding of a problem context by the researcher(s) and the role the researcher has in defining and interpreting situations
- The need to employ differing methodologies in one intervention and the skills of a researcher in doing so
- The reflection needed when an intervention either succeeds or fails and how that affects the current research and future research.

All of these issues are not addressed in an explicit fashion by the process of systematic review. A systematic review is assumed to be less biased due to the rigor in which it is performed. In that process it is not seen to require reflective practice beyond the placing of the findings managed in the discussion section of the review. Bias may be minimized by the quality of the review process and the manipulation and

elimination of bias through additional statistical analysis. For these reasons, these issues require additional attention for the development of a more critically systematic review process.

In the diagram below, literature review and meta-analysis are part of the process of systematic review. They can however also stand alone in many other forms of research so therefore only overlap with the systematic review process. The drawbacks of the systematic review, also listed earlier, focus on the systematic review standing alone without reference to the research context and the environment and influences surrounding the research. To address such drawbacks, critical systems thinking and practice (CST and CSP) is one way of adding evaluation and reflection to the theoretical rigor of systematic review.
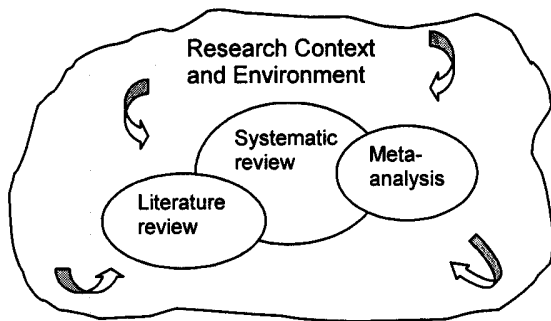
3. A FRAME FOR CRITICAL SYSTEMS REVIEW

One means of providing that evaluation is through the methodology of critical systems thinking (CST) (Flood and Jackson, 1991) and critical systems practice (Jackson, 2003). CST/P is an evaluation and questioning of the technical (hard systems), practical (soft systems), and empowerment interests in the method or model of interest. This use, of a critique of one model from within the standpoint of another methodology, is an important implementation of CST/P.

When first introduced into systems thinking, CST had three commitments: critical awareness, emancipation,

and complementarism. In another iteration, these commitments have been addressed and described as critical reflection (rather than critical awareness); pluralism (rather than complementarism); and improvement (rather than emancipation)" [6]. In CST/P currently, the work focuses on critical awareness, pluralism and improvement [7]

CST has relevance to this proposed methodology in terms of providing an underpinning philosophy for evaluation and critical reflection and in realising the limitations of the individual researcher in any study. The observer (researcher) should always be engaged in a constant and iterative self-reflection as an ongoing part of any analysis. This would also involve the "sweeping-in" of alternate perspectives [8].

The need to explore "the relationship between a methodology, the types of problems it was designed to address, and its value its use added to the decision making process" [9] is the basis for the development of CST/P. It is also the reason for utilizing CST/P to enrich the practice of systematic review and counter the drawbacks inherent in the process of systematic review that were enumerated earlier in this paper.

The task of self-reflection is necessary and vital, and requires an on-going self-examination and self-reflection of the biases, filters and paradigms brought to the study by the individual researcher, and by the physical and intellectual communities of which the researcher is a part recognising that the output of this dissertation is only one of many explanations from the data gathered.

One means of providing that evaluation is through the methodology of CST [10]. CST is an evaluation and questioning of the technical (hard systems), practical (soft systems), and empowerment interests in the method or model of interest. This use, of a critique of one model from within the standpoint of another methodology, is an important implementation of CST.

The following table details an overview of the subgroups and individual steps in the critical review mode that can be used to critique any systems methodology.

Table I. Process of Critical Review

Subgroup One: Creativity/Understanding	
Step One	Details the candidate methodology's philosophy, principles, methodological practice, and process.
Step Two	Critiques the candidate methodology in terms of how its theory, methodology, utility, and ideology address the technical, practical, and emancipatory knowledge-constitutive interests based on the work of Habermas [11].
Subgroup Two: Choice/Categorizing	
Step Three	Evaluates which of the three phases, creativity, choice, and/or implementation, the candidate methodology contributes to using the three phases themselves as the process for evaluation.
Step Four	Asks how the candidate methodology creates a vision of the organisational-enterprise ideal (as described later in this chapter) while also tackling the four key dimensions of organisation: efficient design, effective organisation, culture, and politics (the "How?", "What?", and "Why?" questions.)
Step Five	What meaning, if any, does this candidate methodology give to these four key principles of TSI: being systemic, being reflective, enhancing emancipation, and encouraging meaningful participation? (Realizing that each methodology will answer these questions in different ways and using their own terms of reference.)
Subgroup Three: Implementation/Analysis	
Step Six	Asks how does the information gathered in Steps 1 to 5 combine to present a critique of the candidate methodology? How does this analysis enhance TSI and how does the information gathered enhance the candidate methodology itself? Finally, how does this critique enhance our understanding of the system of methods and how is the system of methods itself enhanced by this critique?
	In step 6 there is an accumulation of knowledge about a candidate methodology which is used to answer the questions detailed in this step. In addition, at this step there are also final questions about the methodology's ability to work instead of, or with, other methods which are already a part of the system of methods. This will be discussed in greater detail in step six.

The first step, in terms of *creativity*, surfaces information about the philosophy underpinning the candidate methodology in terms of how this philosophy creates and develops the worldview of the candidate methodology, and how this development contributes to the philosophy of systems thinking. It then describes the candidate methodology's principles based on the philosophical underpinnings surfaced in the philosophical description, and finally, this step describes the details of the candidate methodology and its model—a detailing of what the philosophy and principles have created in practice.

The *implementation* of this synthesis of information from this step provides the critical review mode with the basic information about the candidate methodology that can then be utilised in all of the following steps of the critical review process.

Step two is a critique of the candidate methodology's theory, methodological principles, utility, and ideology in terms of how each of these four areas addresses the technical, practical and emancipatory knowledge-constitutive interests (Habermas, 1972) inherent in problem solving situations. Questioning a candidate methodology as to what extent, and how, it addresses the technical, practical, and emancipatory knowledge-constitutive interests is the central aim of this step. Technical interests are those of prediction and control (the underpinnings of hard-systems approaches);

practical interests are those of understanding, shared meaning, language, ways of observing, worldviews, and roles in achieving consensus (the underpinnings of soft-systems approaches); and emancipatory interests are those which address people's interest in being free from unjust power relations (the underpinnings of critical systems approaches) (Flood and Jackson, 1991a). These three knowledge-constitutive interests (technical, practical, and emancipatory) are similar to three other types of explanation that work together to provide an understanding of the underpinnings of TSI. Table III shows how these four concepts relate to each other.

Table 2. Validity Statements and Systems Methodologies

Habermas 1972 [12]	Flood and Jackson 1991 [13]	Flood 1993 [14]	Flood 1995 [15]
Technical interests	Hard systems methodologies	Design methodologies	"How?" methodologies
Practical interests	Soft systems methodologies	Debating methodologies	"What?" methodologies
Emancipatory interests	Critical systems methodologies	Disemprisoning methodologies	"Why?" methodologies

In the above table, each of the horizontal rows deal with the development of a line of thought ranging from the more complex to the simplified; from terms that are understandable and are of benefit to theoreticians, towards terms that are understandable and of benefit to practitioners and individual problem solvers. The first column lists the three knowledge-constitutive interests (technical, practical, and emancipatory) from the work of Habermas [12]. These are translated in the second column by Flood and Jackson [13] into terms understood in the field of systems thinking. The third column [14] details the same concepts in terms of explaining what these concepts (and the systems methodologies they embody) mean in practice for addressing issues of freedom in systems design and implementation. Finally, the terms in the fourth column [15] are concepts to which individual participants and managers of problem solving situations will, more possibly, relate to and understand.

The *implementation* of this synthesis of information from this step and the previous step provides the critical review mode with the basic information about the candidate methodology being reviewed and this information is either passed into the next step or fed back into the present step for further reflection and critique.

The third step is summarised by the question: what forms of creativity, choice, and implementation are advocated by the candidate methodology?

Step four is designed to gain an understanding of how the candidate methodology may be able to contribute to the organisational-enterprise ideal (which is explained in detail in the next paragraph) by addressing the four key dimensions of organisation as operationalised by the following four-part question: How does the candidate methodology tackle the four key dimensions of organisation: a) in the efficient design of processes?; b) in the effective design of organisation?; c) in the context of organisation culture?; and d) in the evaluation/acceptance of these designs and decisions and their implications and responsibilities for the stakeholders. These key dimensions (of efficient design, effective organisation, culture, and politics) are the "How?", "What?" and "Why?" questions.

Step five must answer how the candidate methodology being reviewed meets the requirements of the four key principles of: 1) being systemic; 2) being reflective; 3) achieving meaningful participation; and 4) enhancing freedom. These four principles are central in the evaluation of a systems intervention [16], and so it is vital that the candidate methodology being evaluated in the critical review mode addresses these principles.

Step six completes the operationalisation of the critical review mode by asking four questions: "How does the information gathered in steps 1 through 5 combine to present a critique of the candidate methodology?"; "How does this analysis enhance critical systems practice?"; "How does the information gathered enhance the candidate methodology itself?"; and

finally, "How does this critique enhance our understanding of the system of methods and how is the system of methods enhanced by this critique?".

It may also happen at this point, or any point within these six steps, that the output of this critical review will require a return to a previous step for further development of the critique of a candidate methodology.

The output of these six steps provide a bank of detailed information about any systems methodology. The problem solving and critical reflection processes depend on the use of the critical review's comprehensive process of critique to provide the richness of information about the methodologies that may be employed in the managing of complex situations. The operationalisation of the critical review process presented in this paper is a beginning to which further work must be done in refining and validating the process especially as it ties into the process of systematic review.

The model presented here for the critical systematic review is a beginning; there is much more that can and will be added its structure and process. Further, it is a basic premise of CST/P that this proposed process itself should be evaluated, critiqued and reflected upon as it is now implemented in evaluating other methodologies. This is the iterative process of critical practice and will the subject of future investigation.

The goal of this systematic critical review of hierarchy theory is to provide theoretical rigor and practical implementation for this area of systems science. It is also useful in this symposium as an underpinning and plea for rigor in addressing the question as to "what really constitutes systems, their development, and their design".

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