

A Research Agenda for General Systems Transdisciplinarity

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ABSTRACT We believe that a general theory of systems is attainable in principle and would be valuable in practice. In this paper we present our perspective on the key projects to be undertaken and key questions to be addressed for a program to develop a general systems transdiscipline and put it into effective use. In our view this program is urgent and important, and we urge the systems community to support efforts to make this potential a reality.

KEYWORDS General Systemology, General Systems Transdisciplinarity, GSTD, exploratory science, General Systems Theory, GST, GST*

1. Introduction

Systems Thinking and the Systems Sciences have gathered a substantial following in recent years (Hooker, 2011; Buckle Henning, Wilmhurst, & Yearworth, 2012; Capra & Luisi, 2014; Dekkers, 2014; Mobus & Kalton, 2014), but the field of systems as a whole is characterised by a high diversity of perspectives and methodologies (Midgley, 2003; Skyttner, 2006; Dekkers, 2014), a variety of views about its significance and potential (Warfield, 2003; Dubrovsky, 2004; Denizan & Rousseau, 2014; Rousseau & Wilby, 2014), and multiple perspectives on the possibility and viability of a unifying framework (Boulding, 1956; Gaines, 1979; Midgley, 2001; Rousseau, 2014c).

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This variety is not a serious problem *per se*, as both new and established disciplines go through cycles of critical reflection, fragmentation, and unification as they evolve. Current examples include, amongst new disciplines, the Science of Team Science (Falk-Krzesinski et al., 2011) and Transdisciplinary Action Research (Stokols, 2006), and, amongst established disciplines, Systems Engineering (Collopy, 2012; Soban, Price, & Hollingsworth, 2012; Pennock & Wade, 2015) and Evolutionary Developmental Biology (Green & Wolkenhauer, 2013; Jaeger, Laubichler, & Callebaut, 2015).

However, in the case of the systems field the variety appears problematic. Systems science is *not* a new field – the first scientific work on systems appeared in the 18th century (Condillac, 1749) – but nevertheless systems science has made scant progress towards a unifying framework (Francois, 2006), despite this already being envisioned early on in the 20th century (Bogdanov, 1913; von Bertalanffy, 1932) and many re-iterations of it since (von Bertalanffy, 1955, 1969; Klir, 1969; Troncale, 1984, 2009a; Sirgy, 1988; Pickel, 2007; Drack, 2009; Drack & Schwarz, 2010; Hofkirchner & Schafraneck, 2011; Pouvreau, 2011; Friendshuh & Troncale, 2012; Drack & Pouvreau, 2015). Moreover, the community of researchers working towards developing unifying frameworks is small and funding for such work limited (Drack & Schwarz, 2010; Rousseau & Wilby, 2014). In our view the lack of attention and funding significantly lowers the prospect of the systems field finding its unifying framework and, by implication, the prospect of the systems field making a significant contribution to solving the serious systemic challenges facing present-day socio-ecological systems.

We believe, and have recently presented supporting arguments (Billingham, 2014; Rousseau, 2014a, 2014b, 2015a; Rousseau & Wilby, 2014; Rousseau, Wilby, Billingham, & Blachfellner, 2015a, 2015c, 2015d; Wilby et al., 2015), that:

- the systems field cannot become an established academic discipline without developing a unifying framework grounded in a general theory of systems
- that a unifying framework for the systems field exists in principle and that its development is a practical prospect, and
- that such a unifying framework would support the development of powerful and useful systemic methodologies for discovery, insight, innovation, intervention, management, control and engineering in all branches of science.

In the light of this position we recently launched a *Manifesto for General Systems Transdisciplinarity* (Rousseau, Wilby, Billingham, & Blachfellner, 2015b, 2016b), calling for renewed efforts toward the development of a foundational general systems theory for the systems field, and the development of methodologies and perspectives that would put it to practical use and fulfill the potential of the systems perspective. The purpose of the present paper is to propose a research agenda for this work, identifying the core questions to be answered and key strategic initiatives to be established.

A key challenge for such proposals and work is that the systems field is not only fragmented in content but also in terminology. For this reason we have recently proposed (Rousseau, Wilby, Billingham, & Blachfellner, 2016a) certain key terms which we will adopt in the present work, as follows:

- *GST** (pronounced “g-s-t-star”) for the foundational general theory of systems (we propose “GST*” because the meaning of “GST” has become highly ambiguous, see (Rousseau et al., 2016a);
- *General Systemology* for the discipline that seeks to develop, apply and promote GST* (in line with an earlier proposal by Bertalanffy scholars David Pouvreau and Manfred Drack (Pouvreau & Drack, 2007));
- *General Systems Transdisciplinarity* (GSTD) as the activity scope of General Systemology;
- *Systemology* for the overarching (trans-)disciplinary field of systems (in line with an earlier proposal by Russ Ackoff (Ackoff, 1973, p. 669).

2. Vision for GSTD

In our *Manifesto* we proposed that progress towards establishing a valuable and competent General Systemology can be made by focusing on the development of:

- a **General Systems Worldview (GSW)** that is informed by our best scientific knowledge, by new discoveries in systems science, by advances in general systems research, and by the debate about the unity of science and the plurality of perspectives employed in systems thinking and practice;
- a **General Systems Theory (GST*)** that includes:
 - an ontology of systems that can be used to describe systems and classify them in an unambiguous way;
 - models that characterize the kinds of processes that support the evolution, expression or degradation of systemic behaviours;
 - models of the mechanisms that underpin systemic evolution or systemic behaviour;
- **General Systems Methodologies (GSMs)** that can leverage GST* under the guidance of the GSW to:
 - extend and refine GST*, the GSW and the methods of General Systemology;
 - discover new Theoretical Systemics, i.e. specialised theories about kinds of systemic structures, processes, behaviours, etc., or enhance existing ones;
 - discover new Methodological Systemics, i.e. specialised methods for systemic research, design, engineering, management, education etc., or enhance existing ones;
 - support exploratory science in all areas of scientific inquiry;
- **General Systems Transdisciplinarity (GSTD)** that employs the GSMs to address the looming and present crises facing human civilization; and to contribute to the building of a thriving future world.

We have elsewhere (Rousseau, Wilby, Billingham, & Blachfellner, 2016b) discussed the systemic relationships between these components, as illustrated in Figure 1.

3. Research Agenda

3.1. Structure of the Research Agenda

In order to meet the objectives set out in the previous section, and establish General Systemology securely in academia and in practice, a wide range of strategic questions will have to be addressed. In our Research Agenda below we outline such questions in a systematic way.

In preparing our Research Agenda we have drawn on prior work by others who have proposed research agendas in other and similar contexts (Sirgy, 1988; Keating et al., 2003; Stokols, 2006; DeRosa, Grisogono, Ryan, & Norman, 2008; Drack & Schwarz, 2010; Griffin, 2010; Falk-Krzesinski et al., 2011; Buckle Henning et al., 2012; Collopy, 2012; Pennock & Wade, 2015; Troncale, 2006, 2009a, 2009b; Soban et al., 2012). We have arranged our agenda in a bespoke way, by employing our previously-presented systems model of the structure of a discipline (the “AKG Model” presented in Rousseau et al., 2016a), reproduced here as Figure 2.

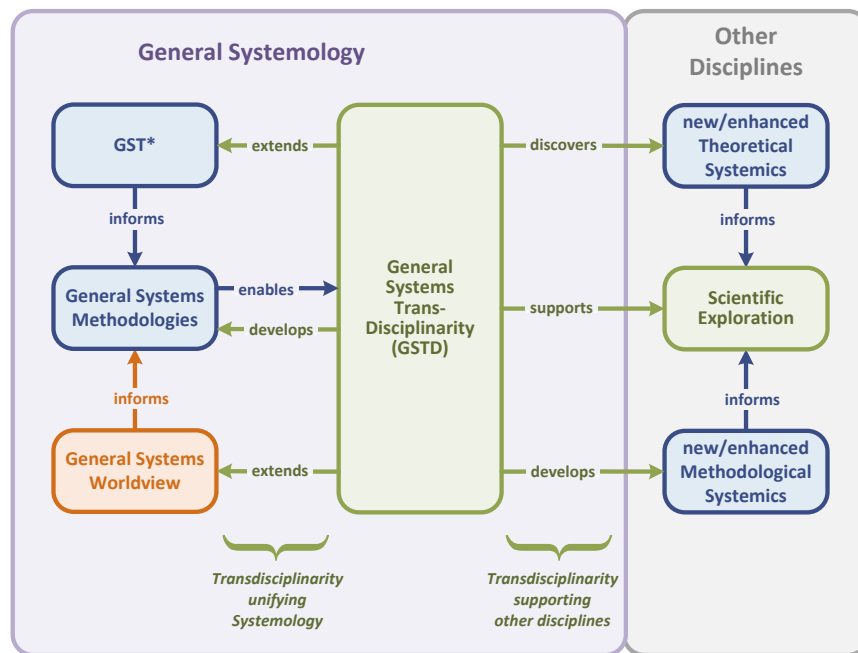


Figure 1: General Systems Transdisciplinarity as the activity scope of General Systemology
(Rousseau et al., 2016c, p. 56, reproduced with permission)

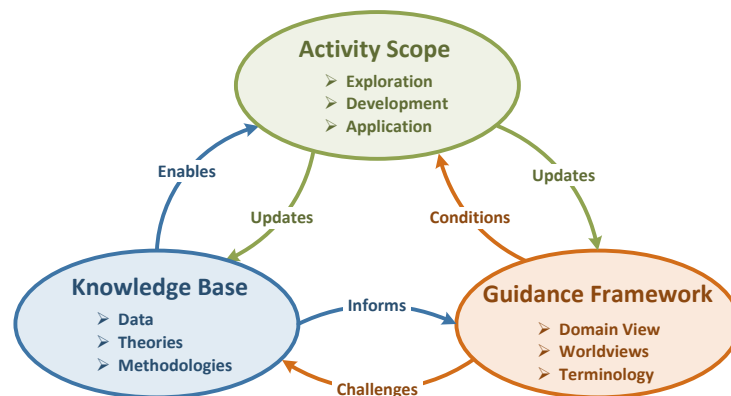


Figure 2: The AKG Model of a Discipline
(Rousseau et al., 2016a, p. 23, reproduced with permission)

3.2. Key questions towards effective GSTD

3.2.1. Guidance Framework questions

(1) Domain View questions

- (i) What differentiates GSTD from other forms of systemic thinking, research and action?
 - What are the high-level objectives of GSTD?
 - What is the scope of the content of General Systemology? What theories, methods, practices and perspectives does it include, and why?

- What is the scope of applicability of GSTD? What kinds of problems and question can it address? In those contexts, what is its particular value, potential and limitations?
 - What is the relationship of General Systemology to other systemic and non-systems disciplines? How does it inform, and how is it informed by other disciplines?
- (ii) How do we assess the merits of General Systemology?
- How can we demonstrate the “virtues” of General Systemology? What are “virtue criteria” for General Systemology and why? How is the “value” or “goodness” of the domain differentiated from the respective virtues of its theories, methods and perspectives?¹
 - What are strategies for ensuring or improving the “virtues” of General Systemology and its components?
- (iii) What resources are needed to make GSTD feasible (e.g. local/regional, individual/communal, universal/cultural, academic/technical? How should they be organised and how do they dynamically relate to each other?
- (iv) How do we ensure support for the development and application of GSTD?
- How do we promote the value of GSTD to the wider community?
 - How do we support recruitment of new researchers and practitioners in General Systemology?
- (v) How do we ensure the future of GSTD?
- How can we support the professional development of academics and practitioners involved in GSTD?
 - How we do inculcate a sense of community amongst General Systemologists?
 - What programs do we need for recruiting and training new generations of General Systemologists?
 - What cognitive competencies are required for GSTD? How can they be assessed or taught? Are there any to which the effective practice of GSTD is particularly sensitive?
 - How do we attract intuitional, industry and governmental support for General Systemology?
 - How do we promote public and academic understanding of the value and potential of GSTD?

(2) Worldview questions

- (i) What is the General Systems Worldview (GSW)?

¹ For example, virtue criteria *for the domain* might refer the extent to which it unifies the field of Systemology, and its ability to provide a framework for guiding research, while virtue criteria for its theories might be about explanatory power, predictive power, etc., virtue criteria for methodologies might be e.g. about how efficient they are and about the range of contexts in which they can be applied, and virtue criteria for the activity scope might be e.g. about the extent to which it facilitates cooperation by providing a common linguistic framework, facilitates discovery by providing versatile observational perspectives, and facilitates modelling by providing versatile conceptual frameworks.

- What are the fundamental assumptions upon which the theories and methodologies of GSTD are based, and why do we have confidence in them?
- (ii) How does the GSW influence actions?
- How is GSTD limited or empowered by the GSW's assumptions? What are the consequences of violating these assumptions? Are there any assumptions to which the validity or effectiveness of GSTD is particularly sensitive?
 - How can we recognize when these assumptions have been violated? If we know in a particular research or practice context that the assumptions have been violated, what are the resulting risks and what steps can be taken to mitigate them?
- (iii) How does the GSW differ from other disciplinary worldviews and what is the significance of these differences in practice?
- To what degree are GSW's assumptions in line with or in conflict with mainstream assumptions in other disciplines?
 - What are the implications of these difference for collaborative working with other disciplines?
- (3) Terminology questions
- (i) What are the core concepts of GSTD and how are they labelled and defined? E.g. what is a system, the systems perspective, a systems isomorphy, a general systems principle, a systems law, etc.?
- (ii) How adequate are the concepts for their context of use? Which ones are most in need of refinement?

3.2.2. Knowledge Base questions

- (1) Data questions
- (i) How is systemicity in nature detected?
 - (ii) How does the systems perspective influence what we look for when we make observations, and/or change how we record and present observations?
 - (iii) How does the systems perspective influence how we record, collate, present and share observations?
 - (iv) How do systems processes limit or enhance experimental opportunities?
 - (v) How does the systems perspective influence how we analyse and communicate project outcomes?
- (2) Theory questions
- (i) What are the components of a general theory of systems? How complete is the best current theory? What are strategies for advancing it?
 - What are general systems principles and why are they important? How would we use them if we had some? How can we discover general systems principles?
 - What is a general systems model and how do we employ it in different contexts?
 - (ii) What does a "good" general systems theory look like? What are the "virtue" criteria and how do we employ them?
 - (iii) Is there one GST* or are there several? Why should we think so (either way)? What is the significance, either way, of there being only one or many?

(3) Methodology questions

- (i) Why are general systems principles important for general systems methodologies? How do general system methodologies rely on or employ general systems principles?
- (ii) How do we assess the effectiveness of general systems methodologies? What are the “virtue” criteria and how do we apply them?

3.2.3. Activity Scope questions

(1) Exploration

- (i) How does GSTD support the scientific enterprise?
 - How does GSTD help us to capture new practical needs and help us initiate new exploratory initiatives?
 - How does GSTD support scientific exploration in fieldwork, hypothesis formulation, experimental testing, theory development and application development?
 - How does GSTD help us accelerate the transition from need recognition to exploration to theory development to innovation to practice to new need recognition?

(2) Development

- (i) How do we ensure the effectiveness and efficiency of GSTD?
 - How do we organize and manage GSTD projects and teams?
 - How can we assess and ensure the effectiveness of GSTD projects?
 - What is ‘best practice’ for GSTD and what are the standards for best practice?
 - How we identify and enculture best practice?
- (ii) How can we use the principles, theories and methods of General Systemology to improve the quality, scope, variety and competence of General Systemology’s principles, theories and methods?

(3) Application

- (i) What new application areas might be possible?
- (ii) What open questions in other disciplines might become tractable if GSTD were applied to them?

4. Conclusion

We believe that a general theory of systems is attainable in principle and would be valuable in practice. We have here presented key projects to be undertaken and key questions to be addressed for a program to develop GSTD and put it into effective use. In our view this program is urgent and important, and we call on the systems community to support efforts to make this potential a reality.

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Wilby, et al., 2015d). Each event attracted an audience of about 50, and we would like to thank these participants for their valuable comments and advice.

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