

# **DESIGN RESEARCH METHODS FOR SYSTEMIC DESIGN: PERSPECTIVES FROM DESIGN EDUCATION AND PRACTICE**

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## **ABSTRACT**

The recent development of systemic design as a research-based practice draws on long-held precedents in the system sciences toward representation of complex social and enterprise systems. A precedent article (Jones, 2014) established an axiomatic and epistemological basis for complementary principles shared between design reasoning and systems theory. The current paper proposes an initial basis for shared methods (techne) and action practice (phronesis). Systemic design is concerned with higher-order socially-organized systems that encompass multiple subsystems in a complex policy, organizational or product-service context. As a design practice, it is distinguished from user-oriented or industrial design in its direct relationship to systems theory and explicit adoption of social system design tenets. By integrating systems thinking and its methods, systemic design brings human-centered design to complex, multi-stakeholder service systems as in industrial networks, transportation, medicine and healthcare. It adapts from known design competencies - form and process reasoning, social and generative research methods, and sketching and visualization practices - to describe, map, propose and reconfigure complex services and systems. Design research methods provide means for validated qualitative inquiry into the human behaviors, organizational processes, and systemic relationships of services and artifacts in a social system. By expressing the shared principles by which systemic and design practices are understood and coordinated, design and design research methods might be effectively applied in large-scale social systems.

Keywords: Systemic design, Design methodology, Design principles, Social systems design

## **INTRODUCTION**

Contemporary systems science has evolved a set of preferred theories for system description (or explanation), prediction (or control), and intervention (change). Jackson (2010) traced the development of systems thinking and mapped the predominant schools of thought as hard systems and system dynamics (control oriented), soft systems and postmodern systems thinking (explanation oriented), and emancipatory (change oriented). Three other branches were located in complexity science - complexity theory, network science and organizational cybernetics. However, design applications, and the contributions of traditional design disciplines of industrial, information or service design, remain marginal in the system sciences. The relationship of systems to design has been developed theoretically, as a fusion of design science and system sciences (Banathy,

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1996). “Design” has been typically presented as a process of system design, but has not been explicitly developed as a praxis or discipline of academic study.

The integration of systemics to enrich design methodologies and practice has become imminent. We might initiate inquiry by matching design discipline to systems science philosophy, as an additional context for general systems theory. Philosophies (epistemological stances) of design methods have been characterized as rational, pragmatic, critical, generative, and phenomenological (Jones, 2010). These influences initially gained adherence as design methods “generations” but have blended with each other over the years, so that their unique contributions are deeply embedded in design thinking. An emerging consensus in design thinking represents a fourth generation of design methods, based on a transdisciplinary episteme, a *techne* of generative and participatory design methods (Sanders and van Stappers, 2013), and a *phronesis* (practical wisdom) of multistakeholder co-creation . This relatively recent turn in design methods corresponds with the stakeholder-based principles of social systems science.

Social systems design provides the template for design thinking in the systems sciences to date. Social system design provides models for system analysis and collective inquiry for engaging stakeholders in the activities of designing organizational and planning outcomes. As acknowledged by Banathy (1996), Gharajedaghi (2011), and Metcalf (2010) social systems design becomes in practice a guideline for systems thinking in complex social applications. It is a multidimensional inquiry, not a “studio” practice as engaged by design firms or taught in design schools. In practice, social systems are not “designed” with a prescribed set of design methods or a toolkit (such as IDEO’s Human-Centered Design). Since the social system is a social entity or service ultimately defined by its stakeholders, the methods and strategies adopted for systemic design must be accepted and understood by these stakeholders. Relevant design research methods might then draw upon all four intentions: Explanation by social research, Prediction by process evaluation and system design, Change by stakeholder engagement, and Design by design research methods.

In a previous paper (Jones, 2014) I identified a set of systemic principles shared between design practice and systems theory, which might guide design thinking and perhaps assess the systemic reasoning of design proposals. These relevant design principles call for the discovery of methodological relationships between systems theory and design – an initial theory of systemic design methodology.

Systems thinking identifies methods that contribute to design by reconfiguring boundaries, subsystems, and intervening in system functions. However the various schools of systems thinking do not promote the function of design as enhancing relevant human-centred interactions and experience. And we also find no acknowledgement that the notion of “intervention” is both a) an admission of system objectification and b) a position on the necessity for a design process that explicitly recognizes human-centred design in systems.

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### SYSTEMIC DESIGN PRINCIPLES

Ten systemic design principles shared between design and systems disciplines were proposed in Jones (2014), based on meta-analysis of concepts selected from system sciences and design theory. Design principles were selected that afforded significant power in both design and systems applications, and were sufficiently mature and supported by precedent to be adapted to a general range of applications with minimal design risk.

- Idealization
- Appreciating complexity
- Purpose finding
- Boundary framing
- Requisite variety
- Feedback coordination
- Generative emergence
- Continuous adaptation
- System ordering
- Self-organizing

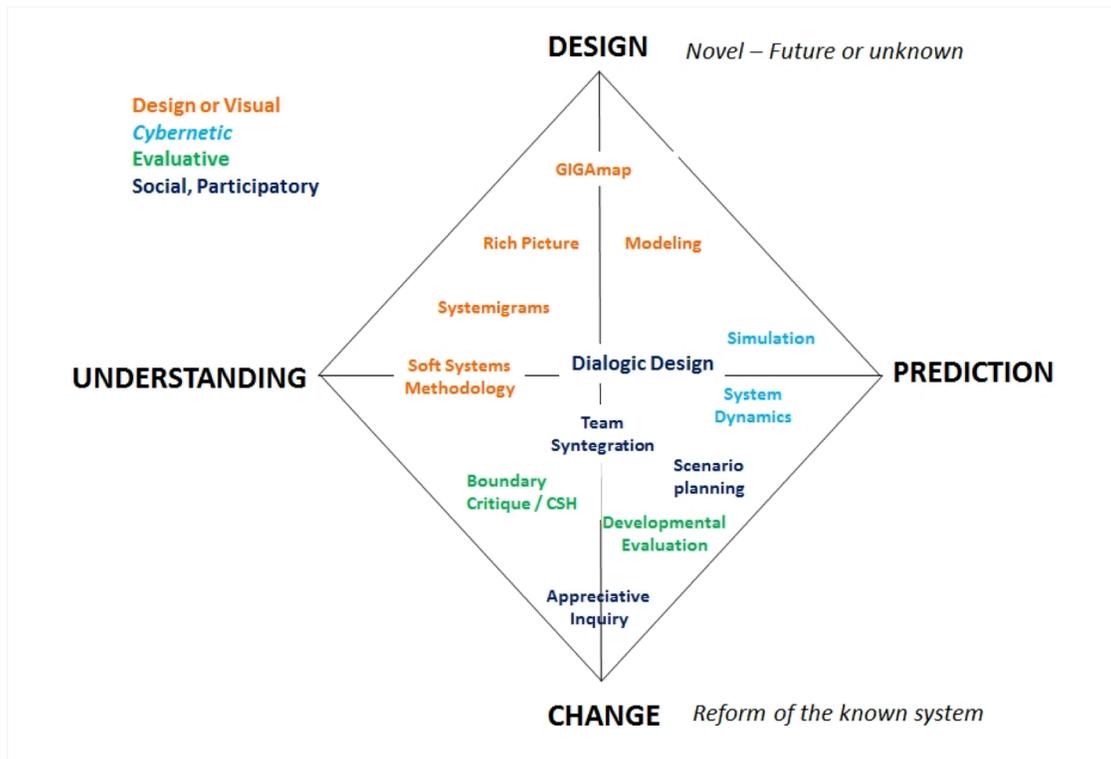
Nelson and Stolterman (2012) wrote that “every design is either an element of a system or a system itself and is part of ensuing causal entanglements.” In this position they support a view of design as a systems-oriented discipline, and the products of design as systems. The ten principles are implicated across many types of design activities, ranging from the consumer products of industrial design to the complex services of customer-facing businesses to the social services of public sector organizations. Nearly any design process or design project of any significance could effectively apply one or all of these systemic principles. The more complex, multidisciplinary design projects in human services such as healthcare or urban planning would benefit from consciously selecting methods that elicit the principle for a relevant problem instance. An organizational redesign to meet future strategic goals for ecological sustainability might draw on every principle, with multiple iterations to apply the principle in the shared design space of the organization.

### Systemic Design Methods

Figure 1 portrays a range of (hard and soft) systems thinking methods commonly cited in studies and taught or presented in the graduate level Systemic Design curriculum at OCAD University. These methods are organized around four intents of systems practice, identified as understanding or prediction (as *research* outcomes) and design or change (*intervention* outcomes). These four intents were based on the three aims of research following Braa and Vidgen (1999), adding Design as a type of systemic intervention that

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was not conceived for the information science domain of their research. The model has general relevance to the evaluation and selection of any research methods, and supports social systems design methods as social sciences research. Here the adapted method selection model incorporates systemic design research methods for the four research and intervention intents.



**Figure 1. Systemic design methods by research intent.**

Four design *modes* are also indicated in the key. Design/Visual modes are identified (in orange) as relevant to the intentions of understanding and design. While useful in change and prediction intents of systemic research, visual methods (such as the GIGAmap (Sevaldson, 2011)) enable the development of a shared understanding of the construction systems. Only two cybernetic methods are identified, simulation and modeling methods can be considered both cybernetic and quantitative reasoning modes. These enable prediction, critical in systems engineering, but less represented in typical design contexts that employ human-centered methods. Evaluative methods are positioned as research modes for system and organizational change. Four participatory methods are noted, typically associated with change (action research and organizational development) but also the co-creative methods of social design. In systemic design, any or all four intents

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may emerge in a relevant research application. In some cases at least one of each intent - for the different stages in research - may be appropriate.

A selection of general design methodologies (related methods associated with a theory or approach) may be drawn from reviewed sources and case studies. The first set (Table 1) represent design methodologies associated with the ten systemic design principles drawn in Jones (2014). Each of these methodologies may include numerous techniques adapted by designers in research and design programs for accomplishing the goals of the principle.

**Table 1. Design methodologies associated with systemic design principles.**

<b>Principle</b>	<b><i>Design Methodologies</i></b>
1. Idealization	Iteration
2. Appreciating complexity	Sensemaking
3. Purpose finding	Saliency - Meaning-making
4. Boundary framing	Provocation and strange-making
5. Requisite variety	Multiple perspectives
6. Feedback coordination	Modeling
7. System ordering	Structuring
8. Generative emergence	Future projection
9. Continuous adaptation	Multiple reasoning modes
10. Self-organizing	Co-creation

Most of the design methodologies stated are generic, well known modes for performing design activity associated with the principle. Specific methods from Figure 1 are not included, as most of them include or cross over several principles. Not all of these are true methodologies, but each label can represent a collection of relevant methods and techniques for performing those methods, so we might allow this definition for the purposes of understanding. For example, idealization as a principle refers to the formulation of a target ideal state for a function or object, toward which a series of design movements are employed. Iteration is perhaps the most basic of design actions - and while not a true methodology, there are methods for iteration that are involved in progressing a design toward the idealized state. Different methods of rapid prototyping, visual sketching, and multiple mockups are types of iterative methods applicable to the principle.

In a similar way, sensemaking (visual, organizational, or information) encompasses several methods and even full methodologies. In design practices, collective group processes informed by visual sensemaking (sketching emerging rich pictures) are employed for understanding the complex relationships in a problem. They might all contribute to the resolution of the principle “appreciating complexity” in its systemic design meaning.

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If we specify systems methodologies against the same set of 10 principles, significant differences between design and system thinking methods are exposed. Systems methodologies are more systematic and explicitly structured, and deal with much higher complexity than the design methods. In principle it would be possible to adapt many (if not most) of the design methodologies for the same purposes as the systems thinking practices. The constraining factors for this are mainly disciplinary and cultural - design practices are orchestrated as tools for co-creation by multiple participants in creative projects, usually for short term outcomes. Yet these more unstructured “convivial” practices could complement the analytical, expert-based methodologies developed from systems sciences.

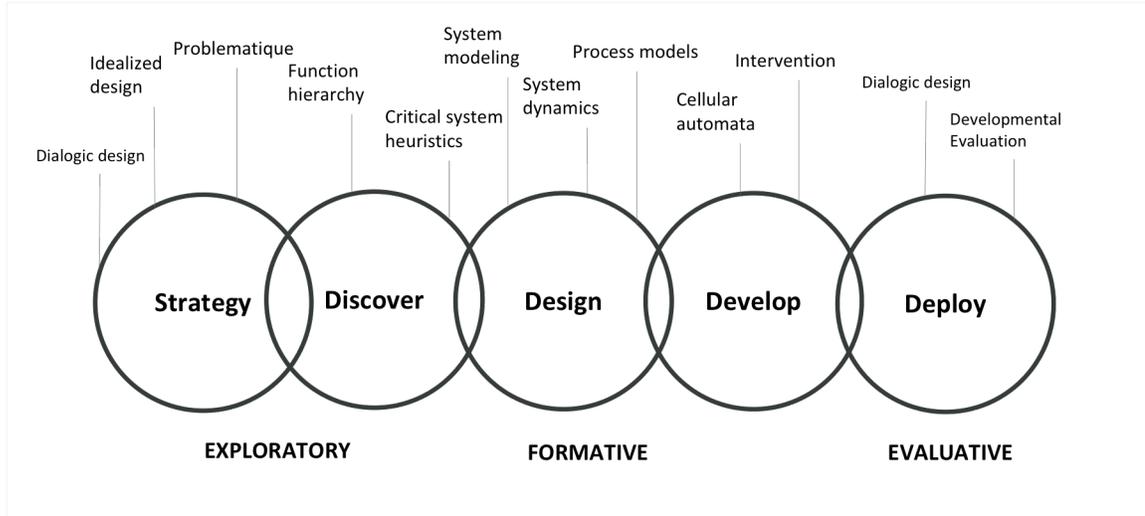
Table 2 shows 10 systemic methodologies employed in well-known practices to obtain the desired effects of the design principle. For example, as *idealization* is indicated in Table 1 as the iteration of states toward a collective objective (design approach), the systemic methodologies supporting this mode include idealized design (Ackoff, 1993) or dialogic design (Christakis and Bausch, 2006). Associated with appreciating complexity, the *problematique* (Warfield and Perino, 1999) has been represented and advanced over decades as an effective method for analysing and representing complex social systems. With only minimal guidance, designers could express problematiques as visual maps to creatively communicate the salient features and causal relationships of a structured problem system. Likewise, the results of system modelling might be expressed in the visual vernacular of human and system agents in GIGAmaps.

**Table 2. Systems methodologies associated with systemic design principles.**

<b>Principle</b>	<b>Systems Methodologies</b>
1. Idealization	Dialogic design, Idealized design
2. Appreciating Complexity	Problematique
3. Purpose finding	Function hierarchy
4. Boundary framing	Critical system heuristics
5. Requisite variety	System modeling
6. Feedback coordination	System dynamics
7. System ordering	Process models
8. Generative emergence	Cellular automata
9. Continuous adaptation	Intervention (leverage points)
10. Self-organizing	Dialogic design, Developmental Evaluation

The placement of *design* methodologies (Table 1) within a service design process (such as shown Figure 2) would be readily recognized as canonical and obvious. However, the placement and progression of systemic methodologies within a general purpose design model reveals opportunities for complementary implementation of these practices within a series of stages in a practical service or system design context. Figure 2 illustrates the system methodologies associated with the purposes for each stage in a five-stage design model.

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**Figure 2. Systemic Design Methods Mapped to Design Model.**

We can acknowledge that this initial mapping of design and system methods to process and principles does not provide a research basis for new practice. Yet this arrangement of relationships does invite further research into methodological development for systemic design in contemporary problem domains, including healthcare, urban planning, sustainable resource management and other social systems. Several systemic practices provide templates for assigning creative design methods within the series of stages. Appreciative inquiry has been employed by both design firms and organizational consultants as a framework to adapt compatible inquiry and representation methods. Dialogic design processes are well-structured for incorporating alternate methods that a defined set of patterns research and structured comparisons

The current paper presents a model for employing systemic methods for social system design practices associated with co-creative, interpretive and critical epistemologies. The model is not based on an exhaustive analysis of documented methods, but rather presents the basis for continued development and assignment of methods to shared principles between systems and design thinking . Future work will extend this initial basis to the formulation of a theoretical model of systemic design and explanatory guidelines for design practices in complex domains, allowing designers and systems practitioners to collaborate effectively on problems with shared functions and shared methods.

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