Peter Jones · Kyoichi Kijima   *Editors*

Systemic Design

Theory, Methods, and Practice

Springer

Translational Systems Sciences

Volume 8

In 1956, Kenneth Boulding explained the concept of General Systems Theory as a skeleton of science. He describes that it hopes to develop something like a "spectrum" of theories—a system of systems which may perform the function of a "gestalt" in theoretical construction. Such "gestalts" in special fields have been of great value in directing research towards the gaps which they reveal.

There were, at that time, other important conceptual frameworks and theories, such as cybernetics. Additional theories and applications developed later, including synergetics, cognitive science, complex adaptive systems, and many others. Some focused on principles within specific domains of knowledge and others crossed areas of knowledge and practice, along the spectrum described by Boulding.

Also in 1956, the Society for General Systems Research (now the International Society for the Systems Sciences) was founded. One of the concerns of the founders, even then, was the state of the human condition, and what science could do about it.

The present Translational Systems Sciences book series aims at cultivating a new frontier of systems sciences for contributing to the need for practical applications that benefit people.

The concept of translational research originally comes from medical science for enhancing human health and well-being. Translational medical research is often labeled as "Bench to Bedside." It places emphasis on translating the findings in basic research (at bench) more quickly and efficiently into medical practice (at bedside). At the same time, needs and demands from practice drive the development of new and innovative ideas and concepts. In this tightly coupled process it is essential to remove barriers to multi-disciplinary collaboration.

The present series attempts to bridge and integrate basic research founded in systems concepts, logic, theories and models with systems practices and methodologies, into a process of systems research. Since both bench and bedside involve diverse stakeholder groups, including researchers, practitioners and users, translational systems science works to create common platforms for language to activate the "bench to bedside" cycle.

In order to create a resilient and sustainable society in the twenty-first century, we unquestionably need open social innovation through which we create new social values, and realize them in society by connecting diverse ideas and developing new solutions. We assume three types of social values, namely: (1) values relevant to social infrastructure such as safety, security, and amenity; (2) values created by innovation in business, economics, and management practices; and, (3) values necessary for community sustainability brought about by conflict resolution and consensus building.

The series will first approach these social values from a systems science perspective by drawing on a range of disciplines in trans-disciplinary and cross-cultural ways. They may include social systems theory, sociology, business administration, management information science, organization science, computational mathematical organization theory, economics, evolutionary economics, international political science, jurisprudence, policy science, socio-information studies, cognitive science, artificial intelligence, complex adaptive systems theory, philosophy of science, and other related disciplines. In addition, this series will promote translational systems science as a means of scientific research that facilitates the translation of findings from basic science to practical applications, and vice versa.

We believe that this book series should advance a new frontier in systems sciences by presenting theoretical and conceptual frameworks, as well as theories for design and application, for twenty-first-century socioeconomic systems in a translational and transdisciplinary context.

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*This book is dedicated to the memory of
Dr. Ranulph Glanville, former president of
the American Society for Cybernetics and
fellow traveler with the authors in this
volume, connecting the systems disciplines
through his life and career. To Ranulph,
design and cybernetics were two different
sides of constructivist sensemaking in the
world, and not separate disciplines as we are
schooled to believe. I learned from him the
understanding of cybernetics and systemic
problems led to designing, as the most
befitting course of informed action. Ranulph
spent much of the last decade of his career
bringing these fields together, very clearly in
several essays and talks, including his final
public lecture at Relating Systems Thinking
and Design (RSD3) in October 2014.
Dr. Glanville's inclusive insistence on
co-informing theory and practice across
cybernetics, systems thinking, and design
inspire values shared by many of us
seeking wiser ways across related fields
of practice today.*

Design and systems theory both gain from the influence of timeless ideas, the cross-appropriation between frameworks and models, and the intimate and often guild-like relationships with leading practitioners. These chapters call forth too many authors and thinkers to recognize with concision here, but if we were to list the most influential first- and second-generation leaders in design and systemics, I might suggest we acknowledge Ross Ashby, Gregory Bateson, Buckminster Fuller, Margaret Mead, Herbert Simon, Fred Emery, Eric Trist, Heinz von Foerster, Hasan Özbekhan, West Churchman, Christopher Alexander, Horst Rittel, Stafford Beer, Erich Jantsch, Alexander Christakis, John Warfield, Gordon Pask, Humberto Maturana, Russell Ackoff, Charles Owen, Victor Papanek, and of course Harold Nelson, a co-founder of RSD.

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Preface: Taking Stock and Flow of Systemic Design

The following book is an edition in the Springer Translational Systems Sciences series and addresses the continuing development of systems theory and methods for complex design contexts. This volume aims to make progress towards a continuing absence in the systems sciences and the discontinuity of design as theory and method for innovation, change, and process implementation. Systems and cybernetics practices have made several notable attempts to resolve this discontinuity, some with extensive publishing and project track records and others more quietly successful.

Systemic design has emerged to address this developing interdisciplinary area of practice, growing from leadership within design studies and its intersection with systems sciences through dedicated collaboration and respectful cross-appropriation. The nine chapters published in this collection were developed by authors from the proceedings of the fourth Relating Systems Thinking and Design (RSD) symposium[1] held in Banff, Canada, in 2015. These authors clearly overlap and share multiple influences and earlier systems programmes that have led to the recent confluence of systems thinking and design.

The broad fields of design and systems have both historically presented approaches to general-purpose problem solving, with domain-independent methodologies based on design rationale (Moran & Carroll, 1996) or scientific principles (Simon, 1962) for holistic problem solving (Fuller, 1969; Jones, 2011). As "thinking" modes, both design thinking and systems thinking promise effective, cross-disciplinary approaches to complex problem resolution. Perhaps, the most prominent interdisciplinary approaches of systemics and design thinking were developed in the Ackoff and Banathy-era social system design schools that promoted whole system approaches to the challenges of the modernist technological era.

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[1]Ryan, A., & Jones, P. (2015). *Proceedings of Relating Systems Thinking and Design (RSD4) 2015 Symposium*. Banff, Canada, September 1–3, 2015. systemic-design.net/rsd-symposia/rsd4-proceedings

The systems science origins of systemic design can be traced to the influential operations research and planning schools, the East Coast schools (Ackoff, Özbekhan from University of Pennsylvania, Senge from MIT), and the West Coast (Horst Rittel, C. West Churchman, Christopher Alexander, and Harold Nelson all from U.C. Berkeley). Social systems theory and methods, perhaps the first inclusion of systemics as a design practice, evolved from the 1970s following the Club of Rome prospectus titled *The Predicament of Mankind* (Ozbekhan, 1970). We can trace references and ideas from today's systemic design from the social systems methodologies that followed in this era, such as Peter Checkland's soft systems methodology (1975), Erich Jantsch's evolutionary design (1973), Russell Ackoff's idealized design (1985), Bela Banathy's social system design (1997), John Warfield's generic design science (1985), and Alexander Christakis' dialogic design (2006). All of these projects shared approaches and values in common, such as a strong orientation to boundary and perspectives as opposed to problem solving, post-positivist (or constructivist) epistemologies, the adaptation of complementary modes of thinking, and the necessity of stakeholder participation.

These social schools of thought argued against many of the precepts of the predominant systems thinking methods of the time, systems thinking as modelling and intervention (Meadows, 1999), and systems dynamics (Senge, 1986). Social system design did not achieve the broader acceptance of hard systems sciences, in part due to the superior fit of the hard systems thinking mindset to modernist culture in the late twentieth century and the perceived ambiguity (and lack of method) of social systems processes and technologies.

However, on behalf of design scholars and professionals, I might argue that the design functions of the social systems methodologies were not ever designed for the human uses and applications needed from extensive sociotechnical development projects. Social systems never evolved to become "designerly"; with its roots in systems theory, its applications remained too abstract and removed from human behaviour. For too long we have included design thinking as a peripheral passenger in the systems journey, following along with the Herbert Simon definition of design as a "move from a current situation to a preferred situation.[2]" If we do not fully embrace designing as an advanced way of knowing and enacting with the sociomaterial world, we risk failure in desired transformation.

The recent designerly turn in systems thinking must credit Buckminster Fuller's early exploration (1960s) of what we now call transdisciplinary design, in his "comprehensive anticipatory design science" for complex problems of industrial production, transportation, habitation, and environmentally sensitive design. At least three other significant designers from the 1970s era, architect Christopher Alexander, Victor Papanek (with critical social design), and John Chris Jones (design methods originator), influenced a new generation of designers. Their design practices were well integrated and did not reveal much in the way of formal cybernetics and systems theory, even if their approaches were deeply informed by systemics. We recognize this integration of knowledge, experience, and sensitivity as the "designerly

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[2]Simon, Herbert A. (1969). *The sciences of the artificial*. Cambridge, MA: MIT Press, p. 130.

way of knowing," as Nigel Cross (2002) has referred. Perhaps, the designerly aim might be to emulate these designers for their integrated practices and not to disclose the many, possibly confusing, contributing references making up the practice.

Systemic design draws on the wellspring of a half-century of discourses from both systems theory and design practices, fruitfully developing a research base and new methods. It provides a welcoming field for emerging design practices to plant theoretical ideas that reach across disciplines. Several recurring precedents in the evolution of systemic design are prominent within these chapters and symposia, including:

- Design cybernetics, especially second-order reflexivity in design practice (Glanville, 2009; Krippendorff, 2007)
- Design thinking for wicked problems (Buchanan, 1992)
- Systems-oriented design (Sevaldson & Vavik, 2010)
- Systemic design approach to ecological design (Bistagnino, 2011)
- Product-service systems (Manzini & Vezzoli, 2003; Morelli, 2002)
- Transformation design (Sangiorgi, 2011)
- Transition design (Irwin, 2015)
- Dialogic design (Christakis, 2006)
- Design for conversation (Dubberly & Pangaro, 2015)
- DesignX (Norman & Stappers, 2016)

Design is an essential partner in transformative projects and is an essential mindset and discipline when facing "actual" wicked problems—the sort that Rittel meant as contexts that resist problem-solving mindsets. These situations, messes and meta-messes, require our capacity to rethink received notions, to reframe and redirect, to creatively inquire, to engage many skills and senses, to powerfully communicate central ideas to others, and to produce campaigns for change. We may reform, improve, innovate, or otherwise *design* systems but fail to change outmoded cultures, create effective new practices, or inspire positive norms. We also risk losing the unique critical power of systems thinking to transform organizations and practices when advancing theories of change without fully integrating design. Systemic design advances an integrative interdiscipline with the potential to implement systems theory with creative methods and mindsets, by bringing deep technical knowledge, aesthetic skill, and creative implementation to the most abstract programmes of collective action. The cases and practices in the following chapters attest to these new modes of thinking and acting with stakeholders on such problem domains, in healthcare, urban development, informatics, and public service.

Relating Systems Thinking and Design

For 7 years, the Relating Systems Thinking and Design (RSD) symposium has convened a design-oriented conference to develop the intersection of systems science and theory and design practice, methods, and education. This intersection between

systemics and design has not been addressed by other scholarly or practitioner conferences, as these two fields have actually drifted apart while often invoking the languages of "systems" and "designing" without truly understanding the core methods of each discipline. We have aimed to develop a strong relationship between the disciplines that brings out the best in each tradition.

Systemic design has developed through integration of design research programmes at several universities participating in the RSD symposium series. These schools have evolved systems-oriented design programmes for roughly a decade, in some cases longer, in search of powerful approaches to transdisciplinary design for complex sociotechnical contexts. While a small number of design scholars have worked and thrived rather naturally in this intersection throughout their careers, awareness of the import of systems thinking was fragmented and inconsistent across design specializations. There was no common understanding of a practice or a canon of theory for design applications. In fact, judging by the prevailing popular themes at design and systems conferences, the fields were continuing to drift apart. Design and architecture have been moving into advanced service and interaction design for big data, urban systems (e.g. smart cities), healthcare, and other complex systems applications, but without a foundation of systems methods or well-understood cybernetics concepts. Similarly, in systems thinking and sciences, the increasing attention to organizational, service, and social systems led to new models and theory, but little design of prototypes or exemplary applications. These gaps appeared as far more than missed opportunities for a complete design discourse, but rather as the necessary emergence of an integrated discipline better adapted to our problems than its component disciplines.

The symposium expresses an intent as "relating" two worlds, between two wide-ranging, continually contested disciplines of systems thinking and design. Many observers in the past have attempted to join features of these fields together to achieve expected synergies between the perspectives and logics of the systemic and, the sensemaking and form-giving of design. Earlier attempts at forging a relationship, a net new identity between these discourses, have generally failed to connect to the current generations of scholars and endure beyond initial forays. Mature, developed scholarship from preceding conferences was previously published in the online design journal *FORM Academic (FORM Akademisk)*, which has edited a special issue for developed symposium work since RSD2. The design journal *She Ji* published a collection of five articles developed from RSD5 (Toronto, 2016) as a theme issue[3] in late 2017. This issue follows their support for the emerging DesignX[4] discourse only 2 years prior.

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[3]Jones, P. (2017). The systemic turn: Leverage for world changing. *She Ji: The Journal of Design, Economics, and Innovation, 3*(3), 157–163. https://doi.org/10.1016/j.sheji.2017.11.001

[4]Norman, D. A., & Stappers, P. J. (2016). DesignX: Complex sociotechnical systems. *She Ji: The Journal of Design, Economics, and Innovation, 1*(2), 83–106.

Significance of the Collection

As the RSD conference has grown in reach each year, the breadth of scholarly work has expanded, and the variety of interests and directions expressed by the author community has greatly increased. We believe the interstices between these highly conceptual disciplines and their creative intellectual practices afford a productive field of play for studies and practices with sufficient power to address the critical concerns of the day.

The title suggests variety across the contributions in three designations of theory, method, and practice. After continuing to read and work with the ideas in these ten chapters, it becomes clear that few papers neatly fit one category fully, or at the expense of the others. We might consider most of the chapters as integrative, as their research intent is to integrate systemics and design practice as adaptive methodologies that enable significant transformative capacity within particular wicked problem contexts. These chapters all show methodological integration, with an appropriate theoretical perspective, for collective power in various human practices.

Readers will discover a wide range of theoretical positions informing the design rationale in the reported studies and cases. For several reasons—editorial selection and the developmental progress of systemic design over several years—these analyses avoid the conventional tropes of systems thinking and complexity presented as theory, force-fit to design practice problems. Rather than drawing on systems methods or concepts for supporting observations, most of these studies show deeply integrated models and present new frameworks founded on social and/or systems theories.

The first three chapters are integrative practices and models, not pure theory or case studies but rather connecting a theoretical basis for a systemic design methodology in particular areas of practice. The collection opens with the editor's chapter *Contexts of Co-creation: Designing with System Stakeholders*. Over the last decade, we have been studying and designing collaborative practices for multistakeholder engagements in technology and organizational strategy (Jones et al., 2008), governance and policy planning, and collaborative foresight in long-horizon R&D (Weigand et al., 2013). We have collected observations and compared applications to propose effective practices for stakeholder identification and discovery, problem framing, and continuity. New contributions in the article include a review and critique of co-creation, analysed here by contexts (stages in progression) based on John Warfield's (1998) domain of science model. This model enables us to compare and transfer learning from dialogic design applications to systemic design, which is a recent discipline developing without a canon or shared standards. A new framework is proposed for stakeholder convening, transferring learning, and practice development across purposeful venues. System design and stakeholder planning projects require longer-term collaborations than provided by structured encounters such as design workshops. Therefore, a pragmatic concept defined as collaborative efficacy is proposed to assess engagement in continuous complex design situations.

Chih-Chun Chen and Nathan Crilly built a theoretical framework for integrated design, *A Framework for Complex Design: Lessons from Synthetic Biology*. Their work presents the value of an integrated design approach using synthetic biology as a learning model, reminding us that synthetic biology is itself a design-oriented practice. The chapter develops a model of designing for complexity where problems and solutions, as framed for design, are complex conditions themselves. Their proposals for systemic design practice intrigue the reader to observe, avoid, exploit, and compensate for inherent complexity in problematic contexts. They suggest both "rational" and black-box strategies for street-lighting proposals that trade off complexity features for a case problem of "designing out crime" through such interventions. Their work provides a theoretical basis for identifying and designing for characteristics in any complexity context (as they suggest swarm robotics, policy formation, and healthcare) that share similarities in complexity.

Peter Pennefather and colleagues Deborah Fels and Katie Seaborn share work from a continuing study investing electronic health records systems for health promotion for the aspiration of human flourishment. *Inclusive Systemic Design for Health System Flourishment* is a unique contribution due to the mix of disciplines and research intent, including systems biology, human factors, and information studies. Although systemic design has oriented to the ecological concept of flourishing for several years, the idea of flourishment has co-evolved as a quality of individual eudaimonic flourishing, a human phenomenon associated with psychological wellbeing, analogous to nourishment in the relationship to bioecological energy. The authors develop a link to reinforcing flourishment through registrations of human data and narratives within health records and information systems in system design. The chapter develops a framework based on social neuroscience, psychology, and inclusive human-centred design that expresses a virtuous cycle of flourishment transactions within a system of patient-centred collaborative care, in this proposal, as designed for people living with chronic pain.

Part II, Theoretical Foundations, presents four foundation studies, including resilience theory, design ethics, a systems theory of settlement, and a German cultural history of systems thinking influences and its continuing relevance to design. Wolfgang Jonas presents a "German narrative" of the history and disciplinary development of systemic design in Considerations to the Jonas title in *Systems Design Thinking: Theoretical, Methodological, and Practical*. Jonas builds on theories of first- and second-order cybernetics, complexity, and system evolution. He explores foundational systems concepts, such as irreducible complexity, the problem of control in complex systems, and the function of inquiring systems in design. Jonas proposes a scenario design methodology based on his APS (Analysis – Projection – Synthesis, Jonas, 1997) model of design and research. He positions his own work in the tradition of three precedent systems thinkers, Frederic Vester (sensitivity modelling), Jürgen Gausemeier (foresight), and Peter Schwartz (scenario analysis), leveraging scenario modelling as a design visioning process. Jonas incorporates his model and practice of Research Through Design as a core methodological framework around which the Analysis, Projection, Synthesis process is carried out. Jonas develops RTD as a design/inquiring system specifically suited for high uncertainty

in complexity, building on scenarios as an analytical design method. In this way, Jonas' chapter provides a strong link between systems thinking and strategic foresight, through the projective modes of design research.

Design cyberneticist Ben Sweeting contributes to the design ethics discourse in *Wicked Problems in Design and Ethics*, a cybernetic inversion of the common normative inquiry. He reminds readers that ethics is not a settled body of knowledge or theory that we use to judge or guide design decisions in practice—that ethical inquiry is implicitly entangled with the situation, our perspectives, and our possible knowledge of options. Because ethical insight and outcomes are deeply dependent on the theories we bring to decisions and design problems, Sweeting turns this around and suggests that design may contribute as much to ethical theory as ethics to design. He explores the relationships and structural morphology between design's wicked problems and normative ethical dilemmas as a basis for proposing this symmetry. With design and ethics responsive to each other in mutual terms, ethical design questions might be released from the historical position of external limitations and trade-offs between competing priorities. Sweeting suggests the ways in which designers cope with ethical challenges in socially complex wicked problems can inform action towards complex ethical challenges in other contexts, including those within ethical discourse.

Eloise Taysom and Nathan Crilly analyse resilient systems from a design perspective in their chapter, *On the Resilience of Sociotechnical Systems*. Based on ongoing research by Taysom in Dr. Crilly's University of Cambridge lab, an analysis is developed on the differentials of resilience theory, the applications of resilience, and the possible impacts of these differentials on sociotechnical systems. Sociotechnical systems are constituted within networks of stakeholders and users, who have the most at stake in situations where the continuity and function of complex systems are tested under resilience scenarios. Deconstructing resilience as an umbrella concept, a pragmatist position is taken by drawing out the perspectives of stakeholders across numerous complex system domains. A theoretical framework is proposed addressing resilience in terms of three properties of resilience response: (a) resilience as resisting influences, (b) resilience as recovering from influences, and (c) resilience as changing to accommodate influences. Systems enabling all three responses to exogenous shock or influence can be considered to have higher capacity for resilience than systems based on one or two of the properties, as a higher variety of responses to unforeseen influences would be possible.

University of Waterloo's Perin Ruttonsha closes the section with an epic chapter, *Towards a (Socio-ecological) Science of Settlement*. Ruttonsha's analysis presents a sweeping review of urban systems thinking informed by design, culture and social sciences, and the evolution of systemic planning from the era of Doxiadis' ekistics to current complexity theory. The chapter leads with the proposal for a science of settlement (in essence, bringing Ekistics into the next century) as a study of the full complement of human–environment interactions. A comprehensive analysis of the *sustainability perspective* in urban ecology develops the locations and methods for sociomaterial intervention in the sustainment of cities in natural ecosystems. Ruttonsha further develops a phenomenological analysis of the *dwelling perspec-*

tive of human interaction in the places and experiences of habitation. The chapter closes with an analysis of the complex systems dynamics of habitation in the evolving urban form, connecting multiple theories and ideas in socio-ecological systems thinking. She connects the chapter's message to Humberto Maturana's compelling keynote at RSD5, where he challenged the conference with the many social concerns in a single question, "how do we want to live together?" The chapter aims to build a socio-ecological science of settlement, which might bridge between domains and practices in quality of life, settlement planning, and transition management.

Part III, Method and Practice, opens with Birger Sevaldson's recent development of the Gigamap as methodology. He extends the theory and practice of systemic design mapping with *Visualizing Complex Design: The Evolution of Gigamaps*. Sevaldson recounts the development of Gigamaps in systems-oriented design as an "organic" studio practice for collaborative engagement in complex system design projects. Sevaldson presents a basis for a knowledge framework for the evolution of this core methodology in systemic design. He builds upon Cross' (1999) notion of design praxiology, a philosophy of purposeful practice leading to designerly wisdom and adaptive expertise in complex systems design. Given the emphasis on "myriadic" expression, whereby system relations are expressed in their inherent complexity, Sevaldson endorses several new methods for interrogating this multiplexity that extends the sensemaking aspects of collaboration to "sense-sharing."

Silvia Barbero (Politecnico di Torino) presents studies from the Torino programme of systemic design with *Local Ruralism: Systemic Design for Economic Development*. The potential for regional economic flourishing through rural community development is demonstrated through integrated design research and ground-level projects. Her approach to social innovation aims to improve the quality of life and economic wellbeing of people, evaluating engagements with people to develop local economies in disadvantaged rural regions. Local ruralism takes into account the need to design locally supportive structures for economic and social flourishing, organically co-produced within the regions themselves. Barbero presents three significant case studies in different geographies (Mexico, Italy, and Spain) all facing declining economies. The studies develop evidence for approaches and concrete guidelines, through a systemic design framework, to facilitate systemic improvements in rural regions.

John Cassel and Susan Cousineau, collaborators in the agroecology informatics field, develop a chapter from their advancement of permaculture principles in scaling sustainable agriculture, in *Permaculture as a Systemic Design Practice*. This chapter presents the exciting possibility of relating the ecological design practices and ethics of permaculture to design and systems thinking. The permaculture movement has evolved principles for ecologically sensitive management of farming, land restoration, and the social cultivation of communities. Similar to the domain of science model (Jones' chapter), their permaculture model is extended through specific applications in an arena of practice, with lessons drawn forward into a grounded theory for general application. They suggest that systemic design can significantly enhance permaculture practices, by developing techniques for forming stable objectives, assessing appropriate technology, stakeholder engagement, and launching and

managing viable agroecological projects. Building from across the systems history of permaculture sources, Cassel and Cousineau promote a framework for enabling ecological farming and management practices through designing local and distributed systems of permaculture for agriculture.

The collection that follows includes some of the most definitive and compelling ideas in systemic design, developed in an active discourse community, with peer collaboration, over the course of several years of symposia. Each of these authors discloses not only an intellectual position guided by transdisciplinary study but also their emerging practice areas of new applications that are now being tested in various stakeholder settings.

Acknowledgements

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Contents

Part I
Integrative Practices

Contexts of Co-creation: Designing with System Stakeholders

Peter Jones

Abstract The concept of co-creation includes a wide range of participatory practices for design and decision making with stakeholders and users. Generally co-creation refers to a style of design or business practice characterized by facilitated participation in orchestrated multi-stakeholder engagements, such as structured workshops and self-organizing modes of engagement. Co-creation envelopes a wide range of skilled social practices that can considerably inform and enhance the effectiveness of organizational development, collaboration, and positive group outcomes. New modes of co-creation have emerged, evolving from legacy forms of engagement such as participatory design and charrettes and newer forms such as collaboratories, generative design, sprints, and labs. Often sessions are structured by methods that recommend common steps or stages, as in design thinking workshops, and some are explicitly undirected and open. While practices abound, we find almost no research theorizing the effectiveness of these models compared to conventional structures of facilitation. As co-creation approaches have become central to systemic design, service design, and participatory design practices, a practice theory from which models might be selected and modified would offer value to practitioners and the literature. The framework that follows was evolved from and assessed by a practice theory of dialogic design. It is intended to guide the development of principles-based guidelines for co-creation practice, which might methodologically bridge the wide epistemological variances that remain unacknowledged in stakeholder co-creation practice.

Introduction

In less than a decade, the promise of participatory design as a sustained practice has diffused into mainstream practice as design co-creation. Co-creation has emerged as a normative mode of participatory engagement for design ideation, creative problem

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solving, and decision making. While contemporary practitioners may regard these practices as accepted methods, they have evolved over a 50-year period or more, from earlier forms of co-creation based on social systems and democratic practice theory. In this lengthy integration into common use, the diffusion of co-creation confirms a social form of Buxton's (2008) "long nose" of innovation, whereby new forms of practice incubate for long periods before adoption. Throughout this period, a deep foundation of knowledge and principles has been formulated, contested, and practised based on supporting research from social and systems sciences. However, we can observe that knowledge, methods, and practical applications from the originating systems practices, in particular, have not been translated to modern co-design and workshop methods. The concern for collaborative efficacy addressed here claims that normative design methods have not fully developed and remain at risk of degradation into popularized forms insufficient to the complexity of design problems purportedly addressed by co-creation.

As creative and traditional participatory design methods became popularized across a wide range of contexts, co-creation (or co-design) has emerged as a common reference to participation (Sanders & Stappers, 2008; Robertson & Simonsen, 2012). Systemic design practices have developed co-creation approaches that integrate social systems principles to guide stakeholder design for complex systems. However, emerging design schools such as systemic design, service design, and transition design offer little precedent for research support or universal guidelines for co-creation. Where systems methods cite prior scientific principles to support intervention approaches, design practices often follow "best methods" that are assumed to embody effective principles. Design co-creation methods that fail to account for social systems principles are vulnerable to systematic errors that might result in problematic consequences.

This study addresses the contexts, structures, and processes of design co-creation methods considered essential practices in systemic design. To better bridge theory across design disciplines, we include comparable practices such as design thinking workshops, stakeholder engagements, and participatory and collaborative design methods. The philosophy of co-creation, drawing on participatory design and democratic practices, assumes that stakeholders will achieve satisfactory outcomes if given responsibility for decisions and have equal status in convening roles. However, if we fail to compare these practices with other structures for engagement, we may assume or conclude that successful outcomes are causally determined by certain methods, when many rival hypotheses could explain either beneficial or unsatisfactory outcomes. If we merely valorize the perceived goodwill or social benefits of co-creation, we risk obscuring critique of co-creation methods. Our avoidance of critical discourse inhibits collective scientific learning and, pragmatically, the ability to constructively improve these methods.

Co-creation practices are highly variable in outcome, are contingent on the skills of individual practitioners, and have limitations of which their practitioners are unaware. These are similar concerns expressed in the communities of team consultants, group facilitation practices, and across all types of dialogic practices. As these practice concerns have not been addressed sufficiently in the literature, the problem of *collaborative efficacy* is introduced in this study as a concept of assessment.

What requirements can be identified for effectively adapting co-creation to match the demands of real-world complexity? Our design choices in co-creation practice must have sufficient power to anticipate and effect desired outcomes in target social systems following a design workshop.

Four current questions of co-creation practice are explored and developed:

- How can we improve our ability to understand social system contexts and to select appropriate co-creation methods to the context?
- How can we enhance collaborative efficacy in design co-creation?
- How does system context determine stakeholder representation for complex social systems?
- What systems science models might significantly enhance co-creation practice?

Background and Contexts

The practices assigned to the term co-creation are observed across several domains, and in all cases we find not a coherent methodology but a term of art encompassing many methods. As with other modes of psychosocial understanding (e.g. sensemaking), a framework for practice supported by theory would usefully inform capacities for collaborative efficacy and engagement. A framework enables the transfer of knowledge and training across different domain practices and the development of new skills upon a corpus of accepted knowledge. The intent of the current study is to propose a framework and methods, supported by an established (but relatively unknown) practice theory, to improve the capacity of organizations to advise and enact systemic design workshops with clients, users, and other stakeholders in complex engagement situations.

Both design and systems methods employ participatory stakeholder engagements, whether referred to as inquiries or interventions (in systems modes) or workshops and studios (in design). Group intervention practices based on systems theory include published processes such as Interactive Management (Warfield & Cárdenas, 1994), Appreciative Inquiry (Cooperrider et al., 2008), and Team Syntegrity (Espinosa & Harnden, 2007). Design co-creation practices are not as formally documented or developed. Numerous branded methods have been developed based on structured brainstorming and creative problem solving. Three classes of methods are frequently identified by both design and systems schools: creative problem-solving methods (Osborn, 1963; Nadler, 1981; Basadur et al., 2012), organizational development (Owen, 1987), and group deliberation processes. VanPatter and Pastor (2016) organized 63 process models into six distinct groups, all of which involve co-creation practices:

- Creative problem solving
- Design process models
- Product design
- Service design processes

- Organizational innovation
- Societal innovation

The VanPatter and Pastor report did not perform an evaluation and comparison of method efficacy; rather, they identified (mapped out) internal structures and the applicability of methods to practice contexts. No similar peer-reviewed evaluation has been published to validate the effectiveness of co-creation methods in their appropriate contexts. Many specified methods, even if claimed as scientifically based (e.g. MG Taylor and Basadur Simplexity), are branded or proprietary craft practices and therefore difficult to validate or compare. For these reasons, as well as the difficulty of mastering multiple methods, we find minimal peer critique of methods between practice communities.[1]

Branded co-creation methods are typically supported by core practice communities, trained facilitators that become associated with a single method, even if trained in many through exposure to related practices. Continuing in-cohort practice and invested expertise generally results in a kind of method allegiance, so we might argue that little motivation exists for professionals to objectively assess the effectiveness of a preferred co-creation method. Due to the absence of critical cross-evaluation or peer review of practice methodologies, we might propose that co-creation methods would be enhanced if they were evaluated and improved by assessment according to scientific or reference standard principles.

An unbiased assessment of prevailing methods would present a methodological challenge—what evaluation criteria would be deemed acceptable by the different schools of practice? How could relative levels of expertise be measured? How could the relative effectiveness between methods be presented fairly across practices without the evaluators having significant expertise in the methods themselves?

These questions are raised but not answered. The purpose of this study is to identify methodological and developmental issues shared between all co-creation methods and to recommend a common methodological solution. The assumption is made that systems theory and design methods mutually influence and enable more effective design co-creation and collaboration, and indeed that both are necessary for collaborative efficacy in stakeholder engagement. The knowledge claim is that systems science provides a basis of principles and guidance for assessing and qualifying the effectiveness of all co-creation methods.

Recreating Co-creation

A review of published practices of design co-creation reveals a scattered literature across related disciplines. Forms of structured co-creation, as a stakeholder organizing activity, are noted across disciplinary journals, from collaborative design to

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[1] This observation is made based on the author's personal involvement across many group method communities of practice, from the period of research for *Handbook of Team Design* (1998) and continuing into the latest design thinking practice groups, including international online communities and conference-based communities.

design methods to dialogue workshops. The concept of co-creation has evolved independently across several broad disciplines and manifests differently in business, design, or systems fields. There is no apparent canon or core theory of co-creation that the various schools or approaches all recognize. If a widely accepted methodology is to be adopted and propagated across many practices claiming its use, it might make sense for the disciplines that promote co-creation to seek and specify a common referential basis.

Co-creation as Theory of Value

The dual distinction of "co-creation" as a design process and as a business value-finding process requires some clarification from the literature. *Value* co-creation was established as a core theoretical concept in the business literature by Prahalad and Ramaswamy (2004a). Value co-creation was proposed to encompass the shared value constructed between a service provider and consumers in their interaction with the provided service, of value in use, where value is co-created between the provider (and their constellation of resources) and consumers in interaction. In this perspective, value is not "delivered" or exchanged but co-created in active use. Prahalad raised early issues regarding value co-creation through *experience* (Prahalad & Ramaswamy, 2004b) as the basis for value realization. A radical vision for its time, they raised numerous questions only recently studied, for example, with respect to the means by which firms might engage in dialogue with consumers, the emerging governance structures for online firms with massive user bases, and the determination of appropriate management styles and methods for co-creation with customers. Several systematic reviews of value co-creation (Voorberg, Bekkers, & Tummers, 2015; Galvagno & Dalli, 2014; Frow et al., 2015) demonstrate the development of studies with empirical support for value co-creation theory, extensions, and application studies.

Co-creation is also found as a concept of value, rather than an organizing activity, in business innovation contexts. Co-creation represents the realization of value propositions in business contexts and in stakeholder engagement (Frow et al., 2015), and the concept of value co-creation is proposed by service-dominant logic (Vargo, Maglio, & Akaka, 2008). Further, Ind and Coates (2013) have connected the business theory of value co-creation to the co-creation of goods and services in collaboration between consumers and organizations. They extend the context in which co-creation occurs to the meaning-making among participants in a value constellation, including customers, designers, managers, and other stakeholders, equally. Ind and Coates suggest participatory design as a means of co-creation, but recommend no particular methods or practices.

However, many of the theoretical issues raised remain unaddressed, in particular the questions of "how" value co-creation occurs and the observed construction of the experience of value in particular domains. Prahalad's theory has been translated to the practices of design co-creation, where the formulation of new product and

service propositions and artefacts are co-produced to embody the preferences and values of consumers, through key users. This leap, as it were, from theory to method might be considered one of the most influential contributions of value co-creation.

Co-creation as Design Method

In design fields, co-creation is understood as a mindset for creative participatory practice (Sanders & Stappers, 2008), with the adoption of co-creation mindsets following the diffusion of design practices into corporate and public organizations. Yet design co-creation has also been constructed as a process method in action research, as a means of facilitating stakeholder workshops in formal design. If co-creation workshops are to be used in qualitative research, a foundation of canonical work and guidelines might be expected as in any codified disciplinary practice.

The published review of design co-creation process models by VanPatter and Pastor (2016) is one of the few accounts that compare and describe factors across these models. The systems literature does not often refer to the term "co-creation," but reveals a long history of group intervention and problem structuring methods.[2] The systems studies explicate methodologies for group interventions, but do not differentiate collaborative (co-creative) versus expert-led methods. Neither design nor the systems literatures compare relative effectiveness of co-creation methods, again because there are no accepted criteria (across practices) for process or outcome evaluation.

Co-creation methodologies (or methods) are difficult to compare because they are performed in very different practice contexts. Co-creation methodologies can include modes of facilitation (e.g. Art of Hosting), creative organizing (OASIS), generative co-design, and dialogics (Open Space, Appreciative Inquiry). These practices can be rightfully defined as methodologies when structured as frameworks entailing a system of mutually coordinated methods. Yet they are frequently presented as philosophical stances and not formal methods. Even when referenced in social science studies, their phenomena and outcomes are discussed, but not their performance or measures of effectiveness with group behaviour or engagement quality. This study aims to provide a foundation for defining performance criteria and the fit of co-creation methods to appropriate contexts and effective adaptation.

In practice, facilitated or workshop methods are rarely assessed for their fit or weaknesses in a given context. The open literature may be biased by numerous practitioner studies reporting on craft workshop techniques recruited as generative design methods. There are also few scholarly articles that present cases describing applications and outcomes of more than one co-creation method. The quality criteria for this area of design practice is not guaranteed by adherence to standards or

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[2] Two widely cited discussions, although not systematic reviews, include Mingers and Rosenhead (2004) and Midgley, Cavana, Brocklesby, Foote, Wood, and Ahuriri-Driscoll (2013).

evidence, or even to process criteria, but to the participants' assessment of workshop outcomes. Evaluating a final result cannot resolve the counterfactual of what a better process might have been.

Co-creation Systems

Systems approaches to co-creation are recognized by their appearance in the systems literature and their specifications of systems science principles underpinning the methods. Systems methods have been developed to support collective planning, social change, and organizational development, all atypical contexts for design practices. Systems methodologies imply their adoption of design as a process, not as a creative discipline but as an approach to synthesis in problem solving and creation of future alternatives, and to "dissolve wicked problems" through system redesign (Pourdehnad, Wilson, & Wexler, 2011). According to Pourdehnad's review, the distinctive difference between design thinking in system and design modes is the different focus of designing activity. Systems co-creation identifies stakeholders as the designers in co-creation and designers as participants invested in their future aims, plans, and outcomes—a central distinction emphasized by Christakis (Christakis & Bausch, 2006).

Systems co-creation methods are developed by formulating models, identifying systemic principles, and evaluating by continual and improving use over numerous cases. Systems methods can account for over 70 years of methodology development, as even basic workshop methods cite Lewin (1951), Mumford's ETHICS, and Trist's Search Conference. Organizational practices for large group intervention and team collaboration developed through guidance from the systems sciences, since the development of the Tavistock Search Conferences by Emery and Trist as early as 1958 (Emery & Purser, 1996), and Jungk's development of the Future Workshop in the early 1970s (Jungk & Müllert, 1987). These methods predated participatory design (i.e. Bjerknes et al. 1987) and anticipated the large group interventions now considered common practice.

Structured systems-inspired methods for collective sensemaking (co-creation) and decision making were developed following the era of normative planning and direct stakeholder engagement, as advocated by Özbekhan (1969) and Jungk in the 1960s. Following Lewin's change methodology and the Tavistock Search Conference model, early organizational change methods were directly based on social systems methodology. During a period when design workshops rarely ventured outside the immediate client context, systems thinkers Warfield and Beer were developing software algorithms to represent group decision making in emerging consensus building methods. The IBIS (Issue-Based Information System) methodology (Kunz & Rittel, 1970) was also developed during this era and adapted for collective issue analysis decades later with the Dialogue Mapping process (Conklin, 2006), an embodiment of IBIS.

   The four common systems-oriented co-creation methods include Team Syntegrity (Leonard, 1996), based on Beer's methods; Appreciative Inquiry (Cooperrider & Srivastva, 1987), based on Ackoff's idealization methods; Future Search (Weisbord, 1992), based on the Emery and Trist Search Conference; and Structured Dialogic Design, based on Interactive Management (Warfield & Cárdenas, 1994). All of these share an explicit underlying principle of selection for requisite variety and/or idealization, even though each has uniquely distinct modes and other principles. Systems co-creation methods evolved from the development of scientific theory anticipating collective human behaviour. Well-developed sets of principles and methods of multi-stakeholder participation have been developed within these separate practices by peer review in discourse communities. Little work has been published relating the underlying theories to one another; as with design co-creation, practitioners of one method have not blended or integrated these forms.

Design Co-creation

Design co-creation emphasizes the collaborative, generative creative participation of individuals in design-led workshops and group practices. Sanders and Stappers (2012) describe co-creation as an evolution of participatory design practice that can be conducted by one or more of three modes: mindset, methodology, or tools for engaging users and stakeholders. Design co-creation emerged as a general approach to participatory design resulting from the broader adoption of co-creation as both method and mindset.

   Searching for the sources of *design* co-creation reveals a range of commonly adapted practices, from participatory design (Muller, 2003) and IDEO's design thinking methods (Brown & Katz, 2011) to the adoption of the "unconference" derived from Open Space (Owen, 1987) as a co-creation structure.

   Design co-creation draws from an ever-expanding range of creative ideational activities employed with appropriate external participants that inform generative ideation, the essential function of co-creation. The context for participation is a key differentiator in design practices. The four design domains in Fig. 1 suggest four populations of participants. Design 2.0 entails product and service design, a context in which product users are situated as the primary participants informing co-creation. Design 3.0 (organizational process) draws on the population of an organization and their knowledge and values from managers, staff, and employees. Design 4.0 draws from across stakeholder populations for social contexts of any scale—community members or citizens, for example, or members of an industry. By definition, the contexts for Design 1.0 are not indicated for co-creation. Design 1.0 involves non-complex design tasks sufficient for a designer or team under direct guidance and not directly informed by stakeholder engagement.

   Since roughly 2010, the trend of increasing demand for Design 3.0 (intra-organizational) and 4.0 (social/societal) applications has driven the integration of systems-informed inquiries with design methods. After early attention towards field
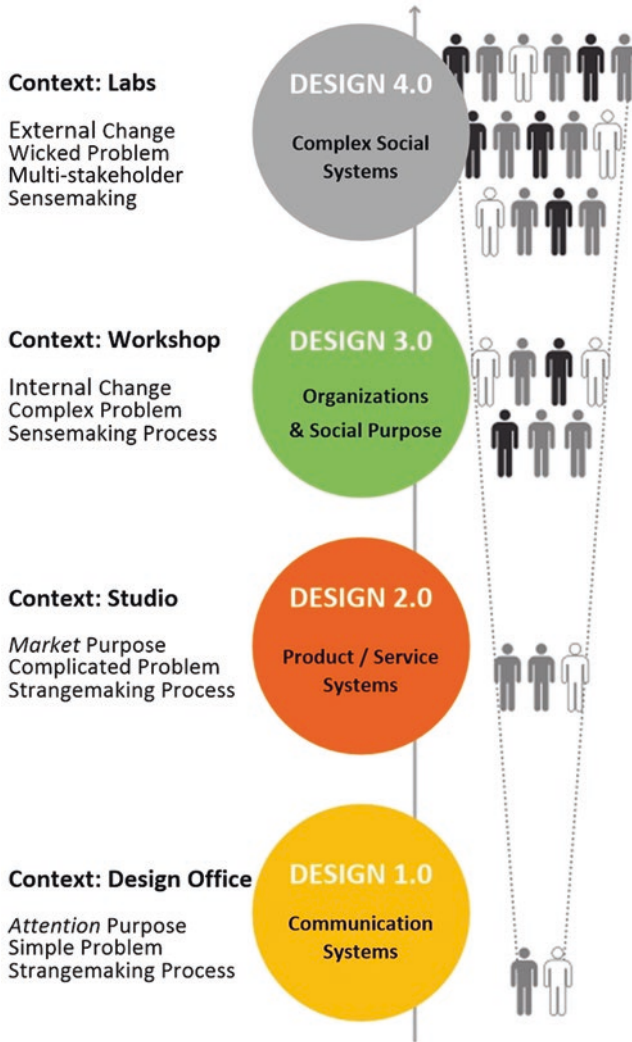
Context: Labs

External Change
Wicked Problem
Multi-stakeholder
Sensemaking

DESIGN 4.0

Complex Social Systems

Context: Workshop

Internal Change
Complex Problem
Sensemaking Process

DESIGN 3.0

Organizations & Social Purpose

Context: Studio

Market Purpose
Complicated Problem
Strangemaking Process

DESIGN 2.0

Product / Service Systems

Context: Design Office

Attention Purpose
Simple Problem
Strangemaking Process

DESIGN 1.0

Communication Systems

Fig. 1 Design domains and associated contexts

development of theory, methods, and cases, a current focus among scholars (as represented by other articles in this volume) has turned towards developing these contributions to improve performance in their applicable practice areas. Systemic design may be ultimately valued and recognized for field development and methodological contributions to practices and human performance in social systems.

A recent trend in design co-creation is perhaps an antithesis of systemic methodology. The "sprint" (Banfield, Lombardo, & Wax, 2015) is an emerging co-creation workshop approach that has gained use in business and public sector contexts, derived from the agile development processes now accepted and widely used in

corporate practice. As its name suggests, the sprint process favours a rapid action mindset and is an intensive approach to early-stage design production and value proposals. Sprints draw on available organizational participants (Design 2.0 and 3.0) and typically proceed without user research or field studies. Sprints are similar in intent and process to joint application development (Carmel, Whitaker, & George, 1993) and Team Design (Jones, 1998) methodologies, in process and facilitation. These practices all share in common their origination as business-oriented strategies to maximize stakeholder and user responsiveness for often limited periods of team time involvement. The difference with the sprint is its emergence within a significantly different business culture than in the 1990s. JAD and Team Design aspired to become participatory practices, but such approaches remained at cultural variance to North American business organizations. The sprint process has revived the structured facilitation of these methods, with goals of high productivity and return on participation.

Among the notable trade-offs in rapid design co-creation are the lack of time for challenge reframing, the high probability of low stakeholder variety, the groupthink effect facilitated by the consensus drive to immediate accomplishment, and the brittleness of design proposals constructed in a rapid linear process. However, with the emphasis on early-stage design (initial creation) in the sprint or JAD modality, the products of these workshops are never final and are formally assessed, further developed, and evaluated by process teams following the co-creation event.

Co-creation in Design Process

While design co-creation can inform and facilitate nearly any collaboration, it emerges as necessary in complex domains for which a design team would not have knowledge or agency. In earlier work (Jones, 2014), we illustrated four domains that define contexts for design team, participation, and venue for design activities. Figure 1 presents this scaled model differentiating relationships that facilitate the focus of design attention to sensemaking (understanding and articulating stakeholder concerns for design decision), change-making (orienting design decisions towards social or organizational change), or "strangemaking" (articulating design products as distinctive means of shaping attention, as in design of brand identity). The venues—Studio, Workshop, Office, or Lab—reflect four currently practised applications. The framework developed further in the article proposes new distinctions for these venues as contexts aligned to design purposes.

Design 1.0—*Design Office or Studio*. Simple design problems, well defined by briefs. A small design team working within a team context, guided by project sponsors and a design brief.

A "strangemaking" context where the typical object of design is to produce a distinctive, original artefact perceived as unique and high quality.