SELECTION AS DESIGN: SEEKING CENTRAL DOGMAS IN THE IS DISCIPLINE

Completed Research Paper

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Abstract

For much of its history, IS has lacked enduring agreement about core theories uniting the IS discipline and its work. This paper borrows from biology the idea of a “central dogma” to propose a way to frame both thought and conversations about broadly diverse but related work within a discipline, to amplify the value of existing research through systematic synthesis, and to identify and guide new research and applications. From several IS and non-IS perspectives, it develops the novel idea of “selection as design” as a common thread by which to frame IS research and practice, and as an approach having some expected features of a disciplinary central dogma. It then uses a case study to operationalize selection as design through “selection bridges” which enable us to both examine connections among silicon and human information systems, and to leverage our findings across is theories and contexts.

Keywords: IS theory, IS research, CSCW, Theory building, Case studies, Systems approach
Introduction

For much of its history, IS has been challenged to understand and realize routines and practices that support collaborative work. Among the difficulties has been a lack of enduring agreement about core or overarching theories uniting the IS discipline and its work. Although IS work is often framed through problem-solving, technological, and sociological lenses, it is unclear that those lenses regularly hold any theories in common, or provide insights that cut or communicate across problems. Despite decades of apparently crosscutting advancements in “design science”, much of its operationalization remains contentious in terms of (for example) what is design, who are designers, and the outcomes of design.

This paper borrows from biology the idea of a “central dogma”. In short, the central dogma of molecular biology is that “DNA makes RNA makes protein” (Niernberg, 2010) in a unidirectional information flow. This dogma underpins many explanatory and predictive theories in biology, offering systematic ways to configure socially and industrially useful biological processes by selecting from existing documented components, and to discover and design new components. This paper compares selection and design across central dogmas of six disciplines, in order to address the research question: What can selection and design in other disciplines’ central dogmas reveal about selection as design in IS, and about the characteristics of potential central dogmas of IS? This paper cannot answer that question in full, but merely outline an approach and potential avenues of research.

(The term “dogma” reminds us that a discipline’s established beliefs or doctrines are not necessarily fully supported by the discipline’s subsequent work, but may continue to provide very good operational approximations and foundations for ongoing research and practice. Operationalizing “dogma” this way enables the assortment of theories from different fields to be considered together without dwelling on their details of relative maturities, scales, or controversies.)

This paper proceeds as follows: First, it establishes selection and design as related ideas in the IS literature. Next it argues for the value provided by a central dogma to a discipline, and reviews central dogmas from disciplines that share some features and complementarities with IS. Third, it considers some candidates, drawn from IS, as central dogmas of IS. Fourth, it proposes “selection as design” as a way to concisely express a concept that is argued to be common to many diverse areas of IS. Fifth, through an existing case study, it demonstrates selection as design as a tool to understand and communicate about empirical phenomena among different IS perspectives and stakeholders. Finally, it concludes with some thoughts about how selection as design might be generalized or applied across IS.

In this paper, “selection” has the colloquial meaning of adopting one of several accessible circumstances, while “design” has the colloquial meaning: to configure an environment to obtain an anticipated outcome. These definitions are elaborated in different (potentially divergent!) ways as circumstances demand.

Selection and Design in the IS Literature

The concept of selection as part of design is at least latent in IS literature. Hevner et al. (2004) discussed a part of a design process in which stakeholders decide if a proposed IS should be implemented for use. This requires selecting between proposed design(s) and the status quo. Papers discussing the design of research repeatedly mention the importance of selecting appropriate research and analytic methods (e.g., Constantinides et al., 2012). Abbasi and Chen (2008) reported about the design of a computer-mediated communication analysis system that enables runtime “feature selection” to highlight characteristics of texts being analyzed. In other words, users design some parts of their analysis tool through selection. Hahn et al. (2009) discuss selecting for locations and vendors in the design of offshoring strategies.

Slightly more rare are explicit links between selection and design of IS components. Sein et al. (2011) recognize that “design constructs” and “demonstration contexts” may be selected as part of action design research with respect to developing and testing artifacts. They further state: “the ADR team may use its chosen design constructs to shape its interpretation of the organizational environment, use this increasing understanding of the organizational environment to influence the selection of design constructs, and/or interleave the two”. The entire decision-support systems IS sub-discipline is concerned with the design of systems to enable good selections to be made from alternatives. Pollock and Williams (2008) outline
several ways in which stakeholders build and test frameworks through which to select from among different designs of software packages and implementations.

These references link selection to design within but not throughout IS. They provide hope that a central dogma, perhaps involving selection and design, could be developed in IS as it has been in disciplines as diverse as biology (e.g., Presta, 2005), chemistry and sustainability (e.g., Robert et al., 2002), communication (Lengel and Daft, 1989), and public policy (Hans et al., 1998). In those examples, selection of tactics is one way to design systems to meet anticipated needs. Later sections of this paper illustrate benefits of considering selection as design in IS.

**Seeking a Central Dogma in IS**

IS authors have pined for three decades for a body of unifying IS theory (Lyytinen and King, 2004). Approaches to unification have recently returned to a design focus, but design as a central dogma leaves unsolved the problem of where to take perspective, and how to select “system goals” and “system features” when considering complex emergent systems (Hanseth and Lyytinen, 2010). Thus we need a robust approach to situate systems, design, selection, and other approach in IS, which elegantly scales across contexts. Echoing Crick’s (1988) reflection, IS as a systems discipline could gain from a “new assumption [that is] more central” than the plethora of ideas (seemingly interchangeably labeled “models”, “hypotheses”, “theories”, etc.) that enable IS’ rapid differentiation into all manner of niches.

Such a “central dogma” in IS can be operationally identified (if not precisely defined) as a conceptual claim about the world that: a) is embedded in many kinds of IS work, b) which, if shown to be unsupported, would question the sustainability of building further theories or ISes on that claim.

**The Central Dogma of Molecular Biology**

The central dogma of molecular biology is rooted at the micro scale, but explains and predicts phenomena at the macro scale. It was first stated by Francis Crick (co-discoverer of DNA structure), as follows:

> The central dogma of molecular biology deals with the detailed residue-by-residue transfer of sequential information. It states that such information cannot be transferred back from protein to either protein or nucleic acid.

In short, “DNA makes RNA makes proteins” in a deterministic way at the individual cell. From this central dogma arises many sound and supported theories based on the unidirectional information flow from an organism’s molecular DNA sequence to its external traits such as size, color, and ability to metabolize or resist antibiotics, etc., and ultimately the organism’s success at reproduction.

Biology has a complimentary macroscopic central dogma (not conventionally designated as such) linking genes to populations in Charles Darwin’s theory of “natural selection”. Natural selection holds that within a population, a particular trait may gradually become either more or less common depending on how well the trait enables its bearer to survive and reproduce the trait to the bearer’s offspring in its environment. Thus, the two central dogmas span distant scales of biological phenomena in a common frame.

Together, these two central dogmas enable theories that explain rabbits’ change of color with the seasons and the decreasing effectiveness of some antibiotics with ongoing misuse. They also enable theories that predict that less snow cover during shorter winters will decrease the duration during which rabbits will have white coats, and that enable better design and management of antibiotics to prolong effectiveness. Yet both natural selection and one-way inheritance dogmas do not explain many phenomena.

Our food and industrial supply perpetuates (often sterile) individuals selected and designed for ease of handling and for devoting disproportionate resources to producing industrial materials, rather than for survival or reproduction. Modern humans perpetuate viral and hominid DNA, while bacteria copy DNA plasmids within and among species, implying that horizontal and non-reproductive gene transfers are not rare. And epigenetics breathes new life into Lamarckian inheritance of traits shaped by parents’ environments. Although one-way inheritance and natural selection are agreed upon dogma for most biologists, much debate remains in related disciplines such as ecology with respect to identifying core philosophies and goals of what IS might call articulation work in performing research and conservation.
according to best available theoretical and practical bodies of knowledge. Nonetheless, the two central dogmas have served as a backstop against which many biological discoveries are and have been made.

**Design Implications for IS**

Now what could all this contribute to IS? Despite the abundant differences in settings, contexts, technologies, and implementations of modern fields of biology (and related disciplines such as medicine), almost any problem concerning the organization of life can be initially oriented through the two central dogmas of information transfer and selection. The dogmas point researchers toward relevant bodies of existing related knowledge, and toward potential modes of research and intervention. They also provide a common conceptual grammar to (relatively) unambiguously relate works in any field or scale of biology. In short, biology’s two central dogmas enable stakeholders to both explain and produce, with some imperfect reliability, interesting phenomena concerning biological systems. It also permits them to (re)interpret data and samples not collected with those dogmas in mind (say, by citizen birdwatchers, or museum curators) to support new research.

A central dogma or two to relate, explain, and predict phenomena across IS, as enjoyed in biology, would help to more reliably discover and transition theories, knowledge and aspirations concerning local practice into other relevant contexts. A system to directly characterize and interrogate the plethora of rich work in cases and ethnographies about people and their information designs and practices would enable better framing of local observational and analytic approaches, and help to plan and facilitate cross-case, cross-site, and cross-scale work. A common base from which to extrapolate and compare local experience would enable more members of the IS discipline to benefit from and contribute to each other’s local work.

This paper cannot fully develop a central dogma for IS. It instead offers vignettes of several disciplines in which selection and design connect dogmas to research and applications. It also refits selection as design onto one case to compellingly explain and anticipate IS phenomena, and to identify future research.

**Chemistry**

Chemistry, as the science of matter, systematically explains properties of matter, why and how matter interacts with other matter, and predicts with useful precision and accuracy how new combinations of matter could be formed and what their properties might be. Almost any problem concerning matter at a micro scale (whether or not previously encountered by chemistry) can be afforded a useful start by considering the electron configurations of the species of matter involved. A long history of struggle with particle and wave electron models has revealed and guided studies into the most interesting areas of chemistry including the quantum and statistical realms.

Synthesizing desired chemical compounds from available materials requires designing reaction sequences by selecting and testing template reactions from libraries of known reaction types (e.g., reduction, oxidation, halogenation, ring expansion, etc.) based on commonly framed knowledge. Occasionally, a new reaction is devised and added to the library, eventually becoming a template as bounding conditions are explored and characterized. Scaling up and replicating reactions—by optimizing time, cost, waste, purity, yield, speed, and local suitability (e.g. skills, technology, legislation)—requires different research and production specialists to iterate and communicate based on shared background and theory. Unlike people and information in ISes, chemical properties do not vary across culture, geography or time.

If chemistry’s current well-tested Standard Model relating subatomic particles, waves, and energy turns out to be wrong, much of the discipline would need to re-evaluate how it understands the universe. Although paradigm shifts (Kuhn, 1962) and advances such as quantum mechanics and string theory give us reason to re-examine classics like the Bohr model, electrons and waves continue to explain and predict useful new chemistry across scales and contexts. Different fields of chemistry and allied disciplines may focus on different (sometimes contradictory) roles, properties, and concepts of electrons in their work (i.e., as an emitter of light when energized, as holding a ‘1’ or ‘0’, as one factor arranging DNA), but theories and designs involving electrons are mutually intelligible across different fields because the electron has a core set of shared meanings. Electrons’ shared and non-shared characteristics facilitate rather than hinder diverse research and practical work, all around a recognizable disciplinary core.
Note that this paper is not proposing to circumscribe a new IS paradigm—that must come from the broad IS community. At this point, it proposes the need for a central dogma around which we could gather our current observations and ways of observing, and implicitly seeking more observations and experiments from different perspectives of existing kinds of interesting phenomena. This paper suggests selection as design—one neglected thread running throughout IS—as a possible step toward a central dogma, but it does not propose a new IS paradigm which would require new kinds or structures of research questions, new phenomena to observe, nor new ways to interpret what we observe. Those innovations must come from the various perspectives within the IS and allied disciplines. Hopefully some central dogma of IS is discovered which fits those exciting results together, perhaps in conjunction with a new IS paradigm.

**Policy Science**

Policy (or political) science, as the science of collective rule-making (in the sense of making laws, and in the sense of distributing the authority to rule) systematically explains how different sets of rules emerge and interact at local through global scales, following common kinds of needs to allocate resources and control. Although policy science has an intellectual background rooted all over the world and has been revised perpetually since antiquity, its core set of phenomena and problems has remained stable. It has provided a small number of new approaches as new kinds of details arose, by adding different models for allocating power or resources (such as mercantilism around the Enlightenment, or globalization in the 20th century). Policy science also informs the design and evaluation of new policies through policy analysis tools that allow one to consider changes at short to long timescales; effects on individual and collective stakeholders’ behaviors, powers, and resources; and how policies can affect policy-making itself.

Most policies can be characterized by how they: a) promote, or b) inhibit; an: a) existing practice, or b) new practice. A policymaker has four broad policy levers: a) procure, b) tax, c) regulate, or d) prohibit. Anything could be taxed and/or regulated but it is difficult to inhibit a practice through procurement, or to promote a practice through prohibition. The selection and design (and interactions) of policies and levers is broadly constrained in understood ways, and we can identify exploitable corner cases. Thus we can select, design, implement, and revise policies to encourage desirable behaviors and ways of organizing, while minimizing undesirable outcomes. Similar to industrial chemistry, a technical bureaucracy implements policy designed by legislators, enabling selections from the global library of public policies and cases to be evaluated and localized on the most relevant terms. But unlike chemistry, iterating policies through trial and error raises significant ethical concerns for humans. The field would be upset if reality does not meet assumptions about actors’ rationality and motives, power, and resources (terrorists exploit such assumptions).

**Communications**

Communications, as the science of information gaps, systematically identifies bodies of knowledge, their differences and similarities, and characteristics of messages that overcome gaps in information. It also relies on understanding how individuals and groups receive, internalize, and act upon received information. As such, it systematically explains the effectiveness of messages, their mediums, and their designs, and it informs the selection of tactics to design new messages to communicate new information to achieve specific kinds of outcomes. Communication as rhetoric enables communicators to use similarities and differences among discussants to select from a stable of strategies with known qualities in order to formulate an appropriate argument for a given context. By considering cognitive conditions of both sender and receiver, communications provides tested and related frameworks from which to select and combine strategies and tactics to characterize and span information gaps. The communications discipline would be upset if information theory or cognition became unsupported.

**Social Anthropology**

Social anthropology, as the science of human beings in social groups, identifies and describes how people are organized, what they do, and the rationales by which they assort and act. Using diverse research methods rooted in holistic and often long-term fieldwork, it tries to understand how such features and patterns emerge in order to provide thick descriptions of particular groups. Its reflexive strength enables researchers to select and design arbitrary objects of study, enabling many more or less defined
specializations of study that may or may not be mutually intelligible. Although it can understand humans in social contexts through their structures (as does political science), the focus is not to suggest, select or design new contexts or organizations or behaviors. The discipline is not centrally focused on selection and design of individual and group identities and dynamics, although some social anthropologists work in settings concerned with those problems. Unlike above disciplines, relatively few attempts are made to systematize observed variations, and predictive power is not highly valued since intervention is not universally accepted as a valid research practice. A central dogma of social anthropology would concern the apparent varieties and relations among individuals, groups, and peoples. Removing that premise upsets the entire field; but the field would remain relatively intact were we to negate supporting theories about, say, humans in art, politics, culture, economy, cognition, etc.

**Innovation**

Innovation, as the science of new tools and practices, understands technology and people through a predominantly sociological lens backed by economic interests. In particular, innovation provides some ways to describe novelty, once it has occurred, and a general approach to predicting some kinds of difficulties of adoption, but on its own it does not enable us to reliably select or design new tools and practices that will become adopted in any given context. This characteristic and limitation is shared with ethnographic approaches to understanding ISes, practices, design, and people: they tell what not to do. Via Schumpeter’s (1942) dogmas about sources of advantage over current methods, and Rogers’ (1962) dogma about risk-taking entrepreneur-adopters, innovation can make limited suggestions about selecting from risky approaches to enact innovation. Findings converge on innovation as a non-deterministic phenomena in which the few visible successes are highly contingent on network dynamics reachable only indirectly through systematic policy, which suggests long-term statistical bets like Google’s 20% time rule.

Removing advantage, entrepreneurship and adoption from innovation would not remove its ability to understand changes to practice as both arising from, and contributing to, motivations among adopters. “Social” innovation may expand dogmas of advantage and adoption to design for community gains.

**The Struggle with Information Systems**

Across biology, chemistry, policy, communications, social anthropology, and innovation disciplines, interesting phenomena occur where ambiguity is explicitly accommodated between neighboring systems where ambiguity supports multiple selections and designs around a commonality explicitly provided by their central dogmas. Those disciplines all have practical and conceptual relevance to IS, and provide contrasts against which to identify potential central dogmas of IS. That many diverse disciplines can collaborate on IS problems provides evidence that they share some common ideas about concepts core to IS. However, that important ISes are routinely designed and implemented without explicit formal IS expertise suggests such commonalities are always globally incomplete. Although empirical approaches provide somewhat easily relatable individual contexts, overarching work remains limited to a form of descriptive sociology, with few themes or insights that transcend the IS discipline.

**Some Candidates for Central Dogmas of IS**

Several theories are reasonable candidates for being parts of a central dogma of IS. But we want a dogma that distinguishes the IS discipline from potentially confusingly similar others, yet is strengthened by everything IS does alone and with other disciplines. In short, identifying a central dogma of IS rests on identifying: “What theories or assumptions from IS can we not remove and still retain IS as a discipline?”

**Information Theory**

Information theory (Shannon and Weaver, 1949), originating from problems storing and sending information, concerns the quantification of information. This seems a strong candidate for a central dogma for IS, but evidence is scant that current IS theory remembers the information contents of systems it engages. Few contemporary IS authors discuss entropy, largely leaving the concept to mathematicians
and engineers. Some knowledge management and awareness literatures stress the importance of replicating information from sources to sites of use, but the information content and quantity required to perform a particular task, or to satisfice a decision, is rarely expressed quantitatively. Parts of IS focus on designs for storage, retrieval, and visualization of information. But they identify problems of aesthetics or raw capacity, rather than problems concerning the relevance of information or its density.

If information theory is a central dogma of IS, then IS would be something of a sub-discipline or an implementation of the communications disciplines. If that were the case, we would be able to design ISes as exact communications tools in a systematic way to overcome knowable information gaps, and anyone would be able to make adequate IS design just like anyone can communicate. The second implication would question parts of design science. However, treating IS as only a communications discipline ignores important management dimensions and heritage of IS. Another possibility is that IS is part of the mathematics or electrical engineering disciplines, but crucial human dimensions are lost in those interpretations. In addition, IS research appears to focus more on software and high level concepts, and even hardware-intensive HCI is largely unconcerned with low-level storage and transmission hardware.

**Computer Science**

Similarly, the influence of computer science is only felt in narrow parts of IS, for example, in security where mathematical approaches to computing and theories of computation are highly relevant. New computer science developments (e.g., process parallelization, virtualization, etc.) only connect to a few to IS selection or design practices. However, computer science has the potential to inform IS design in a more abstract way: source-code can be considered as designed in the sense of abstracting new problems, designing and enforcing policy, or selecting from libraries of capabilities from the operating system or third parties. Each line or module of source code is designed by some human (directly, or via some program), and all software must interoperate with other selected and designed systems.

**Systems Theory**

Systems theory (von Bertalanffy, 1968) is based on self-regulating systems—which are similar and pervasive in natural environments and man-made sciences—that employ simple individual rules about input and output feedbacks to maintain a suite of related activities. It is tempting to frame systems theory as a central dogma for IS, but ethnographic, survey, and case study methods are not specifically oriented to gather comprehensive long term data about ISes, their use, and their contexts as and within systems, meaning the information they collect are not often suitable for systems theoretical analysis. (Spatial and conceptual scales are missing from IS research practice, rather than from IS or systems theories.)

Although general systems theory was key to linking IS analysis to IS design in the 1970s, contemporary IS problems have grown to include broader factors that are not amenable to a straightforward engineering approach. Non-deterministic (and unobservable) human-mediated interactions, along with ISes that suppress rather than highlight variation, renders it difficult to obtain a full qualitative or quantitative view of ISes in context. And there is little evidence that IS has enthusiastically leveraged systems knowledge from other systems disciplines, or that IS supplies its own systems knowledge to other systems disciplines, as suggested by the general systems theory approach. (Recall that this paper attempts to link selection and design insights from other systems disciplines to IS.)

The related complex systems (Ashby, 1956) approach has generated some insights about ISes through mathematical modeling, and models have to be selected and designed. Although selection criteria for behaviors are somewhat crucial to models, not all ISes or aspects are amenable to being modeled, for reasons related to their difficulty of being comprehensively observed or described in quantitative ways.

**Design Science**

As mentioned, design science has traction as a potential central dogma of IS. In particular, the design of boundary objects potentially links local and distributed practices and ISes via maps, scripts, and templates. But current approaches: may under-recognize that existing emerged systems are designed (in whole or in part) to the extent that it is difficult to professionally design substitute systems; may under-
Breakthrough Ideas

appreciate the design contributions of stakeholders not recognized as designers in the IS discipline; and may under theorize long-term sustainability of designs and incremental revisions.

Holistic appreciation of stakeholder needs remains disconnected from practical design insights. That experimental software engineering persists indicates that piecemeal statistical approaches continue to have appeal. Design science does not explain how to systematically consider existing or new case studies about ongoing selection, design and implementation. A central dogma to which empirical data is difficult to relate is not practically useful. Likewise with sociological approaches.

Why “Selection as Design”?  

Removing any of the above potential IS central dogmas individually would not fatally wound IS. However, without (at least) all of them, IS would not be a discipline. Selection and design, together, are common and critical to that wide range of IS theory and practice, which makes the pair a reasonably good candidate for being important to any central dogma for IS. However, not any arbitrary combination of the above candidate dogmas could be fused to form a central dogma, nor enable them to suggest IS theories and works that might be helpful in any given context. Thus, we explicitly add to the definition of a central dogma for IS (beyond spanning and supporting many kinds of IS work) the requirement that it guides navigation of a large body of IS theory and existing work, just as biology's central dogmas situate nucleotides up through to populations, and across geographies and times.

We must thus adopt definitions of “selection” and “design” that are recognizably common across many areas of IS. “Selection” must arrange and prefer some available options about how information is sourced, transformed, and connected. “Design” must yield new options of information sources and arrangements from which to select. And both must aim to support a practical purpose, beyond an IS for the sake of IS.

Selection as design must therefore situate our accumulation of piecemeal and incremental cases and theories about those IS things that are selected, and those IS things that are designed, through a common frame of observation or conceptualization, a central dogma, which brings us closer to considering how our many individual works contribute to IS as a whole. The few properties that we do sometimes report in common (e.g., gross characteristics about users and firms, criteria for selecting or designing existing or new ISes) are not currently systematically observed or reported or indexed, nor do we use accurate or precise ways to select or describe the relevant contexts of ISes that we do report. We may initiatively and correctly agree that an arbitrary IS will succeed or fail in a given circumstance, but agreeing on why (or even on a full description of relevant context) is difficult.

A Case Demonstrating Selection as Design

Selection as design offers a unique opportunity to combine strengths of different IS focuses, across theoretical, spatial, and temporal contexts, because it enables the broad range of activities of an IS, along with the many ways to study an IS, to be fitted together in a consistent way.

The defining idea of “selection as design” is that selection of information resources to combine, and design of ways to combine information resources (whether embedded in silicon or other forms), need not be distinct processes within or across scales or areas of theoretical focus (“design as selection” also works). This definition deliberately provides ample room for local interpretations of selections and designs in each context, while retaining core that is relevant across the discipline. When we design or select something in IS (an icon, a user interface, a CRM, an ERP platform, a business rule, a policy, a confidence interval, etc.) we do so to satisfy needs embedded in an IS selection or design by someone else. These are not new ideas, but neither have they been successfully used to pull IS together.

This approach is not reductionist. It systematically leverages boundless variation in ISes and research settings and approaches without being dominated by each variation’s details. This section illustrates selection as design in IS through an empirically successful international scale organization which develops and operates ISes without explicit IS theory. It draws on a fuller treatment given in (Li, 2012).

The Taiwan Forestry Research Institute's (TFRI) Ecoinformatics Working Group (EIWG) is an informal collaboration of leaders, researchers, and support staff from several divisions of TFRI, including two
Keeping Feet on All Boats in Case One Takes Off

At EIWG, selections concerning whether and how to connect persistently ambiguous aspects of systems between one energy state and another, or between one time and another. Botanical gardens, a museum, a warehouse of local and international plant and insect specimens, and several field sites and stations. Although TFRI is part of the island nation’s agriculture department, EIWG has no formal existence and supports itself via interested division leaders. It is lead by TFRI Fire Research Division’s leader, who sought to share his division’s data for reuse at the conclusion of a major research effort. EIWG’s core team of a dozen members ingests, develops, supports, and repackages open source and proprietary software and hardware platforms and standards related to collecting, managing, sharing, and reusing ecological (meta-) data. EIWG adapts, translates, and localizes tools from the international ecoinformatics (EI) community for use by other government departments, institutes, and researchers in Taiwan; and for regional collaboration among researchers in several countries in Asia. By offering free regular internal and external training workshops, technical support, platform integration assistance, hosting and administration services, etc., EIWG has become expert at practical IS design. EIWG’s expertise spans spreadsheet macros and blogging packages, through to virtual and cloud computing and big data platforms to support collaboration via ecological data. EIWG enables and entices lay citizens and experts alike to participate in opening its physical and digital information resources worldwide.

Of note, EIWG includes members trained in ecology, healthcare, language arts, and various other disciplines, but none in IS, even though it is relied upon to perform leading edge IS work. EIWG is situated between China and the US politically, between the regional north and south in terms of technological capital and capability, between its status as an ecology unit and as an IS consultancy, between US and European models and standards of ecological information management, between a rich collection of legacy physical and digital data and an unlimited future of semi-automated sensor networks and workflows, and between Asian and Western ideals of scholarship and IS practice. It must therefore constantly connect people, places, information, and systems across different scales and contexts.

The following sections use selection as design to briefly illustrate how EIWG selects, designs, and selects designs to bridge some of that, to show how selection bridges themselves change (beyond “lock-in”), and to raise some concerns about selecting lenses through which to understand IS at EIWG.

Keeping Feet on All Boats in Case One Takes Off

In biology, a species may try to secure or expand its range by selecting and exploring nearby niches, and perhaps specializing or generalizing. We select individuals and populations for their (in)ability to be resilient outside particular environments in order to manage biological systems. In chemistry, electrons of an atom or molecule are most interesting at outside shells where they can attract or be attracted to other atoms or molecules, to yield more energetically favorable combinations and bonds. We select chemical reagents for both energetic and functional properties in reaction design. In these domains, the connection endpoints are not only persistent, but they are persistently ambiguous, in the form of unreacted chemical reagents, surplus resources, etc. Gains are had by exploiting differences between one niche and the next, between one energy state and another, or between one time and another.

At EIWG, selections concerning whether and how to connect persistently ambiguous aspects of systems shape the dynamics of the team’s ongoing interactions. In selecting from a variety of IS components (e.g., software by the Global Biodiversity Information Facility or the Knowledge Network for Biocomplexity) to translate, localize, support, and train, EIWG designs generic EI packages that can then be further localized at each partner ecological research site (e.g., translated instructions, training, and support that enables a partner research group to make its datasets available to the public with metadata). To create a selection bridge from an English-language environment with EI IS abundance to a multilingual environment where such tools were rare and in an incompatible language, EIWG first temporarily opened its own information sources and systems (including databases of items in its botanical gardens and collections, particular team members and division leaders, virtual and physical servers and storage, etc.) to the possibility of connecting with other systems (for example, remote computing services, regional and global metadata repositories, other EI researchers). Second, it selected a small number of desirable connections around which to re-close its information and systems connections to the outside world. One main outcome of this coordination is that EIWG became (in reality but not officially) responsible for ensuring that KNB’s Metacat software accepts, stores, and displays common names in Asian scripts, so that EIWG and other groups could share data in Asian scripts alongside English. Such a “selection bridge” may be defined by the advantage gained—by purposefully configuring and connecting selected information resources in a new way supported by a local theory about why it works—over previous similar
selection bridges or over no previous similar selection bridge at all.

“Selection as design” embodies EIWG’s work to select IS components, design bundles, and offer and deploy selection bridges to those it supports, along with bridges EIWG deploys to sustain itself, and bridges deployed to EIWG by others. (EIWG does not use the term “selection bridge”. Selection bridges are intended to be a conceptual device to describe, explain and predict, rather than any particular directly observed tangible item. Selection bridges take forms appropriate to relevant theories.)

EIWG’s strategy creates and renews (at least) two kinds of selection bridges. The first set of bridges for EIWG itself (to gain both ecology information and information about ecology IS components) becomes renovated as each bridge is exercised and differences between endpoints diminish. This is evident in a several year effort during which EIWG developed patches to open source ecological metadata software to support Unicode, persuaded the US software maintainers to accept those patches, embedded a team member at the competing body responsible for the European ecological metadata standard, and developed de facto standards of its own for how to discover and ingest ecological metadata software. Such other efforts now operationally rely on selection bridges to EIWG to reach Asian users. EIWG’s work additionally extracts and distills those parts of selected IS components that align most with its objectives and regional cultural considerations, such as smartphone technologies that specifically enable and respect citizens’ overt patriotic and sometimes patrimonial participation in decisions about their ecological resources as they interact with TFRI’s outreach. As social mediators among software and standards developers, and environmental scientists, EIWG’s bridges also mollify hairy details, such as tax codes and policies designed to block Internet domain names and services hosted in other political jurisdictions.

The second set of bridges connects EIWG’s clients’ and their ecological data to similar researchers and data from across the world, which itself inspires EIWG and its clients to seek more new bridges. This is evident in EIWG’s continuous pursuit of new kinds of information resources and systems to which to bridge. For example, EIWG actively sought to develop expertise in cloud computing, Hadoop, and workflow engines in order to develop and maintain bridges with the latest advances in information and information systems in the US and Australia (and to comply with national government directives requiring EIWG to migrate ISes to a common virtualization service), while EIWG’s success at bridging and bootstrapping Japan’s EI infrastructure has resulted in EIWG promoting Japan’s to professionally recognize information management and publication as first-class scholarly research activity.

**Raising and Razing Bridges**

A careful reader would note that the preceding narrative could be legitimately interpreted through many combinations of IS and borrowed lenses. A short list might include concepts such as Confucian Dynamism, supply-side innovation, theory of technology acceptance, gender studies, cultural competence, etc. Yet, it cannot be known ahead of time which sets of lenses would convincingly analyze EIWG’s most interesting circumstances and successes. EIWG’s team faces similar challenges with respect to how to decide which of many possible selection bridges to pursue. That is, they must operationalize their tacit theory of EI to instantitate connections to address not only EI problems at hand or anticipated, but also connections to position EIWG to become aware of and address the next generations of EI problems. They design a selection bridge by understanding: the substantive contents of the information sources to be bridged; the expected outcome of the bridge; why the selection bridge’s outcomes support the organization’s system goals; and, how the bridges may be sustained. These kinds of information are persistently observed but not systematically reported by IS researchers and practitioners alike. As with central dogmas that help other researchers and practitioners orient their challenges and tools, selection as design: first enables IS researchers and practitioners to gauge how a selection bridge might be strengthened for sustainability (i.e., how to refine the local use of a theory), and second informs how to theoretical and operational lenses and advises about of their blind spots.

On sustainability, information resources connected by selection bridges combine through some artifact (at least the physical embodiment itself) to yield some specific desired outcome. To build a selection bridge and apply transformations to the information requires resources. To be sustainable, the selection bridge must directly or indirectly supply: additional information to at least one of the bridged information resources or systems; resources for stakeholders to generate new selection bridges; or resources to identify, design or generate new information resources. The selection bridge must generate resources
faster than it consumes them. Sustainable selection bridges thereby alter their environments and themselves, and hence alter their end-points. On the other hand, a bridge might be used only a few times (for example, a database migration script) at a particular IS and then purposely fall away without altering the bridge itself through final use (while still changing its environment during its own development).

At EIWG, this is both directly and indirectly manifest by the reciprocal relationships reinforced and formed alongside selection bridges through new funding opportunities (as an informatics unit, rather than an ecology unit), social capital (via influence or “face” at local, national, and international institutions), new research opportunities (via access to other sites’ data), etc. External theories, in this case from ecology and scholarly publishing, limit the number of scientifically advantageous combinations of given datasets. Therefore, EIWG trains its team explicitly to look for new bridges to secure additional data or apply new transformations to existing bridges, and for new kinds of connections. The team also encourages others to draw upon EIWG as a resource through public offerings of information and EI IS assistance to encourage others to bridge to EIWG. Such efforts have attracted collaborations with targeted environmental scientists, but also with social scientists whose work compliments ecology. Recombination as the key to sustainable advancement is part of EIWG’s central dogma, and can be understood through EIWG’s selection activities, and as a target of others’ selections and designs.

Selection bridges also enable us to examine connections or contents that are not sought or desired by those connected. For example, TFRI’s formal connections to the national government bring information and financial resources, but also a mandate to transition all IT services to a national virtualized cloud infrastructure. This policy mandate imposed direct costs on EIWG, but also presented an opportunity to build competencies in managing and deploying virtual machines, cloud storage, etc. which they in turn offer to other organizations. Selection bridges trace EIWG’s establishment of a new favorable equilibrium.

On theory work, selection bridges make explicit the sets of resources that could or have been bridged, at particular levels of abstraction, and via particular theories. They provide an accessible way to find and evaluate present and potential combinations of information resources and theories. Technically identical bridges may also reveal different context-dependent local theories. EIWG selects potential combinations and theories through individual, team, and international deliberation, and by default are made explicit and tested by several team members. Many team members are trained to instantiate common selection bridges (e.g., LDAP authentication systems that pilot for more substantial information links across institutions; and routine training workshops that connect researchers to EI platforms).

In this way, the selection bridge concept more than describes static or dynamic connections in a network post hoc, but predicts kinds of connections that could sustainably form given the kinds of ISes, people, and circumstances on hand. From EIWG, it is clear that many of the tensions listed previously have not been addressed alone or in combination. If we view EIWG’s work to date as piloting technical systems and professional relationships that bridge maximally diverse spatial, social, and temporal contexts, then EIWG’s strategy to strengthen its role as a key node connecting many bridges as the region’s expert on forming bridges becomes a very clear sustainable proposition. Selection bridges enable us to conscientiously navigate among theories about Confucian Dynamism (loyalty and 12-hour work days), gender roles (female PhDs who serve tea), economics (relatively lower cost of labor compared to capital), cognition (decades-long outlook on organizational succession) etc. Each explains part of EIWG through each theory’s (kind of) bridges, but together they help us better understand and communicate about EIWG as a whole. Even in the superficial treatment above, the selection bridge both enables us to view details of interactions among silicon and carbon ISes not as severed “technological” and “social” IS dimensions, but through the common lens of how and why information flows now and in the future.

**Chasing the Bone in the Reflection**

In choosing analogous organizations or systems for comparison, the selection bridge forces us (as researchers and practitioners) to detect, if not fully consider, the set of conditions that could affect an IS or design in each setting to be compared, and the set of perspectives present and absent guiding our understanding of the context. Current ways to relate IS knowledge about organizations and systems have not let IS provide an abundant, consistent and inexpensive supply of what various IS theories would consider to be ideal ISes across scales. Selection bridges give us a way, through information and social relationships embedded in the connections, to discover more about why organizations of apparently
similar gross dimensions and function exhibit very different ISes. EIWG’s IS success is largely attributable to how it selects people, technologies, and ISes with which to bridge in detail through an eclectic internal set of socially sustainable abstract theories and logics outlined elsewhere. The US Long-Term Ecological Research Network’s IS successes in EI might be interpreted through its selection and design of ISes to bridge information and people within its long-standing network to comply with data-sharing legislation. Selection bridges let us know which kinds of data to gather to such unambiguous and thorough comparisons, for example, to evaluate theoretical and/or practical fit between an IS and operational needs, or to evaluate the completeness of our research perspectives about such needs and contexts.

**Table 1. Selection Bridges from EIWG’s Perspective at Several Scopes and Theories.**

<table>
<thead>
<tr>
<th>Theories</th>
<th>EIWG</th>
<th>TFRI</th>
<th>Taiwan</th>
<th>Japan</th>
<th>Asia</th>
<th>US</th>
<th>Eur.</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Policy:</strong> political science, international collaboration, sociological approaches</td>
<td>Selecting successors [planning and enacting]</td>
<td>Shared leaders, policies</td>
<td>Via former leader, remains a challenge</td>
<td>China (science, industry) a potential concern for future</td>
<td>[Potential role for EIWG, but not well developed]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Culture:</strong> sociological approaches, Confucian Dynamism</td>
<td>Building out to local scientific, industrial, social communities; enrolling citizens and partners supporting education, eco-tourism</td>
<td>Shared Asian values, culture, but practical challenges</td>
<td>Adopts as counter-weight to China</td>
<td>[???]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>People:</strong> data-intensive collaboration, CSCW, human factors, HCI</td>
<td>Non-IS hiring [very effective, why?]</td>
<td>TFRI units support EIWG</td>
<td>Local scientific, cultural groups</td>
<td>Other institutions embed people at TFRI, share practice and culture</td>
<td>Ongoing work with ecological metadata standards, SW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Stories:</strong> CSCW, design, sociology, ethnography, pedagogy</td>
<td>Origin/ongoing stories, struggles, successes, challenges builds and extends group identity</td>
<td>EIWG</td>
<td>Japan professionally recognizes data papers [others soon?]</td>
<td>[Potential for long-term sustained international collaboration inadequately studied]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Workplace Policies:</strong> IS management, government computing, gender</td>
<td>EIWG team members include key IT and HR administrators, division leaders; conspicuous team and skill building</td>
<td>Bound by national gov’t IS, HR policies</td>
<td>Japan professionally recognizes data papers [others soon?]</td>
<td>Patchwork of formal and informal sharing, including workshops, KBS, emails [EIWG is considering its role via long-term strategy]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Systems Management:</strong> security, availability, reliability, services, process management</td>
<td>Some shared w/other divisions. [informal and formal, inadequate study]</td>
<td>Subject to gov’t cloud/VM mandate</td>
<td>Japan professionally recognizes data papers [others soon?]</td>
<td>Patchwork of formal and informal sharing, including workshops, KBS, emails [EIWG is considering its role via long-term strategy]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Technology and Adoption:</strong> innovation, software engineering</td>
<td>Explorer, entrepreneur, risk-taker</td>
<td>Supplies tech., IS, infrastructure, services and management skills to other units.</td>
<td>Former supplier [future roles?]</td>
<td>Customer of US and Eur. standards, SW and knowledge, supplies bundles, training to Asia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Software Design:</strong> HCI, CSCW, CS, CE</td>
<td>Might become an IS, not ecology group.</td>
<td>EIWG customizes SW, could develop SW?</td>
<td>Adapts and localizes platforms and docs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data, Specimens:</strong> data-intensive science, digital curation, library studies, metadata</td>
<td>Strong internal information management understanding [relationship to research universities?]</td>
<td>Some existing data is being shared [Still not many research collaborations from shared data]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Time:</strong> infrastructure</td>
<td>Build and continue long-term relationships [still deciding on future strategy]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Table 1 arranges EIWG’s selection bridges by geographical scale on the horizontal axis (after OECD’s Oslo Manual on innovation), crossed on the vertical axis with different IS lenses broadly organized by the kind of thing being selected or designed. Clear boxes indicate selection bridges mentioned in this paper, and/or analyzed in (Li, 2012), shaded boxes indicate potential selection bridges that EIWG could build and/or IS perspectives that are missing or inadequate in (Li, 2012) about EIWG’s selection bridges. A similar table can help to analyze the theoretical and practical suitability of any particular selection bridge according to each theory (vertical axis) at each scale (horizontal axis).

For other perspectives about present, absent, and potential selection bridges, one axis may be replaced by any theory or area from Table 1’s vertical axis, say, a temporal scale spanning interactions with past, present, and future ISes, peoples, cultures; or a political scale spanning the kinds of tactics employed to make, maintain and remove selection bridges. The other axis might alternatively be clustered by, say, specific ISes studied, by related theoretical perspectives, or by stakeholder groups, etc. A z-axis could also be layered on top.

<table>
<thead>
<tr>
<th>Theory</th>
<th>Metacat Bundle</th>
<th>Sensor Networks/Workflows</th>
<th>Remote Computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Policy</td>
<td>Role of non-US partners in design of IS infrastructure for US network?</td>
<td>How to select and design interpretations of politically sensitive data while maintaining access to government resources?</td>
<td>How to violate national IT cloud policy to support international scientific collaboration?</td>
</tr>
<tr>
<td>Culture</td>
<td>How to value foreign design contributions and selection priorities/perspectives</td>
<td>How to design experiments around socially and politically sensitive topics? How to select research to compliment new ISes?</td>
<td>Trust outsider custodians? Extent of trust in EIWG? Trust ISes to do new kinds of data work?</td>
</tr>
<tr>
<td>Systems Management</td>
<td>Ongoing responsibility to update and extend bundles for Asian partners? Sustainable?</td>
<td>Labor is inexpensive in TW, physical access to sites is easy. Experiment with leading edge higher maintenance systems?</td>
<td>Create/avoid single points of scientific and IS failure by careful infrastructure positioning/planning?</td>
</tr>
<tr>
<td>Technology and Adoption</td>
<td>Enough social capital to keep taking design and selection risks? Respected as EI leader?</td>
<td>Can other countries afford extensive network and workflow designs in terms of finance or politics? Add SW to bundle?</td>
<td>TW gov’t cloud platform only scales nationally. Support different cloud for international partners?</td>
</tr>
<tr>
<td>Software design</td>
<td>Time to design or add own software for local needs? What new bridges required?</td>
<td>How would EIWG starting development affect current bridges? Will US, GBIF see EIWG as a competitor?</td>
<td>Already doing some design/development with virtualization company on networking topics. More?</td>
</tr>
</tbody>
</table>

Table 2 presents along the horizontal axis three related ISes that EIWG pursues, and on the vertical axis a subset of IS and supporting theories. Each cell presents selection and design considerations or questions that EIWG faces directly in its IS and scientific strategies and planning. Looking across the rows suggests IS knowledge, selection and design strategies for reuse within EIWG. The review also suggests potential research directions to create or discover suitable selection and design choices that would support multiple dimensions of EIWG’s IS ambitions (e.g., what kinds of cloud infrastructure should EIWG select, repackage, or design?). Looking down the columns reveals how little of a complete view each theoretical perspective provides, but also how the perspectives could be combined to ask and answer interesting new questions (e.g., how should foreign policy considerations guide and be guided by IS infrastructure selection and design at EIWG?).

These types of tables could be constructed for any individual or set of case studies, by expressing selections and design choices via commonly identifiable facts including: Who is providing choices? Who is doing the selecting or designing? What ranges of choices are made/actually available? What stakeholders
do the choices connect? Why is selection or design happening? How long should the selected designs be in use? etc. Not all columns and rows are required for every case, but considering them reveals exactly which columns can be substituted or assumed away, or are deliberately absent from analysis. Doing so also enables us to evaluate the quality of fit between research approaches, people and ISes, by comparing how proposed solutions may or may not connect with actual or neglected problems and contexts. Plotting versions of Table 2 for rationales, IS selections and designs carried out at, say, KNB and/or several small Taiwanese IS firms and/or other organizations with ISes positioned for international (scientific) cooperation would provide interesting background information and considerations for EIWG. It would also help synthesize the similarities and differences among those other cases into new IS knowledge with some predictive power about the potential outcomes of IS selection and design options available to EIWG. That type of comparison through common conceptual and explicit terms also provides an opportunity to test the quality of observations and inferences drawn from individual IS cases against other (apparently similar) IS contexts reported in the literature.

To summarize the contribution of the selection bridge: It re-opens for IS the rich data gathered through countless ethnographies and cases to new discoveries about practices, knowledge, values, etc. by linking them together through a common concept and grammar of selection as design to relate those observations. The selection bridge explicitly places the work and theories from individual IS settings alongside each other to both generalize from their commonalities, but also to expose and highlight contrasts and differences, in order to better inform strategies and decisions about connecting people and ISes. Something like the selection bridge would be accessible under the same terms to both IS researchers and practitioners, and explicitly reveals theories, assumptions and perspectives present or absent in the analysis. It leverages IS' role as a common solvent of all kinds of information and local theories. And it draws from and feeds into allied disciplines featuring selection and design in their theories and practices.

By showing to both IS researchers and practitioners which possible selection bridges could yield profitable outcomes for both research and practical needs. IS experiments and new selection bridges could be designed around each other to fill in specific gaps in knowledge, rather than waiting for organizations to randomly encounter the need for new ISes. We will need to learn how to claim this advantage.

**Implications for IS**

The idea of selection as design runs through major IS approaches, while the selection bridge tangibly ties disparate IS approaches together across humans and silicon. This approach draws upon, and is compatible with selection-design-implementation approaches from biology, chemistry, policy science, communication, sociology, information theory, and innovation, which collectively span many activities and information that IS engages in the real world. In particular, it enables both IS and non-IS scholars to identify where their perspectives can fit into a systems picture by conceptually and visually depicting and relating bridges between stakeholders and information sources at various scales. This will facilitate multi-site ethnography, and enhanced understandings in areas as diverse as virtual communities, collaborative design, and open government, which all engage in selection design of various scales through ISes.

Although the selection bridge supports analysis of ISes as systems at various abstractions, it is not limited to the system level of abstraction. As uncountable numbers of case studies have shown, it can be beneficial to break down a system into smaller components or times for study. Identifying bridges that are in place, as well as those conspicuously missing, provides a guide to not only which parts of an existing system remain to be studied, but also highlights where a system might expand. This method also illustrates which theoretical perspectives are present or absent from an individual or set of analyses. In this way, the selection bridge approach enables local observations to be rigorously related to each other and to broader observations to provide system-level knowledge, and local ISes to be rigorously related to each other and to broader ISes for practical planning and strategic purposes. The selection bridge can also view specific attempts at bridges that failed or succeeded at particular times, providing a way to grasp the system.

The selection bridge approach also identifies the particular theories, information systems, and stakeholders, that could enable findings, theories, phenomena studied at one scale or locality to gain passage to findings, theories, and phenomena at different scales or localities. We would learn about the circumstances in which, say, Confucian Dynamism, would be expected (or not!) to enable the success of a proposed cross-cultural IS in a particular part of Asia; discover variations concealed by gross measures of
IS magnitude; triangulate our observations from different theories and different scales; and to knowledgably distill and apply IS templates or models that work reliably and independently in well understood varieties of circumstances. In so doing, we can more robustly identify, respect, and present productive, redundant, or detrimental selection bridges, the theoretical and practical reasons behind such arrangements, along with potential selection and design optimizations. IS could export such insights.

As an anonymous reviewer highlights, the IS discipline would benefit from some attempts to explicate “the roles of dogmatic and axiomatic belief and assumption” in IS. Discovering and elaborating on the unstated and empiric threads that run through IS (whether selection as design or others) provides a solid foundation from which to better define and position IS among the community of systems sciences.

**Limitations**

It is not the goal of this paper to nominate selection as design, or the selection bridge, as candidates for being a central dogma of IS. Probably all of these ideas have been expressed elsewhere in disciplines that have long traditions of linking selection, design, and implementation. Indeed, Ashby (1956), von Bertalanffy (1968), Kauffman (2000), and others have all written exquisite general formulations of these ideas. Selection as design is compatible with and therefore echoes general systems theory with some communication theory. As theories that start at and span widely different scales and scopes of interaction, systems plus communications theory would provide diverse bases from which to investigate and commonly situate the plethora of theories and narratives in IS. However, we would still require some intellectual machinery to bridge scales and contexts, which selection as design is poised to provide through selection bridges. Indeed, systems and complexity theories would suggest that IS could do well with a central dogma centered on macro-scale emergent systems or *populations of ISes* (perhaps arising from information and Internet security research and practice), in addition to relatively micro-scale IS phenomena directly mediated by humans at levels accessible through selection as design.

Major limitations of selection as design are that it has not been critically examined against a wide variety of real world circumstances in IS. While it has substantial precedent in several allied fields, the peculiarities of IS that have encumbered a unified approach for decades may also encumber this approach in unexpected ways. Treating both (non-deterministic) humans and (mostly deterministic and explicit) transistorized systems as comparable endpoints for selection bridges may lead to human resource or managerial issues, especially as assumptions in computer code diverge from reality through time.

We have come to think the IS function as deeper than simply plugging this into that, and thinking in terms of selection bridges risks over simplifying the many roles and practices of IS. Electrons are common to all chemistry problems because they link (or not) different systems of atoms and their collective properties together, but we need not frame all our chemistry problems *only* in terms of electrons. Many interesting chemistry problems require thinking and working through how electrons are configured and shared, but the problems are solved for non-chemist stakeholders in terms of distributing new designs for solar panels and combinations of drugs (the electrons disappear), not in terms of bundles of elections. Similarly, bridges are common to information systems problems because they link different systems of information and their collective properties together, but we need not frame all our IS problems *only* in terms of bridges. Many interesting IS problems require thinking and working through how information is configured and shared, but the problems are solved for non-IS stakeholders in terms of implementing new information infrastructures and business practices, not in terms of bundles of bridges.

This approach appears to be able to consider and parse a wide variety of case studies into a relatively simple framework, but conceptual and empirical information could be lost in the simplification. Additionally, broad compatibility with other disciplines might be a liability if IS wishes to protect a unique core. To that end, other topics for central dogmas might be considered including: representations on planar displays, information abstraction for human cognition, or interactions among deterministic and non-deterministic systems, all of which span several IS strands. Selection as design provides only one debatable potential component of a central dogma for IS. But it would be an advance to merely provoke a discussion about why a central dogma would be an *in*appropriate way to gather the many threads of IS.

Operationally, mapping out networks of selection bridges and gathering and comparing them remains a large task. Although the selection bridge potentially enables information gathered from empirical research
to more readily inform design in IS, accelerating into design in this way requires considering relatively new risks to IS. Our ability to identify potential selection bridges in the wild is also underdeveloped. Expressed in terms of Schumpeter’s framework for sources of innovative advantage, we might look for new information sources, new selection rules, new outcomes from selection bridges, new uses of bridge outcomes, new kinds of selection bridges according to local or broad theories, new kinds of people connecting or connected by selection bridges, etc. that enable an improvement to a present condition. Or we might look for selection via information theory, designing a connection between different information sources provides access to a much larger world of potential interpretations of the external realities represented by the information sources (through combinations) than either original information source alone. Interesting combinations enabled by selection bridges can be selected and acted upon in order to reduce this large space of possibilities into a manageable space of combinations.

Indeed, the ability to identify and practically and theoretically mobilize unknown selection bridges from many IS and allied perspectives is one of the most interesting yet undeveloped outcomes of this research.

Conclusions

This paper has made two main arguments. First, that a central dogma for IS that provides a common conceptual and practical grammar would broadly enable IS researchers and practitioners to better communicate and leverage work across the discipline. And second, that a common lens that treats selection of ISes and design of ISes as different views of “selection bridges” between information resources provides a way to situate existing and future diverse IS work on common disciplinary ground. This paper synthesizes “selection as design” from selection and design which are common ideas across diverse kinds of IS theory, and theories that support IS, including systems theory, communication theory, information theory, and sociological theories. In so doing, it has identified, as a key requirement of any central dogma for IS, the ability to situate research or practice among other theories and findings that did not originally inform the research or practice. It used a case study to show how diverse IS approaches may be easily and systematically brought together to reveal potential new research and implementation avenues. This paper seeks to provoke a conversation about what might go into one or two central dogmas of IS, and offers selection as design as a bundle of ideas to consider en route.

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