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Secondary Design: A Case of Behavioral Design Science Research

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Abstract

As user interactions have become more central to specific classes of information systems, design theorizing must expand to support the processes of interaction and the evolution of information systems. This theorizing goes beyond user-aided, participatory design to consider users as designers in their own right during the ongoing creation and recreation of information systems. Recent theorizing about an emerging class of tailorable systems proposes that such systems undergo an initial, primary design process where features are built in prior to general release. Following implementation, people engage in a secondary design process where functions and content emerge during interaction, modification, and embodiment of the system in use. This case study reveals that people are engaged designers, framed by dualities in behaviors including planned and emergent behaviors, and participatory and reifying behaviors. We contribute to design science research by extending work on tailorable systems, investigating processes of secondary design in a highly interactive system suited to support user engagement. We also contribute more broadly to design science research by explicitly extending behavioral aspects associated with the use of information system artifacts.

Keywords: *Secondary Design, Design Theory, Tailorable Technology, Systems, Embodied Interaction, Qualitative Methods, Duality.*

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1. Introduction

The phenomenon of secondary design, in which users modify technology in the context of use, is well recognized but under-researched. Research into secondary design provides insights into two areas that can inform the design of information systems. First, it strengthens the conceptualization of secondary design as a key component of design for a growing class of information systems. Specifically, it illuminates the processes by which people directly participate and experience the everyday world through construction of meanings and representations within, and mediated by, information systems. We illustrate that system *use* can sometimes be best understood as system *secondary design*; that people are active, aware, and intentional participants in an ongoing process of embodied interactions involving technological and social dualities. Within the class of systems that are intended to be tailored are a large number of social-software systems built on the philosophy that a community and its members are responsible for the creation of system value through processes of secondary design. What is Wikipedia without articles generated by community members? What is Twitter without the tweets of millions? What is Flickr without the photo tagging of members? They are all pieces of technology that realize their true potential only through the secondary design of an active community of members, willing to share their time and effort in the design of systems (Shirky, 2010).

Second, this paper offers a critique of the predominant conceptualization of design science research (DSR). Current design science research is often focused on the development of artifacts, and an expansion of DSR to include the people and processes by which systems change and evolve will improve our understanding of design processes and design products and lay the foundations for behavioral design. The widely accepted DSR model, as articulated by Hevner, March, Park, and Ram (2004), is concerned with the primary design of a system artifact prior to implementation and use of the system. The build and evaluate phases are informed by both technical and behavioral theory but do not address the secondary design of a system by users in the context of their everyday behaviors and activities (Germonprez, Hovorka, & Collopy, 2007). DSR incorporates behavioral theory and may include people as informants in a participatory design process or as sources of feedback on prototypes in the primary design phase. However, people who encounter and modify the system are not considered secondary designers in the context of their use of the system. While the predominant conceptualization of DSR is important, it does not recognize secondary design as a process in the evolutionary design trajectory of systems. In current design science research, we see too often that the “functionalist thinking acts as an end point rather than a starting point for analysis” (Pierson, 2000, p. 477). In constructively addressing this critique, we examine the processes of secondary design, and we provide an investigation of embodied interaction, further developing behaviorally-oriented design science research. This provides an evolved behavioral design in which functional thinking is supplemented and extended through non-functionalist perspectives.

Initial research suggests that secondary design practices can be supported by theoretical principles that are embedded in the system during its initial, primary design (Germonprez et al., 2007). This design perspective recognizes that people’s behaviors and contexts change over time and that when information systems are inhabited and engaged by people, secondary design can occur. Secondary design recognizes that “there is an inherent uncertainty between design and its realization in practice, since practice is not the result of design but rather a response to it” (Wenger, 1999, p. 233). Our research emphasizes the potential for, and the process of, secondary design within boundaries provided by technological and social structures. We address how people engage to secondarily design a system through the contribution, discussion, negotiation, and dissemination of function and content. The primary design provides functional support, and the secondary design provides the information, the connections, the relationships, and the history of a system. We argue that people engage systems in ways that were not planned by the designers (Winograd & Flores, 1986) and that secondary design is a desired practice for organizations interacting with the public in online spaces (Shirky, 2010). In addition, we argue that systems can mediate people’s dynamic interactions with functions and content and in identifying these interactions we reveal how systems are enacted and inhabited. Thus, the primary research question that guides our investigation is: *What are the processes of secondary design?*

In investigating the processes of secondary design, we develop design science research as we consider the intertwined relationships of technical systems and social actors. Understanding the processes of secondary design allows us to address a second research question: *How can design science research be extended to encompass the evolution and change entailed by secondary design?* In addressing this question, we extend design science research, by including a clear expectation that people and systems create an embodied interaction through processes of secondary design. We shift the focus from discrete artifacts toward contextually-oriented and unique processes in the continual redesign of systems or *behavioral design research*.

2. Design Science Research

Design science research often maintains an underlying goal of creating meta-requirements for a specified class of artifacts. A general aim has been to formulate principles to support and guide the design and development of technological artifacts that are intended to solve problems. The procedural rules or guidelines that govern the design process (Walls, Widmeyer, & El Sawy, 1992; Hevner et al., 2004) emphasize a functionalist perspective that couples the actions possible with the system to the desired outputs. But within the classes of information systems that require user engagement and participation, the most successful designs “allow for modification and evolution to generate new structural couplings with the world” (Winograd & Flores, 1986, p. 53).

For example, some information systems, such as enterprise and accounting systems, are meant to satisfy well-defined organizational needs and have clearly defined evaluative criteria. Accordingly, their design reflects a functionalist problem-solving perspective that defines clear functional system boundaries, identifies specific processes, and provides clear structure for people's actions in order to satisfy performance criteria as efficiently as possible. Design, therefore, involves formal identification of objectives and the generation and evaluation of multiple alternatives. In the primary design phase, processes instantiated in the system are tightly coupled to the real world (e.g., storing, transmitting, or presenting information; initiating a control action; and transforming information). For tightly coupled systems, allowable processes and actions must be built into the system structure and instantiate the conventions by which the system may be encountered, thus limiting user engagement. The problem-solving perspective is centered on the optimization of the outputs that are decoupled from the activities of people in social and organizational environments. DSR often *privileges* the rational worlds created by systems development methodologies, business process models, and requirements to create systems that enable well-understood and modeled phenomena. But functionalist design science research does “not include people or elements of organizations” nor does it “explicitly include the process by which such artifacts evolve” (Hevner et al., 2004, p. 82). This exclusion obscures the importance of designing for the behavioral aspects of situated use and does not account for, or support, the secondary design process whereby systems are apprehended, inhabited, and embodied.

In response, our research highlights the design capability of human interaction, “which is an essential ingredient of what information is, how the lifeworld gets encountered, defined, and reshuffled, and, last but not least, how technology gets used every day” (Ciborra, 2004, p. 19). For secondarily designed systems, fewer controlling structures are designed into the system itself (Winograd & Flores, 1986), and some goals, operators, and conventions are designed by the system users. As an everyday example, consider the queuing system of a coffee shop. In the primary design of the system, we may structure the placement of the stanchions and ribbons relative to in-store displays and sales. The placement may make the nature of the queue ambiguous and it may be unclear whether there is a dedicated queue for each server or a single centralized queue. To address this, one could *engineer* a solution through precisely placed signage, ribbons, and stanchions. One could *also* support secondary design where, over time, customers establish conventions through body language, disapproving glances, and comments. Support for secondary design could stem from the decision to not include stanchions, but instead the inclusion of employee reminders for queue positioning (“please form queue to the right side of the counter”), and signage to respect other patrons. A consensus is formed around an appropriate queue and subtle efforts are made by the employees and customers in the queue to engage new customers to understand the behaviorally designed system. This consensual queue system is the result of secondary design, through participation, negotiation, and reification and is analogous to the type of

complex social phenomena which emerge and are required for many information systems to evolve and function. Theorizing about secondary design identifies and explains these processes and challenges design science research to recognize the role of the lifeworld, the everyday interactions of people as they engage and secondarily design the complex social-technical processes of systems.

3. Secondary Design

Information systems can be intentionally designed to be tinkered with and tailored for the creation of systems where people actively reflect on and engage with their local contexts, tasks, and technologies (Germonprez et al., 2007). The perspective of secondary design views people and the social and physical environments they inhabit as inseparable aspects of a phenomenon (Orlikowski & Scott, 2008), be it architecture (Alexander, 1979), organizations (Romme, 2003), communities (Wenger, 1999), history (Heidegger, 1971), or systems (Dourish, 2001).

Theorizing about secondary design requires that a person's reflections, actions, tinkering, and tailoring of systems are supported and accounted for. The emergence of unanticipated and even previously unknown uses of systems is a result of multiple forces: people engage in secondary design to fit changing tasks and contexts, to accommodate greater competencies, and to build artifacts through application of learned use patterns (Germonprez et al., 2007; Shirky, 2010). These behaviors are supported when systems are designed to adapt to dynamic reassessment of situations, to accommodate altered plans, and to mediate non-typical, independent, or cooperative work (Ferneley & Sobreperez, 2006). Primary design of behaviorally-oriented systems should not over-specify and determine anticipated use patterns because people will modify the use processes to realize *in situ* secondary design. As such, secondary design encompasses reflection on the potentialities embedded in or mediated by the system, and actionable changes to system function or content that will realize those potentialities. People reflect on and act with systems in unexpected ways to support local practices and address situated needs and issues, thereby challenging designers' preexisting expectations (Ciborra, 2002), and through reflection and action, people embody systems and come to find them meaningful.

Research on secondary design parallels and complements lead user and open innovation research (von Hippel, 1988; Chesbrough, 2003) by providing critique in regard to three components of the design process: community conventions, value-neutrality, and process identification. First, as in lead user innovation, both individuals and communities may engage in secondary design, but secondary design entails communities as *ad hoc* and loosely structured assemblages of people contributing in the design processes. In contrast, lead user and open innovation research primarily considers communities as an assemblage of "members of the user population at the leading edge of important market trends" (von Hippel, 2005, p. 22) that are open, yet hierarchical meritocracies (Dafermos, 2005). Second, we consider the design process to be value-neutral, where a secondarily-designed system is not necessarily the *best* or *optimal* solution. This position provides an alternative to lead user research, which privileges economic valuation of the innovation outputs, and to open innovation research, assuming the goal is an economically improved artifact (Lerner and Schankerman, 2010). Third, secondary design considers the multi-level processes by which people engage with and redesign systems as they are encountered and experienced in everyday life. In lead user and innovation research, the innovation is one of function; the requirements are known, the process of construction is well understood, and the evaluation criteria are clear. Lead user and innovation research places an emphasis on identifying and solving specific functional *problems* (Riggs & von Hippel, 1994), whereas secondary design focuses on *processes*, where the re-design may be at functional or content layers, the process is emergent, and the goals and evaluation criteria are negotiable.

3.1. Secondary Design at the Functional Layer

When engaging with systems, people reflect on potential actions that may be taken through a continuous process of aggregating functions during the ongoing creation of a contextually relevant information space. Examples of research on secondary design at the functional layer include research on integrated applications (Joo & Lee, 2009) and e-commerce systems (Fensel et al., 2002).

These papers shift the focus of functional design from the creation of a singular artifact to the creation of new combinations of functions that emerge through secondary design by people.

As an example, consider secondary design at the functional layer as it occurs along a design and development chain. At the start of the chain, hardware designers provide a platform designed with both the power and flexibility needed by software designers. The hardware design follows planned, primary design issues such as adhering to communication protocol standards but also includes the potential for unplanned, secondary design by software designers to realize their own goals. Software designers can maintain planned, primary design issues such as adhering to object-oriented guidelines but can also include the potential for system architects to aggregate objects in unique ways in the creation of new systems. The chain continues through functional designers until it is released to the public and reaches the "end user." In each step, planned, primarily designed functions are supported (e.g., the support for TCP/IP or class libraries). But in each case, a designer does not fully specify the path as to how the system will functionally emerge. The hardware engineer cannot fully anticipate the software engineer, the software engineer cannot fully anticipate the system architect, and the system architect cannot fully anticipate the end user.

We see that secondary design at the functional layer is shifting beyond the domain of the IT architects as organizations and the public begin to mash-up systems and services in the creation of new and unknown couplings of seemingly disparate services. This is seen in research on public safety networks (Dias, 2009) and organizational service systems (Montealegre, Hovorka, & Germonprez, 2008). Montealegre et al. (2008) propose a *service view* as a design environment for organizational projects that develop and implement secondary design at the functional layer. Their research identified the supporting structural and procedural components for organizational secondary design at the functional layer. They found that support for secondary design at the functional layer is focused, in part, on the technical stability of the primarily designed system. They also found that secondary design entails the organizational support of the next-in-line designer to pursue new couplings and design patterns in support of corporate vision, strategy, and governance. In these cases, secondary design at the functional layer moves beyond an engineering view, toward one based on personal or organizational needs and behaviors (Montealegre et al., 2008; Dias, 2009).

3.2. Secondary Design at the Content Layer

In spite of the growing number of systems supporting secondary design (Shirky 2010), few studies offer the empirical data necessary to describe secondary design at the content layer. To ground our understanding of secondary design at the content layer, we take the perspective that the design of a system continues as it is enacted in practice and modified through human processes of engagement, reification, and representation (Wenger, 1999). This is a departure from the appliance-view of design; it incorporates user modifications as part of the design trajectory rather than considering design to be purely the purview of system engineers. Key to our paper, we consider secondary design at the content layer as the encountering and negotiating of representations (Moscovici, 2001) within the information spaces of experiential computing (Yoo, 2010). Secondary design at the content layer assumes that people's relationship with the world is invariably mediated by a layer of socially constructed and continuously evolving meanings and representations (Winograd, 1987; Suchman, 1999; Moscovici, 2001).

Secondary design at the content layer entails adjustments to the manner in which the information embedded in the system is created and presented. The content layer was the focus of a study by Germonprez et al. (2007) in which the authors proposed principles for the *primary design* of tailorable technologies but did not examine people's secondary design of the system. Figure 1 shows the primary design of a portal system capable of secondary design at the content layer.



Figure 1. Secondary Design at the Content layer (Germonprez et al., 2007)

Secondary design at the content layer has not been a primary focus of research studies. Instead, it is generally incorporated as a by-product of the presentation of information in studies of task-technology fit (Germonprez & Zigurs, 2009), the technology acceptance model (Golding & Donaldson, 2009), and media richness theory (Nicolajsen & Scheepers, 2008). These studies primarily examined content layer secondary design by examining changes to the presentation of a system. While we believe there is merit in understanding content layer secondary design as changes in the presentation of information (see Figure 1), we further believe that content layer secondary design includes changes in language actions and representations embedded in systems.

Language serves as an important component of secondary design at the content layer and serves as a focus for analysis in systems (Lyytinen, 1985). Language provides grounding for representations to familiarize the unfamiliar (Voelklein & Howarth, 2005) in that new events or phenomena that people encounter in their daily lives are cognitive challenges to be coped with symbolically and collectively. At these moments there is a gap between what people know and what they have yet to make sense of and understand. As a result, there is a lack of meaning, a point where the unfamiliar appears and increased linguistic and representational work is undertaken to re-establish familiarity (Moscovici, 2001). A person must find referents from which to make sense of a new event and attach meaning to a representation. Language can serve to enact secondary design at the content layer as collective elaborations of unfamiliar phenomena or events (Wenger, 1999), and these phenomena or events become *social* reality by virtue of representations a community linguistically creates (Germonprez & Zigurs, 2009).

Secondary design in information systems can be enacted through representations that first emerge when new events or phenomena are observed and are named and anchored to existing, global referents or categories in a shared environment. From these events, content is negotiated among people in an effort to define and characterize it. Through a negotiation process emerges a localized, objectified representation that uniquely describes the new phenomena and enables it to be integrated into the communal stock of commonsense knowledge (Bangerter & Heath, 2004). As people engage with a shared IS environment that mediates their lived experience – the system and the community become the experienced world. Expression in conducting ourselves in and toward

this experienced world by itself modifies the system in the context of engagement (Introna, 2007). We, therefore, envision secondary design as occurring not just through changes to function and presentation, but also through representational changes of the content used in the expressions of interacting in the world.

Although secondary design at the functional layer allows flexibility in the action and reflection of people, the flexibility often has boundaries, as organizational architects and end users are constrained by corporate policy, governance, and design procedures (Montealegre et al., 2008). Hardware and software also impose limitations on secondary design, as no system is capable of unlimited functionality (Kallinikos, 2004). Secondary design at the content layer is less organizationally and technologically constrained but may be defined by *roles* through which people engage in secondary design, the social norms and conventions necessary to reflect and act in processes of secondary design.

3.3. Roles Associated with Secondary Design

Along both functional and content layers, people can engage in secondary design in a variety of roles. People can engage in secondary design as *contributors*. In this role, people are active contributors to a core system. They contribute to the functionality or the content of a system in its ongoing creation and re-creation, while staying within the planned boundaries of that system. Users of Flickr.com represent an example where people engage in secondary design as contributors. They upload new information, tag images, and create connections among content that did not previously exist within the confines of Flickr.com. People can also engage in secondary design as *differentiators*. In this role, people use the functions or content of a system beyond the original core of the system. The open community development of the Linux kernel is an example. Organizations differentiate the kernel for use in embedded, distinguished devices (e.g., TiVo and Google Android). The kernel that is available in the public domain is secondarily designed in ways beyond what the core Linux community maintains. These distinctions between roles are important for reasons of research framing and generalizability. Figure 2 summarizes the discussion of roles associated with secondary design.

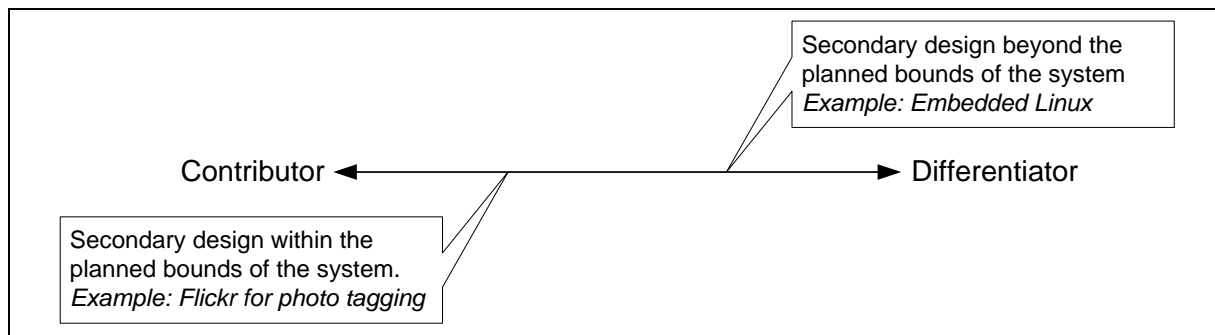


Figure 2. Roles Associated with Secondary Design

In our research, we focus on secondary design with respect to *contributors* of both functionality and content. While differentiation warrants investigation, its inclusion represents too large of a scope for a single project. In focusing on one half of Figure 2, we can examine a single case study (Wikipedia) and draw conclusions and implications of secondary design processes associated with core contributions of functionality and content.

4. Behavioral Design Science Research

The view that *design ends when use begins* has brought about an interpretation of design as an activity intended to devise an artifact to solve a particular problem through a pre-specified set of procedures that are then merely enacted by the people using the system. But systems continuously *mediate* between human activity and information, social, and physical environments, and they enable people to achieve their goals in ways that cannot be entirely pre-determined or planned. This mediation is always present during use and requires embodied human interaction with technology through reflection and action. We

first present the perspective of embodied interaction to support an approach that does not look solely at people or solely at technology, but an assemblage of both. We then present dualities inherent to secondary design as a methodological lens for examining the data. Finally, we present the findings regarding secondary design from the case study used in our research. Our presented approach regarding secondary design is likely one of several in the investigation of behavioral design science research.

4.1. Framing: Embodied Interaction

Embodied interaction (Heidegger, 1962; Yoo, 2010) posits the mediation of a person's lived experience by technology. Technology shapes the activities of communicating, negotiating, and creating meanings and representations and is, in turn, shaped by these activities. These activities are not abstract ideas or merely cognitive meanderings, but are interactions with physical, social, organizational, and linguistic entities that are experienced as an indispensable part of people's existence in the world. The *embodied* element focuses on the ways in which we experience the everyday world through direct physical and social participation both with constructed meanings (i.e., language, symbols) and representations (Dourish, 2001). The *interaction* element focuses on "the interplay between different components, rather than [their] fixed and pre-specified paths" (Dourish, 2001, p. 4) prescribed in the artifact in the form of procedures and modes of use. This view of interaction captures the way that people accomplish dynamic and contextual actions through a series of *ad hoc* interventions, tinkering, improvisation, and "being-in-the-workflow" (Ciborra, 2004), in addition to planned and designed procedures. Embodied interaction accounts for much of the "drift" in the role and functions of technology in contextualized situations and recognizes that technological artifacts are embedded in the world. This embeddedness reflects the mutually constitutive nature of technology-in-use as humans inhabit systems and interpret the world through them (Suchman, 1999).

Through secondary design, people inject agency into their actions and redesign systems to forge new processes through experimentation and exploration. Thus, a person's or group's goal is not merely to *use technology* but rather to interact with information or communicate "with the world in which we act, and which acts upon us" (Dourish, 2001, p. 116). This perspective on design encourages the framing of people as *designers-in-use* (Henderson & Kyng, 1991) and recognizes that the process of design does not end when a system is implemented. There is always a two-phase design process, of which primary design and the creation of the technological artifact is only the first part. The second, equally important part of the process entails understanding and designing for the embodied interactions, whereby people realize systems meaningfully in specific ways (Wenger, 1999). People are simultaneously *acting with* and being *acted upon by* system functions and content; they are engaging, distancing, and reengaging in processes of continuous system design.

4.2. Framing: Dualities of Secondary Design

Systems are, in part, physically constructed technological artifacts. They are also socially constructed through the meanings of objects attached to them, the functions emphasized and used, and the contextual positioning of the system. This is alluded to by Hevner et al. (2004, p. 77), who state that "technology and behaviour are not dichotomous in an information system. They are inseparable." The concept of the *duality* provides a linguistic frame to focus attention on the relationships of people and systems.

Dualities *are not* opposite ends of a dimension; rather, each pair complements and contrasts with the other such that, to understand one concept, we must also understand the other. Observation of one part of a duality immediately raises the awareness of the other side and focuses attention on their interactions, as the relationships between the two are often collapsed and difficult to untangle (Orlikowski & Scott, 2008). The duality of technology (Orlikowski, 1992) highlights the fact that the physical, technical parts of a system present an opportunity for, or indeed may require, a person to construct the functional or social aspects of the system, reflecting the dual-phase design posited by Germonprez et al. (2007). Although many systems and patterns become reified and less amenable to secondary design as their use becomes institutionalized and path dependent, there is always the opportunity to reflect on the system and recast and redesign it for new contexts through processes of secondary design.

The first duality used to frame secondary design is *Planned/Emergent*. It is observed in systems that are primarily designed for broad purposes and then exhibit emergent characteristics at the functional and content layers as the systems are embodied. The planned aspects of the system are intended to determine functional outcomes based on computational procedures, processes, and technical structures. A Wiki, for instance, must support the posting and editing of content, web portals must technically allow for changes in accessible services, and service architectures must enable service re-combinations. But many systems present or even require more participatory, serendipitous, and emergent practice in the production of variable outcomes in the overall production of *systems-in-use* (Wenger, 1999). Emergent practices are supported and even encouraged in systems designed such that people become designers-in-users.

The second duality framing secondary design is *Participation/Reification*. People actively participate in systems and, in doing so, their experiences of the world are given form, shaped, and given “thingness.” Shirky (2010) highlights this duality by arguing that people have free time, and from free time comes cognitive surplus. As we move into a socio-material world (Orlikowski & Scott, 2008), we are turning to a variety of practices to spend this surplus, to participate. People can use the growing number of social media systems as vehicles through which to participate and create in their world, and we consider this participation to entail embodied interaction. Through participation, we reify “things” to give our daily experience a sense of persistence, concreteness, and dependency that an experience may not artifactually possess. Reified objects may act as metaphors and are important to orient how people interact with the world around them (Moscovici, 2001). They provide grounding for people to understand their current state so that they can anchor, negotiate, and further reify the world. Participation/Reification is a duality where we project and contribute our meanings into the world and then realize them as existing in that world (Wenger, 1999).

4.3. Grounding: A Case of Secondary Design

The presented dualities (Planned/Emergent & Participation/Reification) serve as a catalyst to observe processes of secondary design. The dualities are not an ontological structure, but a means for observing processes of secondary design. We do not know the actual processes of secondary design *a priori*, instead we have constructed a means by which processes can be observed and explained. Thus, our goal is to build upon the external theoretical grounding of secondary design by providing empirical grounding (Goldkuhl, 2004). Using the two dualities, we enter our specific case study, maintaining our focus on both functional and content layer secondary design of an embodied system as well as our research questions: 1) *What are the processes of secondary design?* and 2) *How can design science research be extended to encompass the evolution and change entailed by secondary design?*

We employed the dualities to study secondary design in Wikipedia, as it represents an example of *contributors to secondary design at the functional and content layers* (see Figure 2). While many people use Wikipedia to simply view articles, Wikipedia presents an opportunity for investigating secondary design because it is constructed collaboratively by a large, active, and varied community without the benefit of pre-determined processes. Wikipedia represents one of many similar systems that derive value from secondary design, requiring *ad hoc* groups of contributors to establish conventions for interaction in the design of page functions and content. We chronologically captured changes to selected portions of Wikipedia – wiki pages that described a significant new event – to ensure sufficient activity to contain processes of secondary design. We focused on the case of secondary design in the Wikipedia pages of the Resignation of Sarah Palin as Governor of Alaska. Our goal here is not to deconstruct a specific topic which may be viewed as inconsequential, but rather to reveal the secondary design processes by which consensual conventions for function and content are designed.

Any design instantiates a set of conventions, and through analysis of a well-bounded and uncomplicated instance, we can see processes that would be obscured in a more complex example. The case of the Resignation of Sarah Palin is an example of rapidly unfolding online processes in the design of representations of high visibility events about which people discuss and create representations for through social media systems. Similar examples in 2011 include Oprah Winfrey discontinuing her television show and Arnold Schwarzenegger’s marital affairs. In each example, the subject may be considered trivial to the course of human history, but the processes by which people engaged in secondary design around these subjects have broad implications.

Sarah Palin was the Republican nominee for vice-president in the 2008 U.S. election and was the focus of intense public attention. We did not focus on the exact period of her nomination for vice-president, but instead focused on the period of the *Resignation of Sarah Palin (RoSP) as the Governor of Alaska*.¹ We use recorded discussions and the screen shots of her resignation, totaling nearly 170 discussion postings and more than 90 major changes to the Sarah Palin Wikipedia page. The recorded data are from the period July 3, 2009 to July 26, 2009, the announcement of her resignation and the day of her resignation, respectively. We examined the data qualitatively at the *functional* and *content* layers using the *Planned/Emergent* and *Participation/Reification* dualities as sensitizing frames, specifically using the dualities to observe processes of secondary design.

The presented case study provides flexibility in how researchers extend observed processes of secondary design. Though researchers “may feel obligated to define a range of generalization precisely” through multiple cases (Kennedy, 1978, p. 24), a single case study prevents over-specification of how findings must be applied, avoiding attempts to level the class of secondarily designed information systems into a single generalizable archetype. Additional cases could prove useful to build momentum in understanding this class of highly personalized information systems, but are not necessary to improve theoretical generalizability (Lee & Baskerville, 2003). By revealing the *processes* underlying secondary design, we generalize to theory within the case. This provides inference through the systems context, the involved participants, and the processes of the case that become flexible and applicable for future research on secondary design.

5. Findings: Secondary Design in the Resignation of Sarah Palin

We first focus our attention on the secondary design processes associated with the planned and emergent duality. This is followed by an examination of secondary design processes associated with the participation and reification duality. Within each duality, we consider secondary design of both the functional and the content layers of the system.

5.1. Secondary Design Findings: Planned/Emergent Duality

Wikipedia is a system designed to be inhabited by participants who experience aspects of the world by interacting with people through the system. Processes of secondary design occur within a technologically and socially bounded design space that was formed to support specific planned activities (Kallinikos, 2004). The planned structure of Wikipedia and the range of allowed system interactions mediate communication by structuring presentation and language actions and providing a framework for action. Secondary design is evidenced as people inhabit the system and produce and modify the representations of the world within the system through function and content — an outcome supported but not determined by the planned aspects of the technology. Table 1 shows how the Planned/Emergent duality helped us understand secondary design processes at the functional and content layers.

Layer	Duality	
	<i>Planned</i>	<i>Emergent</i>
<i>Functional</i>	Support for searches, inputs, edits, discussions, hyperlinks, and a history of edits. Consistent with Windows conventions, consistent screens, and GUI interface.	Use of language outside social norms resulting in new methodological and linguistic structures.
<i>Content</i>	Wikipedia as an encyclopedia; as a source of current and dynamically updated information. Expectation of conventional language and symbol systems, and adherence to social norms of grammar and language use.	Tailoring of content in the creation of new representations. Each page is unique within the boundaries of the planned system. Content, images, and linking are secondarily designed on pages.

¹ http://en.wikipedia.org/wiki/Resignation_of_Sarah_Palin

First, the planned aspect is evident at the functional layer in structures such as the recognizable conventions, tools, and components (Germonprez et al., 2007) that enable people to interact with the system in broadly understood ways. For example, people are able to search, navigate, and create an account (Figure 3). These are planned functional practices that the primary design of Wikipedia supports across all pages.

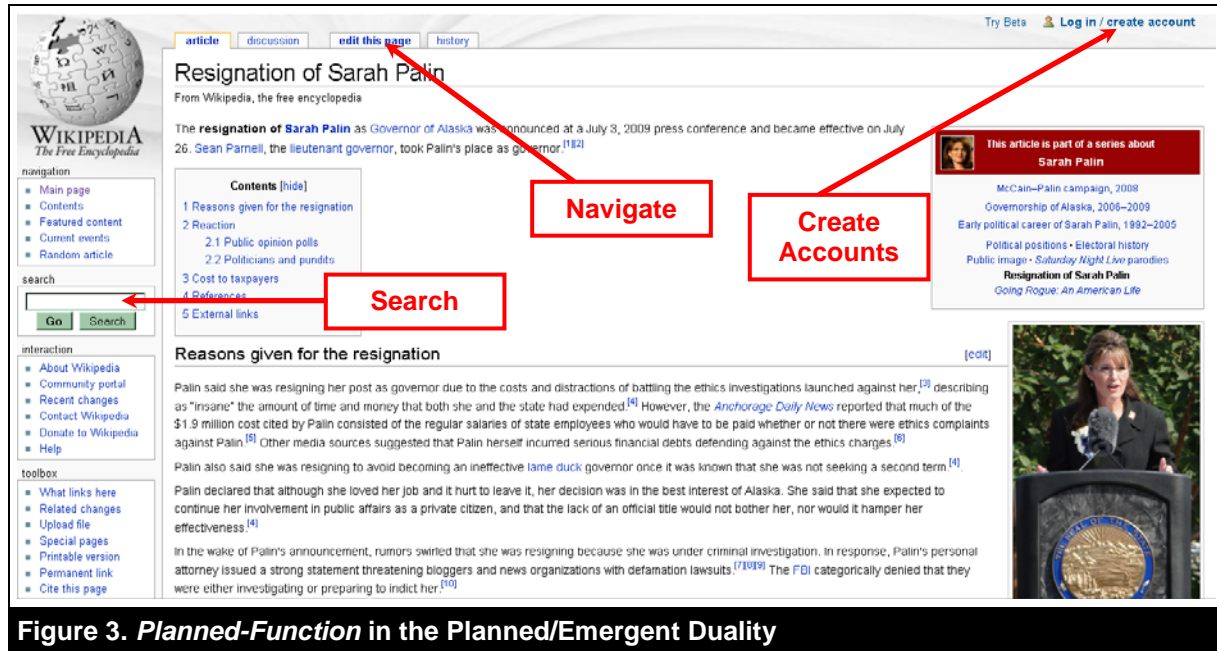


Figure 3. *Planned-Function* in the Planned/Emergent Duality

Concerning *planned* at the content layer, we see content anchored in the global metaphor of an encyclopedia, to which the name “Wikipedia” implies a connection. We see people couching Wikipedia in the recognizable lingual conventions of an encyclopedia, showing the proposal for the negotiation of a new representation anchored by a global metaphor to inform local content (i.e., Encyclopedia up-to-date) (Figure 4).

Yes, it absolutely is more significant, as of today. It is part of a single thought: She's the governor, but she resigned and will leave in a few weeks. You can't have one without the other. Wikipedia is indeed an encyclopedia, hopefully an up to date encyclopedia.

Figure 4. *Planned-Content* in the Planned/Emergent Duality

Considering the *emergent aspect*, we see evidence of secondary design at the functional layer. People are not able to directly affect the core functionality of the system (e.g., search features) but they are able to create functionality around the methods used for secondary design of the RoSP page. By understanding intentions in language and social mechanisms, people draw on *in situ* work practices to recognize expanded processes of secondary design. We found that emergent functionality included the development of a work method so people can align future methods in the secondary design of the RoSP page (Figure 5).

Note my example in the case of the resignation paragraph, where I cut and pasted the existing contents here on the talk page, made a few edits that indicated what I'd changed and then allowed other editors to manipulate that and collaborate towards an agreeable end result. I strongly suggest you follow that same model.

Figure 5. *Emergent-Function* in the Planned/Emergent Duality

Finally, with respect to *emergence* at the content layer, secondary design is evident in the histories, discussions, language conventions, social norms, and practices that are realized within the planned structure of Wikipedia. As seen earlier in Figure 3, there are planned components of *discussion*, *history*, *tools*, *navigation*, and *edit this page*. From these components, editing supports secondary design of the representation of the specific phenomenon (The Resignation of Sarah Palin) as well as the creation of the editing history. The representation and history represent new content and an information-rich representation of the process that provides understanding of the discussion, the actors, their roles, and the process of negotiation. Figure 6 shows the screen capture of the *edit this page* tab as an environment for emergent content secondary design. Figure 6 does not show the process of secondary design, instead it shows an environment that supports the emergence of consensual representation at the content layer.

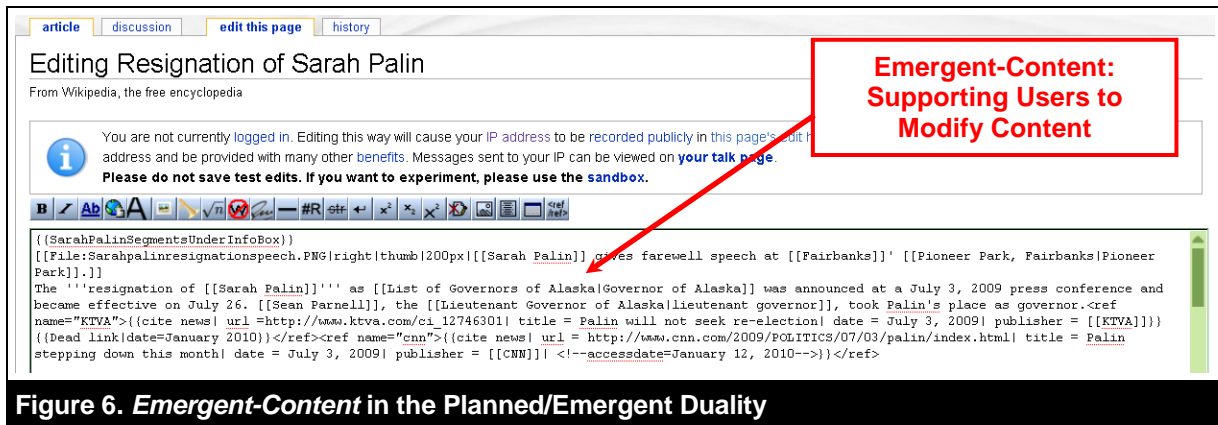


Figure 6. *Emergent-Content* in the Planned/Emergent Duality

Wikipedia *per se* provided no planned procedures for how secondary design emerged, what was permitted or prohibited, or what the content of RoSP ultimately became. Processes, priorities, and rules for permitted functions are engaged differently by different people and in different contexts that result in a unique design to the functional and content layers. Looking beyond the Planned/Emergent duality, we further identify secondary design through the Participation/Reification duality.

5.2. Secondary Design Findings: Participation/Reification Duality

The Participation/Reification duality recognizes the tension between participation in making sense of a phenomenon in the world through creation of a linguistic representation and the reification or solidification of consensual meaning. Participation involved personal reflection and action, habitation within the system (Wenger, 1999), and creation of meaning as represented by text, imagery, conversation, metaphor, and/or linguistic representation. In participating, people interacted through the defense of positions, the offer of alternatives, the inclusion/exclusion of wiki content, and the acknowledgement of consensus. People's intentions and actions suggested that participation was significant and meaningful to their lived experience and was worth the investment of time and effort. These issues involved gathering information, aligning methods to streamline the emergent design practice, and negotiating an agreed upon stance for page content. Table 2 shows how the Participation/Reification duality helped us understand secondary design processes at the functional and content layers.

We began by examining participation in the RoSP pages at the functional layer. Many different abstractions were reified into functional objects including the history of participation, approaches, degrees of participation, and strengths of opinion (Introna, 2007; Wenger, 1999). These functional objects provided peripheral awareness of what people had done and why (Robinson, 1993) and provided understanding of the path by which consensus was reached. Participation at the functional layer occurred at the intersection of the planned functionality of Wikipedia and the emergent nature of people's contributions; it is how people interacted with each other and with the system in the formation of functional objects. Figure 7 shows a sample of participation history (specifically the discussion/talk history) in the RoSP, an emerging functional component that provides a glimpse of how the final page came to take its current form.

Table 2. Secondary Design and the Participation/Reification Duality

Layer	Duality	
	Participation	Reification
Functional	<p>Interaction of people mediated by language and the system.</p> <p>Practices for the creation of an evolving knowledge repository constructed by a community; historical record of participation, discussion, and changes.</p>	<p>Support for hyperlinking to other articles both inside and outside of Wikipedia; establishment of accepted processes by which new users interact with the RoSP page.</p> <p>Redefining the metaphor of an encyclopedia from analog to digital and from professional expert to egalitarian crowd-source.</p>
Content	<p>Metaphors as representations of the world to make sense of objects in everyday life; metaphor affects perceived affordances and intentions of interacting with the system.</p> <p>Wikipedia as an unbiased, neutral point of view, intellectual discourse with references.</p>	<p>Anchoring of an established representation to other Wikipedia pages to provide understanding to readers; consensus (decrease in changes) on a representation that becomes “accepted knowledge”</p> <p>Constructed content becomes persistent and referred to as having a sense of reality that anchors future discussion.</p>

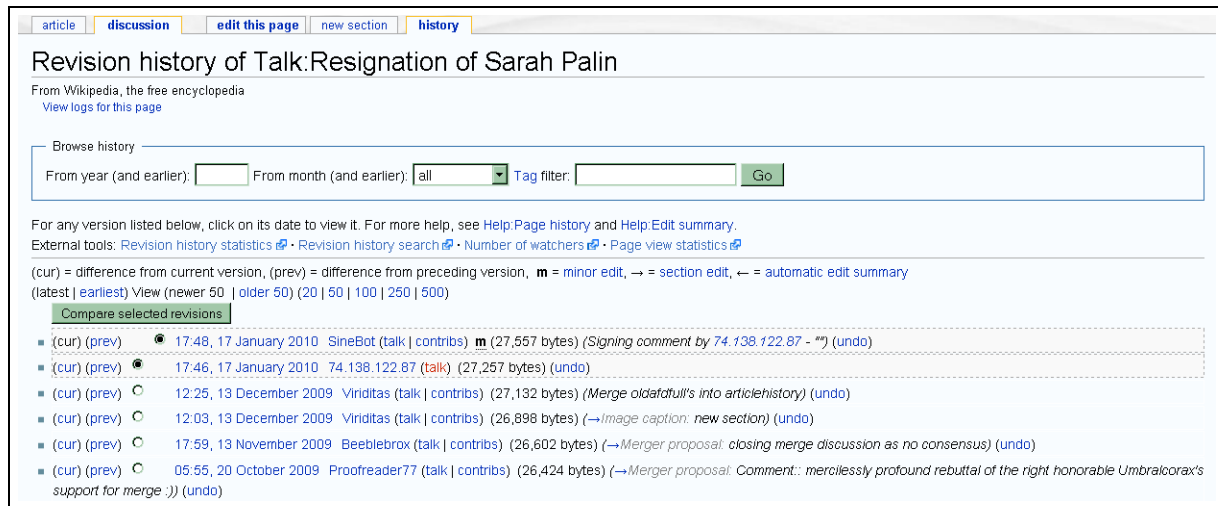


Figure 7. Participation-Function in the Participation/Reification Duality

Other participation at the functional layer included histories of changes to the presentation of the RoSP page itself, beyond the discussion history seen in Figure 7. In both cases, people participated in a knowledge space, which functionally held historical consensus and contradiction, and the path that led there. We treated histories at the functional layer because they represented concrete chronological records of past participation, applicable in future settings. Treating histories as functional representations of participation also helped reveal secondary design as participatory processes at the content layer.

From here, we saw people use language and metaphors as “the cognitive lenses we use to make sense of all situations” (Kendall & Kendall, 1993, p. 149) and to form their experience of understanding new environments (Madsen, 1989). Metaphors are representations of the world that can be used to make sense of objects in everyday life (Lakoff & Johnson, 1980) and to form new trajectories in the creation of new practices (Moscovici, 2001; Wenger, 1999). By identifying metaphors used to anchor content, we exposed processes of secondary design as people brought global experiences to localized settings. The metaphor of the *Resignation of Richard Nixon* was used to argue against a dedicated representation of Sarah Palin’s resignation (Figure 8). The metaphor represented a reified and commonly understood event used as an anchor to make sense of the current phenomenon.

*Support – simply put, I'm not sure this really needs its own article, and that the information can be more adequately handled in the article on Ms. Palin herself. As an example, we do not have a page on the **Resignation of Richard Nixon**, which quite frankly was a much bigger event*

Figure 8. Participation-Content (Example 1) in the Participation/Reification Duality

Additionally, participation at the content layer included value-laden positions with emotional discussions that produced reactions by participants adhering to established norms. Social norms of Wikipedia are based on the metaphor of a *neutral point of view* (NPOV) – a construction to remove bias from the RoSP page. Figure 9 shows the development of NPOV regarding a speech by Sarah Palin, which itself lead to ongoing, egalitarian changes at the content layer.

COMMENT: If the title is positive (and this one is), I assume the article was not written as a hatchet job. The "rambling" nature of the announcement ... and the confusion following ... are part of an accurate NPOV description of the resignation.

Figure 9. Participation-Content (Example 2) in the Participation/Reification Duality

Considering *reification* at the functional layer, we have shown the inherent structure of Wikipedia as a crowd-sourced encyclopedia, open to view points and judged by supporting evidence and valid anchors. Because of the reified structure, the RoSP can be leveraged in other instances of secondary design. The achieved discussions and page edit history as well as the page itself were available to a larger community of Wikipedia readers or content-layer consumers. The RoSP page served as a reified object in contexts beyond Wikipedia (Figure 10).



Figure 10. Reification-Function (Example 1) in the Participation/Reification Duality

We also saw the reification of the RoSP functioning within Wikipedia itself. In Figure 11, the RoSP page was used as an anchor for the Wikipedia page dedicated to the overall Governorship of Sarah Palin. The representation of the Governorship of Sarah Palin likely included, in various degrees, the processes associated with planning, emergence, participation, and reification, in using the RoSP to anchor the secondary design of the main Sarah Palin page.

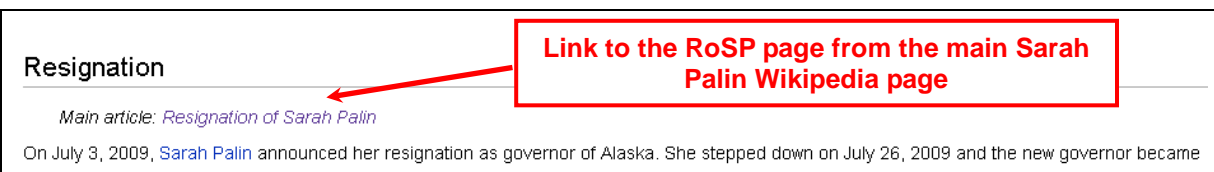
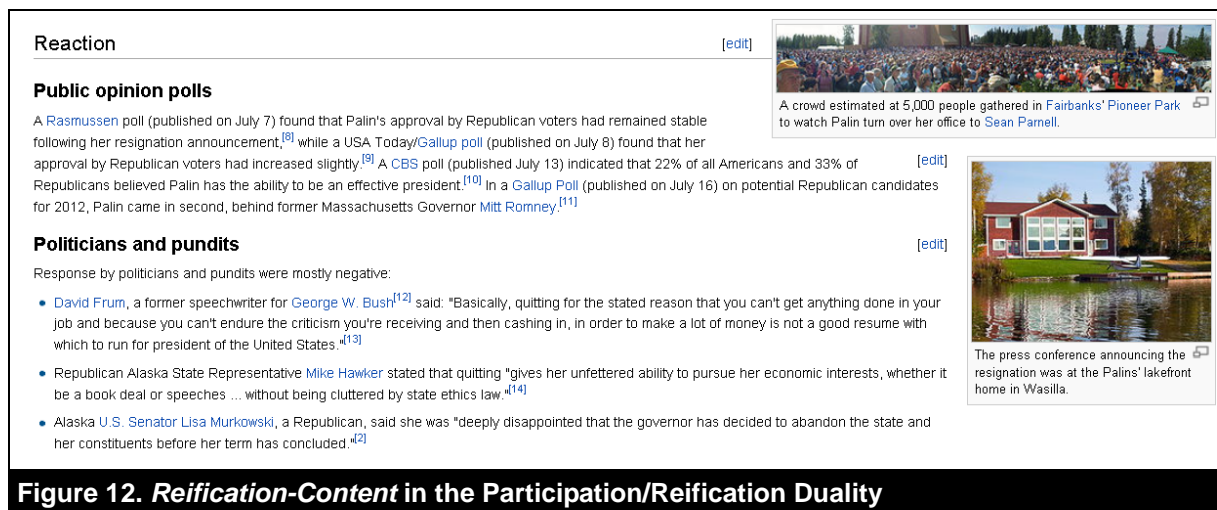


Figure 11. Reification-Function (Example 2) in the Participation/Reification Duality

People anchored local content through article connections, providing a network of material to aid in understanding the issues at hand and shaping the functionality of the RoSP page. Reification transformed the metaphor of an “encyclopedia” to its modern equivalent of anywhere, anytime, crowd-sourced information. Reification also transformed the encyclopedia metaphor through digital access to the information of RoSP, as well as the millions of other Wikipedia pages. This extends the scope of design to not only include instances of simply reading the information. It extends the scope into other likely cases of secondary design, giving Wikipedia additional utility beyond an up-to-date encyclopedia, to actually foster the embodied interactivity of people and systems.

Finally, *reification* at the content layer is observed in the stabilization of content presented on the RoSP page itself. The sentences and phrases that are consensually constructed on the RoSP page are the culmination of the planned, emergent, and participatory actions of people supported by planned technical functionality of the system. The stability of the system may only be temporary, where at any time people can reengage this particular representation (RoSP) in new processes of secondary design. But the page can be considered a reified object as it becomes more accepted and resistant to alteration and change over time. Figure 12 shows a portion of the reified content of the RoSP page. We emphasize that the reification of the representation “Resignation of Sarah Palin” is the conclusion of the aforementioned processes of *secondary design*; the specific subject, however, remains trivial.



The Participation/Reification duality revealed additional processes of secondary design whereby people transferred previously established practices and representations to create linguistic and functional couplings to new situations. The duality appeared closely linked across the two layers for secondary design, as people used the planned “encyclopedia” to anchor emergent metaphors and used the planned tools and conventions to negotiate and reify the emergent content through participation in consensual processes. We saw secondary design as a collection of processes leading to modifications of an embodied system through the interaction of people with systems and with each other. We observed processes of modification of a designed object, involving more than just changing a background color, or adding or moving content on a page. We found that secondary design is not a predetermined path of planned and emergent processes, and any specific secondary design path will not likely occur in the same sequence, within a specific technology, or for a specific group of participants. We found that processes of secondary design are enacted by people as they reflect on, act with, and embody systems in relation to the dualities of planning and emergence, and participation and reification.

6. Discussion

Design theory ranges from technological rules that specify artifacts in the production of pre-specified system outcomes (Bunge, 1967; van Aken, 2004), to principles that support emergent processes and structures in less well-defined domains. Research on design science is commonly

oriented toward building and evaluating technological artifacts that provide specific functions for a person or organization. Design science research has largely considered the design process to be completed before the system is placed in context and engaged by people. However, this perspective obscures the recognition that people frequently behave as embodied *designers* by reducing people to a means by which the planned goals of a system are reached.

Our research contributes to the design science research discourse in a fundamental way by explicitly including people (e.g., users) as reflective and active participants in an ongoing design process and in the ongoing trajectory of systems. Secondary design research emphasizes the serendipitous and *ad hoc* processes by which users redesign functions and content in the context of use. We have presented a case of secondary design that illustrates the expressiveness and representativeness of people in their embodiment of systems. Our case study was grounded in the real-world context of Wikipedia, and demonstrated that secondary design of the functional and content layers can be understood by moving between dualities in observing participants' interactions with a system and with each other. The findings illustrate these processes and advance to a more mature theory (Weick, 1995) about tailorable technologies by relating our findings to existing IS theory. Table 3 shows the design principles from the Theory of Tailorable Technology Design (Germonprez et al., 2007), how the principles were evidenced in the current study, and the dualities from this current research that expand the prior theory.

Table 3. Alignment with the Theory of Tailorable Technology Design		
<i>Theory of Tailorable Technology Design Principles (Germonprez et al. 2007)</i>	<i>Example Processes in the Study of Secondary Design in the RoSP</i>	<i>Dualities Evidenced In</i>
Task Setting: Variable tasks and settings	Secondary design at both the functional and content layers	Emergent-Function Emergent-Content
Recognizable Conventions: Use patterns from existing technologies	Ability to post ideas, argue positions, and develop reified content	Planned-Function
Recognizable Components: Components from existing technologies	Search toolboxes, tabbed navigation, and account creation	Planned-Function
Outward Representation: The context that the system will be used in	Hyperlinking to the main Sarah Palin page	Reification-Function
Metaphor: Symbolic representation	Wikipedia as an up-to-date, egalitarian encyclopedia	Participation-Content
Tools: Existing design tools	Functional support for emergent practices at the function and content layers	Emergent-Function Emergent-Content
Methods: Design methods	Emerging methods for secondary design of RoSP content	Emergent-Function
Functional Characteristics: Functional requirements	Discussion and RoSP page change histories	Participation-Function
User representation: Ability of users to embody the system	The stable RoSP as culmination of secondary design practices	Reification-Function Reification-Content

The evidence of secondary design principles provides a mechanism for generalizing from descriptive observations to theory (Lee & Baskerville, 2003) and identifying a distinct class of information systems. We do not attempt to generalize the notion that Wikipedia is similar to other systems that are secondarily designed by community members (e.g., Flickr, Twitter, or Facebook). We generalize that the design principles of tailorable technology are viable and applicable to both a web portal system (Germonprez et al., 2007) and the RoSP page on Wikipedia (see Table 3) and may serve theoretically useful in future behavioral design science research.

We contend that people collaborate to modify or create reified objects as a system follows a trajectory of evolved functionalism (Pierson, 2000). As the RoSP was reified, it became a stable representational object to which people now refer in new cases of secondary design. Figure 13 shows the secondarily designed RoSP page being used in the Wikipedia page on Sarah Palin's book *Going Rogue* as a representational object describing the events leading to the authoring of the book. In future instances of secondary design, actors will again participate in planned and emergent behaviors, while their views are shaped by their existing metaphors and histories, including the newly reified representation of RoSP.

long as it does not interfere with your official duties."^[5]

For Lynn Vincent worked on the book with Palin for several weeks shortly after she resigned the governorship in
 for inter **RoSP as a Representational Object** publisher Jonathan Burnham said that Palin
 very stage and fascinating detail."^[9] HarperCollins has

Figure 13. RoSP as a Representational Object in Other Cases of Secondary Design

As the design of RoSP is not necessarily a process that continues forever, the evolved artifact can become a stable, reified object, functional enough to be used in future instances of design. The initial design of systems can change over time as planned, evolved, participatory, and reified objects are woven together in the formation of newly designed systems that *people as secondary designers* achieve over time.

Information system artifacts in and of themselves are frequently quite empty, but through secondary design they become systems of interest, function, and meaning. Design science research can benefit from recognizing the dualities created within systems during their everyday use. Recognizing dualities can help guide new thinking about secondary design and aid in understanding the functionalist perspective of Hevner et al. (2004) as a starting point for considering behavioral-oriented information systems design theory. Future challenges for design theory are to understand an *increasing potential* for secondary design, a *decreasing potential* for secondary design (e.g., critical command, control, and regulatory systems), and the interaction of these two characteristics (e.g., understanding users' desire to engage systems with an *increasing potential* for secondary design, only to receive *decreasing potential* from hosting systems (Germonprez & Hovorka, 2011)).

Understanding *increasing* and *decreasing* potentials may create inconsistencies and tensions in systems (Pierson, 2000). We believe systems that do not properly account for users' secondary design requirements may have uniquely affected trajectories. In the design of social information systems, it is impossible for a primary design effort to completely specify all possible system uses *a priori*. It becomes incumbent upon design theorists to recognize secondary design as an integral part of the systems people embody, one for which theorizing should address and provide guidance. For this specific class of artifacts, the focus of design should shift from how an artifact can solve defined problems to how the interaction between a system and situated experiences enable people to meaningfully create, reflect on, and engage with representations of their current and desired states. Design science research must be expanded to include the critical role of behavioral interactivity, which recognizes the proactive reflection, tinkering, and tailoring that people apply when they enact unforeseen solutions to emergent problems.

7. Summary and Conclusions

The redesign of systems by people within their own contexts is recognized in the literature. Lead user innovation (von Hippel, 1988) and technology tailoring (Germonprez et al., 2007) demonstrate that design evolution or refinement occurs outside the purview of accepted design science research boundaries. In this research we observed that during secondary design, people participated to negotiate consensus and modify both function and content. Secondary design is a mix of embodiment and emergence as people encounter a world mediated by social information systems.

The type of secondary design processes evidenced in our case of Wikipedia may be evident in other types of systems. Livari (2007) presents a "seven-class" taxonomy of information systems based upon functional roles (e.g., automation, productivity augmentation, communication mediation, information, entertainment, art, and accompaniment). For production-oriented systems, the planned structures and social norms embedded in the system reduce the availability of embodiment and interaction with the system and, consequently, reduce the potential for secondary design. But for socially-oriented systems, design theory must include consideration of the embodiment and interactions people have with the systems as they create and assign meaning over time. We propose that design research on communication and collaboration mediation systems may require interpretive and neohumanist (Hirschheim & Klein, 1989; Niehaves, 2007) or

phenomenological and hermeneutic approaches (Boland, 1978; Introna & Whittaker, 2002). Further design theorizing must incorporate the processes for construction of meaning, embodied interactions by the people who use the system, and the manner in which the system may evolve. Purely functionalist systems, on the other hand, are best guided by the positivist and functionalist form of design science research that Hevner et al. (2004) describes.

By incorporating secondary design into design theory, we overcome an apparent contradiction raised by Hevner et al. (2004): specifically, that design research is composed of cyclic design activities between two incommensurate paradigms (design science and behavioral science). All systems are a function of the designed technical structures; behavioral language actions, reflection and action; and interaction. Behavioral theories are not merely the kernel theories that inform design and by which design is evaluated; rather, behavioral theories are inherent in the ongoing design of systems in use. As Hevner et al. (2004) contend that design theories “must explain how artifacts are created *and adapted to their changing environments and underlying technologies*” (p. 82 – emphasis added), we increase the theoretical understanding of the secondary design processes by which people and organizations produce the trajectory of systems, two areas explicitly excluded in prior research. This approach widens the design perspective, leading to a greater potential for understanding human-technology interactions and increasing the knowledge base from design science build-and-evaluate cycles. Theoretical consideration of secondary design anticipates the divergent paths that systems may follow by recognizing that artifacts are not singular, solitary, and stable entities. Rather, they are embodied systems that undergo an ongoing secondary design process whereby new states of existence move outside the boundaries of the initial problem domain (Romme, 2003).

Secondary design is a series of processes among people and the systems they inhabit as they experience the world mediated by the system. In the Wikipedia case, secondary design was a fairly rapid process entailing real time aggregation, juxtaposition, combination, and stabilization of representational objects. As such, our research focuses on *the design principles and processes engaged with through system secondary design*. In systems that support secondary design, the processes can result in divergent paths and, as a result, they become increasingly ideographic and localized. As we move forward, we should consider that our research contributes to a theoretical understanding of the processes that lead to secondary design in support the localized contexts into which artifacts are placed. Behavioral design science research is a complementary view of the design science work based on Hevner et al. (2004), which extends the familiar and functional thinking of much design science research. Rooted in the received view of design science research, our presented, behavioral perspective is important for studying an expanding class of information systems that incorporates secondary design as an explicit and required characteristic.

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Dirk S. HOVORKA is an Associate Professor in Information Systems in the School of IT, Bond University, QLD, AU. He attended Williams College, MA for his BA, holds an MS in Geology and an MS in Interdisciplinary Telecommunications, and received his PhD in Information Systems from the University of Colorado. His research includes the philosophical foundations of IS research, the development of design theory, and the evolving role of information systems in science. He has published research in the *Journal of the AIS*, *Information Systems Journal*, *European Journal of Information Systems*, *Communication of the AIS*, and *Decision Support Systems*, has co-authored five published book chapters, and presented research at all major IS conferences.

Uri GAL is Lecturer in Information Systems in the Discipline of Business Information Systems at the University of Sydney. He holds a Ph.D. in Information Systems from Case Western Reserve University and an MSc degree in Organisational Psychology from the London School of Economics and Political Science. His research takes a social view of organisational processes in the context of the implementation and use of information systems. He is particularly interested in the relationships between people and technology in organisations, and in the changes in the nature of work practices, organisational identities, and interactions associated with the introduction of new information technologies.