Systematic Service Innovation in Organizations: EDCI – A Template for Human-Centered Design of E-Services

Nigel P. Melville
Stephen M. Ross School of Business
University of Michigan
nmpelv@umich.edu

Michael Hopps
Cisco Systems
mhopps2@gmail.com

Abstract
This article introduces the EDCI template for human-centered design of e-services, which we developed in five iterations over five years. The template contains two dimensions (conceptual vs. real world and problem finding vs. solution development), yielding four phases of e-service design: 1) Explore, 2) Discover, 3) Concept and design, and 4) Implement and assess. Examples and reflections from applying EDCI in numerous action learning projects are provided. A single instantiation of the EDCI template to a specific e-service (environmental information management) is described. The primary contributions of this article are to introduce the EDCI e-service design template, demonstrate its usefulness in a learning context, illustrate its value within a specific real-world setting, and suggest how it might provide the early stages for a full e-service design theory.

1. Introduction

In the field of information systems, a design theory has been defined as “a prescriptive theory based on theoretical underpinnings which says how a design process can be carried out in a way which is both effective and feasible” [20, p. 37]. A similar view is that “an IS [information systems] design theory [ISDT] shows the principles inherent in the design of an IS artifact that accomplishes some end, based on knowledge of both IT [information technology] and human behavior. The ISDT allows the prescription of guidelines for further artifacts of the same type” [9, p. 322]. In this article we focus on one aspect of an ISDT, namely, the design method, “which describes procedure(s) for artifact construction” [20, p. 43].

Services enabled by information technology are rapidly emerging, necessitating enhanced service innovation processes, as noted by others: “what are the design principles for digitally enabled services” [17, p. 330]. Unlike tangible products, IT-enabled services are intangible and must be experienced to be understood. We describe a design template for IT-enabled services that we developed over several years across tens of action learning projects. Future studies in this research program will address other aspects and components of an ISDT, such as kernel theories and hypotheses (Table 1).

<table>
<thead>
<tr>
<th>Component</th>
<th>Meta-requirements</th>
<th>Class of goals to which theory applies.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Product</td>
<td>Meta-design</td>
<td>Class of artifacts hypothesized to meet the meta-requirements.</td>
</tr>
<tr>
<td></td>
<td>Kernel theories</td>
<td>Theories from natural or social sciences governing design requirements.</td>
</tr>
<tr>
<td></td>
<td>Testable hypotheses</td>
<td>Test whether meta-design satisfies meta-requirements.</td>
</tr>
<tr>
<td>Design Process</td>
<td>Design method</td>
<td>Description of procedure(s) for artifact construction.</td>
</tr>
<tr>
<td></td>
<td>Kernel theories</td>
<td>Theories from natural or social sciences governing design process itself.</td>
</tr>
<tr>
<td></td>
<td>Testable hypotheses</td>
<td>Verify whether design method results in artifact consistent with meta-design.</td>
</tr>
</tbody>
</table>

Note: Shaded area is focus of this article.

In the next section we motivate our study by defining what we mean by the term “e-service” and explain why we focus on e-services. Next, we describe the EDCI template. We then describe a specific instantiation that illustrates how EDCI can be applied in a real-world setting. We end with a brief discussion of next steps in the research program.

2. E-Services

A service can be defined as a time-perishable, intangible experience performed for a customer acting in the role of a co-producer [8]. Given widespread use of IT to enable services – financial services, communication services, customer services, marketing services, telematics services – we focus on e-services, which we define as services enabled by information systems [18]. By framing the IT artifact in this broader way, we emphasize people and their role in the production and use of IT-enabled services. This addresses a dimension of IS design that is sometimes underemphasized and can lead to user
frustration, poor adoption and assimilation, and significant financial losses [13]. E-service contexts that we have observed in action learning projects include electric car apps, senior connectedness services, visualizing environmental information, vampire energy, virtual conferences, and mobile augmented reality browsing.

Focusing on e-services leads to a human-centered approach to design, thereby ensuring that “the customer’s needs and interests genuinely matter” [2, p. 201]. For example, EDCI emphasizes human-centered methods from narratology, anthropology, the performing arts, visual arts, etc. This contrasts with methods for software development involving stakeholder discussions of business needs, project scope, system requirements, etc. In summary, we focus on e-services due to their importance in the broader economy and the need for better e-service innovation processes [1, 3].

3. EDCI for designing e-services

EDCI is a systematic yet flexible template for the empathic design of e-services. Given the experiential nature of e-services, we draw on the rich foundations of design and innovation research streams that focus on user-centered and empathic techniques (sometimes referred to as “design thinking”) [7].

Design thinking, or human-centered approaches to generating solutions, focuses on the human experience and separates problem finding from solution development. A design thinking process for developing new products or services may comprise three “spaces”: inspiration (exploring the design space), ideation (developing ideas), and implementation (implementing ideas) [6]. In the context of interaction design, design research, brainstorming, and design can be viewed as three phases of a design process [19].

A two-dimensional product design space has been suggested in which one dimension is Abstract-Real and the other dimension is Analytic-Synthetic, the former denoting the degree of reality of processes and the latter denoting analytic reasoning versus abductive or generative reasoning [14]. The space is used to illustrate various methods of new product development, e.g., one-step versus three-step.

We developed a human-centered design process template for e-services over the space of five years across five action learning programs containing more than 25 e-service projects (Figure 1). First, we leveraged the product design space by retaining the two aforementioned dimensions. Second we changed the nature of activities within each phase to reflect an empathic orientation needed for e-services. The four phases of the EDCI template are 1) Explore, in which the goal is to determine behavior in context, pertinent trends and statistics, and value network characteristics; 2) Discover, in which the goal is to synthesize gathered data to determine what a new or better e-service would do; 3) Concept and design, in which the goal is to design the e-service and develop a business case; and 4) Implement and assess, in which the goal is to implement the e-service and assess whether objectives have been achieved. Third, we used prior research, consulting frameworks, and student feedback to develop a set of activities pertinent to e-services within each phase (unless otherwise noted, specific design activities mentioned herein such as customer journey mapping were developed by others). Last, we developed flow diagrams to illustrate sub-processes.

![Figure 1. EDCI for e-service design](image)

As an illustration of the evolution of EDCI, the first version did not contain a flow chart for the Explore phase, which led to student confusion about where to start. As a result, we developed a simple flowchart illustrating what comes first (initial problem framing, hypotheses, biases, hunt statements, etc.), second (empathic research), third, (problem re-framing), fourth (more research), etc. Feedback from students was positive. In summary, the EDCI template synthesizes and integrates prior empathic design methods within a single design template that is simple to learn and apply, yet allows for complexity and flexibility.

3.1. Explore

The Explore phase involves “stepping back and stepping in”: stepping back from implicit biases and hypotheses of the designer and stepping in to the
problem space. The goal is to determine behavior in context, capture market trends and statistics, identify capabilities of the service delivery organization, and assess pertinent value networks. Overall, the idea is to diverge and collect a broad set of data from the field (Figure 2). From a process perspective, this phase involves determining an initial problem framing, which leads to activity statements, hypotheses, stakeholder and context identification, selection of research methods, and problem re-framing as new data emerge.

Behavior in context is determined via a variety of human-centered design research methods, including ethnography, narratology, self-directed, and visual and theatrical. For example, development of a software application to assess incoming MBA student Excel abilities may employ narratology techniques such as directed storytelling (“tell me about a time when you had to take a webinar to assess skills”) or ethnographic methods such as being an “undercover agent” in which a student acts as if she is taking an actual Excel class to learn how it is conducted. These and other tools form the basis for the Explore phase [5, 19].

Observation and reflection of more than 100 students within 25 projects over several years applying EDCI in action learning projects yields several insights. First, students report that they enjoy being exposed to new methods and ideas (both MBA and BBA students). They have many “aha moments” and are generally not shy in jumping in, for example, to observe a fellow student using Facebook to observe actions and emotions (“I had no idea that people use Facebook so differently than I do!”).

A pervasive challenge during the Explore phase is suspension of the urge to jump to Concepting and designing (“When we recognize a problem or an inefficiency we automatically jump to conclusions…it’s hard to change that mindset”). Indeed, some students are quite uncomfortable embracing the divergent nature of the Explore phase, though it is unclear whether this has to do with the specific student sample (primarily BBA and MBA students). Other challenges include how and where to begin, who to observe, privacy issues, embracing a different mindset of interest in the tails of the bell curve instead of averages, holding the tension that both traditional statistical analysis and qualitative research can co-exist and contribute valuable insights, and when to stop.

3.2. Discover

While the Explore phase is “stepping back and stepping in,” the Discover phase is synthesis and convergence towards insights. The goal is to bring together the vast set of qualitative data in a meaningful way. Specifically, a framing question is to determine what a new or better e-service would do, not to specify specific design features or functionality. This insight-based problem identification step is a critical part of the e-service development process. The importance of problem identification has been identified in the IS design literature [11, 15], for example, Hevner, et al. [10, p. 85] state that: “research must address the problems faced and the opportunities afforded by the interaction of people, organizations, and information technology.”

Methodologies used in the Discover phase include personas, character profiles, mind maps, as well as customer journey mapping to describe the e-service experience and user emotions. For example, a customer journey map might be used to map the emotions of a bus rider as she waits for a late bus in a snowstorm to determine how smart phone information might be provided about bus locations and arrival times to improve this service.

The Explore and Discover phases ensure that user needs (whether explicit or latent) are built into the design artifact by creating a point of view, which captures the nature of who a user is, what her needs are, and a story that ties it all together. The Explore and Discover phases reduce the chances of “designing artifacts when desiring patterns of action” [16]. By examining customer journeys and experiences rather than focusing on technology, EDCI places patterns of action front and center, both in terms of what is as well as what might be.

In reflecting on the Discover phase, there is generally more anxiety and a sense of challenge here versus the Explore phase (“which tools should we

---

1 See http://servicedesigntools.org/repository for an extensive list of empathic design methods, accessed on June 13, 2011.
use?”). One reason is that synthesizing qualitative data is a learned capability that is not mastered quickly or easily. It is very different than, for example, learning how to compute a t-statistic. Another reason is that iteration is required between Discover and Explore phase activities, which can lead to feelings of an endless loop (“When can we say we’re finished and move on?”). Finally, there is the challenge of completing the goal statement itself, which requires team members to agree on what lies at the core of their insights, which will shape future concepting and designing activities. For example, a student team examining problems with attending business conferences (cost, hassle, and greenhouse gas emissions), struggled with several different insights that emerged from their field research of conference attendees and other stakeholders. After much debate, they decided that the most important discovery after synthesizing their data was that people want to be able network with others at conferences as much or more than attending seminars. It is not clear whether this insightful discovery would have emerged from surveys or analysis of secondary data.

3.3. Concept & design

The Concept and design phase moves from the problem finding to the solution development side of the EDCI template, with the goal of designing an e-service and business case that meet the design goal of the Discover phase. As shown in Figure 1, the process starts with ideation, followed by an iterative concepting stage involving building to learn using rapid prototyping, showing concept to users, refining ideas, and iterating. Once an effective concept emerges, the process moves to experience design (touch points, service system specification, service blueprint, look and feel, etc.) and business case development.

Concept development includes familiar approaches such as brainstorming and affinity diagrams and not-so-familiar approaches such as emotional clustering and group sketching. For example, to prototype a new set of glasses enabling 3-D movie watching and Internet surfing, a team may act out a scene showing how the glasses work using simple drawings to show what the user sees and to demonstrate potential scenarios, such as walking into a wall due to distraction. This exemplifies the observation that to test user’s reactions to an e-service, you don’t need to create the service. In fact, students are often surprised at the power of low-fidelity prototypes in determining behavioral reactions and assessing emotional responses. For example, students used color-coded sticky notes to mock-up an energy feedback tool to tell users how much energy a given appliance was using. An insight was that the physical location of the feedback mattered a great deal, with one user asking “why can’t the plug just text me when vampire energy is an issue?” Other tools for idea generation include brainstorming and SCAMPER.

In the context of e-services, design involves not only design of an interface and features, but also design of new work practices or routines, i.e., the entire e-service experience. Moreover, the design of touch points (interface of the e-service with users and service providers) is a key aspect of EDCI that is critical to developing effective e-services. Service blueprints are especially useful in displaying the roles of various stakeholders and how they all fit together in the e-service experience [4].

As with the Explore phase, the Concept and Design phase is readily embraced by students, given the interactive and interesting range of approaches employed. Challenges that I have observed include when to stop concepting and move to designing as well as how specific the design needs to be.

3.4. Implement and assess

Once the e-service is designed, the last step is to implement it (whether in pilot or full stage) and assess performance. Conventional approaches are employed to set a rollout schedule, involve and train users, construct affordances, and so forth. Note that for e-services, this initial launch retains a strong learning component – over time refinements will occur based on actual usage. Given the time constraints inherent to the typical classroom setting, the Implement phase has not been conducted in an action learning context.

4. Illustration of EDCI at BigU

To further illustrate the developed EDCI template, we demonstrate its instantiation to a particular class of e-services: environmental information management. This real-world project has thus far focused on Explore and Discover phases and the authors have conducted more than 100 hours of design research, which we now describe.

4.1. Genesis of the project

Like many universities, BigU publishes an annual sustainability report, including information about energy use, greenhouse gas emissions, water use, and
4.2. Starting activities

The project began by developing an initial frame for the problem, identifying subjects, locations, and contexts, creating Explore activity statements, and identifying implicit biases and tentative hypotheses (Figure 1). The initial frame of the problem (which was later reframed) was: “how can we improve greenhouse gas emission information management at BigU?” Why this frame? It was perceived based on very limited researcher knowledge that the problem context was focused on greenhouse gas emissions. It was only later, through empathic Explore phase research, that the scope of inquiry expanded and the problem was reframed as “how can we improve environmental information management at BigU to serve producers and consumers, whether internal or external to the university.”

Identification of people, places, and service contexts began by consulting with a key environmental manager, who also provided an organization chart. We thus identified several important stakeholders: 1) environmental data manager (DM) who aggregates data from the entire campus in an Access database and aids in report development; 2) recycling coordinator (RC) who manages data from waste management activities; 3) fleet manager (FM) who manages data from busses and van pools; 4) BigU administrator who reads the environmental report; and 5) BigU MBA student who knows little about environmental reporting. Each stakeholder is associated with a specific e-service context and location. For example, the DM sends emails to remind other data providers throughout campus to fill out their spreadsheets and email back to him at his location in the environmental management unit at BigU. He typically does not go into the field. Finally, an Explore activity statement might be: “What is the process for converting recycled goods into digital information?”

We identified implicit hypotheses and biases to ensure that the design research was conducted objectively. For example, we believed as researchers that a new e-service could be developed to improve efficiency and effectiveness (though we cannot be sure that this is the case). We also had a bias against spreadsheets, having had personal experience with their limitations. Finally, we had an implicit hypothesis that stakeholders would have higher morale if the environmental e-service exhibited enhanced transparency, accuracy, and ease of use.

4.3. EDCI problem finding activities

We conducted substantial human-centered research to understand the service space and experiences of various stakeholders from both a human and a functional perspective. We summarize a few of the activities here.

We first conducted contextual inquiry of key stakeholders as they conducted their data activities to understand key processes and associated emotions. We also used directed story telling and other techniques to gain insights. To synthesize this research, we made extensive use of customer journey maps, which embody empathy by drawing the service journey of a stakeholder including actions and emotions (Figure 3). The journey map has the advantage of simplicity and is useful to both capture insights as well as to communicate them. It is not to be confused with more complicated process diagrams, which are employed for other purposes.

![Figure 3. Customer journey map](image)

Another tool we employed was a system map, used to provide a visual description of the various stakeholders, the links between them, and the flows of various resources flowing through the links, for example, information, money, materials, etc. (Figure 4).
5. Conclusion

The development of the EDCI e-service design template is ongoing. We have explained its phases using examples from action learning projects and described a specific instantiation from practice. We have also described challenges that we have observed in its application.

From a practical perspective, the EDCI template has great potential in addressing wicked problems in the environmental sustainability context. New e-services will be needed for energy, transportation, carbon emissions, and a host of other organizational and consumer contexts where change is being driven by climate change, resource scarcity, and population explosion [12]. Also, new e-services are enabling new types of e-service research, such as “dscout” (from consultancy Gravity Tank), a mobile app that captures real-time user experiences in the field.

From a research perspective, many questions arise, such as quantifying the efficacy of the EDCI design template versus non human-centered approaches, examining the use of EDCI across different types of designers and users, and employing kernel theories and hypotheses to develop an ISDT incorporating EDCI.

6. References