THE DESIGNEXCHANGE: SUPPORTING THE DESIGN COMMUNITY OF PRACTICE

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ABSTRACT
Design – and more specifically, the quality of the process of design during the conceptual phases – has been shown to have high impact and leverage on the quality, cost, and success of engineered products. As design research does not fall into any one disciplinary body of knowledge, there is a need to consolidate and organize the many design research methods used, develop a community of practitioners to evaluate and categorize those methods and educate the next generation of design innovators in appropriate research methods to support the conceptual design process. In this paper, we introduce a preliminary design for *The DesignExchange*, an interactive web portal to meet these needs.

Keywords: Design Research, Design Methods, Community of Practice

1   INTRODUCTION

Design is inherently a multidisciplinary process, with projects crossing disciplinary boundaries as they progress from problem definition, to concept generation, to manufacturing, and beyond. The practice of design itself lives in multiple domains – there are graphic designers, product designers, architects, UI designers, etc. Each of these disciplines produces different things, but they all consider themselves in some way "designers", and can learn and borrow from each other's practices.

The concept of a "design method" originated in 1962 at "The Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications" [1]. The conference focused on concerns about how the modern industrialized world was being manifested. Conference participants stressed that designers need to work in cross-disciplinary teams where each participant brings his/her specific body of skills, language, and experiences to defining and solving problems in whatever context [1].

Since 1962, the field of design theory and methods has evolved significantly. From Peter Rowe's [2] early definition of design thinking as the "situational logic and the decision making process of designers" and the "theoretical dimensions that both account for and inform this kind of undertaking" to Christopher Alexander's [3] creation of a "pattern language" to capture design ideas as repeatable patterns to Morris Asimov's [4] description of the analysis-synthesis-evaluation sequence through which designers proceed, there has been a construction of information and knowledge about the process of design.

By 1997, a study by the Product Development and Management Association (PDMA) showed that nearly one-third of the sales and revenues in a mix of US companies came from new products and the highest performing companies followed a formal design process that included user studies and design research [5]. PDMA's more recent study found that these firms also use numerous new methods and techniques to support the design process [6]. The UK Design Council found that between 1997 and 2007, shares in design-led businesses outperformed the FTSE 100 by more than 200% [7, 8]. Hertenstein et al. similarly showed that "high design companies" outperformed "low design companies" in earnings, net income, cash flow, and stock market returns over a seven-year period [9]. With design and design research playing such an important role in business performance, it is important to study and support the field's ongoing development.

Although the field has matured in many ways, both in research and practical application, there is still no formal body of knowledge that enumerates the methods of user design research or provides explanations as to how these various research methods relate to each other within the conceptual design process. There are publications that describe some of the tools used in design research (e.g., [10], [11]), but none provide a comprehensive collection of methods, and none is interactive – a living body of knowledge that develops and grows over time. Such a body of knowledge would not only increase our understanding of

structured conceptual design processes, but would also be an invaluable tool with which to train future engineers and designers.

In this paper, we introduce a concept for an online resource, *The DesignExchange,* to facilitate building a body of knowledge on the development and use of design research methods. In addition to providing a tool for the design community of practice, *The DesignExchange* will provide a rich resource for academic researchers studying the design process. Some initial questions we aim to answer by collecting information through the use of the site include:

1. What are the salient design methods of interest?
2. Which methods are useful in different situations? This includes variables such as different types of questions the methods address, classes of products on which they are applied, and the context of use for the results of using the methods.
3. What are the strengths of different methods and how can they be effectively combined? Can design research patterns be identified?
4. Given information on what is useful in what situation, what approaches can be used to guide the selection of methods for a new project?
5. How are new methods created when existing methods do not effectively or efficiently answer a research question? When developing a new method, what factors need to be considered (e.g., human subject issues, type of data needed to answer the question, ability to turn that information into a deliverable, etc.)?
6. How does discussion around a method change that method's definition or use?

Throughout this paper, we will discuss how we will use information from *The DesignExchange* to answer these questions.

2   BACKGROUND

Those who practice design research for conceptual design comprise a community that would benefit from open discussion about their practices across domains. We will draw on two concepts of shared knowledge creation in this paper: 1) situated learning and communities of practice, and 2) open innovation.

2.1 Situated Learning and Communities of Practice

In *Situated Learning: Legitimate peripheral participation*, Lave and Wenger [12] propose that, rather than a process of receiving factual knowledge or information, learning is a social process that happens as we become members of a sustained community of practice [13]. A community of practice is a group of people who share a passion for something they do, getting better as they interact regularly. A community of practice can be defined along three dimensions [14]:

*   The domain – the joint enterprise as understood and continually renegotiated by its members.
*   The community – a mutual engagement that binds members together into a social entity.
*   The practice – the shared repertoire of communal resources (routines, sensibilities, artifacts, vocabulary, styles, etc.) that members have developed over time.

Addressing the kind of dynamic "knowing" that makes a difference in practice requires the participation of people who are fully engaged in the process of creating, refining, communicating, and using knowledge [15]. Therefore, a community of practice is more than a network or set of relationships because it is "about" something. By producing a shared practice as members engage in a collective process of learning, the community also creates an identity as a community, thus shaping the identities of its members [14].

Communities of practice tend to self-organize, but they benefit from time and space to collaborate and from leadership to get things rolling [14]. Internal leadership is diverse and distributed, and can take many forms, from inspirational (provided by thought leaders and recognized experts), to interpersonal (weaving the community's social fabric), to classificatory (collecting and organizing information in order to document practices). Building on Lave and Wegner's work and the experiences of various organizations that have built community of practice support structures, Cambridge, Kaplan, and Suter [16] provide guidance on how to design and cultivate a community of practice. They identify four main areas of activity: developing relationships, learning and developing practice, carrying out tasks and projects, and creating new knowledge. As the community develops, each of these activity areas become more or less central to the community's goals, and each requires a different set of tools to support it. To

create a 'sense of place' in the minds of community members, they advocate a combination of *face-to-face meetings*, live *online events*, and collaboration over time within a *persistent Web environment* [16]. *The DesignExchange*, as a persistent Web environment, will support the design research community of practice in the four main areas of activity through features such as the community-contributed library of methods, the project portal, and the feedback module outlined below.

2.2 Open Innovation

According to Chesbrough [17] organizations need to be open in order to utilize and harness external ideas in their innovation processes. As knowledge has been widely distributed, it is now difficult for organizations to rely on their internal abilities to generate new knowledge and technologies. Therefore, there is a strong need for organizations to be open, and to share their knowledge and research with external entities. By having multiple organizations follow this open structure, each organization benefits. InnoCentive, Inc. (www.innocentive.com) is a great example of a company supporting the open innovation model. It offers a brokerage service to problem providers and problem solvers. Providers, mostly pharmaceutical and biomedical firms, offer problems which cannot be solved internally or for which they seek innovative ideas from InnoCentive. Then solvers, who register with InnoCentive from all over the world, provide solutions and get paid if providers select their solutions. Another example of open innovation is Proctor & Gamble's "Connect and Develop" strategy, which recognizes that many innovative solutions can be found outside its own research labs: Proctor & Gamble aims to develop 50% of its innovations through collaborations with external partners [18]. *The DesignExchange* will be an open innovation source for information on design research methods, working to elicit contributions from design practitioners in multiple fields. To facilitate this, we will look to research on fostering open innovation to guide design decisions.

3   RELATED WORK

The design community of practice supports itself in different ways, including design toolkits put out by various academics and practitioners, and publications and meetings (such as this ICED conference). In addition, there are other community-contributed web portals in the design field, though none are aimed at collecting design research methods to support conceptual design and the design research community of practice.

3.1 Design Toolkits

Several textbooks [e.g., 10, 19] and collections of design research methods exist in print [e.g., 20, 21] and online [e.g., 11, 22, 23], each covering some portion of the conceptual design process [e.g., 10], or some subset of methods appropriate to a particular discipline [e.g., 23]. For brevity, we only cover a few of the more well known ones here.

A participant of the 1962 conference, Christopher Alexander wrote his seminal series of books *A Pattern Language* and *A Timeless Way of Building* [3], which document a set of methods for designing and constructing buildings. Alexander lays out 253 unitary patterns, each with a description and what you need to construct it, written as a set of rules that are invoked by circumstances.

At the same time, conference organizer John Christopher Jones wrote *Design Methods* [20], often considered the seminal work on design methodology. Jones presents 35 methods developed to assist designers and planners in becoming more sensitive to user needs, including for each method: the aim, an outline, and a detailed example illustrating the steps of the outline.

IDEO, a leading firm in the design field, published a collection of Method Cards [21], with each card briefly outlining how and why to use a method, and categorizing the methods into Learn, Look, Ask, and Try. More recently, IDEO put out a "Human-centered design toolkit" for NGOs and social enterprises [22] that lays out a process of three phases: Hear, Create, and Deliver. For each phase, IDEO lays out a few select methods to accomplish the objectives of the phase, along with some guidelines and tips for using the method. And just this month, they have released a toolkit aimed at educators, *Design Thinking for Educators*, which lays out a five phase process: Discovery, Interpretation, Ideation, Experimentation, Evolution [24].

Hugh Aldersey-Williams, John Bound and Roger Coleman compiled a collection of design research methods, drawing on industry experts to author 32 individual method entries in 1999 [25]. This past year (2010), some of their colleagues at the Royal College of Art Helen Hamlyn Centre revamped 20 methods

as a part of the designwithpeople.org site release [11]. They provide a short description of each method, along with the Aim, Background, and Resources necessary to accomplish it. Though they provide examples of each method in use, they do not include any instructions for performing the method.

In 2006, Usability.net posted a Methods Table [23], which documents a number of methods for a six-phase process focusing on user-interface design: Planning & Feasibility, Requirements, Design, Implementation, Test & Measure, and Post Release. Each entry includes a summary, benefits, a detailed description of how to use the method, some alternative methods, next steps, and references for more information. They also provide capability for filtering methods based on resource limitations (limited time, limited access, limited expertise).

A different view of a problem solving, and collection of methods for doing so, is widely documented in the broad literature on Six Sigma. It describes the methods used in its five-step process: Define, Measure, Analyze, Implement, and Control (DMAIC). Some of the tools used by the DMAIC process – such as process flowcharts and fishbone diagrams – are similar to those used in the design process.

While these books and collections cover a portion of the human-centered design process, none of them account for the evolving nature of the practice. A more dynamic catalog of design research methods would allow for discussion and evolution of the characterization of the methods.

3.2 Publications and Meetings

Journal papers are often considered the highest level of academic publications. However, though they are effective for disseminating and archiving vetted research findings, they do little to support the development of the design community of practice due to their slow turnaround, high bar to entry, and a focus on academic research as opposed to practice.

In comparison to journals, conferences provide fast and regular publication of papers and offer the opportunity to present and discuss the paper with peers. However, they are expensive to attend, and only offer this opportunity once every one or two years. Design practitioners are often under-represented in comparison to academic researchers. For a "sense of place" and community, a more persistent and practice-oriented discussion needs to take place.

3.3 Community contributed web portals

Engineering for Change shares with *The DesignExchange* the strategy of providing a library of techniques based on context to designers,. Put out by the American Society of Mechanical Engineers (ASME), with the Institute of Electrical and Electronics Engineers (IEEE) and Engineers Without Borders-USA (EWB-USA), *Engineering for Change* has aggregated information on solutions to problems in developing regions, hosts a technology library, and provides tools to enable collaboration amongst teams worldwide. Users can search by sector or region, and browse the solutions library to find relevant projects and solutions, or contribute their own stories [26]. It provides extremely helpful inspirational material if the problems being faced in different regions are similar. However, even in these cases, work must be done to ensure that the correct solution is being applied, and is appropriately modified to meet the individual needs of the local population, which is where *The DesignExchange* can play a part.

Another portal that has a similar mission to *The DesignExchange* is *People & Participation.net* [27]. This site is put out by Involve, a UK charity focused on public engagement strategies. *People & Participation.net* embodies Involve's expertise on participatory methods, as well as collecting case studies and methods from users, to support those who want to better engage the public when designing public services and drafting policy changes. Though aimed at a different audience, we found the site to be similar to our initial prototypes and looked to it as a source of validation and inspiration for the development of *The DesignExchange*.

4 THE DESIGN EXCHANGE

To address these gaps of knowledge, we propose *The DesignExchange*, an interactive web portal to facilitate the capture, analysis and widespread use of design research methods. *The DesignExchange* will create a structure within which to collect and document the many design research methods in use today, including their origins, how they are used, how they interact, and examples of their use. By creating this structure, we can begin to codify and structure understanding of design research methods in a way that can be systematically searched or recalled for use as a design research resource. We can also help designers make informed decisions about when to apply those methods in the conceptual design process.

The portal would support the entire life-cycle of the conceptual design process—from observation through synthesis and analysis to realization and evaluation – providing educators and practitioners alike with a versatile and extensive library of tools. Powered by a multi-disciplinary community-contributed database, *The DesignExchange* will provide the largest collaborative library of design research methods. By allowing both practitioners and educators access to this portal, we can improve not only the understanding of design research methods in practice, but provide a more structured educational tool for those hoping to enter the design field.

Given the community-of-practice model and wide application of conceptual design processes/methods, the *The DesignExchange* portal is fundamentally multi-disciplinary. The subject matter draws on the diverse range of contributors engaged in a user-centric design process (engineers, designers, business people, educators). By recognizing and promoting the common thread among these different disciplines, *The DesignExchange* supports cross-pollination of methodologies among them.

Drawing on research and best-practices from social and professional networking websites, *The DesignExchange* will incorporate advanced community functions, including diagnostic and contextual tools to gather information not only on the methods themselves, but on the context that surrounds their choice and use. As community members contribute methods, use and vet those methods, and record their experiences, it will become clear which methods are most useful in which contexts, allowing for better application of methods, and answering our research questions. By facilitating this community-based discussion and documentation of design research methods, *The DesignExchange* has the potential to be the world's first open innovation archive of design-practice-related subject matter. To accomplish this, we will be pulling from previous work done in design theory, communities of practice, and expert/lead user-generated content. A prototype version of the site at www.thedesignexchange.org will be tested before ICED 2011.

4.1 Consolidate and Organize Design Research Methods

By collecting and organizing different design research methods, along with information on contexts of use, *The DesignExchange* will help answer the question of which design research methods are effective in different situations, while supporting the design community of practice in selecting appropriate methods for specific projects. The following components of *The DesignExchange* are critical for supporting these goals.

Library of Methods

We propose to begin our work by developing a library of current design research methods. We define a *design research method* as a discrete component of the iterative human-centered design process, which helps inform design decisions. In different phases of the design cycle, manifestations of design research methods vary based on the fundamental goal of the particular activity. However, design research is typically heaviest in the early conceptual stages of the design process. Though the model of *The DesignExchange* is that, eventually, the community of practice members will add and edit method entries, the initial set of methods includes summaries from popular and academic literature, with proper citations from peer-reviewed publications and respected industry sources, where possible (e.g., [19, 23]). The library will be structured around six main activities of design research, based on our developing understanding of various conceptual design processes: understand, observe, synthesize (and analyze), realize, prototype, measure. So far, we have identified 150 methods to include in the library, though we expect this number to expand as the community gets involved.

The library will consist of individual entries, called Methods. A Method can be used to catalog any set of activities to support the conceptual design process. This may include really basic methods, such as the use of open-ended questions, to complex patterns of design research methods such as contextual inquiry or rapid ethnography. More complex Methods may refer to other Methods as components. For example the Method Contextual Inquiry may call upon the Method Interviews.

Evolving taxonomy of design research methods

By understanding the relationships among methods, we can start to look at what elements they have in common and what makes them more or less useful in a particular context. Initially, relationships among methods will be based on those that emerge from an extensive review of current publications, augmented by a card-sort study by expert community members.

However, *The DesignExchange* will not only supply the community with a default mapping among methods, but will be able to evolve that mapping by allowing the addition and removal of links within individual accounts, and the development of account-specific relationship mappings. By capturing how individuals create and delete links among methods, the taxonomy can evolve to reflect the understanding of the community, especially as new methods are added. The inclusion of user-generated "tags" for each Method entry will also inform the development of the taxonomy.

Navigational interfaces

Different people have different ways of understanding and using bodies of knowledge [28]. We propose to support variations in learning styles and cognitive approaches by developing alternative navigation interfaces for exploring the library of methods. There are many possible solutions, and an initial investigation will determine what navigation interfaces allow the most intuitive access to the method library.

Members will be able to see all methods used in a particular project and in what order they were employed. This will be a large component in our collection of usage patterns of methods, which will inform the method taxonomy.

Community-contributed method entries and case studies

We are interested in both the gamut of methods that the community uses, especially in disparate disciplines, as well as the development of new methods. Though novices may tend to repeatedly use methods and patterns they are familiar with, regardless of the appropriateness, veterans of the design process will often improvise new methods when faced with a new situation. As such, we will encourage community members to record and develop methods that they have come up with to answer particular questions. Selected authors of new methods will be interviewed to better understand the process of method creation. These interviews will add to our understanding of what is useful for different contexts, what leads to the creation of a new method, and what factors need to be considered when designing a new design research method.

We will also elicit contributions of case studies, drawing on the research on user-generated content outlined earlier. A user-study of the design community will allow us to determine motivating factors (e.g. social prestige, or professional reputation, etc.). We can then develop features to support those factors.

To increase participation in the creation and review of methods, we turn to research on other sites with user-generated content to understand the factors that may lead people to contribute their time and knowledge to *The DesignExchange* [e.g., 29, 30]. As collaborative content creation has drawn more interest in academia, a great deal of information has been collected on why people contribute their time and knowledge to others on sites such as Wikipedia [e.g., 30-32], iStockphoto [33], and Mechanical Turk [34]. In common with these systems, *The DesignExchange* will be a site built around user-generated content and can leverage the information gathered about the users.

Project portal

A project portal will be made available to members, so they can collect and share methods with project team members. *The DesignExchange* will be able to recommend appropriate methods to try next based on the project and the methods already used. In addition, completed projects will act as a source for additional case studies with the inclusion of information on context of use, problem solved, and eventual outcome. These projects along with user-supplied case studies will provide data for our analysis on patterns of method use.

Method recommendation system

Like other recommendation systems, *The DesignExchange* will rely on user-supplied rankings to help inform its recommendations. However, rather than a simple five-star rating for each method, users will be asked to supply project specific information (e.g., type of problem to be solved) to inform the mapping of effective methods to different situations. Data collected from methods, case studies, and contextual method ratings, will help illuminate which methods are useful in different situations.

4.2 Support and Develop the Design Community of Practice

As mentioned earlier, communities of practice benefit from time and space to collaborate, and from a sense of community. The following components are designed to help facilitate these needs.

Interactive web-based portal

The portal "experience" is fundamental to the success of the community of practice endeavor. As such, we will employ a user-centered approach to design and develop it. We recognize that members of the community coming to *The DesignExchange* may not all be using the same terms for different steps of their process, and so rather than focus the portal around any one particular process model, we will provide different ways to access the methods library, such as activity type (e.g., primary research, prototyping, etc.), question type (e.g., how vs. why do people do things), or context. The method recommendation system will take all these factors into account to provide a dynamic way to access the library of methods. Figure 1 shows the current design of the site, which will evolve as we gather insights from the design research community of practice:
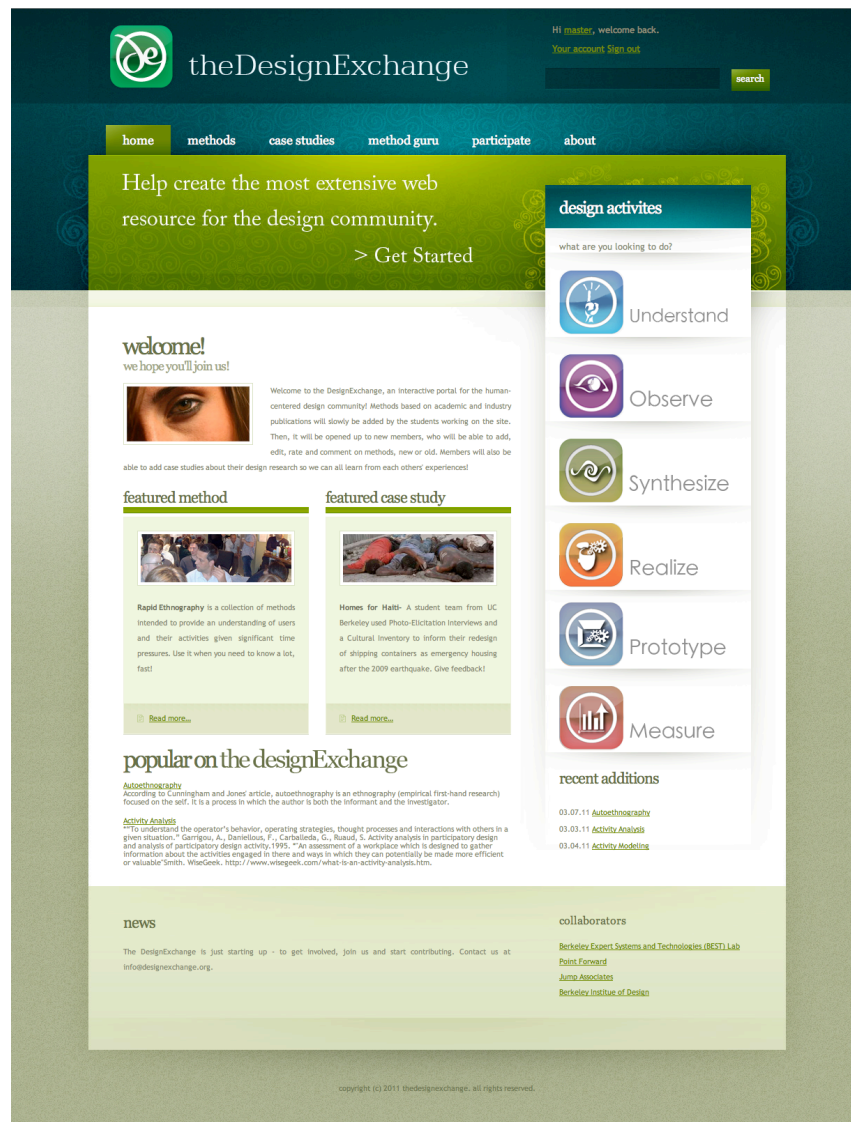

Figure 1. Screenshot of The DesignExchange portal.

Reputation system of community members

By intent, *The DesignExchange* is a dissemination project. Initial membership in the community will be invite-only, based on similar introductory models used to roll out, for example, Google mail and Facebook. Initially, members will only be able to rate and comment on methods. As members are more active on the site, they will be given more privileges, such as editing rights, or ownership rights of particular methods.

Zhang & Zhu [32] examined the relationships among social interaction, perceived competence, intrinsic motivation and performance to understand contributor incentive. They found that the net effect of online collaboration enhances contributors' intrinsic motivation. Brabham suggests that individuals are likely to

participate in crowd sourcing ventures to gain peer recognition and to develop creative skills. He found that the desire to make money, develop individual skills, and to have fun were the strongest motivators for participation at iStockphoto [33]. *The DesignExchange* will support peer recognition by incorporating a point system for participation, collaboration through the project portal, and skill building by providing access to the library of methods.

Discussion pages for design methods/sets of methods

For virtual communities of practice, relationships are supported by frequent synchronous and asynchronous interaction [31]. In addition, Viegas [35] found that discussion pages serve many purposes, in particular supporting the strategic planning of edits and enforcement of standard guidelines and conventions. *The DesignExchange* members will be able to review and discuss individual methods, and the interactions between methods. Reviews and discussions will give us qualitative information to better understand the relationships between ratings of methods and the situations they were used in, as well as how different methods are used and changed to fit individual projects.

Curriculum modules

We are also interested in the application of *The DesignExchange* in design education, and in its ability to encourage designers and engineers to develop the ability to fluidly apply appropriate methods throughout the design process. These research methods will form the basis of new educational modules that integrate design process thinking and fundamental skills for the application of a wide variety of design methods, without focusing in on particular methods, and include the use of *The DesignExchange* to support and inspire the design of a project plan.

Feedback on method use and questions

Another way to support the education of young designers within the design community of practice is to help them get access to more senior members. As student members use a new method, they can submit their testimonials for feedback from more expert users. Members who watch particular methods can be informed of the request for feedback via email so they can see how others are using the method and respond if they like. We are also investigating the possibility of having a question-answer system where experts in design research supply the answers.

5   SUMMARY

The DesignExchange will help designers make better decisions about when to apply methods and patterns of methods to support a more innovative, user-centered process, while serving to answer several key questions about the effective use and development of design research methods. In total, *The DesignExchange* will provide the largest public library of conceptual design methods, supported by a multi-disciplinary community of contributors.

Drawing on research and best practices from social and professional networking websites, *The DesignExchange* will incorporate advanced community functions, including diagnostic and contextual tools to gather information on the patterns of method selection. User contributed methods, along with a community rating system, will facilitate the discussion of methodological patterns. As community members use and vet various processes, and then record their experiences, those methods that are more useful in particular contexts will become clear, allowing for better application of methods as the discussion matures. The synergy and organization of these research methods will provide a foundation to better advance the state of the art in best practices – their use and integration – as well as a framework for creating new methods.

The community of practice of design research reaches across disciplinary boundaries. This tool will pull from many of these different disciplines, and encourage interdisciplinary discussions about design methods by providing an integrated reviewed database of methods from each. Disciplines range from business and marketing, to engineering design and development.

The DesignExchange will provide the foundation for improved design innovation in both industry and university education. As we collect methods and it becomes clear which methods are most useful, we will be able to leverage that information to determine and teach the underlying skills for these various methods and how they combine, allowing new graduates a more fluid understanding of how and why they are applying certain methods. Eventually the student designers and new graduates will become part of the

design community of practice, with the ability to contribute to the further development of *The DesignExchange*. The prototype website will be available for demonstration and review for the ICED conference.

6 FUTURE WORK

The key to the success of this site, and its ability to answer the questions we put forth in the introduction is the participation of design practitioners and design students. To insure relevance to practicing designers and design researchers, we have recruited industry collaborators to inform the development of *The DesignExchange*. Many of our collaborators are leaders in the product design field, among them are: IDEO, frog design, Autodesk, The Palo Alto Research Center (PARC), Lunar Design, PointForward, Jump Associates, and Portigal Consulting. We are also in collaboration with the Industrial Design department at the California College of the Arts. Our immediate next step is to involve these collaborators in face-to-face design meetings and then in active use of the prototype site to insure that *The DesignExchange* is relevant to expert as well as student community members.

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