



IT'S GETTING SO COMPLICATED!

Design research methods to change the vector of change in an increasingly complex world.

Bill Moggridge¹

ABSTRACT

Complex problems are messy! They make your head hurt! They are difficult to understand and challenging to solve, but they are often the ones that make a difference to the sustainability of our society and planet. If designers are to change the vector of change, we will need clarity about the directions that we choose as well as our methods.

Bill describes the design research methods that he has seen employed in the USA, as well as elsewhere in his travels, both in general and for sustainability. He examines the design research methods that are used as part of the design process, as well as the research about design itself, illustrating his findings with examples.

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1. IT'S GETTING SO COMPLICATED

I studied Industrial design at the Central School in London in the sixties. The course was very practical, with a small studio of twelve students learning through a series of design projects. We were taught lots of skills of drawing and model making, which were exercised in the design of a series of products over a period of three years. The assumption in the curriculum was that we would spend our whole careers designing everyday things for work or life, that our employers or clients would be British companies, and that the leaders in the companies and organizations would decide what products we should design. This situation only lasted five years after I graduated.

It's true that the first consumer product that I designed that went into production was an electric toaster for the UK branch of Hoover, and my first design award was won for a Microscope for a British company, but after that things changed fast! It was like a preview of globalization. Britain announced the decision to join the EEC (European Economic Community) in 1967, becoming part of an economically united Europe. This caused a competitive shakeout, with best companies gaining a continent-wide market and the less strong ones vanishing surprisingly quickly. Britain was strong in service industries like banking and insurance, but weak in most of the manufacturing industries, so that by the time I started my design firm in 1969, most of the clients were in other European countries instead of on home ground. This resulted in my working in ten countries during the seventies, getting used to travel and to the idea that the world is large and diverse. There was an answering machine in Italy, a computer in Spain, a marine radio in Sweden and telephones in six countries, but not in Britain.

Next came the invasion of digital technology. Electronic chips were turning up everywhere, so that more and more products included hardware and software. If we were to design things for people, we had to design the electronic behaviors as well as the physical objects, or we would only solve part of the problem. This led to starting a second office in California's Silicon Valley, developing the practice of interaction design, and forming teams of designers with varying backgrounds, including industrial design, interaction design, human factors, cognitive psychology, mechanical engineering, as well as hardware and software engineering. The design context was too complicated for even the most renaissance individual designer to be effective.

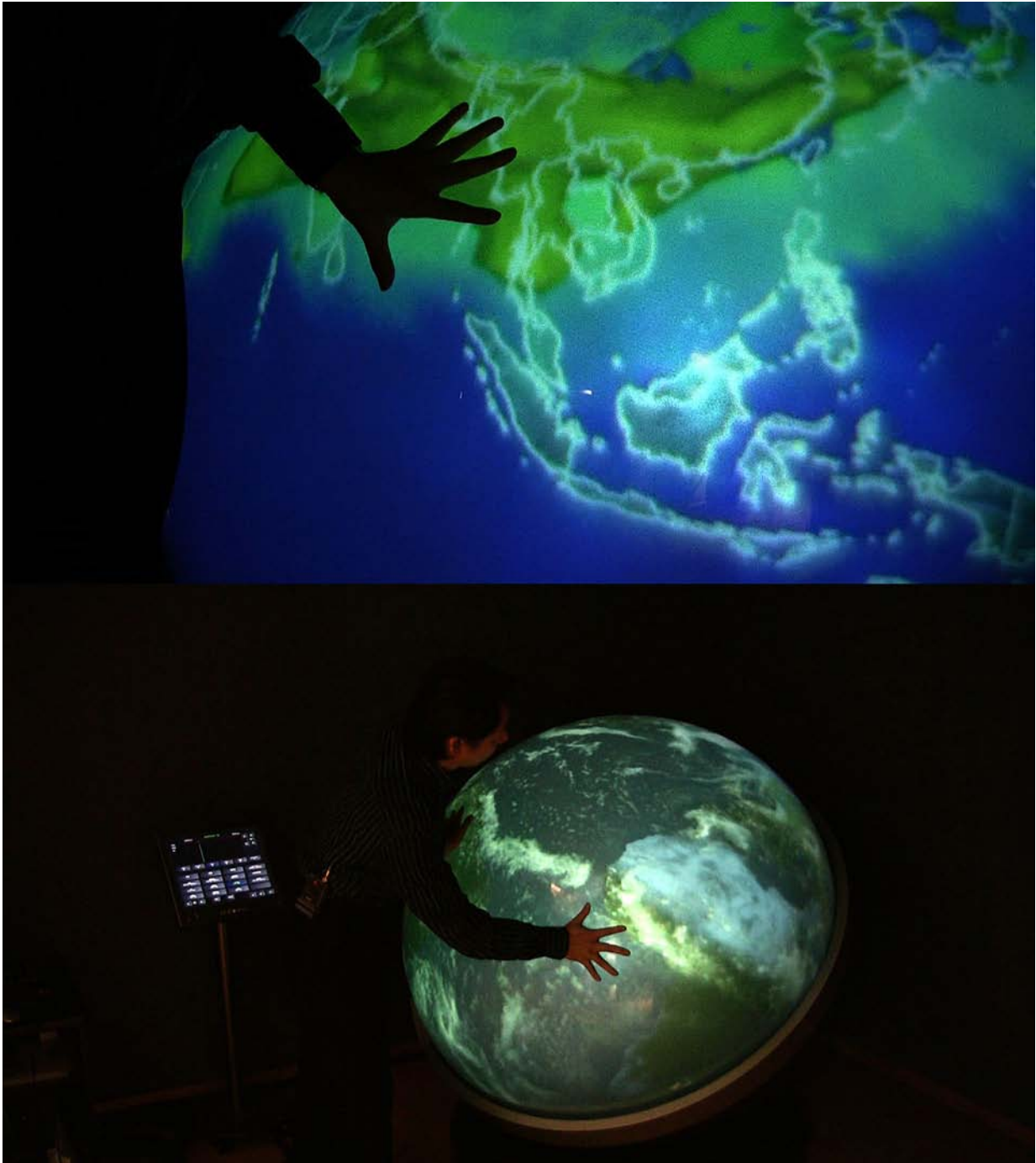
When the internet surged in scale, becoming ubiquitous and accessible, the world suddenly got smaller, as everyone with online access could be connected to anywhere. Globalization was enabled. We could employ resources across national and continental boundaries in real time. Design contexts took another leap of complexity, as now connected technologies were being employed to create complete experiences. We designed websites, connectivity tools, and services that included elements of physical and digital design. We also found ourselves needing to design online solutions to systemic problems in a global context.

Can we design for social innovation towards a sustainable world?

Now we are facing a future where the design context needs to be the whole planet, as we face climate change and realize that human behavior has an increasing impact on everything. Complex problems are messy! They make your head hurt! They are difficult to understand and challenging to solve, but they are often the ones that make a difference to the sustainability of our society and planet.

People may change if they are more aware of the situation. More than a generation ago, the grass roots movement towards sustainability in Germany and Scandinavia changed habits about recycling. This social innovation came from the awareness of the general populace and enabled the implementation of sophisticated recycling systems and the development of new materials.

The public in the USA seemed to be ignoring the dangers of climate change and to be unwilling to take any action towards sustainability until the last few years, but at last there is a surge of awareness, triggered by the Iraq war, energy crisis and perception that climate change is an emergency. The traditional media is at last full of the concerns, helped by the visibility of Al Gore and the popularity of his Academy Award-winning documentary *An Inconvenient Truth*.



Tangible Earth demonstration by Professor Shinichi Takemura

Professor Shin-ichi Takemura is a Japanese cultural anthropologist, teacher and social media designer. He has created a representation of the world called *Tangible Earth* that connects us very intimately to the condition of our planet. Here is a wonderful example of a design that takes advantage of digital technology and the connectedness offered by the internet, to help us feel directly and emotionally the condition of our planet.

(<http://www.tangible-earth.com/>)

The *Tangible Earth* is an interactive luminous world. A transparent hemisphere of 2.8 meters diameter contains a projector with a fish-eye-lens at its center, casting an image of the globe onto the inner surface of the hemisphere. Force sensors recognize the direction of your thrust as you push on the surface, allowing you to spin the globe in any direction and speed that you want. The computers connected to the projector are powerful enough to respond in real time, so that you can see the world move under your hands, giving an emotional sense of what is happening. You feel like an astronaut in space with the means to fly in any direction.

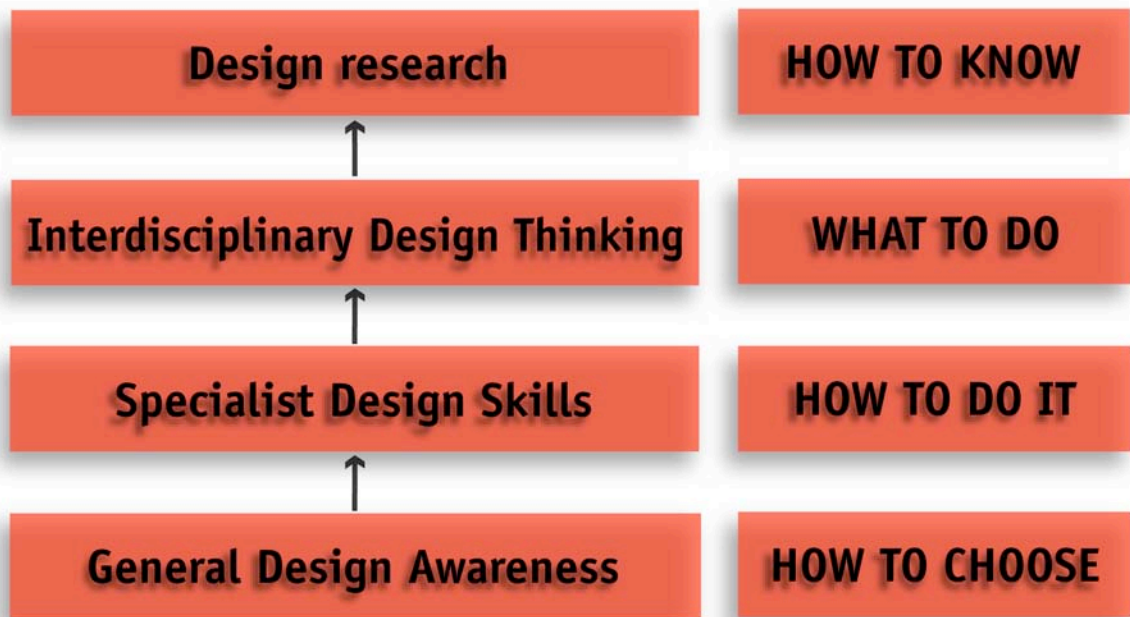
It's not just the satellite view. Takemura and his team have been collecting data for years to allow different representations. The closest to real time is the weather systems of the past four days, played back as a loop of a few seconds, so that you can see typhoons forming or sunny skies approaching. You can see air pollution, ocean currents, bird migrations, earthquakes, temperature changes predicted for the oceans, and global warming projected out to 2050. All of the data is painstakingly gathered from the international scientific community and rendered from the computers to the real time projections. Takemura says:

"I was looking for a way to visualize the reality of what's going on on this planet. It's a matter of information environment. If we design the social signal system so that you can get information in real time, you can make changes by voluntary action. What we need is to design the social use of informational infrastructure. This is what I call social sense-ware to make us more conscious of what is going on in the world. It will become a dynamic self-portrait of our planet, a sensory infrastructure, a public sensory platform for the global age. What we need is the design of media to feel the context of the daily life of the people all over the world to each other."

So far there are several installations of the *Tangible Earth* and Takemura is planning to connect them to each other in real time, as well as allowing access online.

2. LEARNING HOW TO KNOW

You can think of design in four levels, forming a simple hierarchy. At the simplest level, people make choices about the design of their clothes or the environments that they live in, based on their awareness of design qualities and issues. Greater sophistication is achieved by people when they learn specialist design skills; they become designers, knowing how to design with greater fluency and expertise; they become adept at the craft of designing, but they usually rely on other people to decide what to design, to define the brief. It is becoming more widely recognized that design processes can also advantageously be used to decide what to do, employing interdisciplinary design teams in processes that harness the powers of intuition, where the shared mind is more productive and creative than the sum of the individual minds. At the highest level, design research can give access to knowledge; both research for a particular project and also research into methods and processes. Let's look at the items in this hierarchy more closely, starting from the bottom.



General Design Awareness

In the Epilog to his book *Emotional Design*, Don Norman says,

“We are all designers. We manipulate the environment, the better to serve our needs. We select what items to own, which to have around us. We build, buy, arrange, and restructure: all this is a form of design. When consciously, deliberately rearranging objects on our desks, the furniture in our living rooms, and the things we keep in our cars, we are designing.”

When someone chooses what to wear, how to decorate their home or layout their garden, they are exercising skills of general design awareness. These skills are most visible in countries like Italy or Japan that have a strong aesthetic culture and tradition, but are improving fast in countries such as Britain where design is a subject offered as a major option in schools, so that teenagers can choose design as a mainstream subject and qualification before they go on to university.

Specialist Design Skills

Professional designers know how to create new solutions, based on a synthesis of all the relevant constraints. They have mastered specialist design skills, making them expert at deciding how a design can be formed, and how to create an elegant solution to the problem posed by the constraints, but they expect the context that they operate in to be decided by someone else, normally the boss or the client. This expectation limits the economic value of the contribution made by designers. Most current design education is still focused on teaching these specialist design skills, whether the design discipline is industrial design, interaction design, architecture, graphic design, web design, or more craft-based disciplines like ceramic or jewelry design.

Interdisciplinary Design Thinking

Interdisciplinary design thinking is especially valuable for deciding what to do in the first place, so that the power of intuitive creative processes can be harnessed to stimulate innovation, solve any type of problem, and develop new opportunities. Design thinking can help with the messy and challenging

problems posed by the complexity of design contexts in the world of digital technology, global connectivity and the need for social innovation. Complex design problems, such as systems or services, will be better tackled by a team of people from varied backgrounds, harnessing intuitive processes, but collaborating so that the output from the *shared mind* is more productive than the sum of individual contributions.

The range of design disciplines from which an interdisciplinary team is formed for a *Social Innovation* project at IDEO normally includes the human design disciplines, such as ergonomics, psychology, anthropology, industrial design, interaction design and graphic design. It includes people from the technical design disciplines, such as computer science, materials science, mechanical and manufacturing engineering. People from non-design disciplines also contribute to the projects, typically those with business and brand backgrounds, as well as writers, storytellers and prototype developers, for physical, digital and video prototypes.



For example, in the USA a lot of people are fat. Obesity has reached record-breaking levels, especially among children and teens. According to the Center for Disease Control (CDC), an estimated 17% of children and adolescents aged 2-19 are overweight. Resulting from an imbalance in the number of calories consumed and those expended, this epidemic involves genetic, behavioral, and environmental factors that could lead to serious health problems later in life. The problem is growing fast. In 1990 there were no states with a proportion of obese adults as high as 15%, but in 2006 there were 24 states above 20% and 21 states above 25%.

(CDC Behavioral Risk Factor Surveillance System)

The CDC, a sentinel for global health and wellness, strives to provide people with reliable health information and the benefits of strong public and private partnerships. Recognizing the growing obesity epidemic, the CDC and the Academy for Educational Development engaged IDEO to conduct a workshop relating to research done around lower-income women and exercise. The brief workshop led the CDC and IDEO to another project for social impact, looking at fruit and vegetable consumption among tweens.

In this current project, IDEO and the CDC are examining ways to change the habits of an entire generation of tweens, a group susceptible to changing attitudes and behaviors about health before they become life-long issues. To date, IDEO has begun observations with a number of stakeholders and change agents. While still in the early phases of development, and with final deliverables still undefined, the team is looking at communication, product, or service design possibilities to promote wide-scale change and prevention in the battle against youth obesity, and the promotion of fruit and vegetable consumption.

Design Research

You can think about design research in two main categories; research as part of the design process and research about design. When part of the design process, research methods can be included in conjunction with *specialist design skills* as well as *interdisciplinary design thinking* and therefore should not be separated at a higher level on a hierarchy. Research about design is more definitely an enquiry about *how to know*, and deserves the location at the top of the list. Let's look at the two types separately.

3. DESIGN RESEARCH /IN DESIGN

If your goal is social innovation through design, your product, service, or organizational structure has not even been thought of, so by definition it cannot be explained to research participants. This is where mindsets and methods for design research are needed to discover latent needs and desires that will help the members of the design team define potential opportunities.

Design research is most valuable when it is fully integrated into the process. Jane Fulton Suri, Chief Creative Officer at IDEO, describes the way in which design research methods can inform the collective intuition of a design team.

(Fulton Suri 2008)

“To inform intuition, it is important to have team members actively interpret the richness of evidence and discoveries as they emerge. Research that brings rich information will provide not just facts, but insights and possible reasons behind the facts. Even seemingly bad news – that we have been considering something that seems to be a fruitless opportunity or a concept with serious flaws – can serve as inspiration for new and better ideas, instead of signaling a depressing failure. With richly understood bad news, we can adjust our assumptions and perhaps see a new opportunity to move in a more fruitful direction. A huge opportunity for learning is missed when research phases are simply tacked on to a program as ‘safeguarding’ or when research activities are outsourced to a separate team.

To be effective, decisions informed by design research demand a much higher level of personal commitment and engagement at all levels within an organization than do judgments based purely upon hard facts and objective data. Design research often means changing the way work gets done. It means getting out of the office, being where customers are, becoming aware of and sensitive to social trends and the broad ecology of stakeholders, rolling up our sleeves to try out unfamiliar things first hand.

The largely qualitative and interpretive nature of design research is its strength, but this also makes it potentially vulnerable to invalid or ill-founded conclusions. In order to be done well, design research demands that everyone involved be prepared to grapple diligently with ambiguity and nuance. It asks us to bring creative energy to the synthesis of confusing and conflicting information, to be willing to challenge and adapt our own and our colleagues' interpretations, and to stress-test these interpretations both with other points of view and in the harsh light of relevant evidence, even if such evidence is not statistically-proven fact.

This degree of direct involvement often brings another advantage to the design and innovation process – that of creating common ground and shared perspectives among people representing multiple functions within an organization, in ways that have seemed previously unachievable. Enabling teams to share raw evidence and create meaningful frameworks, principles, goals, criteria, and priorities together energizes movement forward with much more enthusiastically supported ideas and greater confidence. In this way, successful design research first requires, then perpetuates, forms of cultural transformation in organizations that enable radical innovation to thrive.”

Jane categorizes design research in three types:

- **Generative:** gaining insights and opportunities – research that provides human-centered insight, revealing new ways of framing opportunities and inspiring new ideas.
- **Evaluative or Formative:** learning and refining – research that provides continual learning throughout the process to determine the what, how, and to whom of the offering.
- **Predictive:** estimating potential – research that helps to estimate the scale and potential of an opportunity even when most variables are unknown.

1. Generative design research

Generative research involves looking for emergent patterns, challenges, and opportunities. The intent is that ideas about new possibilities are informed and inspired by understanding people's aspirations, emotions, perceptions, and motivations within their social, cultural, and technology context. Crucially, it is about interpreting this understanding to inspire new perspectives that disrupt current conventions and ways of seeing things.



For example, after a series of workshops examining various world issues, the Acumen Fund and IDEO decided to pursue the issue of clean water usage in the developing world. The Acumen fund tackles some of the world's most challenging needs for social innovation by combining venture capital with philanthropic business practices.

Currently, 1.2 billion people worldwide are drinking unsafe water. Despite efforts to provide clean and treated water, supplies often become contaminated through improper transport and storage. The approach to design research has been immersive, with IDEO's team spending time in Africa and India in the communities where an absence of clean drinking water is prevalent. We hope to have working prototypes of products, services, and business models that can be implemented by developing world entrepreneurs in 2008.

2. Evaluative or formative design research

Evaluative or formative design research is where design research and prototyping overlap. As soon as ideas emerge that are worth trying, they can be given form, whether as sketches, models, stories, videos or other kinds of prototypes, allowing an iterative series of 'learning loops.' In design research, ideas don't stay intangible or ambiguous for long. In this context, a prototype is simply a visible or tangible representation of an idea, to be thought of as a probe or thought-experiment; it is not a full-fledged pilot or a preproduction version of the real thing.

Evaluative design research is about building confidence by addressing questions and uncertainties *as they arise*. Frameworks, ideas, and concepts are shared in various ways as prototypes from very early (even in insight-gathering phases) to late in the process in order to learn from other people's reactions, and to check, revise, and refine assumptions.

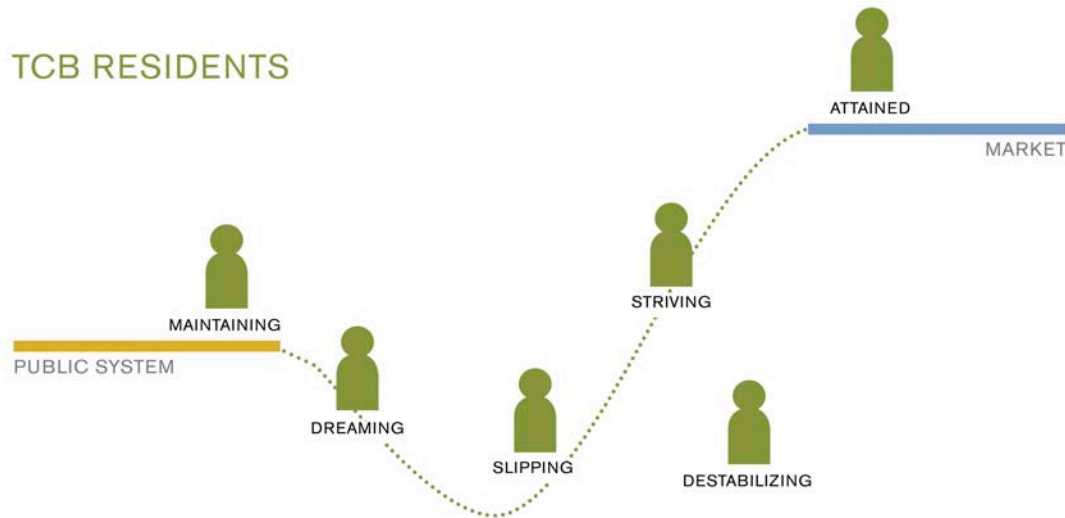


For example, when working with the American Red Cross (ARC) to increase the national blood donor base, spurred by conversations with existing and potential donors, IDEO looked at ways the ARC could refocus its emphasis on the donor as the most valuable asset and gain greater emotional relevance with potential donors. Ideas emerged and IDEO designed and prototyped full-scale spatial layouts, furniture components, service tools and protocols for use in evaluative research around the United States.

3. Predictive design research

Predictive research tries to look ahead to estimate the potential of future opportunities and ideas, primarily from the perspective of their business or organizational viability. How confidently can we really predict whether a radical innovation will be a success? If it were easy, venture capital would no longer be needed and everyone would be an entrepreneur. This type of research is much less well-charted territory

for design, as the unintended consequences of design decisions often surprise, particularly at the level of social innovation. Designers need to be more creative in finding good ways to work through these business and organizational questions, both in helping to define potential opportunities and in determining the viability of ideas.



In-situ experimenting seems to offer great potential to social innovation in enabling accessible, rapid, and considerably lower-risk and lower-cost learning than would a full-fledged launch. For example, The Community Builders, Inc., (TCB), an organization dedicated to developing low-income housing communities in the USA, approached IDEO to examine its approach for helping residents and communities realize their full potential. After team members spent time as guests of low income residents in communities around the country, tangible outcomes were developed as a suite of tools named “Ways and Means.” These are aimed at transforming TCB’s properties from places of residence to arenas of value creation by reorienting offerings from service-based programs to demand-driven opportunities. The tools kits are being tried out in more than 200 situations currently, and will help to evolve the next level of solution.

A similar approach is exploited on an even larger scale by Google, through Google Labs, which has multiple experimental projects running at once and takes full advantage of the nature of hosted software to allow early launches – frequently updated in response to what is learned from users – of what effectively become eternal beta versions of their offering.

In summary at the end of her article, Jane Fulton Suri says;

“Both a personal and an organizational mind-shift are required to get comfortable with the emphasis that design research places on informing our intuition. Like many people in our culture, my formal education placed higher value upon received knowledge than upon personal discovery. But the longer I practice design and innovation, the more I am convinced that true learning comes not only from ready-processed data, but also from concrete sensory evidence and direct subjective experiences that have the power to capture our imaginations and achieve new understanding.”

4. DESIGN RESEARCH *ABOUT* DESIGN

Research about design is not very mature as yet. Most practicing designers *Just Do It*, to quote the Nike slogan, relying on the intuitive nature of their process to yield results. Designers don't worry about underlying principles or postulate theories about methodology. Compare design to the fine arts or poetry. There are plenty of people earning doctorates in the history and theory of fine art and poetry, but nobody expects them to be the same people as those who create excellent art or write beautiful poems.

Korea

Perhaps design is growing up, as interest in design research expands. A methodology for the quantitative assessment of the sustainability management of firms may be the most challenging goal for design research about design, but that is just what Professor Cho, Dong Sung, of the College of Business Administration at Seoul National University, is proposing. The 6th International Design Culture Conference in May was sponsored by the *Korean Design Research Institute* and a *Korean Society of Design Science*. Professor Cho presented a keynote titled *Sustainable Management through Design Creation*.

(Cho 2008)

In his presentation Professor Cho addressed two issues:

- Redesigning the Design Theory for Application to Management.
- Designing a Guideline for Sustainability Management Reporting.

He discussed the objectives of companies and organizations pointing out that there are marked differences between the philosophies applied in different countries. For example:

- In America, the objective is to maximize shareholder value.
- In Europe, the objective is to maximize stakeholder value.
- In Japan, the objective is to maximize employee value.
- In Korea, the objective is to maximize major shareholder (i.e. owner) value.

He gave a critical analysis of existing guidelines for sustainability reporting, pointing out that they are investment driven rather than performance driven, that they impose high hurdles and that they have no auditing. He enlisted the efforts of the BEST (Business Ethics is the Source of Top Performance) Forum, a group of Korean firms inaugurated in 2003, which proposed a sustainability report guideline that was adopted by the Korean government. He explained concepts for the quantification of performance criteria, an auditing system, and the design for a dual reporting system.

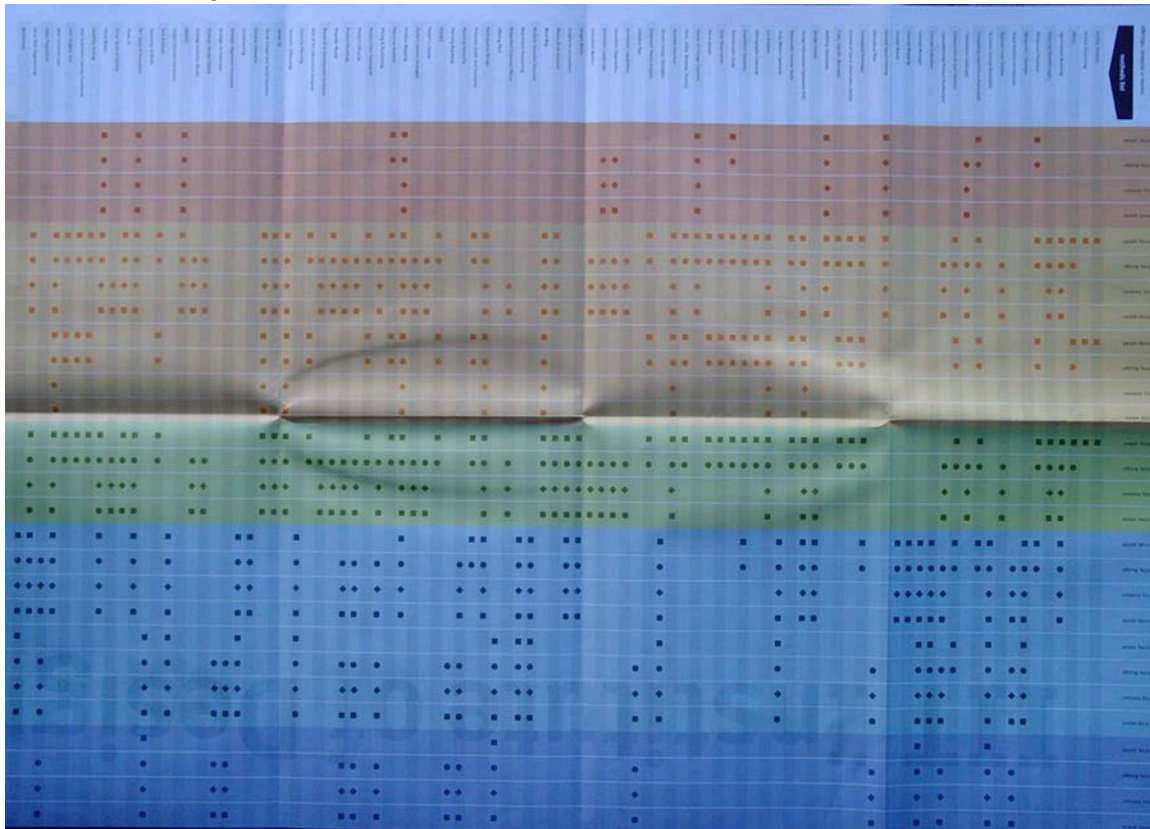
The characteristics of the BEST Guideline embrace subjective criteria such as harmony, balance, unity and rhythm, as well as objective characteristics such as reporting systems, standards, compatibility with other guidelines and report auditing. Professor Cho expects that his new approach will be adopted soon by the Korean government, so perhaps leadership about design research for social innovation and sustainability will come from this initiative.

USA

Most design education in the USA is still very pragmatic, but there are some respected centers of design research. IIT ID in Chicago, where the strongest tradition of Design Research in the USA resides, has published a poster containing over 90 design research methods taught at the school, analyzing them

by mode, so that one can see at a glance where each method can be used, and whether it is focused on users, offerings, company or market.

(IIT Institute of Design)



CMU (Carnegie Mellon University) is another interesting center for ideas about design research. Richard Buchanan, Professor of Design, leads an eclectic and international team of contributors to *Design Issues*, a journal of history, theory and criticism about design, published by The MIT Press.

(Design Issues)

At IDEO, our contribution to design research about design has been to publish team our methods whenever they are evolved to a cohesive level. We have achieved this with our *Methods Cards* describing fifty-one methods for design research. These are all about discovering what people might want and need, revealing opportunities for innovation and inspiring fresh ways of thinking about new possibilities.

(IDEO Methods Cards)

We added ergonomists and psychologists to our staff in the eighties and by the nineties their contribution had proved so valuable that we decided that every project should include their input. As time went by, they evolved a substantial portfolio of tools and techniques. When the number of methods was approaching fifty, one of the team suggested that they represent them as a deck of cards.

The idea of the methods cards is to make a large number of different techniques accessible to all members of a design team and to encourage a creative approach to the search for information and insights as their projects evolve. The intention is to provide a tool that can be used flexibly to sort, browse, search, spread out, or pin up. One can use the cards after a project briefing meeting, working through the pack as if in a game of patience and selecting the most useful set for that particular project in its various phases.

Each of the fifty-one cards contains explanatory text about how and when the method can be used and a brief example of its application to a real design project, with an illustrative and sometimes whimsical image on the other side. The cards are divided into four categories, ranging from the objective to more subjective—Learn, Look, Ask, and Try: “Learn” from the facts you gather,” Look” at what users do, “Ask” them to help, and “Try” it for yourself.

It is generally most valuable to apply, or sometimes modify, a range of different methods for any given project. The most useful set will depend on whether the purpose is primarily a generative one of defining design opportunities for particular kinds of users or a domain of activity, or an evaluative one of refining specific design ideas as they develop. In an evolutionary project, where the new design will be closely related to something that exists, techniques that yield explicit information about a particular context and usage may be valuable. If the project is revolutionary—the design will set a new precedent—methods that help the designer understand a broader domain of activity and related latent needs may be more appropriate.

5. THE DESIGNERS ACCORD

The Designers Accord is a global coalition of designers, educators, researchers, engineers, and corporate leaders, working together to create positive environmental and social impact. Adopting the Designers Accord provides access to a community of peers who share methodologies, resources, and experiences around environmental and social issues in design. Any designer, consultancy, or organization creating consequence at scale should join.

(<http://www.designersaccord.org>)

Valerie Casey is now at IDEO, but she was working with *frog Design* when she instigated this endeavor. Here is how she describes the initiative:

“This proposal began as a personal project, and has grown with the support of a loosely connected and passionate group of people

The inception of the initiative was rather simple. My revelation - or, the "spear through the heart" moment, as one of my green friends calls it - happened as I was sitting on a 50-seater jet, crossing the country for the third time in a month. I had just pitched a packaging project for one of the world's largest delivery services. Earlier in the week, I had discussed new diaper design with one of the world's largest paper product manufacturers.

I was acutely aware of each company's middling environmental record, but I was ill equipped to engage in a productive conversation with either of them about their environmental impact or propose sustainable alternatives. In addition, I was vaguely anxious about bringing up this sensitive issue and possibly losing their business. The negative rhetoric about the cost of green alternatives and accusations of greenwashing has made many companies bristle before a meaningful conversation can even begin.

That was the winter of 2007. At that time, I undertook a program to educate myself and my design teams about green design so that none of us would be in that position again. Throughout my fifteen years of design experience, I have been able to learn about technology, market trends, and organizational behavior, and speak about them with credibility and confidence. I believed I could do that again, with the most critical issue to date. I wrote a "Kyoto Treaty" of Design on that plane trip. Now, with the support of many experienced designers, activists, and thinkers, I feel it is the right time to bring a more developed version of the Treaty - now called The Designers Accord - to the broader design community. I hope you agree.

Thanks, Valerie Casey”

The goal of the Designers Accord is to create positive impact for social innovation and sustainability. There are three ways to join:

- **Adopter** (design firms, corporations, educational institutions) An organized group within the creative community who pledge to work through the guidelines.
- **Supporter** (artists, freelance designers, students) An individual who is making the guidelines relevant to their personal practice. Like adopters, we expect supporters to evangelize the movement within their communities.
- **Endorser** (organizations) Organization that adds awareness to the cause, and can provide infrastructure for education and outreach programs (like AIGA and IDSA).

All adopters, supporters, and endorsers follow a basic code of conduct: do no harm; communicate and collaborate; keep learning, keep teaching; instigate meaningful change; make theory action.

When Valerie started The designers Accord in July of 2007, she managed to enroll 450 people in three countries and covering four design disciplines. Now (June 2008) there are over 100,000 members in 100 countries covering all the design disciplines. This dramatic expansion shows that we are hungry to make a difference by working together for social innovation and sustainability.

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