Design Futures Trend

Complex Problems

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This is one of a series of briefing papers on trends shaping the context for design in the coming decade. It is intended to inform design professionals and educators of processes and concepts adressed by successful design practices.

Our world is no longer one of simple problems. Even when the assignment calls for a discrete object (a book, poster, or website, for example) it is situated within complex systems. Small changes ripple throughout larger systems that are physical, psychological, social, cultural, technological, and economic in their effects. Social media, for example, shift power from producers to consumers, challenge historical notions of etiquette and privacy, and occupy increasing amounts of people's time. Constraints compete for priority and are unstable in their influence on the problem situation. Working at this scale requires a new paradigm to replace a mid–twentieth century focus on the limited issues of appearance and function. "Designers will be required to master certain methods long required in other fields."

—**Danny Stillion**, IDEO Partner

AIGA the professional association for design

Today's design practices trace their origins to twelfth-century European craft guilds. Throughout the centuries, apprentices trained for the design and production of simple objects, perfecting processes and craft through hands-on work under the guidance of a master. The industrial revolution reconfigured work—often separating design from production—but appearance and function remained priorities in promoting the output of a manufacturing economy. Today's design problems, however, are "wicked," poorly defined and with ever-expanding scope. Designers recognize them as situated in complex contexts that exert influence on how solutions perform; on the breadth and depth of consequences. Rather than the creation of distinct objects, the design task is often to build tools and systems through which others can create their own experiences. Amazon offers the affordances for creating a personal reading experience: an exhaustive inventory of titles, reviews from fellow readers, recommendations based on the customer's preferences, and speedy delivery to home or a portable device. Yet Amazon publishes no books. Today's design work extends to the design of services and communities of interest that interact through new models of communication.

Under this expanded mission, craft-driven design processes fall short. Working at the level of systems means that problem components are in interdependent and constantly changing relationships. Linear approaches that address one component or factor at a time are inadequate in addressing dynamic conditions. Stakeholders show a variety of motives and behaviors for engaging with systems. Designers must reconcile competing goals and performance expectations through participatory methods that value stakeholder input and ongoing feedback from the system. And issues of sustainability, technological feasibility, and economic viability are crucial to making design solutions work over time.

See also:
Trend — Accountability for Anticipating Design Outcomes

To be successful in solving complex problems, designers must recognize how systems-level work is different from designing objects; how inputs, processes, outputs, and feedback contribute to system effectiveness. **They must analyze patterns in poorly-defined situations through research, studies of system models and theories of change, and visualization strategies.** They must build connections across disciplines when design knowledge is insufficient for the problem at hand, and they must collaborate in teams comprised of experts from many fields. This work doesn't negate the value of formal elegance or functional efficiency, but instead acknowledges that planning and analysis require equally creative insight and that complex problems are rarely solved by form alone.

Evidence of the trend in practice

See also:
Trend — Resilient Organizations

Designing visual systems — Visual systems are common design assignments for students and professionals. Whether branding or wayfinding, this work addresses problems not only at the level of components, but also at the level of social and technological systems through which diverse audiences and stakeholders engage in a variety of interpretive tasks. More than a coordinated collection of visual elements (logos, typefaces, etc.), **these systems communicate how an organization is structured**, its position with respect to

See also: *Trend — Core Values Matter*

competitors and the larger culture, and its perceptions of the people who provide and use its services. **They reflect values and aspirations, and they guide decisions and accommodate variety in people's behavior**. Even within the graphic simplicity of many visual systems, therefore, there is great responsibility for analyzing and responding to a complex environment.

Today, flexible identity systems respond to rapidly changing conditions. Rather than logos or messages with fixed rules for application, these systems use multiple forms and agile design strategies. Neue Design Studio's branding for remote tourist destinations in northern Norway updates a graphic symbol every five minutes as wind directions and temperatures change. Economical in its visual simplicity, the tourist website unites the competing concerns of several small communities under a common interest in nature, and alerts visitors to weather conditions as they make travel decisions.

Pentagram's design of signage for the Museum of Arts and Design responds to individual visitor interests. Museum-goers locate artifacts in exhibitions through interactive touch-screen panels that provide bird's-eye and detailed views. The system, therefore, responds to variety in individual visitor queries, a technological interpretation of "the right information at the right time" that also guided the design of more conventional exhibition and wayfinding systems of the past.

A student project with Cisco Systems asked for a visual language that differentiated dynamic spreadsheet data on the company's telecommunications hardware testing. Equipment test results were updated every three minutes around the clock, with varying implications for delivering hardware solutions on time and within budget. Managers, each with diverse responsibilities worldwide, tracked dozens of components, making quick decisions to deploy resources based on the relative urgency of cascading consequences. The automated visual coding system had to identify patterns in the data and also suggest actions required for appropriate managers to assess potential risks.

See also: *Trend — Core Values Matter*

Designing social systems — Many "social innovation" projects confuse subject matter or the good intentions of clients with the complex nature of social challenges. Visual artifacts alone, such as logos and slogans, rarely solve complicated social problems. **Meaningful and sustainable change is only possible when addressed at the level of interacting systems**.

International design and consulting firm IDEO organizes its work around "big questions" arising from this social complexity: how design can advance education; how government can be more citizen-centered; how healthcare can be personalized; and how creative organizations can be more agile.[1] Known for its human-centered process, deep-dive brainstorming strategies, and inventory of research methods, the firm took on the task of scaling a network of schools for the growing Peruvian middle class. IDEO developed the curriculum, teaching strategies, buildings, operational plans, and underlying financial model to run a network of Innova Schools. Because the project included developing a business model for the company as well as the school experience,

1. IDEO, retrieved in 2017 from "Building Schools from the Ground Up"

Innova was able to reinvest profits, opening 41 schools for 32,000 students—one of the most ambitious private school networks in Latin America.

Designing technological systems — The challenge in designing technological systems is reconciling the competing priorities of technical feasibility, functional usability, what people want technology to do, and the demands of site-specific use. While a variety of experts contribute to this effort, the role of the designer is increasingly more than crafting the look and feel of a digital screen. **The design of these systems requires a deep understanding of users, context, and how technology works**.

See also:
Trend — Bridging Digital and Physical Experiences; Trend — Accountability for Anticipating Design Outcomes; and *Trend — Making Sense in the Data Economy*

Frog design's work with the United Nations Office for the Coordination of-Humanitarian Affairs resulted in HDX, the *Humanitarian Data Exchange*, a technological platform that assists relief workers from the UN, NGOs, government, and universities by sharing data in disaster situations. HDX displays give relief workers and the public access to critical information, using a visual language that is intuitive and that eliminates the need to master complicated tools while responding to chaotic and often dangerous conditions. Since its launch in 2014, the system has assisted 100,000 unique users in 200 locations around the globe. More than 160 organizations share data and the system is an essential tool of the Red Cross and journalists covering disaster relief.[1]

Oncologists in community hospitals provide an estimated 70 percent of cancer care in the United States, with many lacking specialized genomic information and testing for patients. Under a partnership with IBM, community doctors send patients' tumor biopsies for lab testing and clinical interpretation to Quest Diagnostics. Watson—IBM's computer system capable of answering questions posed in natural language—was used to search millions of pages of medical literature to identify therapies associated with a specific patient's tumor and prepare a report that the local doctor then uses in developing a personalized treatment plan. This *Watson Genomics* project recognizes that computers and humans use language differently and seeks actionable insights

in data. Watson's system design continually learns what to look for from users and improves healthcare solutions in places that would otherwise be limited by the individual experiences of doctors.[2]

Core concepts and principles:

Wicked problems — Design theorist Horst Rittel defined wicked problems as: unique, having potential to be described in multiple ways, often a symptom of another problem, and lacking a clear rule for stopping work or testing a solution.[3] Rittel pointed out that simple problems are easily solved because defining them also defines the solution, yet they rarely result in innovation. He accepted the definition of a problem as subjective, suggesting that both designers and stakeholders are equally knowledgeable. Rittel asserted that

1. Frog, retrieved in 2017 from "UN OCHA Humanitation Data Exchange"

2. IBM, retrieved in 2017 from Watson AI stories

3. Rittel, Horst W. J.; Webber, Melvin M. (1973). "Dilemmas in a General Theory of Planning" (PDF). *Policy Sciences*. 4: 155–169. doi:10.1007/bf01405730. Archived from the original (PDF) on 30 September 2007.

one person cannot keep track of all variables and that the process for taming wicked problems is one of argument and is inherently political.[1]

These characteristics argue for design professionals and students framing problems as well as solving them; for identifying relevant issues and opportunities in a situation and suggesting workable problem boundaries when goals and alternatives are not clear. Academic programs that consistently present students with limited problem constraints and obvious project parameters fall short in developing these skills. When faculty or clients define assignments primarily in terms of format (poster, website, or mobile app, for example)—in the absence of analysis that recommends a particular tangible form over others—they assume that the format is a "best fit" with the full array of factors that make up the problem. Under such definitions, the task for the student or practitioner is to determine the physical attributes of the assigned object, not the unknown dimensions of a systems-level problem; an answer in search of a question.

Systems — A system is a regularly interacting collection of interdependent elements organized in a way that achieves a specific function or purpose. Systems involve inputs, processes, outputs, and feedback. Inputs are anything that goes into the system to produce outputs, including information, resources, tools, labor, and time. Processes are the workings of the system that actually transform inputs into outputs. Feedback is information the system needs to make adjustments during the transformation process. The work of designers is often to use feedback and research to identify leverage points, places where changes in the inputs or processes of the system result in significant positive outcomes. Even when the design project is defined at the component level, it is important to understand its position or role in the work of larger systems.

The elements that make up a system are usually easy to see, but the relationships among them are often informal or invisible and require research. Tacit rules for how an online community governs its behavior or the relationship between intellectual property law and the styling of everyday products, for example, may not be obvious aspects of technological and cultural systems. Likewise, the function or purpose of a system may not be what it seems.

Over-packaging small items sold in the check-out line of a supermarket may appear to protect products, when the real purpose is to make shoplifting a less likely output of a service system. Visually mapping the system identifies relationships and allows the project team to weigh the contributions of various factors in achieving the overall purpose of the system.

A new design paradigm — Much of the work in solving problems at the systems level is in analysis and planning, not in physical production. It is distributed across experts from a variety of disciplines with different worldviews who work closely as a team. A knowledge economy seeks to manage complexity, not to hide it in deceptively simple forms and strategies. It does so through bottom-up processes in which good ideas come from anywhere and the designer is a facilitator, not an author. Emphasis is on building agreement across diverse team members and stakeholders rather than on

1. Dubberly and Rith. (2007). "Why Horst WJ Rittel Matters." *Design Issues*: Volume 23, Number 1, Winter 2007.

controlling decision-making. And the stopping condition is "good enough for now," rather than "almost perfect," because continuous updating is likely to occur as conditions change.[1]

This paradigm shift has enormous implications for where professionals and students spend their time in the design process and the criteria used to judge their work. It also influences who is admitted to study in the field and who has a place at the table in professional work. Attention to detail remains a high priority, however, well-crafted appearance cannot overcome poorly reasoned analysis and strategy. The velocity of change in conditions that affect these systems argues for efficient and effective processes that embed feedback loops through which users actually co-create the next iteration of a solution by interacting with the system.

Interdisciplinarity — Historically, interdisciplinary activity involved various design fields. Architects worked on buildings, industrial designers designed furniture and fixtures, and graphic designers addressed wayfinding and presentations. In college design programs, this combination of skills represented a convenient way to engage disciplines in close physical and conceptual proximity. The complex problems of today, however, require knowledge and skills well beyond the typical domains of design. Anthropologists, psychologists, computer scientists, cultural theorists, business strategists, data scientists, and other specialists now participate in the development of design solutions.

See also:
Trend — Accountability for Anticipating Design Outcomes

Some interdisciplinary work involves the use of research findings or theories from another field. This means designers must be well read beyond their own discipline in order to understand the perspectives and modes of inquiry in other professions. In other cases, designers borrow methods for application in a new setting. Adaptation of these methods for meeting design purposes is often necessary. In all cases, the reasons to engage with fields other than design is to expand the scope of opportunities in which design may have influence and to inform design solutions through expertise and perspectives that reflect the complexity of the problem.

Interdisciplinary work also requires particular team skills: facilitating consensus on the meaning of terms and concepts relevant to the problem, understanding the characteristic modes of inquiry of team partners, making explicit contrasting values and standards, and reaching agreement on theories of action through which the team does its work.

Challenges for designers

Working at the level of systems requires methods that account for accelerating change and the ever-expanding scale of contemporary problems. Deterministic processes used to design objects address one area of friction and then move on to the next. Complex problems are dynamic. Constraints change and argue against fixed features and functions. Therefore, designers must not only develop methods appropriate to an expanded scope of work, but also address the velocity of change.

1. Retrieved in 2017 from Dubberly Design Office: A Model of Innovation

See also:
Trend — Resilient Organizations

While the human-centered focus of design makes designers open to new methods and perspectives for social and cultural analysis, technology presents a novel set of challenges beyond the traditional concerns of production. **A *platform* is a set of components and protocols through which companies and organizations deliver services to customers**. The purpose of a platform is to allow the rapid development of new products and services, either by an organization or by others. The technological platforms that support complex communication and service systems control what is and is not possible; narrow passes through which others must navigate. They contain algorithmic biases that favor their developers. If designers are to participate and lead the future of technology, they must partner with engineers in developing new platforms that meet and adapt to evolving needs.

The challenge for college and university design programs, therefore, is to hire faculty who can teach students to innovate at a technological-systems level, beyond software use, or to form partnerships with technologists who are sympathetic to design issues. This is not a short-term problem and raises questions about threshold qualifications for faculty hiring in art and design programs, as well as the content of graduate programs that prepare the professoriate in design.

The challenge for professionals is in examining design problems at various scales (component, object, system, interacting systems); in determining the relevant scope of work, competing constraints, appropriate methods, and disciplinary partners best matched to the true nature of the task.

Competencies:

College student competencies:

- **Students should frame design problems at various scales, nested at the level of components, products, systems, and communities.** They should have opportunities to respond to open-ended briefs with ongoing responsibility for negotiating the boundaries of problems and for ranking priorities within a well-researched list of constraints and opportunities. Design solutions should be critiqued in terms of the fit with physical, social, cultural, technological, and economic contexts, and the definition of those contexts should be open to criticism as well.

- **Students should identify and visually map the interdependent relationships among people, places, things, and activities in a complex system.** They should develop concept mapping, diagramming, and systems modeling skills that assist in the analysis and articulation of complex problems. They should identify and justify “territories” for investigation within maps and models, acknowledging their position within a larger network of issues and forces.

- **Students should locate leverage points where changes can produce differences in the state of the system and experiences of stakeholders.** They should develop scenarios and personas that describe the varied experiences of stakeholders under these variables. They should visualize users' journeys as a series of motivated actions that constitute discrete episodes of larger experiences, describing elements and forces within the system that affect decisions and outcomes. They should identify feedback loops for recognizing and responding to changes in the forces that affect the system.

- **Students should evaluate design solutions for their short- and long-term physical, social, cultural, technological, and economic effects.** They should anticipate evolving conditions and think in terms of lifespan relationships.

- **Students should identify the nature of values and modes of inquiry in various disciplines that contribute to the successful solution of complex design problems.** They should collaborate with students and experts from a variety of disciplines, facilitating agreement on terminology, concepts, principles, and processes that lead to a shared design solution. They should make effective use of content acquired through general education coursework. **Students should engage in conversation and group decision-making processes that support building consensus around systems thinking.**

Professional continuing education should address:

- Recognizing self-learning, including in fields beyond design, as necessary for adapting to constant change;

- Using tools, methods, and processes for developing adaptive design solutions that account for continuous updating under constraints that change over time;

- Employing tools, methods, and processes for negotiating among multiple stakeholder groups that have conflicting agendas;

- Facilitating users and diverse professionals in co-creating desirable futures and pathways for transitioning from current to future conditions; and

- Collaborating and managing interdisciplinary teams.

Resources

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