Design in the Generative Economy

An Interview with Youngjin Yoo

Youngjin Yoo talks with Jim Euchner about the generative economy emerging as a result of digital technology and its implications for design and innovation

Youngjin Yoo with Jim Euchner

Digital technology is clearly changing the products and services that we use every day, but Youngjin Yoo sees a much more fundamental change. He believes the rise of digital technology is changing the very essence of products, making them generative—in other words, users create their own applications rather than consuming a preconceived product in a preconceived way. Truly generative products are not just digital versions of the old, but new solutions that meet needs in starkly different ways. The emergence of the generative economy results from the convergence of industries, the emergence of innovation platforms, and the engagement of users in the development of their own products. The roles of designers and managers need to change to take advantage of the opportunities created by this shift. In this interview, Professor Yoo, an educator and designer, discusses digital technologies and frameworks for thinking about them.

JIM EUCHNER [JE]: I'd like to begin with the notion of the generative economy. What do you mean by that?

YOUNGJIN YOO [YY]: A generative economy results when one actor's production leads to the creation of new innovations that were not necessarily intended by the original inventor. The Internet is a generative technology. I do not think that the inventors of the Internet foresaw everything we are doing with the Internet.

It used to be that we created new economic value solely based on the use of physical machines to transform natural resources into physical products. The primary engine of economic development and value creation in this world was access to scarce resources that others did not have. This was (and is) the physical economy.

Companies moved beyond this to create symbolic cultural value for products, but these were also created with the same limited (physical) resources. This is what I call the experiential economy: the value of consumption that arises not purely from the utilitarian function of the product, but rather from the cultural symbolic value that we enjoy when we use the product. It's includes, for example, aesthetic value—the refined design of a car or the pattern of leather on a handbag. The product performs the same function, but aesthetically delivers something extra. That's the experiential economy.

The information economy results when the transactions of the physical product produce information as a by-product. In the information economy, information is used in order to control the complexity of the use of the product, as well as to manage its production. Those are the primary value propositions of the information economy.

But in the generative economy, information is the primary product. Information is not the by-product of a physical product that exists in the world: rather, the bits come first, and they point to atoms in the physical world. Because of the way digital technology is constructed, it is incredibly malleable, which allows people to create new combinations in a very flexible and scalable way.

That's the difference between the information economy and the generative economy. Information economies focus on information, but the information is derivative of the physical world. In the generative economy, information is what drives everything and the physical world is derivative of the information.

Think about the analogy with biology. DNA is physical, the four amino acids that make up the molecule, but they are

Youngjin Yoo is the Harry A. Cochran Professor in Management Information Systems and the director of the Center for Design+Innovation at Fox School of Management at Temple University. He is also WBS Distinguished Research Environment Professor at Warwick Business School, UK, and is a visiting faculty member at the Indian Business School. He researches digital innovation, design, and experiential computing; his work has been published in leading academic journals, including *MIS Quarterly*, and *Information Systems Management Journal*. He has worked with leading companies, including Samsung Electronics, American Greetings, Bendix, Moen, Intel, Andersen Consulting, Lotus, NASA, Parker Hannifin, and Poly One, among others. youngjin.yoo@temple.edu

Jim Euchner is editor-in-chief of *Research-Technology Management* and vice president of global innovation at Goodyear. He previously held senior management positions in the leadership of innovation at Pitney Bowes and Bell Atlantic. He holds BS and MS degrees in mechanical and aerospace engineering from Cornell and Princeton Universities, respectively, and an MBA from Southern Methodist University. euchner@iriweb.org

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not as important as the information that they carry. That information is decoded to produce proteins, which also become physical. Our biological system is an information-driven system, and that's why I think it is incredibly generative.

JE: You make the point that innovation in this generative world is, in its essence, very different. What makes innovation in the digital space so different?

YY: The fundamental aspect of digital technology is that it is meant to be programmable. In the past, when we talked about innovation, we talked about innovation of a product: we knew what it was supposed to do when we designed it. We innovated by enhancing its functionality and performance. Innovation often meant using technology to do the same thing better or cheaper.

Digital technology is interesting because it is by definition intended *not* to have any single specific goal. What John von Neumann and Allen Turing wanted to create was a general-purpose computation machine: as long as you can create the particular program, you can do anything you want, whether it's playing games, reading a book, playing music, drawing a photo, or inventing the computer itself. The basic technology enables you to do anything you want. That's very, very important.

In the past, designers came up with an idea for a product, which was typically represented as a combination of form and function. The extent to which you could push that transformation depended on the current state of the art of science and technology. As technology developed, designers found new ways of twisting, extending, extracting new form and function out of the same material. That's typically how innovation has taken place.

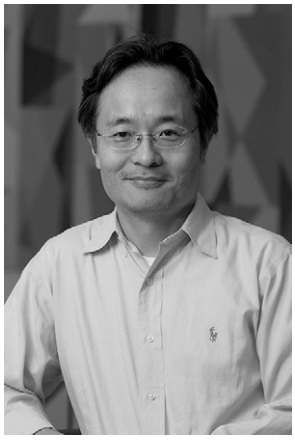
But once designers were done, the product was defined; it's what I call *early and permanent binding of form and function*. With digital technology, the binding of form and function is permanently *delayed* or procrastinated. The product or service is complete only at the time of its consumption, if you will. There is a temporary and procrastinated binding of form and function in these products.

This changes the way producers need to think about innovation. Open source and open innovation, crowd innovation, and platform innovation—all are enabled by digital technology precisely because of this procrastinated and temporary binding of form and function.

JE: That's a fascinating concept. Designers now have to put themselves into the meta-space of the functions they might want to enable. How do people get into the mind state that lets them be effective designers of procrastinated binding systems?

YY: That's the million-dollar question. Let me answer by giving you an example, the latest innovations that came out of Apple, the iPhone 6 and the Apple Watch.

First let me say that I think that the focus on product is a diversionary strategy for Apple. The real innovation is taking



Youngjin Yoo studies how digital technology is changing the very nature of products, and the roles of designers in creating those products.

place at the level of their operating systems [iOS and Mac OS] and their APIs [application programming interfaces] and SDK [software development kit]. The real innovation is in how they are preparing the enabling technology for payment, Internet of Things, and healthcare applications. They are thinking in an incredibly rigorous and deliberate way about who will come into their space and play with them. They are asking what they need to do to convince others to use the technology they are developing and the data they are collecting. How should they engage Visa, American Express, Mastercard, healthcare providers, and insurance companies? Which industrial product manufacturers will embrace their iOS ecosystem? How can they make their technology accessible, but in a way that still allows them to be in a control position, to extract some economic rent?

People pay attention to the iPhone, but there's not much innovation there. If you look at the iPhone as a permanent binding of form and function, the new iPhone doesn't offer much. But Apple has added a whole new set of sensors, a whole new set of libraries and APIs; they're opening up new data ports, providing access to sensors in a way that no one has before.

Designers need to engage in this type of thinking as well as designing the core product. Of course, if the product they sell, which is the main contact point with the user, isn't appealing, it doesn't matter what they do with all the other stuff, because nobody's going to buy their product. But that alone will not make them successful in this generative space. A broader, deeper kind of design thinking that goes beyond the product, to consider the whole ecosystem that keeps the user experience in the center, needs to take place.

JE: Are there other examples of companies that have been successful in this space?

YY: We just finished a study on WordPress, which is the world's largest blog engine. The reason WordPress is popular is because it is infinitely customizable. And the reason it is customizable is because of all the plug-ins it has inspired. In the same way that the Apple iPhone has apps, WordPress has plug-ins. A large majority of those—99 percent—are created

by third-party developers. What WordPress did was to open up their APIs, and others came in and played with them and created a whole host of plug-ins so that end users, who are website designers, can design websites in the way that they would like to. It's a very generative ecosystem.

The PC ecosystem was also very generative. In 1990, Intel decided to change its main architecture from ISA, which was closed. The new architecture, PCI, which eventually led to the creation of USB, for example, allowed others to plug in all sorts of different hardware that could perform different functions. That's another example of generative technology design.

JE: Is anybody doing this well in traditional industries—automotive or construction equipment or air conditioners, or anything like that?

YY: I studied a European automaker that doesn't exist anymore. They pursued this idea of generative technology as part of their strategy. They decided to create an Android-based car; their infotainment system—all the radios and navigation—was going to be replaced with one generic box run by Android and an app store optimized for cars. And they opened up the app store to all sorts of developers.

They eventually made it work, but the company ran out of cash. And after the global financial crisis, when GM and Ford were divesting from European partners, the company went bankrupt, so nothing happened. But they actually had a prototype that was ready for the 2013 market in the U.S.

The most difficult parts of the project were not technical issues; they were organizational issues. Legal and marketing and supply chain people just went nuts. They said, "No, no, no. You cannot do this." It ran against an established relationship between suppliers and automakers, which was that automakers design and specify and suppliers supply. This new concept promised to change things in a major way. Legal people were asking, "What if someone crashes their car? We won't know if it's a software glitch in one of the apps." In the end, they decided to go forward, but it was one of the most difficult aspects of the project.

The challenge for traditional companies is that they are not really designed to deal with the organizational changes required, and they are not designed to think in a generative way, either. These companies hire very smart people to be specialists in vertical domains. I have found this often: while software and information people move across verticals, a lot of industrial people move up and down a vertical. There is a very difficult tension between the two logics. That's the challenge that many companies are facing in their pursuit of digital innovation, and the challenge will only grow as companies embrace things like the Internet of Things.

JE: You have spoken about the paradox of digital artifacts: that just overlaying digital technology on an existing design may not make sense. In other words, a digital product is not just a smart version of an old product. You used the example of the "smart idiot box."

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How do you know what the right unit of analysis is for reconceiving products? A phone or a computer is one level; an app is another. A car is one level, and a tire is another. Does re-conceptualizing a tire (for example) really redefine its role within the automobile as opposed to redefining the product itself?

YY: I think that focusing on things will never get you there. You need to focus on people's experiences and their activities. Only then can you truly discover new opportunities.

People say that no one reads the news anymore, but that's just not true. People do get news, it's just that they do not get it by reading traditional newspapers. They get news through Twitter; they get it through Facebook; they get it through all sorts of different venues. We read the news, but we do not use the newspaper as a product. A big challenge that many companies face is that they have become very noun-centric.

I worked with a major greeting card manufacturer once. I asked them, "Who is your competitor?" and they all named the other card company. I said, "No, you're wrong. Your competitor is Facebook and Twitter and email. Both of you are being killed by Facebook and Twitter." When my son turned 16, he received two physical cards, one from me and my wife and one from his brother. He received about 150 messages on his Facebook wall saying "Happy birthday."

People still celebrate and congratulate; that's a verb. They may not use a card, which is a noun, to do so, but they still celebrate. If you see yourself as a company that sells acts of congratulations and acts of celebration, then you will manage the transition: you will be able to drop your noun at any time in order to keep the verb. The problem is that many companies are so tied to their nouns (their products) that they forget what they're about (their verbs).

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I was talking to guy at a world-leading TV manufacturer, one of the members of the team that developed their new TV. These guys moved to the company's refrigerator line, and they are approaching things the right way. They actually spend a lot of time cooking, a lot of time playing videogames. They don't focus on competitors' products. What they focus on is understanding what it means to cook. What's the value of cooking, the experience of cooking? What are the pain points of cooking? Who are the cookers?

They worked with master chefs during their product development, but they themselves became really passionate about the verb (cooking). And from there, they produced new ideas that drove their innovation activities.

It is really, really important for companies to move their eyes off of the noun and onto the verb and the context in which that verb is taking place. The noun is just a temporary package from my standpoint. And it may be that for the last 200 years, that package was the only way to achieve the function. But that changed in the past and might change in the future. If you really want to be innovative, you need to take your eyes off the thing.

JE: How do you advise people to think about the level at which to approach design? It is a many-layered thing?

YY: The big framework starts with mobile technology, which is one of the most personal and intimate technologies, one that we carry with us all the time [see Figure 1]. It's the entry point to the digital world for many of us on a daily basis. We can expand the concept slightly by talking about smart personal devices, which might include cars, smart home interfaces, and so on. These are fundamentally personal smart devices that we interact with on a daily basis—not for computing but for doing—for living, listening to music, eating, working, and so on.

Those things are interacting with a large data infrastructure, what we call the Internet of Things. It is sometimes called the industrial Internet, and it includes sensors everywhere, for example, the sensors in cars that may not interact with the user directly, but that collect data on the tire and the movement of the car and the health of the engine and so forth. It also includes all the sensors in a building, or in a chopstick that might calculate how many times it is lifted during a dinner.

All of these sensors generate a tremendous amount of data that interacts with our personal devices. Sometimes the sensors monitor our behavior without the help of our personal technology; they just generate data and send it to the cloud. Big data analytics tries to use this data to understand what's going on and what it means. The outcome of the analytics becomes the basis of cloud services that intervene with what we do, often through those mobile devices: What should I eat? What should I read? What should I listen to?

I use Spotify for my music, and Spotify constantly tells me what to listen to. Facebook constantly tells me which Internet links to click. Amazon advises me on the books I should read. The *New York Times* tells me what article might be of interest. Google tells me how to drive.

Our behaviors are being constantly monitored, and yet at the same time they are being regulated through these technologies. This is why I call our world an algorithmic and computed reality: so much of what we do is being computed. The reality that I experience is the result of computation that is taking place somewhere on some server on someone's hardware. This computed reality affects my life: it influences my movement in time and space and the way I interact with other things and other people.

JE: As you noted, at the center of all this technology is a computed reality that changes the customer experience. How do designers think about creating the new user experience? You start, as you said, with what users are trying to do and their activities and their context. After that, is there a particular entry point fine for thinking this through? Is there always a closed loop, from the user and back to the user, or do you see lots of nested open loops?

YY: Innovation and design are the result of an iterative process between the user experience that you envision and the type of resources that you can mobilize to shape that user experience. It's also partly a question of the type of alliances you want to form to enable that experience, and the type of control you want to have in the space.

These are very high-level strategic decisions you need to make to be successful. Let's say that the driving experience is at every moment a computed experience. As a tire manufacturer, you want to create the tire as part of the computed ecosystem. What kind of data can it generate and how might that data intelligently shape and reshape user experiences? Who are the users in this ecosystem? Are they the drivers or a broader set of actors? If the vehicle is an industrial truck, what are the experiences of the fleet managers and maintenance managers? How does the data change their day-to-day jobs?

You need to start from there, and only then do you come back to your own set of resources. If you need a cloud service that collects data and does some kind of analytics to help improve drivers' experiences, how do you create it? Should you make it? Buy it? Form an alliance with a cloud service provider? The primary goal of the designer is developing a compelling vision of the future user experience that can be only implemented with your product and service as part of it. He or she needs to visualize the future state; they need to make it very vivid and concrete.

The primary role of the designer is the visualization of the future. The type of investments that we are talking about are very risky, futuristic, and difficult to make. But managers cannot make decisions based on ideas alone or solely on numbers. The designer who visualizes the future needs to create artifacts—a prototype, a movie or a concrete scenario—that helps to make the future tangible.

Good executives can make pretty solid decisions once they see what the future looks like. They might still be wrong—people make lots of mistakes—but they can be more confident if they have a picture of the future. They can

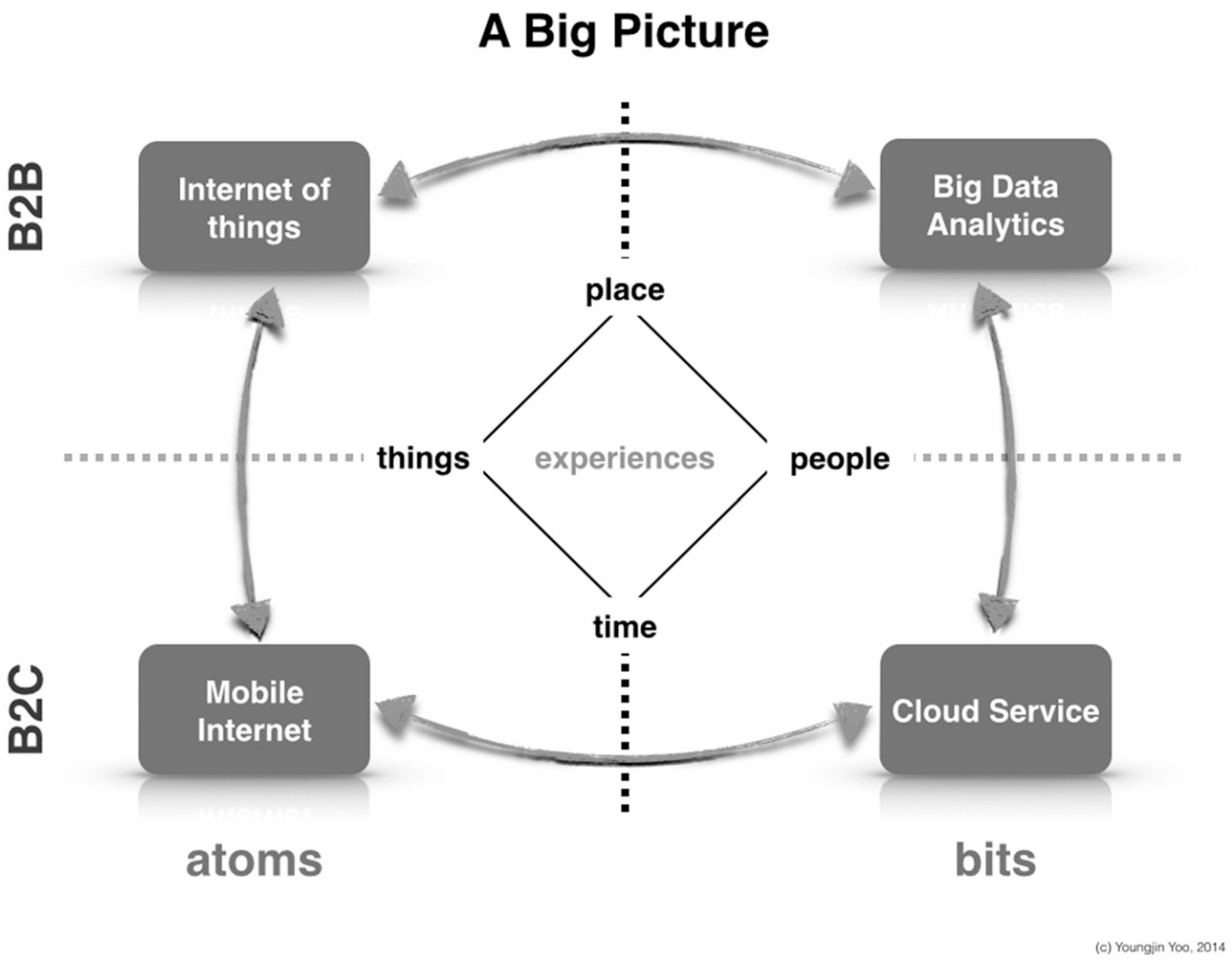

FIGURE 1. Yoo's framework for thinking about the digital world

ground their long-term decisions on something tangible. And I think that's what design brings to the table, especially when it comes to digital innovation. That's my biased opinion.

JE: Digital technology is a new world for design, then—not just a new medium. It's tremendously disruptive. You have said that "digital deconstructs and design reconstructs." Can you say more about that?

YY: Traditional industries are protected by vertical silos. A product is the centerpiece of each of these silos. But what digital technologies do—because digital technology is programmable—is to separate form from function. Because the digital signal is universal, it separates the contents from the delivery mechanism. This is what I mean when I say digital deconstructs.

There are four basic layers of any product that we can think of—you can map almost anything against, roughly speaking: the distribution channel, the content, the hardware, and the service. The traditional product creates a very tight coupling among these four, and it is hardened. It's a socially accepted and legitimized and institutionalized combination of these four elements.

What digital technology enables is the separation of these four things from one another. Once they are separate, they can be combined with elements from other verticals, leading to a convergence of industries. The whole economy is now going through a massive, imaginative recombination exercise, and whoever comes up with the right combination—the one that appeals best to the market—is going to win. Disciplined imagining about the recombination is what I call design.

JE: It seems to me that one has to operate different levels of abstraction if one is going to make this work. Can you talk about some of the tools and ways of thinking that digital designers use? How do they create a new digital thing instead of a digital old thing?

YY: Reimagining four different layers of products and creating a digital product requires that you bring six disciplines together—industrial design, material engineering, mechanical

Seven Properties of Digital Artifacts

In Yoo's formulation, generative digital products have seven properties. Digital artifacts are:

- **Programmable.** Digital artifacts can accept new commands to modify their behavior and function; this ability is provided by embedded software.
- **Addressable.** Digital artifacts can respond individually to messages sent to many artifacts; this ability is provided by standardized protocols, such as IP addresses.
- **Sensible.** Digital artifacts can monitor and respond to changes in the environment; this ability is provided by a combination of sensors and embedded software.
- **Communicative.** Digital artifacts can communicate with other artifacts; this ability is provided by the availability of a communication network and by addressability.
- **Memorizable.** Digital artifacts can store the information they generate, sense, or communicate; this ability is provided by internal or external memory devices.
- **Traceable.** Digital artifacts can chronologically interrelate events and entities over time; this ability is provided by a system of unique identifiers for events and entities (such as a time and location stamp) and memorizability.
- **Associable.** Digital artifacts can be related and identified with other entities (such as other artifacts, places, or people) based on shared attributes; this ability is provided by tags, keywords, or affiliation patterns.

See Youngjin Yoo, Computing in Everyday Life: A Call for Research on Experiential Computing, *MIS Quarterly* 34, no. 2 (2010), pp. 213–231.

engineering, UX design, software engineering, and electrical engineering. On the hardware side, industrial designers work with mechanical engineers and materials engineers; they need to know materials and how those materials can be shaped and stamped and formed. On the software side, UX designers have to understand electronics and software; they have to understand digital design and interaction design and visual aspects of these elements. When you do digital innovations, these six disciplines need to all come together.

It's not about new tools, per se. It is more about working across disciplines in a different way. I think that is the challenge.

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Only a very few companies do it well. Even the great ones stumble. Apple struggled with the cloud in a major way. Google is good at the cloud, but not very good at products.

JE: You have defined seven properties of digital artifacts. [See "Seven Properties of Digital Artifacts," p. ***XX***.] Do designers use those directly? Do they ask, "How do I make the solution programmable?" or "How do I leverage traceability?"

YY: I came up with the seven properties of digital artifacts after a great deal of struggle in how to characterize them. I think of them as design options. For any given product design, you have an option of adding any one of those seven properties, or some combination. That's one design decision that you need to make.

After that, you have to decide how you're actually going to implement the property. So, for instance, suppose you want to make your offering traceable. How detailed is the traceability going to be? That's a design question. You need to think about it from the user experience standpoint and from a resource and engineering implementation standpoint—how the traceability will interact with battery power and the casing of the product, for example, as well as the social consciousness and privacy of the user. How do you create a balance between those different requirements, all of which relate to traceability?

Take it further. Say you hand off from one context to another, from a car to inside a building—how do you handle that transition? That's another very specific design decision one has to think about. When my colleague worked on Bluetooth implementation for a car, the first thing that the team did was a user study. They found that a lot of people were on the phone while they were entering their car, and they had to put the phone down to start the engine. The team decided that Bluetooth should boot up the moment the door gets opened, so that by the time the driver sits in his or her seat, the phone has taken over. These are very, very minor details, but they are the types of things that designers do very well.

JE: What kind of new skill sets do you think R&D leadership in industrial companies is going to need to win in the digital space?

YY: First, they need to learn more about the nature of digital technology – they need to understand what is different about it. Second, they need to be students of human beings: how we live, what matters to us, what experiences are important. A lot of innovation people come from science and engineering backgrounds, not necessarily from the humanities or sociology. I think that, at the end of the day, we are selling products that change people's lives. Unless you become a student of human beings and human lives, I don't think you can change them.

JE: What advice do you have for those who are trying to manage the transition? If products (nouns) are not what is most important, but experiences (verbs) are, does R&D become something very different?

YY: I think that people in R&D really need to embrace the challenge of digital design. The reality of the corporate world is that you need to produce results, so you can't just walk away from your product overnight. But you really need to allow people to challenge your noun.

I think that R&D managers should see themselves as designers and think of themselves as people who are designing a new future for humanity, creating something that the world has never seen before.

What do R&D managers need to do differently? They need to bring the attitude of the architect, or the master builder, to the table, not just the attitude of process management, gatekeeping, and managing variances.

R&D managers need to see their own world as one of design, of pushing limits. The solution you have can always be made better if you work hard enough, if you think hard enough. That's what I call the design attitude.

As a manager, you can ask people, "Is this the best that you can come up with?" Make sure that people really, really work hard to come up with the best solution. And then, just one more time, push them. People will really be challenged, but designers are accustomed to that way of working. When you make that last push, that's when you get really, really creative ideas. Designers are trained to make that extra push, but a lot of managers and engineers are not. That's what I would suggest R&D leaders in the future do.

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