Technology First, Needs Last: The Research-Product Gulf

Don Norman

I've come to a disconcerting conclusion: Design research is great when it comes to improving existing product categories, but essentially useless when it comes to breakthroughs. I reached this conclusion through examining of a range of product innovations, most especially looking at those major conceptual breakthroughs that have had a huge impact upon society as well as the more common, mundane, small, continual improvements. Call one a conceptual breakthrough, the other incremental. Although we would prefer to believe conceptual breakthroughs occur because of a detailed consideration of human needs, especially fundamental but unspoken hidden needs so beloved by the design research community, the fact is that it simply doesn't happen.

New conceptual breakthroughs are invariably driven by the development of new technologies. The new technologies, in turn, inspire technologists to invent things. Not sometimes because they themselves dream of having their capabilities, but many times simply because they can build them. Other words, grand conceptual inventions happen because technology has finally made them possible. Do people need them? That question is answered over the next several decades as the technology moves from technical demonstration, to product, to failure, or perhaps to slow acceptance in the commercial world where slowly, after considerable time, the products and applications jointly evolve, and slowly the need develops.

Are flush toilets, indoor plumbing, electric lighting, automobiles, airplanes, or modern telecommunication essential needs? Civilization got along quite well without them for thousands of years. Today many consider them not just needs but essentials. And every one of these was driven by technology.

Revolutionary innovation is what design companies prefer, what design contests reinforce, and what most consultants love to preach. But if you examine the business impact of innovation, you will soon discover that the most frequent gains come from the small, incremental innovations—changes that lower costs, add some simple features, and smooth out the rough edges of a product. Most innovations are small, relatively simple, and fit comfortably into the established rhythm and competencies of the existing product-delivery cycle.

Successful revolutionary innovation is rare. In any given arena, it happens only a few times per decade. Why? In part because it is difficult to invent a new concept that truly fits people's lives and needs. In part, it is because existing products already satisfy most people, and when the new concepts appear, the older, existing technologies have a remarkable way of rising to the challenge and sustaining themselves for years-decades even—long after people think they would disappear. How long did it take the train to overtake the canal as a means of shipping goods? How long did it take the automobile to overtake the horse and carriage as a means of transportation? Think decades. Even simple innovations take decades to gain market acceptance. The path of diffusion of innovation has been well studied, well documented. Most radical innovations fail. Those that succeed can take decades before they are successful.

The grand breakthrough innovation is what professors love to teach their students, love to write about, and love to discuss. But not only is it rare, but even the occasional brilliant concepts are also difficult to pull off. Yes, it is exciting to contemplate some brand-new concept that will change people’s lives, but the truth is that most fail. The failure rate has been estimated to be between 90 and 95 percent, and I have heard credible, data-based estimates as high as a 97 percent failure rate.

In reality, innovation comes in many shapes and forms. Most new-product development is innovative, but at a very tiny, incremental level. Costs are trimmed. Manufacturing and distribution efficiencies are introduced. Costly features of little use are removed; new features thought to enhance competitive value are introduced. All of these changes are simple and small, yet they are very important in the life cycle of a product.

Myth: Use ethnographic observational studies to discover hidden, unmet needs.

To achieve major conceptual breakthroughs, we should do ethnographic field studies to understand the hidden, unmet needs of our potential customers. Right
or wrong?

It all sounds logical: Study people; discover hidden, unmet needs; fulfill those needs; and leap ahead of the competition, producing yet another wondrous advance. This is the mantra of the design research community. The research community does a wonderful service. It investigates the way people live. It makes voyeurs of all of us, and the results of their studies provide important titillations to our understanding of human behavior. And it’s fun to do: You get to go to exotic locations, watch people do intimate acts, and then come back and tell the world what you have seen—carefully disguising the identity of the “informants.” Oh yes, I know it can also be dull and dreary, exhausting and depressing, and sometimes even dangerous. But even these aspects can serve to embellish the final story.

The real question is, how much does all of this help products? Very little. In fact, let me try to be even more provocative: Although the deep and rich study of people’s lives is useful for incremental innovation, history shows that this is not how the brilliant, earth-shattering, revolutionary innovations come about.

Major innovation comes from technologists who have little understanding of all this research stuff: They invent because they are inventors. They create for the same reason that people climb mountains: to demonstrate that they can do so. Most of these inventions fail, but the ones that succeed change our lives.

Take a look at the powerful inventions that have changed society and ask what role design research played:

The Airplane
The Automobile
The Telephone
The Radio
The Television
The Computer
The Personal Computer
The Internet
SMS Messaging
The Cell phone

What role did design research play? What role did marketing research play? No role. All were driven by technology. In his recent study of technology, the economist Brian Arthur reached a very similar conclusion: Technologies evolve from earlier technologies, driven by science, driven by engineering, driven by tinkerers of all sorts. Needs follow so slowly that Arthur does not even cover them.

Consider the cycle. First comes a new technology; perhaps it is a new idea, or perhaps an old idea that has finally reached a commercially viable state where inventors can consider it. Note that the time here varies. Edison launched his first phonograph company within months of his invention—he never questioned the need. He had invented the paperless office, he announced, and launched his product. The notion that the phonograph was better suited for playing back pre-recorded music came much later, and from Emile Berliner, a competitor (whose company morphed into RCA Victor and succeeded, whereas Edison’s several attempts all failed). Technology first, needs last. Multiple-touch interaction with displays took roughly two decades to move from the research laboratory to its appearance in everyday products, and even so, it is not yet common outside of a few limited product categories.

Brand-new ideas are strange and foreign, and they face two different kinds of hurdles. The first is in the company. If developed within a company, they often do not fit. They compete for scarce resources with other, proven products. New ideas have to fit into the competencies of a company; they have to fit the product schedule, the manufacturing, marketing, and distribution chains. Any new idea that goes outside of the norm has introduced more barriers to success: The innovator’s job is not over until all these other barriers have been taken into account so that the entire system will work smoothly. Innovation is a systems issue; it is not about product or process. It is about the entire system.

The second hurdle is outside the company. If the idea is done outside of a company, then the same hurdles exist in trying to convince people to fund the development. It is risky, unknown, untested. Why should anyone invest? Especially when the data shows that most such investments fail. The history of innovation is filled with the stories of those grand inventors who persisted in the face of severe doubt and near financial ruin before they finally succeeded: the xerographic copier, early automobile companies, the development of television, and then color television. Even the videophone. For that matter, history would be filled with the even greater story of all those who followed similar paths but had to give up for lack of finances—unfortunately, they didn’t make it to the history books.

A revolutionary product is fraught with peril; it may not fit people’s life or work styles. It probably is too expensive, too limited in power, at least in its initial instantiation. Within an established company, it probably is disruptive of the orderly method of product development, manufacture, and development. It causes strains within the organization.
When I was at Apple, I watched many innovative products fail. Badly done? No, simply ahead of their time. For example, from 1992 to 1994 Apple developed one of the first commercial digital cameras, the Apple QuickTake 100; one of the very first pen-based computers (the Newton); and innovative software applications (e.g., CyberDog, Activity Based Computing, OpenDoc). In my consulting practice I helped develop the first digital picture frame and an extremely high-quality distance education system for MBA courses. All failed. Were they bad ideas? No. Were they badly implemented? No. All were excellent concepts that were ahead of their time. The first company to make automobiles in the United States failed. The first commercially sold computer that used a graphical user interface and helped develop many of the ideas now central to today's world of computing, the Xerox Star, failed. The second commercial attempt to use a similar philosophy, the Apple Lisa, failed. The third attempt, the Apple Macintosh, almost failed, saved only by the fortuitous arrival of Adobe's development of Postscript and Canon's introduction of low-cost laser printing.

Why did the Macintosh almost fail? Was the world ready for the concept? Not really. Apple didn't help with its advertising campaign, which snubbed business as dull, dreary, and not worthy of a Macintosh. Yet business should not only have been Apple's targeted customer base—families wanted to buy their children the same computer they would be using in business. As a result, a far inferior computer, the IBM PC, running a command-line, baroque operating system (MS-DOS), swept the market. Within Apple itself, the Macintosh caused huge internal disruption between the Lisa, Macintosh, and the Apple II groups. The Apple II was where Apple was making its money: The other groups were losing money. Internal politics? Massive. Interdivisional rivalry? Yup.

New technological advances inspire inventors to dream of applications, from the silly to the reasonable. Examine patent applications over the past century: Most are mundane, many are silly, and some hint at broad breakthroughs. New products arose through the tinkering and experimenting of inventors. Most fail. But some were accepted as people discovered their value. Often they had to be nurtured, tamed, modified, but over time, a small number found their niche: the technology launched the products. The products discovered needs. People slowly adopted them, leading to more changes in the products.

**Technology first, invention second, needs last.**

Where does design research fit into this cycle? Design research has many definitions, but within the product cycle it consists of studies aiming to understand the activities, desires, and needs of the people for whom a product or service is designed. Design researchers use a wide variety of methods, but all of them—whether it be ethnographic observations, systematic probes, or even surveys, questionnaires, and focus groups—aim at one thing: To determine those hidden, unspoken needs that will lead to a novel innovation and then to great success in the marketplace.

In the product world, innovation comes in many forms. The least interesting innovations to the university and company research community are the small, slow enhancements that gradually lower costs while improving performance. But in fact, not only is this where most product enhancement takes place, but it is also where the research community can add the most value. This is where ethnographic observation can be powerful, uncovering the difficulties people have in everyday use, the workarounds and hacks they invent that can suggest product modifications. This allows existing products to be modified at low cost, low risk, while making them ever more attractive, ever more valuable to the customer base.

But even though incremental improvement is the most powerful and important mechanism for a company, all the excitement revolves around the dramatic breakthrough. And yes, the payoffs from these inventions are so large that their success can compensate for the risk. But the initial products are almost likely to fail, so it takes a company with money and patience to succeed in these markets. And in these domains, although creativity and imagination are essential, design research, market research, and our beloved careful assessment of people's needs—whether visible or hidden—are largely irrelevant. The inventors will invent, for that is what inventors do. The technology will come first, the products second, and then the needs will slowly appear, as new applications become luxuries, then "needs," and finally, essentials.

Once a product direction has been established, research with customers can enhance and improve it. Beforehand? Leave it to the technologists. They will get the grand ideas running, but their implications are apt to be complex, overwhelming, and just plain horrid. Horrid applications? Yes, but that's good news: We will forever be indispensable.
Donald Norman suggest that technology always comes first, and then it creates a need. I interpret this as technology in the beginning will always be rudimentary and difficult to use – innovation in application and design follows in the footsteps of the technology (and I might be a bit impatient).

Posted by Don Norman on Product Innovation – DRC 2010 « End of Business as Usual – Glenn’s External blog on August 8th, 2010 at 4:32 pm:

I agree with Don on this, however my question to him is that when the technologists themselves come with ideas, don't they also naturally think of the general behavior that they may have observed in their daily lives? Can we see the design process in the very thinking of the technologist as and when he makes real new ideas? Why can't it be considered as a natural part of the thinking process by the very experiences of everyday life?

Posted by Amit Patil on May 30th, 2010 at 3:18 pm:

Robinson argues against the point made by Donald Norman in a much debated post and a following article on Interactions, in which he said that ethnography-inspired design research quest for “unmet needs” can

Posted by ユーティピオネット on May 27th, 2010 at 4:33 pm:

At the end of Don’s essay is a nice section on the need for “translational developers”. This is something that, here at Ledant, we’ve been putting to practice. Some of the fault for the failures in innovation certainly lie with the inability of researchers to adequately inform and inspire other parts of their organization (or clients). Our point of view is that translated insights need to be Meaningful, Actionable, Inspirational, and Aspiration. We have a piece in this quarter’s IDSA Innovation magazine available via our website: http://tinyurl.com/yf2efhn

Posted by “Shot” Heard ‘Round the (Design) World | The Human Factor Advocate on March 18th, 2010 at 6:50 pm:

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Posted by User Experience, Usability and Design links for March 17th | BlobFisk.com on March 17th, 2010 at 8:04 am:
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**Norman has long been known for making controversial observations. His article “Technology First, Needs Last: The Research-Product Gulf” is in the March -- April 2010 issue of Interactions Magazine is a great**

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**it sounds as if you are reinforcing the technology/innovation adoption research of Rogers, et al from a few decades ago which describes how people adopt and adapt technology. Mainly, that some enthusiast/innovators develop something, early adopters see ways to make use of that technology to solve a problem/capture an opportunity, then the mainstream either follows or chooses not to adopt.**

**Funny that I've never really put that together with the ideas of product / service design before. Thanks for the perspective.**

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*[24-Aug-10 interactions magazine | Technology First, Needs Last: The Research-Product Gulf](http://interactions.acm.org/content/)*