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## The Age of the Consumer-Innovator

Like many products, the skateboard was originally developed by consumers for their own use. Children built the first skateboards by hammering roller skate wheels onto boards.

# The Age of the Consumer-Innovator

Recent research shows that consumers collectively generate massive amounts of product innovation. These findings are a wake-up call for both companies and consumers — and have significant implications for our understanding of new product development.

BY ERIC VON HIPPEL, SUSUMU OGAWA AND JEROEN P.J. DE JONG

IT HAS LONG BEEN assumed that companies develop new products *for* consumers, while consumers are passive recipients — merely buying and consuming what producers create. However, a multidecade effort by many researchers has shown that this traditional innovation paradigm is fundamentally flawed: Consumers themselves are a major source of product innovations.<sup>1</sup>

Recently, this consumers-as-innovators pattern has led to the framing of a new innovation paradigm, in which consumers play a central and very active role.<sup>2</sup> Rather than seeing consumers simply as “the market,” as the traditional innovation model has long taught, this new paradigm centers on consumers and other product users. It explains why consumers are very important innovators who often develop products on their own.

In this article, we begin by reporting on the large extent and scope of consumer innovation, as documented by first-ever national surveys. Next, we explain how the survey results lend support to a new



## THE LEADING QUESTION

What is the role of consumers in product innovation?

## FINDINGS

- ▶ Consumers are a major source of product innovations; millions of citizens in three countries studied create and modify consumer products.
- ▶ It is getting easier for consumers to design and make what they want.
- ▶ Businesses need to organize their product development systems to efficiently accept and build upon prototypes developed by users.

user-centered innovation paradigm. Finally, we discuss implications of the new innovation paradigm for both consumer-innovators and companies.

## National Surveys of Consumer Innovation

National surveys of consumer innovation are essential to map the true extent and scope of the new innovation paradigm among consumers. Three

### ABOUT THE RESEARCH

To reliably explore the scope of innovation by consumers, we developed a survey-based methodology that was implemented in three countries. The first survey was done in the United Kingdom by means of computer-assisted telephone interviewing. It included a representative national sample of 1,173 responding U.K. consumers aged 18 and over.<sup>i</sup> We then repeated the survey in Japan (with a sample of 2,000) and the U.S. (with a sample of 1,992) by means of Internet surveying of representative samples of consumers aged 18 and over in those countries.<sup>ii</sup> Questions and data analysis procedures were identical in all three surveys.

“Innovation” is an abstract and vague term to many, so we designed our surveys to cast a broad net to ensure capture of any innovations consumers had created but also to capture information to enable us to screen out all claimed innovations that did not meet our conservative criteria. Each survey began by asking respondents whether they had innovated in software products or physical products. Within each of these categories, we then asked separately about instances in which consumers had created a product from scratch, versus had modified a product in the category. When respondents indicated that they had innovated in one or more of the two categories during the previous three years, we followed up with open-ended questions to obtain a detailed description of what they had done and why. These descriptions were then screened to identify and eliminate “false positives” — claimed innovations that were in fact not innovations (such as, “I bought a piece of IKEA furniture and put it together myself.”) Additional false positives were eliminated via analysis of responses to two additional questions. If respondents knew of equivalent products already available on the market, or if they had developed the innovation as part of their jobs, their claimed innovations were excluded. In effect, the surveys were designed to identify and explore only real, new-to-the-market innovations that consumers had developed in their leisure time.

After the screening portion of the surveys, we followed up with more questions about respondents’ most recent innovations. Variables included time and money expenditures, and whether respondents had applied for intellectual property rights protection. We also asked whether they had actively shared their innovations and whether their innovations had been adopted by others.

first-ever studies of consumer product innovation were recently conducted with representative samples of citizens aged 18 and older in the U.S., the United Kingdom and Japan.<sup>3</sup> (See “About the Research.”) All three surveys show that consumers play a very important role as product innovators.

The surveys show that in all three nations millions of citizens innovate to create and modify consumer products to better fit their needs. (See “The Surprising Extent of Consumer Innovation,” p. 30.) We also see that the percentage of the population developing products for their own use differs among countries.

Further research will be needed to understand why this is so. With better understanding, countries may be able to support and enhance consumer innovation activities among their citizens.

The survey data also show that citizens who innovate in the U.S., the U.K. and Japan spend similar amounts of money and time on this activity. This may reflect the fact that average annual household incomes in the three countries are relatively high and relatively similar: Probably much less money is spent by individual consumer-innovators in lower income countries.

When we add up the amount citizens spend in aggregate, we find total estimated annual expenditures by consumer-innovators to be in the billions of dollars in each country. In the U.K., R&D spending as a percentage of the gross domestic product is in line with the average in OECD countries, and the estimated amount U.K. consumers as a group spend on consumer product development is actually more (144%) than what all commercial enterprises as a group spend on consumer product R&D in the U.K. The U.S. and Japan are known to be R&D-intensive countries, but even so, estimated aggregate investments by individual consumers in consumer product development are significant in these countries as well; we estimate that U.S. consumers spend 33% of the amount that commercial enterprises spend on consumer product R&D in the U.S., and Japanese consumers spend 13% of the amount that commercial enterprises spend on consumer product R&D in Japan.

Our analysis of a range of demographic variables finds that consumer-innovators are significantly more likely than the average citizen to be highly educated (with bachelor’s, master’s or Ph.D. degrees), to have a technical education (in science or engineering or as a technical professional) and to be male. (See “Who are the Consumer-Innovators?,” p. 31.) When a single citizen has all three of these characteristics, the likelihood that he will innovate in consumer products is 260% higher than the likelihood that the average citizen will do so in the U.K., 210% higher in the U.S. and 140% higher in Japan. The relative importance of the three demographic characteristics varied by country; in the U.K., a technical education had the most impact on the likelihood that a consumer will innovate; in the U.S., it was level of education; and in Japan, it was gender.

## A Paradigm Shift in Understanding Innovation

What else do we know about consumer innovation beyond the fact that there is a lot of it going on? First, the surveys find that few consumers attempt to protect their innovations from imitators; their innovations are free for the taking. Second, most consumer innovations *do not* get adopted by fellow consumers and/or by producers of consumer products. Third, a significant number *do* get adopted by others. (See “What Happens After Consumers Innovate?,” p. 32.) Taken together, these findings mean that companies that make consumer products have an unexpected “front end” of free innovation designs to serve as an important feedstock to commercial innovation processes in a wide variety of fields. (See “What Consumers Create,” p. 33.)

This new innovation paradigm in which consumers and other product users play a central role consists of three phases.<sup>4</sup> (See “A New Innovation Paradigm.”)

**Phase 1** Initially, markets for products and services with novel functionality are both small and uncertain. For example, at the start, no one knew whether there would be a profitable market for the first skateboard — or for the first dishwashing machine, for that matter. However, producers don’t like small and uncertain markets. Especially in consumer goods fields, producers know they need to spread their R&D and other innovation costs over a lot of purchasers in order to make a profit. As a consequence, consumers often must pioneer really new products for themselves, because producers cannot yet see evidence for a profitable market. And, indeed, that is the history of both skateboards and dishwashers. The skateboard was developed and built by children for their own use. They did it by taking apart a kind of roller skate that attached to shoes and hammering the skate wheels onto boards (thus, “skateboard”). Similarly, the first practical dishwasher was invented by Josephine Cochrane in 1886 to solve a problem she faced as a user: Her servants frequently chipped her fine china when they washed it by hand.

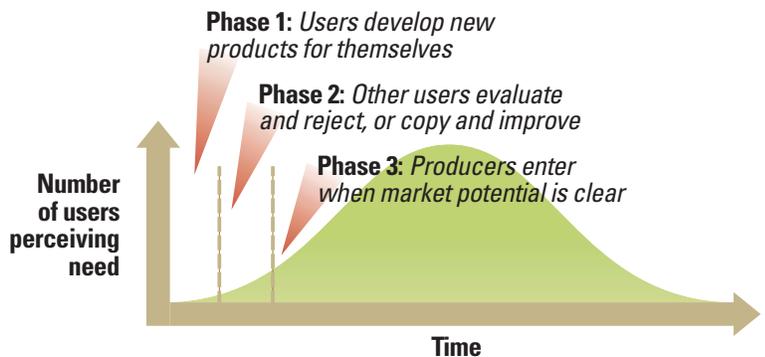
**Phase 2** As the surveys showed, most of the innovations developed by consumers are of interest to the originating consumer only. But some consumer in-

novations have greater potential. Since many of the designs are often freely available, other consumers can test their own levels of interest by freely making copies, trying them out and maybe improving the designs as well. The degree to which this viral diffusion to other consumers takes place — whether through communities on the Web or other communities — offers a progressively stronger signal to producers as to which of the new designs and functions will offer the basis for a profitable new commercial product or product line. In other words, consumers are not only developing new products but also providing marketing research data to any producer alert enough to collect it and assess it.

**Phase 3** Producer companies begin to decide that the information on the design and function of the new product, and how many might want to buy it, has reached acceptable levels for their risk profiles. For example, only after the popularity of skateboards began to spread among children did companies become interested in manufacturing skateboards commercially. Small producers generally enter first, because they are satisfied with smaller markets. Some of these are new startup companies founded by consumer-innovators themselves.<sup>5</sup> Then larger companies enter, often by acquisition, if the market grows still further. Producers, even if they do not develop the initial ideas and prototypes for functionally novel innovations,

### A NEW INNOVATION PARADIGM

In Phase 1 — the earliest stage of a market — users often innovate to create the products they want; then, in Phase 2, other users either reject or validate the initial innovation. If the user innovation is validated through adoption by others, in Phase 3 the market has grown enough to be interesting to producing companies, which refine and commercialize the innovation for sale to a growing market of users.



**THE SURPRISING EXTENT OF CONSUMER INNOVATION**

Data from surveys on the amount of consumer innovation in the U.K., U.S. and Japan suggest that, in all three nations, millions of citizens innovate to create and modify consumer products to better fit their needs.

	UK (sample size = 1,173)	USA (sample size = 1,992)	JAPAN (sample size = 2,000)
<b>Percentage of consumer-innovators in the population aged 18 and over</b>	6.1%	5.2%	3.7%
•Percentage of consumers creating consumer products	2.1%	2.9%	1.7%
•Percentage of consumers modifying consumer products	4.5%	2.8%	2.5%
•Percentage of consumers both creating and modifying consumer products	0.5%	0.5%	0.5%
<b>Estimated number of consumer-innovators aged 18 and over</b>	2.9 million	11.7 million	3.9 million
<b>Annual expenditures by average consumer-innovator:</b>			
•Time spent (days/year)	7.1	9.9	5.5
•Total expenditure* (time plus out-of-pocket money/year)	\$1,801	\$1,725	\$1,479
<b>Estimated total expenditures* by consumer-innovators on consumer products per year</b>	\$5.2 billion	\$20.2 billion	\$5.8 billion
<b>Estimated consumer product R&amp;D expenditures in that country funded by companies per year</b>	\$3.6 billion	\$62.0 billion	\$43.4 billion
<b>Consumer-innovators' expenditures as a percentage of companies' R&amp;D expenditures on consumer products</b>	144%	33%	13%

\*Total expenditures include out-of-pocket expenditures and time investment evaluated at average wage rate for each nation.

also contribute. They may improve the user-developed designs to make them more reliable and easier to use — and will often do redesigns to better suit the products for low-cost mass production.

Notice that we said that the above sequence applied to “functionally novel” products, where near-equivalents do not yet exist on the market. For such products, potential market demand for the functions being performed has not yet been established. A second type of product innovation is the “dimension of merit” improvement to products with established functions and markets. This type of innovation improves an existing product function for which the market is known. As a result, both producers and users may have an incentive to develop dimension of merit improvement innovations. For example, once the skateboard has been established as a product with known functions, and as having a market of significant size, producers might decide to invest in developing improved bearings for the wheels — knowing that the market for such an improvement does exist.<sup>6</sup>

Although the extent and importance of product innovation by consumers are the new findings we focus upon in this article, it is important to note

that the same patterns of innovation have been found in business-to-business products and in services as well. For example, novel process equipment is often developed by companies that have an in-house need for it. These user firms then often reveal their innovations at no charge to their suppliers, because they are eager for an external source of supply.<sup>7</sup> Similarly, novel retail and corporate banking services are often developed by users. For instance, both retail and corporate banking clients systematically swept funds among their accounts to increase returns from interest payments long before banks began to offer “sweep accounts” as a profitable banking service.<sup>8</sup>

**Implications of the New Innovation Paradigm**

What are the implications for consumers and producers of this major paradigm shift in our understanding of the innovation process?

**Implications for innovating consumers** With respect to Phase 1 of the innovation process we described — initial need awareness, product design, prototyping and use testing — consumers should

realize that *they* are important developers of really novel products and services: It is by no means only companies that, as a well-known General Electric slogan put it, “bring good things to life.” With this understanding comes a sense of responsibility and exciting challenge, a sense that “If I want something really new, I guess I have to do it myself.” (Of course, it is common to — and fun to — share the work with like-minded friends.)

Second, consumers should realize that it is getting progressively easier to design and make what they want for themselves. Maybe it looked too difficult to design what you wanted the last time you needed something not on the market. But if you look again, you may find it much easier. The cost of computer-based design tools is rapidly dropping, and today many adequate ones are available on the Web at zero cost. Also, the sophistication and user-friendliness of these tools is rapidly rising. Today you do not have to be a “rocket scientist” to design what you want using a CAD (computer-aided design) program like Google SketchUp.<sup>9</sup>

Third, it is getting progressively easier to build what you design. Many new businesses have sprung up to accept your CAD design files and convert them into real parts and products via CAM (computer-aided manufacture). Different companies specialize in different computerized production technologies, ranging from laser cutting to 3-D printing. Today the production process you need is available to individual consumers to make even a single copy of a part — in very good quality, and often at a very reasonable price.<sup>10</sup>

With respect to Phase 2 of the innovation process — testing the generality of demand and perhaps encouraging imitation — consumers can choose to exert effort to make people aware of their innovation; to assess demand if they wish; and to act upon that information if they wish. Note that the survey data indicate that relatively few consumers protected their innovations via intellectual property rights, but most consumer-innovators did not actively share knowledge of their innovation by, for example, posting their design on a website. Many consumers today have insufficient incentive to actively share their innovations because of the effort involved, or perhaps because they think no one else would find their innovation

of interest. Creating platforms for design sharing can ease the effort required by individual users. For example, Thingiverse.com is a community website that allows anyone to post their designs. As the site says: “Thingiverse is a universe of things. Download our files and build them with your laser cutter, 3-D printer, or CNC.” Other sites allow innovating consumers — or any designer — to post their designs and charge adopters for copies. Either way, a properly instrumented site will enable the innovator — and peers and companies as well — to watch the number of downloads and related adopter comments of appreciation, suggestion or complaint — and thereby get signals regarding general marketplace demand.<sup>11</sup>

**Implications for entrepreneurs** Phase 3 of the innovation process involves decisions to commercialize an innovation if there are sufficient indications of demand. Among the potential producers are the innovating consumers themselves, as well as consumers adopting the initial design, who then decide to produce the design for sale to others. The exciting news for consumer-innovators is that it is getting steadily easier to commercialize an innovation oneself; you need not give up an attractive job or career you already have. Companies can be hired to produce your design in volume, to accept

## WHO ARE THE CONSUMER-INNOVATORS?

Our analysis of a range of demographic variables finds that consumer-innovators are significantly more likely than the average citizen to be highly educated, to have a technical education and to be male.

	Percentage who are consumer-innovators		
	UK (sample size = 1,173)	USA (sample size = 1,992)	JAPAN (sample size = 2,000)
<b>In the general population of adults 18 and over</b>	6.1%	5.2%	3.7%
<b>Consumer-innovators were significantly more likely to be:</b>			
• Highly educated (bachelor’s, master’s or Ph.D. degree)	8.7%	8.9%	3.7%
• Technically trained	12.0%	8.0%	4.2%
• Males	8.6%	5.9%	4.9%
• Highly educated, technically trained males (simultaneous presence of all three factors)	15.8%	10.8%	5.0%

and process customers' orders and payments and to ship the completed product to the customers for you as well. It is a far cry from the all-consuming entrepreneurial effort that was required to perform these tasks in earlier days. In effect, the way has now been opened for the innovating consumer to be a "casual entrepreneur."

**Implications for existing companies** Businesses need to think about how to reorganize their product development systems to efficiently accept and build upon prototypes developed *by* users. The fundamental question to ask is: "What would need to change around here if we really believed that consumers are actually developing, prototyping, use-testing and market-testing some of what will be our most important and novel new products — without us?"

Clearly, it will be important to learn to identify promising consumer-developed innovations that are gaining traction among groups of consumers. Fortunately, earlier research on user innovation has shown that, in both consumer and business-to-business markets, some users — termed "lead users" — are much more likely to develop commercially promising innovations than the average customer. Lead users are those who are both ahead of the majority of users with respect to an important market trend *and* have a high incentive to innovate. Tested methods exist to find lead users, and companies can download the training materials they need from the Web at no cost.<sup>12</sup> Companies

can take other steps, too, such as creating or frequenting consumer community websites or creating innovation contests to attract consumer activity that might not otherwise occur.<sup>13</sup>

In addition, companies will have to help their own product developers look at consumer-developed innovations with new eyes — not just as poorly engineered amateurish efforts. Product engineering is *not* the value companies should look for in the consumer-developed prototype product and related usage. The consumer is showing a product prototype that performs a novel function that people have actually demonstrated that they want. That is the priceless information your companies must take on board. Starting from that point — and preserving the user idea — your product development staff can develop wonderful product engineering improvements if those are needed — and justifiably feel very proud in doing so. Although consumer-developed product innovations are seldom patented, producers can often gain patent protection, nonetheless, via the improvements their engineers develop.<sup>14</sup>

The exciting news for companies that wish to adopt user-generated innovations as the basis for commercial products springs from the fact that product prototyping and initial testing done in-house by their own staff is very costly. Users shoulder those initial costs for their own reasons. Companies can save money and raise their success ratio by focusing on product concepts that consumers have already prototyped and that are, to some extent, already market-tested as well.

**WHAT HAPPENS AFTER CONSUMERS INNOVATE?**

While most consumer innovations *do not* get adopted by fellow consumers, a significant number *do*. Few consumers protect their innovations through intellectual property rights.

	UK (sample size = 1,173)	US (sample size = 1,992)	JAPAN (sample size = 2,000)
Percent of consumer-innovators who acquired intellectual property rights to protect their innovations	2%	9%	0%
Percent of consumer-innovators who actively shared knowledge with others (with peers and/or companies)	33%	18%	11%
Percent of consumer innovations actually adopted by others (by peers and/or companies)	17%	6%	5%

**What, specifically, should companies do?** First, stop attacking your innovating users, whether intentionally or by mistake! Historically, businesses have fought piracy (illegal copying of products such as songs, movies and software) using methods that also caught their user-innovators up in the net. For example, the U.S. Digital Millennium Copyright Act makes it a criminal offense for users to circumvent software security measures that producers may use to keep their product-related software inaccessible to customer inspection. It makes sense for companies to try to deter users from inspecting or altering their software code to make pirated copies. However, it is counterproductive for those same

## WHAT CONSUMERS CREATE

The following table lists some examples of consumer innovations we found in the United Kingdom, Japan and the United States.

CATEGORY	EXAMPLE OF A CONSUMER INNOVATION
<b>Craft and shop tools</b>	<ul style="list-style-type: none"> <li>• I created a jig to make arrows. The jig holds the arrow in place and turns at the same time, so I can paint according to my own markings. Jigs available on the market do not rotate. <b>(U.S.)</b></li> </ul>
<b>Sports and hobby</b>	<ul style="list-style-type: none"> <li>• I fixed the handle of a fishing rod by adding pipe insulation to it to make it easier for a handicapped person with little strength in her hands to spend time fishing. <b>(U.S.)</b></li> <li>• I am a keen cricketer ... I modified the cricket bat so it improves the play and contact with the ball. <b>(U.K.)</b></li> </ul>
<b>Dwelling-related</b>	<ul style="list-style-type: none"> <li>• Use of a GPS system that can be operated by computer and small tags to create a mechanism for immediately finding objects that have become lost in the house. <b>(U.S.)</b></li> <li>• Use of a microwave oven to create a half-pressure rice cooker. Holes were drilled in a plastic container and a large rubber band and small board were used to adjust pressure within the container so that the resulting rice tasted as good as that cooked with other sources of heat. <b>(Japan)</b></li> </ul>
<b>Gardening-related</b>	<ul style="list-style-type: none"> <li>• I made a device for trimming the tops of trees. It's a fishing rod with a large metal hook at the end. This enables me to reach the top of the trees, bend them down and cut them. <b>(U.K.)</b></li> </ul>
<b>Child-related</b>	<ul style="list-style-type: none"> <li>• Creation of wooden water skis to teach small children how to ski. <b>(U.S.)</b></li> <li>• I colored the two halves of a clock dial with different colors, so a child can easily see which side is past the hour and which before the hour. I used it to teach my kids to tell the time. <b>(U.K.)</b></li> </ul>
<b>Vehicle-related</b>	<ul style="list-style-type: none"> <li>• I developed an alternative type of starter motor to get my automobile engine to start in the event of a faulty battery. <b>(U.K.)</b></li> <li>• Modification of the Harley-Davidson exhaust pipe to create a high performance exhaust cooling device. <b>(U.S.)</b></li> </ul>
<b>Pet-related</b>	<ul style="list-style-type: none"> <li>• My dog was having trouble eating. I used a flat piece of laminated wood and put an edge around it like a tray to stop her bowl from moving around the kitchen. It is a successful innovation. <b>(U.K.)</b></li> </ul>
<b>Medical</b>	<ul style="list-style-type: none"> <li>• I do not have use of one of my hands and so created clothing that could be put on and taken off with one hand. <b>(U.S.)</b></li> <li>• My mother had a stroke and became unable to use her limbs. I created a coat that was easy to put on and take off while in a wheelchair. The areas under the sleeves were cut open so that the sleeves could be opened and closed with special tape. <b>(Japan)</b></li> </ul>
<b>Other</b>	<ul style="list-style-type: none"> <li>• I reprogrammed a GPS to make it more user-friendly and efficient. It is different from what is out there because it is tailored to me. <b>(U.K.)</b></li> </ul>

companies to also deter users who are trying to inspect and alter the code to make the company's product better, or to use it in novel ways that could lead to new markets for that company. Companies are learning. For example, Microsoft first deplored the hacking of its Kinect product by users seeking to use it in new ways. Then, within days, it reversed course and applauded those same users — recognizing the potential for mutual gains.<sup>15</sup>

Second, consider actively supporting the consumers that do or could offer you a feedstock for your in-house innovation process. You are in a contest with your competitors for user-innovators' interest and attention. Users generally have a choice among products to use as platforms for, or components of, their efforts. Very reasonably, they tend to focus on the offerings in a category that offer

them the best innovation cost-reward ratio. As one brand or model attracts more innovation, a virtuous cycle comes into play that lowers the costs to subsequent innovators further — and so increases user innovation still further. For example, a few makes and models of autos become especially attractive for users who wish to modify and “tune” them by adding new features or improving performance. The special parts that innovating users develop for those specific models are then often produced by aftermarket producers as interest grows. The increase in special parts availability for those models — and the model-specific design knowledge gained and shared among users — in turn makes those cars even more attractive to the next consumer contemplating an innovation.

There are many ways to increase the attractiveness of your products to user-innovators. Some of the more important ones are:

**Support user innovation.** Create documented, open interfaces to support modifications to your products; create “developers’ toolkits” to assist further; and create websites so that users with common interests can more easily share information and innovate together.<sup>16</sup>

**Explore to determine what users want in exchange for your benefiting from their innovations.** For example, your users may want support for their user communities, free parts or special access to your in-house developers. To create a positive long-term relationship with your innovating users, strive to create a win-win.

**When you decide to produce a commercial version of a user-developed product, give the innovators credit.** For example, if your product is based upon Joe’s — or the ABC user group’s — innovation prototype, say so! Some companies, such as MathWorks, StataCorp and LEGO, do that. Their users appreciate it even when, or especially when, the users are not asserting intellectual property rights claims to their innovations. Most companies still do not acknowledge user innovators today — instead proudly inviting consumers to buy “the brilliant new XYZ product we developed!” Not nice.

The paradigm shift we have described here — consumer prototyping and use, followed by filtering for generality of demand by peers, followed by commercialization of generally desired innovations — is growing stronger over time. The costs of consumer innovation are dropping due to better and cheaper design tools, better and cheaper Internet-based communication and group formation, and better and cheaper prototyping facilities. For many types of innovation opportunities, the creaky old paradigm of “We producers will do it for you” is being competed away — and the new paradigm is both exciting and fun.<sup>17</sup> “Getting with the program” is a really good idea!

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