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Fostering Open Innovation

Mindstorms, Architecture, and the Wisdom of the Clique

You can't fire them, because you haven't hired them.

—Søren Lund, director, Mindstorms NXT

IT WAS LATE APRIL 2010, AND THE GEORGIA DOME WAS rocking. Thousands of LEGO Mindstorms fans had packed the vast arena in downtown Atlanta to witness the world finals of the FIRST LEGO League robotics competition, a kind of Junior Olympics for math and science athletes from every part of the planet. Pioneered by Segway inventor Dean Kamen and his nonprofit organization, FIRST (For Inspiration and Recognition of Science and Technology), the three-day tourney featured a rollicking series of showdowns between eighty-one teams with a total of eight hundred Mindstorms wizards ages nine to sixteen, and hundreds of adult volunteers supporting them. Those eighty-one teams were the best of the best—the regional and national winners from a worldwide contest involving well over sixteen thousand teams.[20]

Each team's goal: design and program a Mindstorms robot—consisting of LEGO components, motors, sensors, and an "intelligent" brick—to weave through an obstacle course and perform a series of complicated tasks, all while sprinting against other teams' bots. Combining the earsplitting thunder of a World Wrestling smackdown with the thrill and mechanistic glory of a NASCAR race, the FIRST World Championship was an amped-up celebration of brains over brawn, as thousands of kids demonstrated what's possible when their imagination and technical prowess were yoked with LEGO and digital technology.

When the kids weren't competing, many swarmed the LEGO Mindstorms booth, where LEGO staffers delivered coaching tips on the finer points of building a better bot and expert adult hobbyists showed off their over-the-top creations, such as Mindstorms Moon Rovers and an astoundingly faithful, LEGO-ized re-creation of Wall-E, the famous robot from the Disney/Pixar movie of the same name.

For a couple of hours, a group of LEGO software developers and other staff members slipped away from the booth and into a vacant hallway, where they met with a thirteen-year-old college student and FIRST LEGO League competitor from Beaverton, Oregon, named Tesca Fitzgerald. Instead of delivering a demo, the LEGO crew witnessed one, as Tesca unveiled the massive artificial-intelligence program she had written for her team's Mindstorms robot.

Outfitted in the red wig and Day-Glo orange T-shirt that were the uniform of her robotics team, the Fire-Breathing Rubber Duckies, Tesca told the LEGO developers of how she had spent 440 hours creating, testing, and modifying a complex algorithm for her AI-based pathfinding software. The program allowed her robot to navigate through a typical hospital environment on its own. With more than twenty feet of flow charts spread across the hallway's floor, Tesca walked the LEGO developers through her program and answered their questions about her code, as well as what improvements *she* wanted to see in the Mindstorms software. When she finished, the

duly impressed LEGO crew invited the precocious programmer (and her parents) to present her AI work at the LEGO Developers Conference in Billund the following year.

Tesca Fitzgerald's foray into artificial-intelligence software development via LEGO was, as Mindstorms marketing manager Steven Canvin later put it, "pretty mind-blowing. It's very likely that this young girl created the largest program ever written in our software." At the same time, Tesca's achievement was one more milestone in a remarkable journey that has seen LEGO transform itself from a remote, highly insular organization, where only the public relations manager spoke for public consumption, to one that has adroitly managed to open up to its most inventive customers, learn from them, and thereby harness their creativity.

Birthing the First LEGO Bot

To appreciate just how insular LEGO has been in the past, consider what transpired in 1998, when LEGO debuted its first Mindstorms set. Sporting a retail price tag of $199, the original kit consisted of a software application that customers could use to program a microcontroller-based brick, dubbed the RCX (Robotic Command Explorer); three motors; three sensors; and a collection of roughly seven hundred LEGO bricks, beams, gears, axles, and wheels for building a wide range of robots.

In those first, crucial months following the launch of Mindstorms, the LEGO Group's brain trust was taken aback when it learned through surveys that 70 percent of Mindstorms hobbyists were adults, not kids. Intended for children, Mindstorms was enchanting tens of thousands of grown-up geeks.

Soon after the Mindstorms release, a Stanford University graduate student cracked open the RCX brick and revealed to the world what was inside. He reverse-engineered the RCX brick's microcode as well as the firmware and put his discoveries up on the Internet.

With the Mindstorms proprietary code spreading across LUGNET (the worldwide network of LEGO user groups) as well as robotics and computer discussion groups, a software engineer whose day job was programming for Motorola Inc. worked off the now public RCX code to create a programming tool called Not Quite C (NQC), a text-based language that allowed skilled hobbyists to add more detailed features for controlling the Mindstorms hardware.* Almost simultaneously, a computer science graduate student at Germany's University of Karlsruhe developed an open-source operating system, legOS, which among other things allowed developers to program a version of the RCX brick that was four times as fast as the original.

Not surprisingly, some LEGO managers fretted that the hacking outbreak, which spread across the Internet in a matter of weeks, would lead to people pirating the code and creating robotics kits that would bite into the Mindstorms market, which was still in its infancy. The company's lawyers were even more alarmed. They pushed to hit the hackers with cease-and-desist letters ordering them to stop mucking with the company's intellectual property. "The legal department went nuts," recalled Søren Lund, who led the 2006 Mindstorms team. "They were like, 'They're showing the code to the world! It will be copied!' "

But rather than sue, LEGO decided to let the hackers have their way. Unlike the LEGO Group's lawyers, the Mindstorms development team believed the hacking signaled that they had come up with a winner. Adult hobbyists wouldn't take the trouble to dig into the RCX brick and write alternative code if they didn't think the Mindstorms platform was worth developing. After Mindstorms discussion groups popped up across the Internet and more software developers began to write their own applications, LEGO sought to catalyze the burgeoning community's creativity by adding a "right to hack" to the Mindstorms software license and creating a Mindstorms website

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* LEGO used an icon-based programming language, RCX-code, which was less powerful than NQC but easier to learn and use and therefore more appropriate for kids.

with its own discussion forum, a heady move for a company that had always sought to tightly control its image. LEGO wasn't thinking about harnessing the crowd's creativity at that point. It just wanted to get out of the way of a rapidly building success.

Nevertheless, some LEGO executives' worst fears were realized when the company hustled out a Mindstorms accessories kit that was less than warmly received. "[Customers] were posting on our message boards, saying the [accessories kit] was overpriced and basically a piece of crap," recalled Tormod Askildsen, who heads up the LEGO Community Development team. "And the reaction from at least some people in the higher levels of the company was that we can't let people say things like that on a LEGO site—we needed to remove the negative comments. We argued that we could take the forums down, but we couldn't edit them. And if we did close the forums, the discussions would just move to another site. So why don't we just open up, admit there's a problem, and do something about it?"

LEGO wisely left the forums alone and even used the Mindstorms site to release a free, downloadable software development kit that further enabled adept hobbyists to dream up their own applications for Mindstorms. In doing so, LEGO switched from contemplating lawsuits against hackers to actively encouraging them to reinvent Mindstorms in ways that LEGO itself had never imagined.

The results were dramatic. Customers lit up the LEGO Mindstorms site—as well as LUGNET and dozens of fan-created Mindstorms sites—with postings on a mind-boggling array of LEGO-ized bots. Along with photos and videos of their Mindstorms MOCs (My Own Creations), fans from around the globe put up hundreds of Web pages with detailed instructions for replicating their inventions. Their zeal for all things Mindstorms sparked a cottage industry of how-to books for building and programming the LEGO bots, as well as a plethora of start-up companies selling third-party Mindstorms sensors and hardware.

Seemingly overnight, an entire ecosystem of customer-generated

Web forums, books, microcompanies, and competitions such as the FIRST LEGO League tournaments had evolved around Mindstorms. Recalled Askildsen: "People were improving on the product and making it accessible to niche needs that LEGO couldn't serve." Buoyed by its fans' creativity with Mindstorms, which drew new customers into the Mindstorms orbit, LEGO sold eighty thousand kits over the first five months of the RCX robot's inaugural year. The set was so popular, it outstripped the company's forecasts and left LEGO out of Mindstorms inventory for the Christmas holidays. Despite that nearly unforgivable sin, Mindstorms would go on to become the best-selling single product in the company's history. It would also dramatically reshape the company's approach to managing innovation.

Through Mindstorms, LEGO began to see the advantages in not just allowing but *encouraging* its customer community to come up with complementary innovations to its toys. When customers wrote new applications for Mindstorms, they helped grow the market by enabling other customers to come up with buzz-generating Mindstorms creations, such as an assembly plant that custom-builds a LEGO car, or a vending machine that takes money, dispenses candy or soda, and gives correct change. With the posting of each new application, innovative customers expanded the possibilities that Mindstorms offered. In the late 1990s, the notion of tapping into a virtuous web of volunteer innovators was "a totally different business paradigm," as Mads Nipper later described it. "Although users don't get paid for it, they enhance the experience you can have with the basic Mindstorms set—it's a great way to make the product more exciting."

At the same time, Mindstorms powerfully demonstrated to LEGO managers and developers that there was much they could glean from skilled adult hobbyists and from child prodigies such as Tesca Fitzgerald. That notion was powerfully underlined in the fall of 1999 when LEGO and the MIT Media Lab organized a gathering, called MindFest, of roughly three hundred Mindstorms enthusiasts, including robotics geeks, teachers, and master builders of all ages. (Since the

mid-1980s, LEGO had collaborated with the Media Lab's Seymour Papert—one of the pioneers of artificial intelligence and author of the book *Mindstorms*, which gave the LEGO toy its name—on research into how children learn through experimentation and play.) The MindFest conference's big-picture focus was on the future of learning; for the LEGO Mindstorms development team, the conference offered abundant opportunities to do some learning of their own.

The most powerful learning moment occurred during a panel discussion among a "dream team" of hackers that included Kekoa Proudfoot, the Stanford University grad student who reverse-engineered the RCX microcode, and Markus Noga, creator of the legOS operating system. The LEGO team listened slack-jawed as the hackers described the RCX brick's potential to enable kids and adult hobbyists to build contraptions that LEGO developers hadn't imagined. Then it was Ralph Hempel's turn to talk. Hempel, an embedded-systems engineer from Owen Sound, Ontario, had written a memory-conserving programming system, pbForth, for Mindstorms. Citing complaints from some robotics geeks that the RCX lacked sufficient memory, Hempel recalled one of technology's greatest achievements, NASA's first lunar landing. With the RCX, said Hempel, developers held in their hands the same computing power that had put a man on the moon. His message: *Shame on us, as a community, if we can't create great code for the brick.*

"It was the first time we met face-to-face with the hackers, and we were all thinking, 'This is too good to be true,'" recalled Mindstorms team leader Søren Lund. "Afterward we took them out for some beers, and it immediately felt like we were a team of equals brainstorming together."

Exploiting the Wisdom of the Clique

Six years later, just when LEGO was attempting to pull out of its financial free fall, the company began preparing for a return to the

wired world with Mindstorms NXT, the next generation of its robotics kit. Recalling the stirring debut of the original Mindstorms, LEGO decided to tap the talents of the world's most creative Mindstorms customers by inviting a handful of them to codevelop the new kit. Such a move was unprecedented at LEGO. Although LEGO had invited expert adult fans to contribute ideas and prototypes for Factory sets, never before had it allowed outsiders into a secret project's core development process. Nevertheless, the business logic for inviting customers to codesign the future of Mindstorms was inescapable. "It was obviously relevant to engage them," said Nipper. "They knew stuff that we didn't."

So began the LEGO Group's disciplined bid to amplify one of the past decade's most talked-about business innovations—tapping the "wisdom of the crowd" to create breakthrough products. Keep in mind that LEGO launched its experiment with crowdsourcing in 2004, a full year before James Surowiecki came out with his groundbreaking book *The Wisdom of Crowds*, in which he posited that because groups of people are "often smarter than the smartest people in them," a crowd's "collective intelligence" will produce better outcomes than a small group of experts. Since the publication of that and other books on customer cocreation, initiatives ranging from LINUX to Wikipedia to more than 240,000 open-source software development projects (according to SourceForge.net) have amply demonstrated that crowdsourcing opens an organization up to a broad swath of insights and ideas that it could never muster by itself.

For more conventional companies, however, crowdsourcing remains a conundrum, and a scary one at that. How can a company open up to the crowd yet still protect its most vital secrets? How can developers separate out the mass's few genuinely inspired insights from its many genuinely loopy ideas? And how can managers capture customers' creativity while ensuring that their fervor doesn't bust budgets and deadlines and ultimately sink the project? Despite those challenges, LEGO managed to leverage outsiders' talents and thereby launch a new generation of Mindstorms that surpassed its

predecessor's impressive performance. Indeed, the LEGO Group's disciplined approach to leveraging the talents of citizen developers helped it overcome many of crowdsourcing's underlying challenges.

Challenge: In established companies, many managers are skeptical as to whether the risk that comes from opening up to the outside world is worth the benefits.

In 2004, as Knudstorp and his new management team were struggling to pull LEGO out of its crisis by selling off assets and shutting down money-losing lines, they also were attempting to build a profitable product portfolio for 2006. (Back then, it took LEGO an average of two years to develop and launch a new line.) Despite the remarkable success of Mindstorms during its first two years, a next-generation Mindstorms did not immediately appear to offer much promise.

During the first years of the last decade, even though melding the brick with the bot seemed like a powerful strategy for keeping LEGO relevant in the digital age, the company largely abandoned Mindstorms as it invested in big-budget lines such as Explore and Galidor. In 2001, after releasing a modest update to Mindstorms, LEGO closed down the line's development team and scuttled its marketing effort. Although LEGO kept manufacturing a comparatively small number of sets, it wasn't long before bloggers began writing an obituary for Mindstorms and speculating on why Mindstorms had been a hit with everyone except LEGO executives. "We tried for years to kill the product," Lund recalled ruefully, "because we did absolutely nothing to support it."

But when Knudstorp and Nipper gave the robotics line a second look in 2004, they concluded there was much to commend a Mindstorms revival. Even though LEGO had lost its enthusiasm for the Mindstorms line, customers hadn't.

Since its debut in 1998, the FIRST LEGO League Mindstorms tournaments had grown from sixteen hundred kids participating in the inaugural year to fifty thousand competitors in 2004. Adult

hobbyists' passion for Mindstorms hadn't waned substantially, either, as evidenced by countless fan websites and the publication of more than twenty Mindstorms-related books by authors who were unaffiliated with LEGO. The line continued to sell about forty thousand units a year, without any advertising. Moreover, the concept of encouraging open-ended play through buildable, brick-based robots adhered to Knudstorp's back-to-the-brick strategy for rescuing the company, with the added benefit that the Mindstorms microcomputer brick would help LEGO stand out in a digital world of MP3 players and video games. Based on those positive leading indicators, Nipper asked Søren Lund and Paal Smith-Meyer, who was then a LEGO creative director, to lead the development of a new Mindstorms kit.

Almost from the start, the pair agreed that cocreating with the most skilled Mindstorms hobbyists, some of whom they knew personally, was the logical next move. Nevertheless, some LEGO managers, concerned about competitors finding out about their new plans, hesitated to embark on such a precedent-breaking path. "In research and development, you just don't tell strangers what you're working on," said Lund. "In hindsight it sounds easy, but at the time it was a huge cultural barrier, trying to cross that line." A nondisclosure agreement provided little real protection, since the source of a leak is often hard to identify. And the remedy—in this case, suing one of your most influential and respected customers—is unpalatable.

Before Lund and Smith-Meyer took the irreversible step of inviting outside innovators into the inner sanctum of the Mindstorms development team, the pair sought to map out the core business logic for cocreating Mindstorms. First, they bet that tapping into outside experts' knowledge and insights would radically increase the odds of breaking out a hit kit. Second, by engaging expert customers—people who were semicelebrities in the Mindstorms world—those customers could in turn act as persuasive ambassadors for the next generation of Mindstorms. They might even help build a more trusting bond between LEGO corporate, which was widely viewed as having grown indifferent to Mindstorms, and a skeptical fan community. Third, just as Apple would later do with its iPhone app developers, so Lund and Smith-Meyer wanted to do with Mindstorms citizen developers—give them the tools and support they needed to create complementary innovations, from sensors to programming languages to building instructions, that would enhance and expand the Mindstorms platform.

Finally, because LEGO was still mired in its financial crisis, the new Mindstorms would have minimal marketing support. So Lund and Smith-Meyer turned to a resource-conserving, PR-based marketing strategy. If customers helped them codesign a breakthrough product, the pair believed they'd have a buzz-generating story for the business and high-tech press, at a total cost to LEGO of next to nothing. Concluded Lund: "We were on such a limited budget we *had* to work with the fans."

Taken together, those four factors—building a better product, catalyzing fans, launching an accessories market, and creating a tantalizing story for the media—amounted to a due-diligence checklist for engaging outside collaborators. If there was pushback from within the company, the checklist would act as a clarifying reminder of why the benefits outweighed the risks.

Challenge: Volunteer developers are smart, but they're not always right. They can take over a project and turn it in the wrong direction.

The design managers for Mindstorms drew a bright distinction between how the crowd could help and how it couldn't. Although they were determined to engage citizen developers in a soup-to-nuts reinvention of their robotics kit, Lund and Smith-Meyer made a number of fundamental design decisions before soliciting any input from outsiders. Despite the remarkable knowledge and creativity of the most elite Mindstorms customers, none had expertise in designing compelling building experiences for children. That remained the company's responsibility.

Lund had seen how the first-generation Mindstorms sets were challenging for ten- and twelve-year-olds to build by themselves, without help from adults or more experienced kids. For the next-generation kit, he wanted kids to have a much more intuitive first-time building experience. Thus, the developers set themselves a goal: create a kit where kids could build a bot within twenty minutes of opening the box. To that end, the team decided to include only LEGO Technic studless components in the kit. Technic components, which lack the knobs found on classic LEGO pieces, gave kids greater flexibility when building and ultimately made for a sleeker, less chunky-looking bot.

Other early design decisions that came without any input from customers included the move to forgo a product face-lift and instead develop a full-on next-generation product. Making a clean break with the past meant the new Mindstorms set would lack backward compatibility with the first-generation Mindstorms set. On the other hand, the programmable brick and the software that controlled the original Mindstorms could be replaced with an updated intelligent
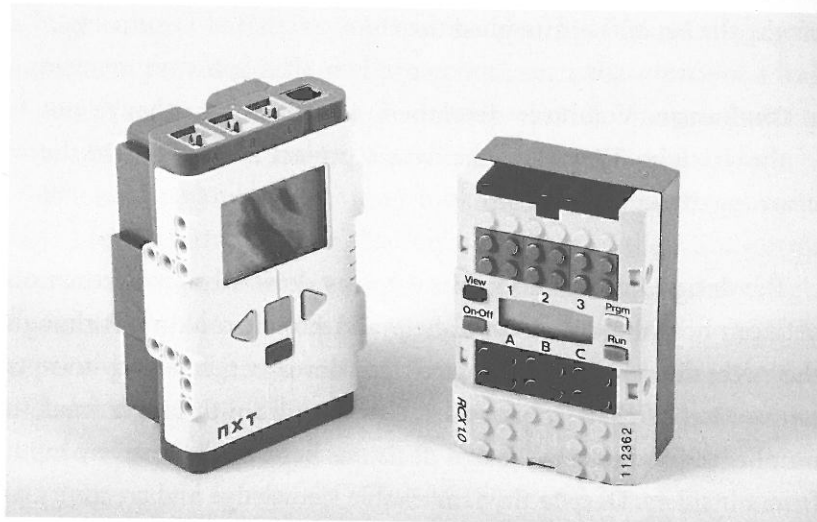
The 2006 LEGO Mindstorms NXT brick (left) used Technic connectors (which fit into the holes in the side) to connect to other pieces in the set. The earlier-generation RCX brick (right) could connect using either Technic connectors (on the sides) or traditional LEGO studs (on the front).

brick, dubbed NXT. Recognizing that LEGO lacked the resources to develop Mindstorms software internally, Lund and Smith-Meyer partnered with Austin, Texas–based National Instruments to build a kid-friendly software platform.

By nailing down such key reference points as studless components and overhauling the robot's brain before fans had a chance to weigh in, Lund and Smith-Meyer lowered the risk that the citizen developers would drag the project off course. With those big-picture decisions behind them, they were prepared to engage lead users in codeveloping the Mindstorms NXT.

Challenge: Controlling the crowd eats up the clock and diverts vital resources.

One of the biggest challenges in any cocreation effort is finding ways to work the crowd without letting it grow into a rule-busting mob. The Mindstorms team's solution was to put a velvet rope around the crowd and admit only a very small, very elite clique into the design team. By limiting the number of codevelopers to only the cleverest Mindstorms hobbyists, Lund and Smith-Meyer believed they'd reap a higher percentage of helpful ideas. The question was who, out of the scores of skilled Mindstorms users, should the team let through the door? "If we had chosen the wrong people," said Lund, "we would have ended up in the wrong place."

Mindstorms managers found the right people by getting guidance from the line's customer community. The managers monitored Mindstorms Web forums and discussion groups with an eye toward identifying those people who were most often cited as masters in their fields. After generating a list of twenty names, they pared the candidates down to a final four, each of whom had expertise in an area deemed vital to Mindstorms. Steve Hassenplug, a software engineer from Indiana, was heralded for his remarkable building skills; John Barnes, who ran a company in upstate New York, Hi-Technic, which developed ultrasonic sensors for the original Mindstorms, was

the clear choice to be the "hardware guy"; Ralph Hempel, the hacker who had wowed Mindfest, was selected for his prowess in developing firmware; and David Schilling, a home-school educator from Minneapolis, was renowned for using Mindstorms to teach math and physics. (Insert photo 15 shows the four original Mindstorms User Panel members with Søren Lund from LEGO.)

In late 2004, a LEGO staffer sent an email to each of the four, as well as to a fifth person who never responded: "We'd like you to join a group of AFOLs for an über-top-secret project. Which project? I'm not telling! At least not until you sign and return the NDA [nondisclosure agreement] attached to this email."

The email invited the stellar Mindstorms users into a closed Web forum, where they formed a Mindstorms User Panel, or MUP, to help LEGO conjure up the next-generation kit.* LEGO didn't offer the four men a paycheck, only the opportunity to spend the next year collaborating with the Mindstorms R&D team. In return for voluntarily contributing countless ideas and critiques to Mindstorms NXT, the MUPs would receive a few free kits, plus the street cred that came from becoming de facto LEGO employees and helping to develop sets for the entire world. Within a few hours of receiving the note, all four citizen developers had signed on. The next note from LEGO, in December, said, "Merry Christmas. A package is in the mail to you." The MUPs opened it to find an early-stage prototype of the next generation of their beloved Mindstorms kit.

At first the MUPs believed LEGO wanted them to test prototypes for which the principal features were already locked in. When they learned that in fact LEGO hadn't even settled on the design specs, the MUPs were ecstatic. "When they told me I was going to help develop the next-generation Mindstorms while it was still on the drawing board," recalled Hassenplug, "it was more than I could have dreamed."

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* The term *MUP* evolved, and the individual members of the panel became known as MUPs themselves.

The MUPs were free to do whatever they wanted—answer questions, lobby for certain features, critique design drafts. "We didn't try to organize their time in any way whatsoever," said Lund, who worked hand in glove with the MUPs. "But they were not to be treated as an alien group. They were part of the team." Nevertheless, cocreating was hardly a frictionless effort. The Mindstorms team continually struggled to channel the MUPs' boundless capacity to generate ideas. For their part, the MUPs never ceased to run up against the company's deadlines, its budget, and the core dictum that the new set must appeal to kids, not just adults.

Striking the right balance between the MUPs' fervor and the company's constraints resided in understanding the difference between "you must" and "I can." As Lund explained it, LEGO employees, like most in the corporate world, work in a "must" culture where, more often than not, work is assigned and commitments are binding. The MUPs, on the other hand, come from a "can" culture where they have the freedom to opt in—or opt out. "They can help, and they can also decide not to help. And guess what: you can't fire them, because you haven't hired them."

By managing the tension between "must" and "can," Lund and Smith-Meyer exploited the power of voluntary commitment. They understood that people are far more willing to give their all when they sign on to a project, as opposed to when they're appointed to it. Because the MUPs worked only on what they wanted and were rewarded with reputational capital by their peers, LEGO reaped a fat payoff: the MUPs' ever-growing zeal and commitment to the success of Mindstorms. "Their enthusiasm, paired with their insight and technical skill set, was just such a winning cocktail," said Lund. "That was the biggest reason for [engaging them]."

Challenge: There's almost always a key manager or team member who believes that outsiders distract and detract from the project.

Although Lund and Smith-Meyer were unabashed advocates for working with the MUPs, the rest of the project team was less than welcoming. One engineer, in particular, protested that "chitchatting on a website" with adult fans was a waste of his time. Lund proposed a compromise: that for two weeks the engineer spend thirty minutes a day talking with the MUPs. If at the end of those two weeks the engineer still believed the MUPs had nothing to offer, he wouldn't have to work with them. "That particular engineer ended up spending more time on the forum than anyone else," Lund recalled. "He saw that they were very clever and there really was a lot of value in talking with them."

The MUPs' biggest contribution resided in their unsparing critiques of Mindstorms prototypes, which helped the design team gauge the true progress of their development efforts. During the project's first months, the MUPs dug into all of the proposed improvements for Mindstorms NXT. They contributed dozens of ideas for upgrading the model's sensors and overhauling the software and firmware. They helped persuade the team to shift to a 32-bit processor, which was necessary for serious robotics. They demanded more powerful motors. And they successfully lobbied for a wireless module that allowed the NXT brick to communicate with Bluetooth devices.

LEGO didn't accommodate all of the MUPs' suggestions, of course. The MUPs pushed for a DC power pack (instead of the much less common AC charger that Mindstorms uses) and more memory for the programmable brick, for example, but LEGO deemed both suggestions to be budget busters. And therein resides a critical lesson for any organization that wants to tap the wisdom of the clique: *cocreators are not necessarily coequals.* Although Lund valued the MUPs' unbridled creativity, at the end of the day LEGO was the ultimate arbiter.

"A lot of people call this consumer-led innovation," said Lund. "But this was not consumer-led, this was innovation led by LEGO. Yes, it was cocreation. But no one was in doubt about who would make the final call." Nevertheless, the MUPs' relentless advocacy for

the innovations that mattered most sometimes prevailed, even after LEGO had delivered a thumbs-down.

Take, for example, what happened in April 2005, when Hassenplug and Schilling traveled to Billund to compete in a Mindstorms contest at the company's headquarters. The trip marked their first face-to-face meeting with the Mindstorms R&D team. On the day after the tournament, the pair were escorted into the Global Innovation and Marketing building, which is strictly off-limits to everyone except LEGO staffers. Upon entering the Mindstorms research sanctum, Hassenplug was somewhat taken aback. "I saw my picture on the wall—they had our [the MUPs'] names and faces up there. It was kind of scary. They really knew us."

Lund gave the pair of MUPs their first close-up look at prototypes for the NXT circuit boards, as well as the set's assortment of studless Technic pieces. Hassenplug was disappointed to find that the proposed kit lacked a 90-degree joint. On a piece of paper, he sketched out a small L-shaped joint, which would enable Technic beams to be connected at right angles in one seamless move. Without it, he argued, it would take an unwieldy combination of seven Technic beams to do the same job. Lund loved the idea but told them he couldn't make it happen. The company's internal FMC targets wouldn't allow it, he explained to the MUPs. The cost of building a new injection mold to manufacture Hassenplug's proposed piece would put Mindstorms over its budget. "But they kept coming back," Lund recalled. "They kept pushing."

Four months later, at a gathering during a BrickFest fan convention in Washington, D.C., the Mindstorms R&D team presented the MUPs with the first working prototype of Mindstorms NXT.* Hassenplug was delighted to find that the set included his proposed piece. While investigating other options, Mindstorms designers

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* During the first half of 2005, the original group of four MUPs expanded to eleven. For example, Hassenplug, who often worked with his friend John Brost to create ingenious Mindstorms models, persuaded the LEGO team to admit Brost into the clique. The original four referred to these new team members as the MUPpets.
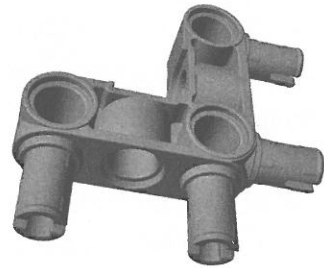
Steve Hassenplug's "Hassenpin," a piece that allows two Technic beams to connect at right angles.

discovered that a mold had long ago been developed for an L-shaped Technic piece that precisely fit their needs. Lund had easily obtained permission to add the piece to the assortment. The community dubbed it the "Hassenpin."

"It turned out to be a key piece for building in three dimensions," said Lund. "Had it not been for [the MUPs], the element would not have been in the set."

Challenge: The right crowd for the early stages of a project may not be the right group for the later stages.

In January 2006, LEGO surprised the tech and toy worlds when it unveiled a showcase prototype of Mindstorms NXT at the Consumer Electronics Show in Las Vegas. Even after a year of working on the project, none of the citizen developers had spilled their secret to the press or their peers. Their silence was a crucial part of the project's success. "If anyone had talked," explained Smith-Meyer, "it would have killed the project." A leak also might have throttled any future crowdsourcing initiatives at LEGO.

That January, LEGO also announced it needed a hundred more lead users for the beta-testing phase, the final debugging prior to the new line's August launch. Unlike the original group, the new volunteers wouldn't get to work alongside the company's developers and they'd have to pay for their kits. But they would get discounted kits and the peer recognition that came with helping LEGO perfect a robot that just might rock the world. According to Smith-Meyer, the team expected about a thousand users to apply for the openings. Instead, in a clear sign that the new Mindstorms line would be a hit with adult hobbyists, more than ninety-six hundred pitches poured in. To land a coveted spot on the testing team, candidates had to
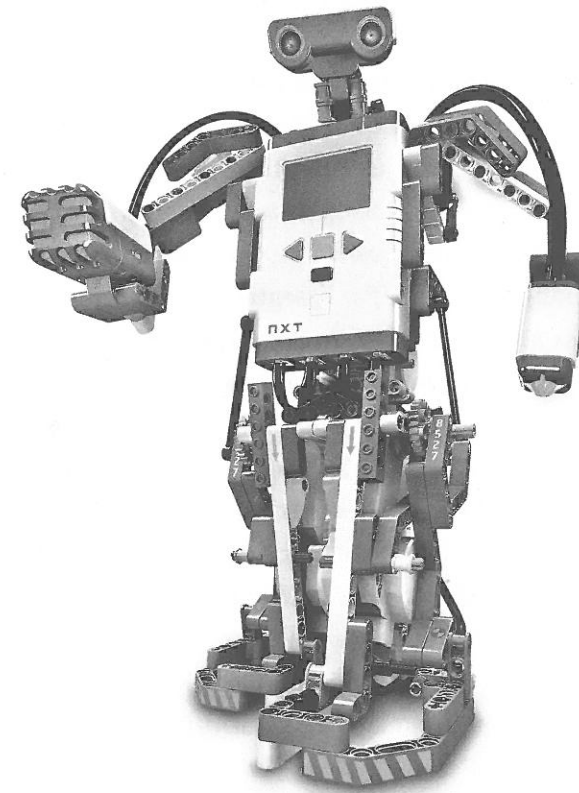
The Mindstorms NXT robot, which was unveiled at the Consumer Electronics Show in Las Vegas in January 2006.

demonstrate how their contributions would expand the Mindstorms NXT platform.

"You had to have built great robots and put them up on the website," said Lund. "Or you had to be writing a Mindstorms NXT book. If you couldn't convince someone that your work was adding value, you couldn't sign up."

Given that the original clique of volunteer developers had swelled into a real crowd of a hundred-plus testers, who were dubbed Mindstorms Community Partners, or MCPs, LEGO brought in Steven Canvin, a design manager on the original Mindstorms team, to coordinate with the burgeoning group and answer the volunteers' questions. On the first day of testing, he was nearly overwhelmed

by the cataract of emails from anxious MCPs who were itching to get started. Canvin was savvy enough to realize that neither he nor any LEGO staffer could rein in an oversize group of accomplished, opinionated geeks. But he could harness the fanboys' passion by organizing the MCPs into forums, each of which would test the robot's critical features, such as the firmware, sensors, and components. To moderate the forums, Canvin tapped the community's most respected members, the MUPs. Essentially, LEGO recognized there were leaders among the crowd, and it relied on those leaders to exercise at least a minimal amount of crowd control.

"We called it an open-source community," said Smith-Meyer. "But it was really more of a society with its own kind of hierarchy, ranks, and roles." The four pioneering MUPs sat at the top of the hierarchy's pyramid, followed by the small army of volunteer testers who also acted as ambassadors for Mindstorms NXT. And then there were the ninety-six hundred fans who registered on the LEGO Mindstorms website.

The Mindstorms hierarchy—or, to be more accurate, the Mindstorms meritocracy—was always in flux. People ascended the pyramid based on their Mindstorms innovations and their contributions to the group, whether it be hacking new code or squashing a record number of bugs. As word of their eye-popping achievements—such as the CubeStormer, a Rubik's Cube–solving robot that beat the human record for cracking the puzzle—spread across the far larger web of LEGO fans and even tech-heads who previously had been indifferent to LEGO, the buzz built upon itself and attracted thousands more converts to Mindstorms. By opening up the Mindstorms NXT development process, not only did LEGO build a better product, but it grew the Mindstorms brand by eliciting the goodwill of volunteer hobbyists who were more than willing to proselytize for a toy they had helped create.

In fact, the next-generation Mindstorms kicked up more buzz than Lund and Smith-Meyer had believed possible. LEGO estimates that the open-source development story, which was picked up by *Wired*,

Forbes, CNN, and numerous other outlets, resulted in millions of dollars' worth of free publicity, a substantial boost for a product that relies mostly on word-of-mouth marketing. Mindstorms NXT was an immediate hit: LEGO sold more than $30 million worth of kits in NXT's first year. Together with the original Mindstorms kit, Mindstorms NXT went on to rack up sales of more than two million units. And yet Mindstorms NXT's most lasting impact might well have been on LEGO itself.

After the arrival of Mindstorms NXT, LEGO went on to tap the wisdom of the clique in new and surprising ways. For example, when LEGO decided to close down its nine-volt train line and replace it with battery-powered trains—a decision that infuriated devotees of the older line—the company turned its most ardent critics into collaborators by inviting a group of fifteen of the most skilled enthusiasts to come to Billund and workshop improvements to the next-generation set.

Cocreating with customers obviously requires a different management mind-set. So let's recap the Mindstorms team's clever approach to sourcing the wisdom of the clique.

- Lund and Smith-Meyer first built a convincing case for reaching beyond the company's internal product development process. Had they not proven to themselves that the MUPs would help build a better bot and inspire the LEGO legions to get behind it, Mindstorms NXT would have been developed in-house.

- The Mindstorms team was realistic about what citizen developers could and couldn't contribute. Before enlisting the MUPs, the team first identified design features that would remain off-limits to the outsiders.

- The LEGO team carefully chose what crowd to source from. And LEGO didn't expand the team before all the major design decisions were locked in.

- The Mindstorms cocreators weren't coequals. Though the citizen developers' contributions were highly valued, the team's leaders were clear that LEGO would make the final calls.

- LEGO realized that crowdsourcing required crowd control. As the project grew and the clique took on more members, Lund tapped the original MUPs to lead the effort to test and tweak NXT.

Given its success with Mindstorms NXT, LEGO might have grown its outside innovation efforts by working with larger groups. Instead, the company proved itself fully capable of going in the opposite direction, from tapping the talents of four adept hobbyists to harnessing the acumen of one inspired entrepreneur. The company's bid to exploit the wisdom of one was born out of its desire to bring new, authentically LEGO innovations to the brick while retaining its discipline and focus. By learning how to locate and work with one black-belt entrepreneur, LEGO developed a successful, highly original product line and opened up a whole new channel to market.

A Crowd of One

By 2006, the LEGO Group's leaders began to worry that their laserlike focus on rebuilding the company's core product lines and running the day-to-day business was leaving them shortsighted. Although Mindstorms NXT was an unequivocal success that had staked out a new market for LEGO, at the end of the day it was just one set. LEGO was still devoting far more of its resources and mind share to "more of the same" than to "new and different." Such a narrow approach to pumping up the business meant that LEGO might well miss out on other growth opportunities.

The LEGO Group's dilemma was one that every forward-thinking company must inevitably face: how to ensure that the effort expended on profiting from the core doesn't shortchange the future.

Google, for example, answered the challenge by developing an explicit formula for innovation, which it calls "70–20–10." Google puts 70 percent of its engineering resources into enhancing its base business, while 20 percent is concentrated on developing services that extend the core and the remaining 10 percent is allocated to fringe ideas that might prove critical for the long term. The policy ensures that as Google strives to continually evolve its core search and advertising business, it still devotes substantial resources to growing new services and launching experimental products.

Had LEGO done the math for its own innovation efforts, the numbers would have skewed closer to 90–10–0, with 90 percent of its resources devoted to advancing core product lines and 10 percent aimed at extending the base with genuinely new play experiences. As for speculative efforts that might one day yield a breakthrough, LEGO just didn't go there. "If you take R&D, we did D," quipped Smith-Meyer, who helped lead the Mindstorms NXT codevelopment effort. "Before the [financial] crisis, we did a lot of big research projects that just didn't amount to anything. After the crisis, it was almost like all efforts were meant to launch."

In 2006, LEGO sought to strike a better balance between innovations that enhanced the core business and those that opened entirely new markets. Knudstorp and Lisbeth Valther Pallesen, who headed up the company's Community, Education, and Direct (CED) division, asked Smith-Meyer to lead a "front-end innovation" unit that would focus exclusively on developing initiatives to take LEGO into unexploited markets. The brief from upper management was undeniably ambitious: within one year, uncover two new opportunities that could potentially grow to make up 10 percent of the company's revenue.

Although Smith-Meyer was eager to take on the challenge, he soon began to doubt whether he or anyone else would know a big opportunity when they saw one. Seeking some inspiration, one day he dug into the birth stories of several resilient companies. He found that while the stories differed wildly in the details, there was a common thread. Whether it was Nike cofounder Phil Knight selling running

shoes from the trunk of his car, a young Michael Dell marketing PCs made from stock parts out of his University of Texas dorm room, or even Ole Kirk experimenting with his injection molding machine, these were entrepreneurs who relied as much on passion as on acumen to build industry-defining businesses.

Smith-Meyer decided his new-business initiative stood a better chance of getting to the future first if he reached outside Billund and enlisted entrepreneurs whose zeal for LEGO was taking the brick in entirely new directions. "The idea," he recalled, "was that they would help us start businesses that are impossible to start within LEGO."

Smith-Meyer had already seen firsthand how an outside group of smart, accomplished brick masters had burnished Mindstorms NXT and reignited the adult fan community. But this time he decided to tack to a course that varied by several degrees from NXT's cocreation effort. Rather than exploit the wisdom of a crowd or even a clique, now the strategy was more a matter of leveraging the wisdom of one—one passionate entrepreneur who had identified an opportunity for a new product line. "If we could mix in a little venture capital with that 'start-up in the garage' mentality, we just might create a successful business."

Smith-Meyer returned to Knudstorp and Pallesen and won their backing to revise his brief. Instead of taking a year to find two potentially big growth opportunities and then invest significant resources to develop them, the front-end team would align with entrepreneurs who were already working on nascent but promising projects. Within a matter of months or even weeks, the team would use the LEGO Group's know-how to help these entrepreneurs test the market, make necessary revisions, and test again. The idea was to avoid making bet-the-farm mistakes by launching a series of low-cost, low-risk experiments, which would increase the odds that one might grow into a runaway success.

Then came the next challenge. Having convinced LEGO to back his unit-of-one approach to cocreation, Smith-Meyer had to find the right entrepreneur.

Finding a Master Builder

About a year before Smith-Meyer assembled his front-end innovation team, a Chicago-based architect named Adam Reed Tucker began to feel the pull of the brick. Tucker had built a healthy practice designing high-end homes, but he hungered to do something more meaningful with his life. In the aftermath of the destruction of the World Trade Center towers during the 9/11 terrorist attacks, he had seen how iconic structures such as the Empire State Building and the Sears Tower endured dramatic declines in tenants and tourists. He began to explore ways of using his architectural experience to help laypeople understand that the stunning human accomplishment called the skyscraper is something we should celebrate rather than fear.

One day, while thumbing through a book titled *The World of LEGO Toys*, Tucker came across a 1970s Scandinavian architect who had showcased his designs by building models out of LEGO bricks. Recalling the countless hours he had spent building with LEGO as a child, Tucker wondered whether the brick might be a powerful medium for demonstrating the complexity of skyscraper engineering while making it easier to view up close.

Tucker immediately decided to "get reacquainted" with the brick. He drove to a nearby Toys "R" Us store and bought nearly every LEGO set he could find, which amounted to thirteen shopping carts stuffed with boxes of LEGO *Star Wars*, LEGO *Harry Potter*, and much, much more. Once home, he tore through the boxes, threw out the instructions, and began to build in a very big way. Working nights and weekends, he first pieced together a six-foot model of Chicago's Sears Tower, comprising five thousand bricks. He was immediately struck by the juxtaposition between the "sincerity and seriousness" of the tower and the playfulness and naïveté of the brick.

"From ten feet away, it looked like a cool, somewhat imposing model of a building," Tucker recalled. "And then you get closer and you're like, 'Wait a minute, those are LEGO bricks!'"

Over the next few months, Tucker snapped together tens of thousands of bricks to create more model skyscrapers, which ranged from eight to twelve feet tall. (Insert photo 16 shows some of Tucker's creations.) As images of his large-scale creations spread through the adult fan blogosphere, a few people suggested that he show his work at BrickFest, the annual gathering of the LEGO tribes. It was there, surrounded by his soaring interpretations of the John Hancock Center and the Empire State Building, that Tucker first met Smith-Meyer, who'd come to the event to scout out potential collaborators. Tucker was planning on selling his LEGO sculptures to art galleries and corporations, but Smith-Meyer left him with a different thought: shrink the models down to souvenir-size boxes and sell them at retail.

Fired up by his fifteen-minute conversation with Smith-Meyer, Tucker spent the next year delving into all things LEGO. He continued sculpting his towering interpretations of famous city buildings, such as the World Trade Center and the St. Louis Gateway Arch, some of which soared up to eighteen feet high and incorporated as many as 450,000 bricks. Inspired by BrickFest, he founded the Chicago area's first fan convention, Brickworld, which would launch the following June. And he worked long nights "scratching out" designs of miniature models of iconic tall buildings, made entirely of bricks. As summer approached, he shot Smith-Meyer a cryptic email: "Come and see us at Brickworld. I'll have a surprise."

When Smith-Meyer arrived at the convention, Tucker handed him an event kit that was presented with a holographic sticker and the Brickworld logo. Smith-Meyer was taken aback by the box's amateurish design but enthralled by what he found inside: a package of LEGO pieces, with a booklet featuring step-by-step instructions showing how the bricks could be assembled into a miniature model of the Sears Tower. The booklet included archival photographs of the tower, along with a brief profile of its architect, the origin of its design, and its architectural features. Taken together, the bricks and

the booklet captured Tucker's ambition: "I wanted to tell a story, not just sell a box of bricks."
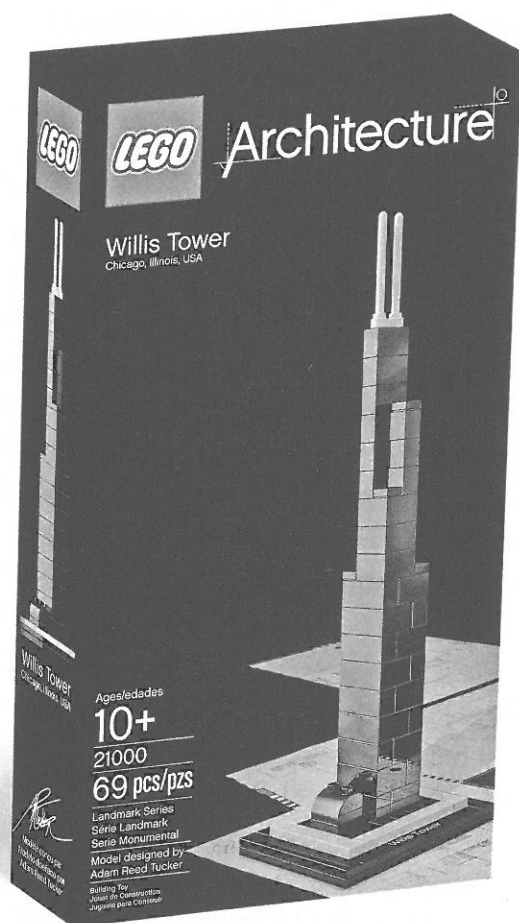
At that point, Smith-Meyer decided that Tucker was for real. Clearly, Tucker possessed the "crazy entrepreneurial gene" that Smith-Meyer was looking for. Equally important, he had an original idea that grew out of the LEGO heritage but potentially took the brick into new sales channels. Moreover, the thousands of enthusiasts who were wending their way through Brickworld and the 250 kits of mini Sears Towers proved that Tucker made things happen.

Over the next two days, the novice entrepreneur and the LEGO executive worked out a plan for a proof-of-concept test. With LEGO providing bricks and the power of its brand, Tucker would create and sell a thousand kits of his LEGO Sears Tower. They would call the new line LEGO Architecture.

Creating a Test Plan

After returning to Billund, Smith-Meyer presented the LEGO Architecture idea to his new-business investment board, which consisted of Knudstorp, Pallesen, senior vice president Per Hjuler, and several other executives. He first sketched out a pathway to test, launch, and grow the new line. It was a simple stage-gate development process that was built around a series of major investment points, or MIPs—except in Architecture's case, it was more a matter of *minor* investment points, as LEGO would absorb only shipping charges and the cost of manufacturing the bricks for the test run. If Architecture made it through the test gate, MIP I, it would move on to MIP II—a minuscule but real pilot launch of four thousand Architecture sets.

The kicker came when Smith-Meyer pitched the review board on the business logic for the new line. He predicted that Architecture would take the company into such new-to-LEGO channels as souvenir stores, museum shops, big bookstore chains, and even high-end

The LEGO Architecture Willis Tower (formerly Sears Tower) kit.

became a true start-up effort that took LEGO back to the garage, literally as well as metaphorically. Just consider:

- Tucker's first "contract," as he put it, was essentially a back-of-the-napkin agreement with Smith-Meyer that was "nothing more than a leap of faith to say we want to do this together."

- Seeking to tamp down development costs, Smith-Meyer bypassed the company's in-house artists and crafted Architecture's initial packaging design himself. Tucker also wore many hats: he not only designed the Sears Tower set but lined up an offset printer to produce the boxes and leveraged the LEGO brand to strike a licensing deal with the owners of the Sears Tower.

- When it came time to deliver the LEGO bricks and boxes for the test run, a tractor-trailer pulled up in front of Tucker's suburban home and unloaded four pallets of packages into his garage, much to his neighbors' consternation. Thus Tucker's garage became LEGO Architecture's first distribution center.

It took Tucker and his wife two weeks to sort the tens of thousands of pieces and bundle them into a thousand sets of LEGO Sears Towers. He then turned the lot over to a souvenir chain, Accent Chicago, with a handshake understanding that if the kits didn't sell, the company wouldn't owe Tucker a dime. Ten days later, he got a call from the chain's buyer.

"He'd already sold through half the line," Tucker reported. "He's like, 'You're on to something here. Polish it up and let me know when you're coming out with more sets.'"

Having proven that consumers wouldn't flinch at Architecture's heady markup over a simple LEGO set, Smith-Meyer took the line to the next stage gate, MIP II: a pilot launch of two thousand kits each of a Sears Tower and John Hancock Center. Only this time, he brought the development effort in-house.

clothing stores. What's more, the line would sell at a premium price. Whereas a simple box of seventy LEGO bricks retails at $7.99, an Architecture box containing the same number of bricks would retail for $19.99. At that, the board's reaction was swift and unanimous. "Everyone was like, 'You can never charge $20,'" said Smith-Meyer. "'That's just crazy.'"

Despite the new-business investment board's skepticism over Architecture's rich price tag, the opportunity presented so little downside that LEGO green-lighted the test. With that, Architecture

Launching the Line

Smith-Meyer recruited an ad hoc team consisting of a dozen LEGO designers, engineers, and operations veterans. Working only during their downtime—staffers still had to fulfill their day-job responsibilities—they perfected Tucker's brick selection and assembly instructions for each kit, crafted Architecture's logo and a sleek white-on-black packaging design, coordinated approval for images and text from the Sears Tower and John Hancock owners, and readied the production run, which was so small the boxes were packed by hand. The goal was to spend the least amount of time and money to test whether the product would sell on its own. Starting only with Tucker's design models, it took the team a mere eight weeks to perfect the line and produce the finished boxes. Total cost to LEGO: $10,000.

"Every time a problem came up, we just made a decision right there and then," said Smith-Meyer. "There was no time for debating."

In November 2007, LEGO shipped the two Architecture products to nine gift shops in Chicago. This was Architecture's proof-of-concept test. The sprawling U.S. souvenir store industry includes about thirty thousand stores with combined annual revenue of nearly $200 billion. If the line sold well in those nine Chicago stores, LEGO would take Architecture from the pilot test to a small but real launch of ten thousand sets. Smith-Meyer's two-year plan was to grow the Architecture businesses in large markets across the United States and then start experimenting in markets overseas.

Within a matter of weeks, the matter was settled. The John Hancock sets were moving quickly, while the Sears Tower was a complete sellout. At least within its test market, Architecture was a hit.

By the time we caught up with Tucker, he and his wife had moved into a new home in Arlington Heights, a Chicago suburb. There was a notable lack of furniture in the house, though his garage and more than a few rooms were packed with bins of LEGO bricks—roughly *ten million* bricks in all. And then there was his studio, which was

overflowing with his LEGO-driven explorations of the aesthetics of engineering: a half-completed model of a swooping, curvilinear roller coaster, made entirely of bricks; intricate studies of Chicago bridges; and, of course, test models of the next generation of Architecture. Having taken the LEGO Architecture series from replicas of the White House and Seattle's Space Needle to a lovingly detailed, eight-hundred-piece rendering of Frank Lloyd Wright's masterpiece Fallingwater, Tucker and Smith-Meyer were shifting their focus to iconic architectural creations in Asia and beyond.

A LEGO Architecture store display showing the White House kit (middle) and Fallingwater kit (bottom left).

"There are so many landmark structures, both ancient and modern, throughout our built environment," Tucker proclaimed. "Architecture transcends race, religion, age—it really knows no boundaries. So the possibilities for LEGO Architecture are almost limitless."

Although LEGO doesn't break out revenues by toy line, it's safe to assume that LEGO Architecture has hit the DKK 1 billion in sales that the company prioritized in its first brief to Smith-Meyer. Since its 2008 launch, the line's sales increased 900 percent in 2009, 350 percent in 2010, and 200 percent in 2011. With popular, advanced kits such as Fallingwater (see insert photo 17) retailing for $99.99, LEGO Architecture is "very, very profitable," according to Smith-Meyer. Not only has the series taken the company into upscale channels such as Hammacher Schlemmer and museum stores, as well as almost-new-to-LEGO chains such as Barnes & Noble, it's also a hit with adults and it's pulling in new fans. Surveys showed that more than 60 percent of those who buy a LEGO Architecture

The LEGO Architecture Fallingwater kit.

kit are over eighteen (and intend to use it themselves); more than 15 percent have never previously purchased a LEGO kit of any kind.

Just as it did with Mindstorms NXT development partners, LEGO went on to ever so slightly expand Architecture's codevelopment effort, enlisting architects who worked in parallel with Adam Reed Tucker to create brick-based versions of famous European buildings. For example, the Slovenian architect Roc Z. Kobe designed the iconic Big Ben Clock Tower kit, while the German architect Michael Hepp created the French Villa Savoye set. By encircling Architecture with a velvet rope and admitting just a few more architects into its exclusive club of talented contributors, LEGO reaped their creativity while still exerting enough control to deliver profitable sets.

Lessons in Crowdsourcing, Sourced from LEGO

Taken together, Mindstorms NXT and LEGO Architecture taught LEGO some valuable lessons about open innovation.

Set a fixed direction; stay flexible in the execution. Although their original brief to Smith-Meyer's front-end innovation team was unequivocal, the LEGO Group's leaders understood that launching a search for unformed business opportunities likely would increase the need for midflight corrections. When Smith-Meyer pushed back with his "leverage the wisdom of one" cocreation strategy, Knudstorp and Pallesen were flexible enough to adapt. No doubt this was in large part due to Smith-Meyer's standing within the company: he was a battle-tested innovator who had earned leadership's trust. And that was key. The CEO didn't consign the open-source effort to a talented but unproven MBA. In Smith-Meyer, he tapped someone who had the throw weight to challenge first assumptions.

With Mindstorms NXT, Søren Lund never lost sight of the peak goal, which was to create a LEGO robotics kit for *kids*. Thus, he was uncompromising in his insistence that a twelve-year-old must be

able to have a satisfying play experience within twenty minutes of opening the box. But like Knudstorp and Pallesen, he recognized there was more than one trail to the summit. Even though Steve Hassenplug's pitch for an L-shaped joint threatened to bust the project's budget, Lund didn't reject the idea out of hand. He worked the problem until he found a way to manufacture the Hassenpin without building a new mold, which saved LEGO upward of $50,000 and ultimately delivered a better building experience for kids. Lund remained open to the MUPs' suggestions, so long as they kept within the project's design parameters and recognized that the primary customers were children, not adults.

Though they have different expectations, outsiders and insiders share responsibility for the ultimate outcome. Both the Mindstorms team and the outside codevelopers had to recalibrate their expectations of what each side could deliver. At the outset, the MUPs and Tucker bumped up against the company's unyielding quality and safety standards. They had to work within the LEGO ethos of "only the best" and remember they were designing for children, not adults. They also had to deal with such unfamiliar terrain as learning to cap the cost and complexity of their designs. For its part, LEGO had to learn how to channel the adult users' creative zeal without choking it off. Lund and Smith-Meyer soon found they had to be both enforcers and advocates. They had to press the outside contributors to recognize the company's rules, even as they argued within LEGO to let the outsiders push the company's limits.

Open-innovation efforts require new roles. In an established company, open-innovation projects require managers to take on some unfamiliar challenges. Smith-Meyer had to set limits around Tucker's expectations—he couldn't strike an agreement to produce the Architecture line without first putting the concept through some rigorous tests. At the same time, he had to represent Tucker's interests within the company and help him overcome internal skeptics.

So it went for Mindstorms NXT. When the NXT project scaled from the four MUPs to the one hundred testers, Steven Canvin had to assume the role of community organizer. That meant educating the community of testers about the company's design goals and limits, setting deadlines, representing them internally, and, above all, demonstrating that LEGO was listening. Roles could act as effective controls for guiding open innovation.

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Less than two decades ago, LEGO was a fortresslike company whose public position was "We don't accept unsolicited ideas." By 2006, the company had upended both the policy and its above-the-fray mind-set. LEGO had recruited expert adult fans to help reinvent Mindstorms, its most successful stand-alone product. Paal Smith-Meyer had begun collaborating with Adam Reed Tucker to create LEGO Architecture, which brought the brand into retailers that had never before carried LEGO. The company had even started developing a "toys for adults" line, the ultrachallenging LEGO Modular Buildings series, which was originally suggested by AFOLs through a poll the company had organized.

To be sure, LEGO continued to develop the majority of its products in absolute secrecy. The company opened up its innovation process only when it concluded that outside collaborators possessed a particular area of expertise that staffers lacked. Or the company would enlist entrepreneurs whose acumen helped identify an emerging business opportunity. As those efforts yielded successes, LEGO rolled out other platforms for sourcing the crowd, as we will see in the final chapter.

LEGO came to realize that while open-source innovation can be managed, it can't be controlled. The process is best understood as an ongoing conversation between the company and its vast crowd of fans. Like any good dialogue, LEGO-style sourcing was built on the principles of mutual respect, each side's willingness to listen, a clear sense of what's in play and what's out of bounds, and a strong

desire for a mutually beneficial outcome. For outside collaborators, the reward could be intrinsic—such as recognition from peers and access to LEGO—as well as financial. As for LEGO, the conversation almost certainly tightened its ties to the fan community. And in some instances, it delivered products that LEGO itself had never imagined.