

Venture Analysis for Lego Mindstorms
in the Educational Technology Market

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In most parts of the Western world, it is nearly impossible to grow up without knowing about Lego. Arguably the world's most famous construction toy, Lego has been around since the 1940s and has developed a strong brand image as the producer of a high-quality toy product that helps develop imagination and visual-spatial reasoning skills.

Lego toys have long been a part of many elementary school classrooms, but in the last decade, Lego has been pushing a product into the realm of higher-level education: the Lego Mindstorms robotics construction set. Mindstorms combines the infinite variability of the traditional Lego construction toy with a powerful programmable computer, servo motors, and a variety of high-quality sensors. Simply put, the Mindstorms set allows you to build and program a huge range of robots: whether you want to build a humanoid walker robot, a Rubik's cube solver, a Tic-Tac-Toe playing droid, or sumo wrestling battle bot, the variety of projects is only limited by your imagination.

As a high school computer science teacher and former Lego devotee, I jumped at the chance to purchase Mindstorms kit for my students. In the two years I have been using them at Lord Byng Secondary School, I have seen students become so dedicated to their projects that their parents have called to complain that they are neglecting their core academic courses or music lessons in order to spend more time perfecting their robots. In fact the robots have been so successful that my elective program has doubled in enrollment. My first-hand experience with Lego Mindstorms has beyond a shadow of a doubt proved to me that it is brilliant as an educational tool for teaching math, science, and engineering concepts. You don't have to take my word for it; the hundreds of fan websites, streams of Mindstorms books, and a worldwide league of Lego robotics competitions can attest to the effectiveness of this product as an educational tool.

So when I tell you not to invest your money in the Lego Mindstorms venture, please understand that I do so with the utmost reluctance. Despite the quality educational experience that Mindstorms delivers, there are a series of interconnected fundamental flaws that will eventually kill Lego's position

in the programmable construction toy market: price point, the potential for competition, and the fact that Lego is Mindstorms' own worst enemy.

In order to understand why Mindstorms is not a sound investment, let's first look at Mindstorms' price history. The first Mindstorms product, the Robotics Invention System (RIS), hit the shelves in 1998. As the brain child of a joint venture between Lego and the MIT Media Laboratory, Lego hoped that the RIS would help stem the loss of their teenage market to video games¹. With Lego's great reputation for delivering fun, peaceful, and quality products, and the growing parental concern over the violent content of many video games, it seemed like the perfect time for Lego to make a comeback. But the RIS had a price tag of \$200², which did not include the price of the six rechargeable batteries and battery charger needed to make the toy work. Although Lego never publishes profit margins, the best estimates have indicated there is little room for lowering the price³. As it turned out, not many parents weren't ready to buy toys this expensive, despite a good deal of positive press surrounding the product.

Sales were particularly weak in the first year, and in 1999 Lego responded by releasing two stripped-down programmable construction kits for \$150 (the Robotics Development System or RDS) and \$100 (the Star Wars Droid Development Set or DDS)⁴. The RDS offered only limited programmability and the DDS was completely non-programmable. Neither sold well, and were heavily discounted to sell off inventories soon after⁵. Lego could not find a way to make a product with the same quality of the original RIS for less than \$200. Instead, Lego concentrated on developing the high-quality RIS in the educational market, fostering national and international Lego robotics competitions and opening up the hardware specs for third parties to develop new programming languages. All told,

1 "Lego Mindstorms." *Wikipedia*. Web. 18 Oct. 2009. <http://en.wikipedia.org/wiki/Lego_Mindstorms>

2 Note: all prices are in US dollars.

3 "Lego Mindstorms: What Went Wrong?" *Techuser*. Web. 18 Oct. 2009. <<http://www.techuser.net/lego.html>>.

4 "Mindstorms NXT: Mindstorms Resurrected?" *Techuser*. Web. 18 Oct. 2009. <<http://www.techuser.net/lego2.html>>

5 "Mindstorms Resurrected?"

they sold 1 million RIS sets over seven years, with the majority of the sales coming from the educational market⁶. This is respectful, and certainly enough to establish Lego as the leading producer of programmable construction sets in the educational market, but it is far from high volume. Compared to Lego's competitor MegaBlocks, who sold thirty million non-programmable construction sets in 2004 alone⁷, this number seems less impressive.

By 2002, Lego made it's second attempt to introduce a Mindstorms product at a lower price point - Lego Spybotics - and it is at this point that we begin to see the second factor that makes Mindstorms venture a bad investment: the fact that Lego is Mindstorms' own worse enemy. The Spybotics line included several sets that all retailed at \$60, were partially programmable, and had sufficient complement of sensors and computer processing power to make a wide variety of projects.⁸ Although sales were not impressive, Lego research realized that this was mainly a marketing problem - consumers had trouble understanding the potential or purpose of the product from the packaging. In an experiment that saw the Spybotics repackaged and sold in the electronics section of Toys 'R Us, the unit sold much better⁹. But Lego did not act on this and instead made the surprising move to let the product die. It turned out that instead of taking a bite out of video game sales, Lego's 2003 annual statement made clear that the lower priced Spybotics sets were taking a bite out of Lego's mainstream construction set sales, which are the company's primary revenue-generating products¹⁰.

As a result, Lego has since abandoned attempts at producing a lower-priced programmable construction set. The RIS's successor, the NXT came out on the market in 2006 priced at \$250. This seems to be part of a larger strategy to distance Mindstorms from mainstream building sets; the NXT also uses special "Technic" construction pieces that are not as compatible with standard Lego bricks.

6 "Mindstorms Resurrected?"

7 "Why the NXT failed."

8 "Tech toys are fighting an uphill battle for shelf space." *Kidscreen*. Web. 18 Oct. 2009. <<http://www.kidscreen.com/articles/magazine/20030801/tech.html>>.

9 *Kidscreen*

10 "Mindstorms Resurrected?"

Lego is set to release the NXT 2.0 this Christmas, and every indication is that it will be priced above \$250. Lego continues to aim Mindstorms product at the only market where this price makes sense and where it will not compete with other Lego products: the educational market.

So why is this a bad thing? Lego is trapped; unable to develop a lower cost product for fear of cutting in on their other products' market, they leave themselves open to competition to undercut their product as technology advances. And again, it is the video game companies that are in the position to muscle in on their product. Companies like Microsoft, Nintendo, and Sony who manufacture microprocessors and other electronic components for their hand-held video game consoles in huge volumes are well positioned to produce the computer-controlled aspect of the building sets¹¹. Microsoft is especially well positioned; they already have a Robotics Developer Studio software to interface with and reprogram a variety of commercial robots like the Roomba, and they have always aggressively promoted their tools to the next generation to ensure their long-term position at the top of Silicon Valley. It is true that Lego has a huge lead in brand-awareness and is already established in the educational market. But speaking from experience, if a more affordable robotics construction set came along, a lot of people would be interested. As we speak, I am struggling to raise more money to field enough Mindstorms kits for my students to work in pairs instead of 3 person teams. If I could, I would field enough for each student to use individually. If there was a significantly cheaper but comparable alternative, I would have gone for it immediately.

Other companies are already beginning to muscle in on the robotics educational market. For example, the Vex Robotics Design System is successfully copying Lego's strategies, offering their own FIRST robotics international competition and their own free programming software. Vex actually offers a more expensive product with higher-quality metal parts and more processing power, which isn't going to kill Mindstorms. But Vex proves two things. First, Vex shows that Lego doesn't have a

¹¹ "Mindstorms Resurrected?"

monopoly on robotics construction sets, and there is room to expand. Second, Vex shows that the strategies that made Mindstorms successful can be duplicated.

The future of Mindstorms is now uncertain. Although no dangerous competitor currently exists, Lego has taken Mindstorms down a road that will leave them unprepared to defend against cheaper alternatives designed to sell at high volumes. The latest Mindstorms product continues this dangerous trend this Christmas, showing that Lego isn't budging from this course. Although I love the Lego Mindstorms product, and I expect the Mindstorms to continue to last awhile longer yet, to invest in Mindstorms now would be foolish. Mindstorms fate is not sealed, but until Lego can demonstrate that they have a long-term plan to deal with having their legs cut out from under them, they are an unwise investment.