



Lego

The Danish company Lego is one of the most famous brands in the world when it comes to children's toys and has grown since it was founded in 1932 into a global business. Its origins lie with Ole Kirk Christiansen, a carpenter from Billund (where the firm is still based) who bought a woodworking business in 1916 and made furniture for local farmers. For various reasons he shifted his production range in the 1930s to make children's toys and in 1934 named the company 'Lego' from the Danish words *leg* and *godt*, meaning 'play well'.

His early products - wooden pull toys, piggy banks, cars and trucks – were reasonably successful but a key turning point for the business came in the 1940s when they began making plastic toys including a truck which could be taken apart and re-assembled. In 1949 Lego began producing a set of interlocking bricks (based on an original patent by the UK Kiddicraft company for which they bought the rights) made from cellulose acetate and using an early version of a hollow design with holes and studs. The now familiar Lego bricks appeared on the market in 1953 but were not initially very successful, partly due to poor perceptions amongst consumers and retailers of plastic toys.

The key was probably the emergence of the idea of a building system based on interlocking bricks – an idea which took some time to develop and is closely linked to the son of the founder, Godtfred Kirk Christiansen. His discussions with buyers, especially in the USA, helped the idea of an architectural innovation – a product platform on which many different designs could be built – to mature. Much work was needed to improve the design to give better locking ability but gradually the concept became reality and 1958 saw the emergence of the patented basic brick design with which we are still familiar. By 1959 the company had stopped making wooden toys and concentrated solely on plastic bricks and related products. A series of product, process and market innovations – adding wheels, figures, targeting and segmenting different markets, switching from cellulose acetate to acrylonitrile butadiene styrene (ABS) plastic, adding instruction manuals, etc. – helped fuel development such that by 1988 there were over 50 elements in the Lego toy system. The company opened a theme park in 1968 which displayed miniature towns with a variety of features all made from Lego bricks – and which attracted over 600,000 visitors in its first year of operation. The power of the underlying architectural innovation becomes clear in the expansion routes followed – developing simple large bricks ('Duplo') for very young children and sophisticated gears, joints, axles and other materials for older 'Lego Technic' builders – all using the same principles and all interchangeable. Underpinning the physical toys was a growing element of 'storytelling', using home grown stories like medieval knights, pirates or space adventures but also linking into key film themes like 'Star Wars'.

Growth continued throughout the later years of the 20th century with Lego becoming one of the top ten toymakers worldwide, and with a wide range of products standing on their basic platform. The range not only diversified – including train sets, model cars and simple robotics – but also extended the architecture to include control and programmability to support such toys. Storytelling increasingly targeted different segments – for example Belville is a product aimed especially at girls whilst Bionicles introduced complex Technic-based action figures for boys.

It is worth putting the power of the basic architectural/platform innovation in perspective. With just two bricks there are 24 different combinations, and with six there are 915 million possibilities, so the range of options – both designed by Lego but also created by end users – is huge. Estimates suggest that over 400 million children (and a fair number of adults) play with the bricks for around 5 billion 'play hours'. Yet the original design still holds –



apparently bricks made today can still interlock with those made in the first batch of 1958. Not surprisingly *Fortune* magazine named Lego as 'toy of the century' in 1999. However by the late 1990s the company had begun to run into difficulties. In their main product area low cost 'good enough' quality competition was making inroads into their market – a classic example of disruptive innovation similar to the low cost airline revolution. For example a Canadian company, Megabloks, began offering a wide range of competitively priced building toys which rapidly pushed Lego along the shelf space of many stores. At the same time a large section of their traditional market – young boys – was increasingly being drawn away from building models and into the world of computer games. And finally Lego was a global company but based in a high cost economy – Denmark – with resulting pressure on its operations to remain competitive. Its supply chains were long and expensive – at one stage with 11,000 contractors Lego had more suppliers than Boeing used to build its aircraft! And its product development had become increasingly complex, with many product ranges involving such a wide range of choice – for example the Pirate figures had no less than 10 different leg designs, each with its own clothing – that it became difficult to manufacture economically.

The combination of these circumstances saw the company increasingly losing money and market share and the crisis peaked around 2003 with a reported loss of \$240m and fears that the giant Mattel company would take over Lego. The tradition of hands on family management ended with the stepping down of 3rd generation Kjeld Kirk Christiansen and the appointment of a new CEO appointed, Jorgen Vig Knudstorp. His arrival, plus the injection of \$178million from the family, allowed a breathing space within which a turnaround could be effected. The transition – although painful – seems to have worked with the company back in profitability by 2006 and in 2007 turning in its best-ever financial performance. It involved extensive rationalization and cost-cutting in areas like supply chain and factory location, together with a rethink of the product development strategy. For example the number of unique pieces being manufactured in Billund was cut from 12,400 to around 7,000. But it also included extensive learning about new ways of working with users as designers as part of the product innovation approach.

Rethinking the role of users

Users have always been involved in the Lego concept since – as we saw earlier – the potential configuration of even a small number of bricks is huge. People might buy a Lego toy to make a car or house but will quickly adapt it and reassemble the bricks in all sorts of different – and user created – ways. But since 2000 Lego has been on a journey which puts this user-linked approach increasingly at the centre of their strategy.

Early work behind the scenes in improving production efficiency involved building digital models of all the bricks and other components which they made. By having such models it became possible to explore new product options via computer-aided design and to link this to computer-aided manufacturing, helping reduce overall time and cost in manufacturing. But this also opened up an interesting product option in the market-place – customizable toys. An early product was called Lego Mosaic, originally launched in 2000, which allowed users to upload photographs to the company's website. Lego would digitize the picture and calculate the bricks required to make a wall-hanging mosaic with multiple colours.

Mosaic provided an early learning experience which has fed through to an increasing variety of user configurable products in which users can modify or even design from scratch their



own toys. Lego Factory offers this opportunity online – users submit designs and Lego calculate the bricks and other components required and generate the building instructions needed. Alternatively users can use design tools on the site to develop their own ideas and Lego simply acts as a service provider, packaging the relevant pieces and sending them out to the user/designer.

As the following press release indicates, the role of users has become a key element in Lego's innovation strategy:

"August 29, 2005: Celebrating the 50th anniversary of its System of Play, LEGO Group today unveils LEGO Factory, a consumer experience that combines today's hottest kids trends -- technology, mass customization and community -- to enhance and build relevance for its classic toy offering. Beginning today, children of all ages can visit www.LEGOFactory.com to design, share and purchase custom models.

LEGO Factory is powered by LEGO Digital Designer (LDD) -- a proprietary virtual building program available as a free download for PC and MAC users. Drawing upon a virtual warehouse of bricks and elements, children can design 3-D models just like professional LEGO Model Designers. Factory models are micro scale -- smaller than traditional LEGO minifigure proportion (roughly 1:50 life-size) found at retail -- but still provide precise detail and functionality.

LEGO Factory sets arrive in custom packaging that shows a child's model and name, and include all of the LEGO elements needed to build the virtual design in physical form. Every customized LEGO Factory creation will have a unique price dictated by the size of the model and elements used. Custom models will take from 48 hours to a week to arrive, depending on which shipment method consumers choose.

LEGO Factory is also designed to create a community of builders who share their virtual creations with consumers around the world. Children can view other builders' custom creations, add and remove bricks, rotate the 3D view and zoom in on the details, download the building instructions to build from their existing LEGO collection, or even purchase someone else's model for themselves.

"Giving children access to a virtual warehouse of LEGO elements to design their own models is a fantastic extension of everything the LEGO System of Play represents and has provided for the last half century, and marks a rare opportunity for true mass customization and community in today's toy market." says Mark Hansen, director, LEGO Interactive Experiences. "With LEGO Factory we can expand beyond our 100 in-house product designers to marvel at the creativity of more than 300,000 designers worldwide." During its Beta phase, LEGO Group sponsored a contest to better understand the types of models that consumers would design using LDD. The contest lasted for 11 weeks and 8,000 models were custom designed. Ten models were voted by consumers and LEGO Master Model Builders to become real LEGO sets available exclusively through the company's Shop-at-Home division. Contest winners, whose ages ranged from 9 to 38, will receive royalties based on sales of their winning designs. For more information on these winning designs visit <http://www.lego.com/eng/factory/design/bios.asp>.

"It's only fitting as we celebrate 50 years of a classic play pattern in an increasingly electronic toy world that we elevate the experience of building what you imagine by blending the best of both the virtual and physical worlds of play," says Soren Torp Laursen, president, LEGO Systems. "We look deep into our compatible system of play to reinvent ourselves year on year, and we only incorporate technology where meaningful and complimentary to the core LEGO building experience."



Open innovation and user engagement

A second important feature in this learning process has been the opening up of the design process to outsiders. An early product aimed at competing with the growing computer games sector was Mindstorms – a sophisticated Technic-based kit with a programmable brick, various sensors and actuators and a simple user programming language. This allowed users to create a variety of programmable models which would carry out various movements – developing ideas which the company had first explored in the 1990s. The original MIndstorms Robotic Invention System (RIS) product was launched in 1998 and became one of the company's best selling lines – with over 1 million units sold. In 2004 work began on Mindstorms NXT – as the name implies, a new generation – which appeared in 2006.

One of the key limitations of the original Mindstorms was the complexity of the programming language – market research suggested that over 70% of users were in fact adults. So a key element in the design specification for NXT was a simpler programming language. Lego – again using an open innovation approach – commissioned a Texas software firm, National Instruments, to help with this. Users can now use a simple programming language and deploy a wide range of sensors and actuators and link to their PCs or mobile phones – resulting in an impressive range of user-designed sophisticated automated products. (See, for example, a working miniature car factory – Youtube video - <http://uk.youtube.com/watch?v=GQ3AcPEPbH0>).

Significantly Lego discovered early in the life of Mindstorms that a growing number of users were 'hacking' the software and developing applications and extensions to the original code which Lego's team at Billund had produced. Rather than try and control or restrict this activity Lego adopted an 'open innovation' approach, recognizing that 'not all the smart guys work for us'. They also recognized that limiting creativity was contrary to its mission of encouraging exploration and ingenuity. As Vice President Mads Nipper commented, *"We came to understand that this is a great way to make the product more exciting It's a totally different business paradigm - although they don't get paid for it, they enhance the experience you can have with the basic Mindstorms set."* By identifying key developers and then engaging their interest – for example by making available source code, running competitions, even putting a "right to hack" into the Mindstorms software license, – Lego were able to gain considerable leverage on the original design. A growing user community began setting up websites, over 40 'recipe' books were produced and all sorts of hardware and software add-ons were developed.

When it came to developing NXT Lego set up a Mindstorms User Panel, recruiting key developers in secrecy to work with them from the earliest stages. From 20 of the 'top' external developers Lego eventually identified four key players who formed the MUP. An important aspect of such involvement – typical of 'lead user behaviour' – is that it is not driven by financial reward but rather from intrinsic interest and involvement. For their participation, MUP members received some Lego sets and Mindstorms NXT prototypes; they even paid their own airfares to Denmark! As one of the team commented, *"They're going to talk to us about Legos, and they're going to pay us with Legos?..... They actually want our opinion?" It doesn't get much better than that."*

As a consequence of this successful experience Lego announced that they are seeking 100 'citizen developers' to work with them on the NXT project and beyond. (Koerner 2006).

This experienced was reflected across other communities. For example, Lego had been producing train sets since the 1960s but had come to a decision to axe this model as part of their rationalization plans in 2004. The response from the community was strong and



highlighted to Lego that there was an important community of users – hobbyists – who had not only bought the original trains but then created their own designs and modifications. In a similar process to that with Mindstorms Lego began to identify key users and designers and encouraged them to contribute their design ideas. The result was that a group of 20 'lead users' created 76 new product designs which Lego were able to produce and sell.

Lego Universe – the next stage?

The process of identifying and working with an increasingly wide range of users and communities has transformed part of Lego's business. It still makes bricks and toys designed and sold in the 'traditional' fashion. But in parallel a new business has grown which engages users at the front end of innovation, designing and co-creating their own products. Importantly designs by one user might be attractive to others and so it is not simply a version of 'vanity publishing' but an interesting extension of design and marketing into the open source world. In adopting an open approach Lego has managed to bring users into its world – rather than have a growing body of users designing and exchanging ideas outside – for example there is a vibrant independent Lego User Network called LUGNET.

The latest development brings several of these strands together. Lego Universe is designed as a Massive Multiplayer Online Game (MMOG) like 'World of Warcraft' and others. But the difference is that the characters and creatures in Lego Universe are digital models created by the children who play in the game. Since – through projects like Lego Factory – Lego knows how to create custom toys to user designs it is now possible to have not only your own digital character playing in a virtual game but also to have its physical representation to play with in the physical world. In this process Lego unites its storytelling tradition with its brick-making and platform advantages but allows the creativity and imagination of its users to shape the real and virtual elements in the game. (See www.lego.com for more details).