Main Case Study **Domino Printing Sciences – facing the limits of technology**

Before reading this case, consider the following generic innovation management issues:

- How can companies recognize that their technological basis is facing a technical limit?
- Do such technological limits necessarily matter?
- What issues face a company adopting a new technology that fully replaces their current one?
- What issues face a company adopting a new technology that overcomes deficiencies of their current one but does not fully replace it?
- What problems may a single-technology company expect to face when it adopts new, overlapping products?

Domino was founded in 1978 as a spin-out from the technology consultancy Cambridge Consultants. Graeme Minto had led a project developing Continuous Inkjet (CIJ) technology for a client. Minto's client eventually lost interest but he believed the technology had promise so he licensed the know-how and set up on his own, working literally out of the garage of his home. The technology was not totally new: there had been academic work in the USA and Sweden in the 1960s, but only one company, Videojet in the USA, had yet applied it industrially.

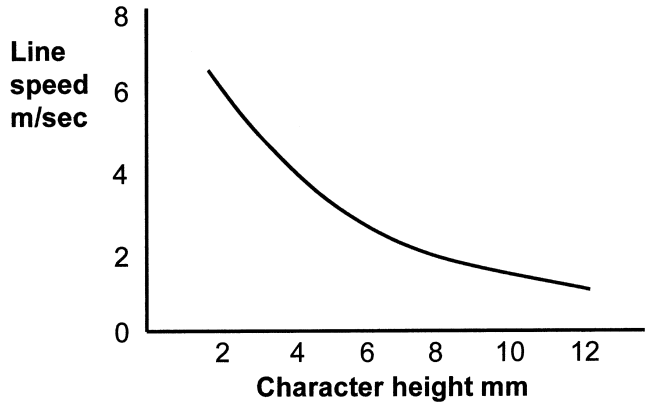
Fortune favours the brave and by the early 1980s the company was prospering, helped by EU legislation requiring the date marking of perishable goods, an application for which CIJ was ideally suited. In 1985 Minto floated Domino very successfully on the UK stockmarket and set about handing over the reins to a new management team with experience in running large companies. He himself became chairman and after four years moved on to other things leaving a thriving company with a technology much in demand, albeit in specialist applications.

Approaching the Limits of Technology

It was in the early 1990s that Domino management started to be concerned about the restrictions that the technology itself would place on the growth of the company. As Howard Whitesmith, Domino's MD at the time, commented: 'CIJ is a great printing technology. It's fully flexible, character by character; it can print at high speeds – up to 5 metres a second – and the drops fly up to a centimetre through the air. It's ideal for printing simple information onto products bouncing along a high-speed production line, like putting codes onto Coca Cola tins, for example. But it has serious limits: it's low resolution – well below what is acceptable on a printed page – and you can't make images more than about half an inch high. In fact as the characters get larger the printing speed goes down sharply (Figure 4.19). By the end of the 1980s we'd made a lot of progress with better resolution and bigger images but it

Main Case Study *continued*

Figure 4.19 Relationship between maximum line speed and character height for continuous inkjet printing



was becoming more and more difficult. The technical guys were quite clear that we were starting to push up against the laws of physics.'

'Many of our customers already wanted to print larger characters, as well as images such as bar codes and logos, while keeping the flexibility of non-contact printing. But we couldn't do it. And there were other things about CIJ that were less than ideal, such as the fact that we used solvent-based fluids. It's not as fundamental as the print size issue but here, too, we couldn't meet what our customers wanted.'

The Domino board recognized that the fundamental limits on CIJ performance posed both a threat and an opportunity for the company. Without a new technology Domino's rapid growth could soon come to an end. But there was obviously a demand for better performance if only it could be done. The big danger was that if a competitor moved in with something better Domino would not only miss out on a new business opportunity but could lose many of its existing customers.

Meanwhile competition became more intense. As David Cope, Domino's Operations director says 'In the 1980s we could still make regular improvements in product performance but in the 1990s there was less and less chance to keep a competitive edge in terms of the actual printing. These days the focus is on the quality and reliability of the product, and the back-up we give in service, distribution, and sales competence. And price, of course.'

The Search for New Technologies

During the 1990s Domino staff looked for ways to print larger, higher-definition images onto moving products. 'It wasn't a big, concerted, project',

Main Case Study ***continued***

says Steve Marriott, Domino's R&D manager at the time, 'Everyone knew about the limitations of CIJ so we kept our eyes open for anything that might be better. We followed up magnetography, ion deposition and various kinds of contact printing such as mimeography. We even played with spraying a light-sensitive layer onto the surface and projecting an image onto it. But we didn't find anything that would replace and surpass CIJ.'

The nearest thing was 'binary' inkjet, a technology related to CIJ but using over 100 jets for each inch of printing width instead of the single nozzle used in CIJ. This gave great printing speed and could be expanded to large printing widths. The equipment would be much more complex than Domino's existing products but there would be good applications in the commercial printing industry for addressing and personalizing magazines and envelopes, markets in which Domino already had some presence.

Another possibility was 'drop on demand', the technology used in desktop printers. This was a high-resolution technology and the print-heads could be stacked together to print large images. But it was slow, very sensitive to the distance from the print-head to the surface, and could print only onto paper or cardboard. Not a suitable technology for coding Coke tins.

A final possibility was laser marking. This works by rapidly scanning a small spot of laser energy over the product. It makes a mark by removing a layer (for example of printed ink) and exposing the surface beneath; or by changing the colour of the surface itself. This technology would be fast, reliable and environmentally friendly but it wouldn't be suitable for all surfaces. One further drawback was that laser marking requires no ink, so Domino would forgo a very important source of revenue. Another was that nobody in the company knew much about lasers, either from a technical or marketing perspective.

The Domino board realized that there was no simple solution to their problem. No single technology would replace CIJ. 'I don't think we ever asked ourselves how many different technologies we might have to take on', says Whitesmith, 'we just took each one on its merits and made separate business cases'. Binary inkjet was easiest to decide because it was within the technical capabilities of the Domino R&D team, and there was a clear commercial demand for higher speed and higher resolution printing in the commercial printing market where the higher price would be acceptable. Developing binary technology proved more of a challenge than expected, but Domino launched a product in 1997 which became successful and substantially replaced CIJ in the commercial printing sector.

Laser was clearly a case for acquisition. In 1994 Domino bought Directed Energy, a small laser company in California that had a unique small high-power laser tube already used in marking equipment. Domino's international distribution and knowledge of the marking market with Directed

Main Case Study ***continued***

Energy's technical expertise allowed Domino to take the leading position in the expanding laser marking market.

Drop on demand proved more complex. Domino's technical team surveyed all the available examples in the early 1990s and found none that met their requirements. They adopted a 'watching brief' waiting for something suitable to be developed elsewhere. Eventually Xaar in UK and Spectra in USA, and others brought suitable print-heads to the market and Domino began to build them into products. They chose to act as integrators, selecting whatever type best suited each application.

The Difficulties of Becoming a Multi-Technology Company

Within a few years Domino changed from being a single-technology company to one with a variety of technologies and products. The problem was that since none of the newcomers exactly replaced CIJ the company now had to handle four product lines with overlapping capabilities (Figure 4.20). 'To start with', says Whitesmith, 'we were very aware that the new technologies, especially laser, meant a big change and a big challenge to the company, especially to our distributors. So we set up separate divisions to drive the new products along, complete with their own sales forces. That didn't last long: it was too expensive and our customers were confused when they got calls from several Domino salespeople apparently in competition with each other. But most salesmen couldn't master the finer points of all the new products so they couldn't really sell them all properly. We ended up

Figure 4.20 **Characteristics of Domino's new product range**

	Cost(£)	*Consumables*	*Reliability*	*Installation*	*Familiarity*
CIJ	5,000-10,000	Yes	High	Easy	High
Laser	12,000-20,000	Some	Very high	Easy	Low
Binary	20,000-30,000	Yes	Medium	Difficult	Medium
D.O.D.	5,000-12,000	Yes	Medium	Easy	Medium

Main Case Study ***continued***

with a hybrid arrangement where every salesman offered the complete range but they had local specialists in each technology to call on for support'.

Domino retained a divisional structure to give independence and focus to each product business. The CIJ-based coding and marking business continues to grow but the competitive focus is less on the product and more on price, quality, service and business processes. The newer technologies are still developing rapidly and their concentration is on new products and new applications. Their management has to be correspondingly more exploratory and entrepreneurial. All the divisions still sell through the established sales channels but the newer technologies are also moving into new markets with new distribution. For example lasers now sell into the semiconductor and clothing markets, entirely new ground for the company. Cope says this all makes for a more complex operation 'but that just reflects the real complexity of the markets and products'. By taking on new technologies to overcome the limits of their original one Domino have protected their existing customer base as they hoped. The new capabilities have driven them into new organizations and new markets that will change the very nature of the company.