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Opportunities for Small
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THE SEARCH FOR TECHNOLOGY: EXAMPLES FROM A SMALL COMPANY

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1. INTRODUCTION

Cambridge Lasers is a small high-tech company serving scientific, medical and commercial customers. High-tech may be a term that sounds impressive, but what it really means is that the company is conducting business in a technologically dynamic market with technological advances occurring rapidly. The continued success of such companies requires constant injections of new technology and continual innovation. Without such injections, they will fail. For a small company such as Cambridge Lasers, technology injections are a challenge; and innovations are not simply nice to have, they become vital.

This paper provides three examples of Cambridge Lasers' search for new products, through innovation and technology transfer (TT), and the opportunities that were opened up. The paper then provides advice derived from the company's experience on encouraging innovation and suggests that many opportunities for small companies arise while searching for technology.

2. COMPANY BACKGROUND

Cambridge Lasers was founded in 1983 by laser experts who had their training in the large American laser corporations. At the time the ion laser market was completely dominated by US companies, there being no ion laser manufacturers in Europe. Cambridge Lasers originally commenced by offering an ion laser repair service using the US technology. The company could perform repairs to American ion lasers at a fraction of the cost of the manufacturers themselves, and continues to do so. Repairs are still an important product of the company and we remain the only company in Europe able to perform many procedures.

The first ion laser to be developed by Cambridge Lasers was an OEM laser tube for fitting directly into laser based instruments such as photo-coagulators, laser surgical devices, flow cytometers and spectrophotometers based on the Spectra Physics system. In 1988 the "CL" scientific laser was developed by the company with a number of innovative features such as a valve-less gas reservoir which reduced gas re-fill errors and a cylindrical resonator for greater stability of the beam. The "CL" laser is mainly used in scientific research. The next laser development was the "Spectrum" laser in 1992 specifically for the leisure market. Its main benefits are that it is simple to operate and affordable. It is mainly used by light show companies for entertainment and promotional displays. This continual innovation throughout the late 1980s and up until 1992 kept the company in a leadership position in the ion laser market and goodwill with customers was enhanced.

By 1995 ion laser technology had been developed considerably by the American manufacturers but Cambridge Lasers' "CL" and "Spectrum" lasers had not seen any new technology and were no longer state of the art. The vital technology injections and innovations just did not happen which caused a downturn in the company's fortunes. This lack of innovation was mainly due to poor management and low staff morale. When I joined Cambridge Lasers in 1995, I asked our laser assembler about this; he showed me a long list of innovations he had come up with while assembling lasers, but there had been no encouragement for them to be used. The company culture had precluded ideas coming to the surface. There was a major opportunity here for improving the company, below are some of the developments made at Cambridge Lasers over the last 2 years.

3. INNOVATION AND HOME GROWN RESEARCH

In 1996 Cambridge Lasers' new marketing department undertook market research to determine the current needs of the scientific research laser market and the direction users saw it going. Of those surveyed, fifty five

percent had one or more ion lasers, of these about 60% had a maintenance problem with at least one ion laser. More interestingly, 40% were or wanted to move to solid state lasers (solid state technology was and is revolutionising lasers). The fact that ion lasers were unreliable came through as the major concern. So we acted on the research in 2 ways. To develop an improved ion laser, and to acquire solid state laser technology.

The reason for the failure of ion lasers is that the materials used have difficulty withstanding the very high stress ion lasers operate under. No one had investigated the new ceramics that were becoming available. After discussions with TWI (The Welding Institute, Abingdon, Cambridge) and various other commercial ceramic suppliers, I determined that a new preparation of aluminium nitride had the right characteristics. To protect this innovation we applied for a patent (no. 9718699.3). We then applied for and won a Department of Trade and Industry (DTI) SMART award to conduct a feasibility study to test the innovative use of the new material together with improved design.

This research is ongoing, but like much basic research it raises more problems along the way. Our research has found that the new material will need a redesign of the cooling system which means more funds. We have found that the original innovation is inexpensive, but testing these big ideas can commit the company to a long term financial drain. However, once the feasibility study is complete, development funding from the DTI SPUR grant can be applied for.

3.1 Help for Small Businesses

In our experience with turning innovation into useful technology, we have found many organisations offering to help small businesses. These include private firms which provide consultation, and various industry bodies that can help. However we found the most helpful and beneficial was the Department of Trade and Industry. I believe that it is a very important part of a small business in a technological market to have a good working relationship with their local DTI government office. More than being helpful, they can involve you in the innovation and TT process, and perhaps help with funding. Further, for innovative companies, the DTI in many regions have set up an Innovation Club for the purpose of promoting innovation through networking. By meeting with people from other companies, we exchange ideas on how we solved particular problems and try and spread innovation around.

4. TECHNOLOGY TRANSFER, UK

As well as our internal research, it was clear that laser research was being conducted apace elsewhere. In early 1996 I contacted many organisations looking for newly developed laser technology. One company with new developments in diode lasers entered into discussions with us. We continue to work with them, but they have proved to be very slow in responding to user requirements and we do not have the resources to wait. We realised that in addition to new technology, we needed inventors that were also customer focused.

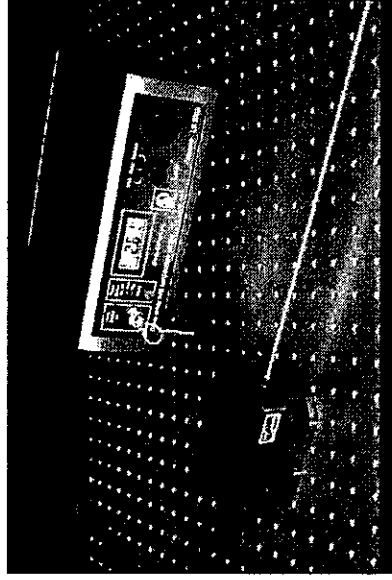


Figure 1 Laser developed in Manchester, UK

After continued searching I entered into discussions with The University of Manchester and their new spin off company Laser Quantum. They had developed new technology in solid state lasers which would lead to just the product Cambridge Lasers' customers were looking for. They were keen to commercialise the laser but needed help understanding the market's needs and in marketing the laser. We agreed to assist and ultimately Cambridge Lasers were appointed distributors of the new laser, the *Forté*, see Figure 1. There are 4 models of the laser at present: a low power green laser suitable for spectroscopy and reprographics; a high power green laser for testing, entertainment, targeting sorting, medicine, pattern projection and particle counting; and two infra-red lasers for research, spectroscopy, marking and medicine.

Initially, the Manchester team needed to protect their intellectual property (IP) rights, develop the lasers for commercial use, manufacture and market them.

Regarding IP protection, they felt that the protection offered by patents was limited and this greatly influenced their decision to manufacture themselves. A US patent was considered expensive and possibly difficult to obtain due to the similar research being conducted there. Also any patent litigation would be far too expensive to entertain. A European patent was also only considered if they were to license the technology. However they considered the return from licensing was too low and continual development of the product through in-house manufacturing would provide enough IP protection. This is because the technology in solid state lasers is developing so fast that the life cycle of each model is very short. By the time someone copies a particular model, it would be superseded. The Manchester scientists were able to set up a company, Laser Quantum, with assistance from industry financial backing and a business angel for the purpose of exploiting the technology, a good indication that they were onto a winner. The backers and the university were confident in the new lasers' potential so encouraged the development and manufacturing to be done by the new company. This way future returns would be maximised [1].

The development of the laser proved to be the most expensive process; packaging the laser in a form acceptable to the market, testing and fine tuning to user needs. Cambridge Lasers were asked to provide information about user needs to assist the development, we also developed the promotional programme for the launch of the laser. The initial marketing of the laser provided valuable market intelligence for Laser Quantum to be fed back into product improvement. This feedback has already led to the development of an enhanced model for specific applications such as holography and interferometry.

Our product launch of the *Forie* laser in late 1997 consisted of industry journal advertising, direct mail campaign, presentation at two industry exhibitions, personal demonstrations and a feature on our web page. Responses have been very good and the first laser has been shipped.

4.1 Opportunities for Small Business

The transfer of technology from a dedicated research body such as a university, whether by license, distribution or some other agreement can be very economical for a small firm, but finding the right match between technology and the company's customers can be difficult.

For small companies that are short of funds for their own research, licensing or distributor agreements to obtain technology is a good value option. This realises the asset a company has in its market knowledge; it is this familiarity with a market that researchers do not have. Such arrangements provide lower returns due to the small initial outlay required. The small company in this situation should also be prepared to help the researchers adapt and fine tune the product to suit the users' needs early in the product's introduction. A new product is rarely exactly right the first time.

5. TECHNOLOGY TRANSFER, RUSSIA

At a major international laser conference in Paris where we were exhibiting with our French distributor, we met many international company representatives with potential new technologies. One may expect most technology to come from the West, but the Eastern Block seems to have much technology just waiting to be uncovered [2]. We also found that much new Western technology was very quickly snapped up in license or distributor agreements. After becoming aware of some of the technology available, we also started to consider searching outside Britain.

Following this we joined the British Council's Joint Industrial and Commercial Attachments Programme (JICAP) where Eastern Block business managers work and train in Britain with a host company. The objective is to encourage British business practices in the former communist countries, encourage exchange of technology, business and understanding. Cambridge Lasers hosted a Russian laser scientist, Sergey Kountis, who works at the High Current Electronics Institute, (Russian Academy of Science) Tomsk and is also

Marketing Manager of Lassy Ltd, a laser hardware and service company. Among the technology present at Mr Kounts' place of work is a medical laser for eye surgery and a powerful ultra-violet lamp.

As well as hoping to transfer his technology to Britain, Mr Kounts was very interested to understand the sources of new laser technology in Europe in the hope that he may find some of use to his business. Interestingly, much of the laser technology present in the West also exists in Russia, developed in parallel during the communist era. After his visit Mr Kounts is now mainly interested in finding uses for his technology in the West [3]. Regarding the use of the business skills he learnt in Britain, the problem for Mr Kounts and most people in his position is not in understanding the principles, but in there being no market for his products in the new Russia. The only customers are predominantly the former state-owned enterprises and these now have little money to spend. Also, foreign companies setting up in Russia tend to buy directly from the West, bypassing Russian companies. These factors mean that it is more likely for new technology to head west rather than IT occurring in the other direction [3]. Many of the Russian research organisations would like to be able to transfer their technology abroad in return for much needed finance, but they are concerned about lack of IP protection and not receiving a fair return on their inventions, so they publish little. As a result it is difficult for British firms to find out about technology in the Eastern Block. A good approach is to establish good contacts with people there [2].

The products that Mr Kounts' organisation have available require development to bring them to a marketable state. They need a British firm to provide final stage development funding and some hardware [3]. For a medical laser such development is very expensive. However we are working together to commercialise the UV lamp with possible uses in water treatment. Such collaborations are made so much easier by the programme's of organisations like the British Council's.

5.1 Potential Rewards for Small Business

The search for technology overseas is more difficult than within Britain, but the potential rewards may be greater so it should be considered as part of a long term technology strategy. For a small technology based firm with sufficient funds to undertake development of new technology, Eastern Block innovations offer an excellent opportunity. There is a lot less competition for the technology and it is often good value [2]. Many countries have established useful links in the Eastern Block and offer small firms assistance to introduce themselves abroad.

6. CONCLUSION

For a small firm in a rapidly changing market based on technology, bringing new technology into the company is vital. The experience that we have had at Cambridge Lasers can provide some interesting lessons.

6.1 Nurseries of Innovation

In section 2 we learnt about the cost of not nurturing innovation. Do not be complacent about innovation or wait for a crisis to occur which puts the company in urgent need of an innovation. A company should have innovation as a naturally occurring phenomenon. Cambridge Lasers was in a technological wilderness for a number of years but that did not mean innovations were not being thought of, just that they were not being used. It is important to understand where innovation comes from and to nurture it. For a small business I believe that there are three nurseries of innovation.

- Your customers
- Your staff
- Communication and company culture

Your customers have the need for improvement and they are usually the ones who come up with ways to make a better product or process. Customers in a high-tech market are usually at the forefront of technology, they

know about the latest developments. Customers will happily tell you about their ideas, this is because they hope that you will put them into practice.

Your staff are working with your company's technology and know it the best of all, particularly production and technical staff. They are in an excellent position to solve problems and come up with a better way of doing something, i.e. to be innovative. At Cambridge Lasers, production staff now come up with many innovations. Most may only be for in-house use, yet they still improve the business, but some are major ideas soon to be exploited.

A company needs to get the ideas out of its customers and staff. Simply talking to customers can come up with many good innovations. By encouraging customer feedback, doing regular market research, and perhaps just meeting with customers more often, you will find innovations coming to you. Also, we have seen how a bad company culture can prevent innovations from rising up. Your staff's ideas need to be encouraged; people need to talk with each other about improvements knowing that they will make a difference to the company. A culture where people's ideas are valued and implemented will nurture innovation.

The Japanese method for encouraging innovation and improvement is called *Kaizen* [4]. It encourages staff to come up with solutions to problems or improvements to products or processes and provides the mechanism for these improvements to be implemented. Some ideas may be minor but occasionally a major innovation will come forward. What is important is that the company with a *Kaizen* culture is always moving forward technologically with continual innovations; many small, some big.

6.2 Intellectual Property Protection

We have learnt that patents are not the final word on protecting IP. Small companies should think seriously about patenting their innovations before spending large amounts. If their market is rapidly changing which means products are continually being improved and the company has the capability to stay at the forefront of technology, then it seems to be better to spend the money on R&D rather than patents. Protection would come from staying ahead of any copy cats. A company using this strategy would need to thrive on change and be good at implementing innovation.

6.3 Technology Decisions

Innovations are inexpensive and their encouragement is good business practice. Turning some innovations into reality, however, can be very expensive. In-house R&D in a small business can be a major burden, a company needs to be sure of the costs of R&D projects, invariably they cost a lot more than planned. In addition, the development component will often be the most expensive part. This was true for the Manchester team and indeed a study in UK biotechnology R&D showed that development was 90% of the cost of all R&D [5]. Development is such an unknown quantity because it is necessary to match the new product exactly with the customers' needs. This can take considerable fine tuning of the design and often a test marketing campaign will be required before one can be sure that the product is just right.

In the case of a tightly funded company, the sourcing of technology from outside the company will prove more efficient. For a relatively small outlay the company can obtain the technology its customers are wanting. Of course the income from the new product will be proportionally smaller. Below in Table 1 is a summary of the pros and cons of the 3 ways we searched for technology.

Technology Decisions

Table 1

Technology source	Advantages	Disadvantages
In-house technology development	• Use own innovations • Better long term returns	• Can be very costly initially • Time consuming
Technology transfer within your country	• Can be achieved faster • Initially more economical	• Poorer returns in long term • Can be difficult to find good technology match
Technology transfer from overseas	• Significant technology is available	• Can require a long search

When making decisions about obtaining technology, one must weigh up a number of factors. How urgent are you, how much funding can you afford, what size of return are you looking for, is your company's internal innovation generation sufficient? Answering these questions should help to determine where and how to look for technology. Finding it is 'a must' because change is relentless.

Change is what high-tech is all about; in any high-tech industry the various competitors will have their share of innovations. To be successful a company must keep up by implementing innovation with in-house procedures that fast-track ideas through to fruition. A company that can cope with change will reveal many more paths to follow for finding opportunities.

This paper has given examples of different approaches to finding technology in a small company. These examples have revealed that there are many opportunities existing both within businesses, and in organisations outside the business. Many countries have government departments that promote trade and industry through various assistance programmes. They usually offer expert assistance, but prefer to help companies who help themselves. While there is a wealth of external help available, the first step is up to those responsible for the company to ensure that innovation thrives.

7. ACKNOWLEDGEMENTS

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