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PROFITING FROM RESEARCH AND DEVELOPMENT

OPTOS

Optos eyes stock listing

A small Scottish medical technology company with a thriving export record plans to go public next year, raising between €30m and €60m.

Optos produces retinal examination equipment that gives a more complete view than other approaches. Exports already account for 95% of the company's revenue.

"One of the first strategic choices we took was to go to the US because we knew that the medical market and the public there accept innovation much more quickly than anywhere else on earth," said Stephane Sallmard, chief executive officer.

Optos plans to use the money raised by a stock listing to increase R&D, accelerate product development and enter new markets.

"I think we should be able to open two or three subsidiaries a year," said Sallmard. "The limit on the company today is the resources it has."

Optos has already entered the Canadian and UK markets and will enter the German market later this year.

The company was founded ten years ago and has attracted more than €52m of funding from venture capital companies including Amadeus Capital Partners and Scottish funds Braveheart Ventures and Archangel.

The first clinical trials of the Optos product were undertaken at 12 sites in the US in 2000. In 2001 Optos had trials underway at 57 sites. By June 2004, it was installing 83 systems a month in the US.

The Optos business model involves renting the equipment and splitting the charge for each eye exam with its operator, an approach that demands early investment but delivers repeat revenue of around $30 000 per unit per year in the US.

Overall revenue has grown from €1.5m in 2001 to a projected €27m for this financial year, and is expected to become profitable in its next financial year. ▶

CDT

Long haul to market

A university start-up that has grown through global partnerships is preparing to go public in the US.

Cambridge Display Technology (CDT) is developing light-emitting polymer technology that can be used to make flexible displays using low-cost ink-jet printing. Its initial public offering is expected to raise up to $40.25m.

CDT was formed in 1992 and signed its first licence deal, with Philips, in 1996. It then signed a licence with Hoechst and a cross-licensing deal with UNIAX in 1997.

In 1998 the company signed a development deal with DuPont of the US and a joint venture with Seiko Epson of Japan to develop ink-jet printing techniques for its materials.

Other licensees, partners or investors include Hewlett Packard of the US, Delta Optoelectronics of Taiwan, Osram of Germany and Franco-Italian semiconductor company STMicroelectronics.

Optos stock listing

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"What has been remarkable has been the patience of our shareholders," said Sallmard. "Plus, it's much more expensive to establish a company overseas than in the UK."

He says Optos avoided growing too quickly so it could use feedback from its early customers to improve the product and provide good service.

"What we paid most attention to was the quality of our service. In spite of having very little resources, we recruited the right number of people to provide service. And although the product had imperfections, we have been perfect in our reaction to dealing with them."

Optos now has 70 staff in Scotland and 100 in the US. Sallmard says a further 110 staff at subcontractors rely on Optos for their jobs.

Norway goes nano

Norway's Research Council has launched a foresight project to accelerate its development and use of materials and nanotechnologies.

Norway wants to build expertise in emerging technologies to position itself for a future in which it can no longer rely on oil exports for its prosperity.

"It's high time we took materials technology and nanotechnology seriously," said Astrid Brenna, project manager of the Advanced Materials Technology in Norway Towards 2020 initiative. "We will focus on Norway's role as an innovative user and producer of materials, and we will highlight important areas of nanotechnology."

The project will analyse challenges in materials technology to 2020, as a basis for the Research Council's strategic work on materials technology and nanotechnology. It will also look at how to balance Norway's R&D funding between new and traditional materials.

"Innovations in materials are very often a prerequisite for innovations in other areas such as medical, information, transportation, space, offshore, aquaculture, energy, environmental and process technology. Materials technology is very important to the value creation of Norway in the future."

VC backs another university

IP2IPO, a venture-capital company that backs university spin-offs, has invested €3m in Techtran, the technology transfer company that handles such opportunities for Leeds University (below).

Leeds joins York, Oxford, Southampton and University College, London in IP2IPO's stable of universities whose technology intellectual property it has acquired rights to commercialise. IP2IPO, which is listed in London, has bought 20% of Techtran. The investment is expected to speed up commercialisation activities at Leeds.

Techtran's deal with Leeds gives it a 30% stake in technology companies and licences spun out from the university.

RICHARD MORAN

PILKINGTON

Self-washing windows look set to help Pilkington clean up

Scientists have developed glass that cleans itself using energy from the sun and the rain.

Pilkington's Activ glass is the result of four years' research and testing and an investment of millions of euros. The company estimates that using Activ glass will add 15% to the cost of a uPVC double-glazing unit.

The self-cleaning glass can be combined with toughened, sound-absorbing and thermal control glass to create glazing units with a range of new properties and applications. Large building projects may be able to do away with complex and expensive window-cleaning equipment by using the self-cleaning glass.

Richard Denno, principal technologist at Pilkington, says the layer works in two ways. The first is photo-catalytic, using energy from the sun to oxidise dirt, breaking it down and loosening its adherence to the glass. The second is a hydrophilic mechanism: the layer attracts water and so encourages it to run off the glass in sheets rather than in droplets. This 'sheeting' effect helps carry away the dirt much more effectively.

The glass is coated with a very thin layer of titanium oxide, the same material that is used to coat ceramic tiles and as a whitening agent in toothpaste and paint. The titanium oxide action has been well known for 20 years.

Pilkington's breakthrough has been to develop and patent a way to apply a 50nm coating, made up of several distinct layers, during production.

Since the photocatalytic activity is continuous, even stubborn deposits, such as bird droppings or tree resin, will eventually be broken down and slide off the glass. To help things along in periods of little or no rainfall, the glass can be hosed or sponged off using clean water.

Public procurement rules hamper European innovation

EU public procurement rules hamper the adoption of innovative products and services, according to EU researchers.

"The EU procurement directives don't leave enough room for effective tendering of innovations," said Anastasius Gavras, co-ordinator of the Inno-Utilities project. The researchers believe this is because there is too little interaction between user and producer during procurement.

"EU legislation has only tolerated such interaction, but hasn't fostered it," said Leif Hommen, a procurement expert from Lund University, Sweden. He says the rules imply that interactions between the producer and the user are undesirable during the tendering process, making it difficult for the two sides to learn from each other.

Public sector purchases in the European Union amount to 11% of GDP, or €9.61 trillion, in 2002.

The Inno-Utilities project proposes that public procurement moves to a three-stage approach. First, a group of potential users work together to define the requirements for a new product or service. Then this group works with a group of potential suppliers to refine the specification. Finally, the potential users ask each provider to submit a tender, based on the jointly defined requirements.

Research: risk and reward

Enabling an entrepreneurial approach to innovation is vital to Europe's success, says Andrew Dearing

The knowledge economy is today's quintessential open market. With knowledge free to move quickly to wherever there are talented people, competitive success increasingly depends on how well a company or an economy can apply all the available insight to create value. Many feel that this requires a more entrepreneurial approach to industrial R&D.

Entrepreneurs are usually seen as exceptional risk-taking individuals who can move forwards when others hold back. A better measure of entrepreneurs is their ability to recognise and effectively manage risk. The quality of the structures that support entrepreneurs is central to their success. The open innovation strategy, which some see as a shift away from internal R&D, is actually about enabling more entrepreneurship. By adopting business models that make it easier to build on others' knowledge and skills, companies increase the likelihood that they will also create value from their internal activities.

One of government's responsibilities is to ensure that the business environment can respond to these changes in innovation. This means recognising that key resources are at once more concentrated yet more widely available than in the past. More than 80% of private-sector R&D investment comes from just 700 companies. Only a handful of European public laboratories and universities have the critical mass to carry out advanced and broadly-based multidisciplinary research.

The innovative strength of an economy depends on these players and how well they work with clusters of smaller companies, institutes and each other to satisfy market needs.

It's four years since the European Council meeting in Lisbon set Europeans the ambitious goal of creating the world's most competitive knowledge-based economy. Progress has been slow. For good solutions to emerge, Europe first had to recognise and accept current trends.

With large markets for technology emerging worldwide, it is clear that Europe must find new value-added markets where it can maintain leadership. What will these be?

Europe also needs to staunch the long-term exodus of scientific talent to North America, by strengthening European universities and making careers in European science and research more attractive. How can this be done?

The limited involvement of women, particularly in senior scientific and technical positions, is a scandal that must be addressed. The lack of staff mobility between the public and private sector is another issue to be resolved.

There is growing recognition that national and European initiatives are necessary to achieve the desired entrepreneurial approaches to innovation. Industry policy has been a taboo in European circles for some years, but has re-emerged within a new Commission communication *Science and technology, the key to Europe's future*. There is greater awareness, too, of the characteristics of successful foreign initiatives, such as America's Small Business Innovation Research and Advanced Technology programmes. They show the benefits of effective financial and tax regimes, better rules on state aid and smarter use of public procurement. It also helps the entrepreneur's cause if the role of the university within the local community is redefined with a greater emphasis on business skills and the handling of collaboration. This helps knowledge move from the laboratory to support market leadership close to home.

Recent EIRMA meetings have discussed the nature of a unique European model of innovation and a step change in R&D effectiveness. The pieces of this puzzle may soon come together, helping to counter apparently negative public attitudes towards science and industry that have been used to justify stifling regulation. Europe's key challenge is to create an approach to innovation that builds on the region's diversity, liberal traditions and strong sense of social justice as a powerful base for its development and future prosperity.

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Emigration key to enterprise culture

What makes America a good place to start a business? Part of its success springs from a culture that applauds risk, says Ross Armbrecht

America is a country of emigrants, many of whom risked everything they have simply to come here. Emigration constantly revitalises America's economy with fresh ideas brought by dynamic people. They meet a financial, legal and academic system structured for success and a culture that encourages them to take risks to be successful.

If a culture is made up of four facets – the actions that it rewards and that it finds taboo, its heroes and its rituals – then the US is rich in behaviours that celebrate risk. Many American rituals, from sports fanaticism to day-trading on the stock market, are about risk. Risk-takers are heroes and one of the strongest taboos is against business leaders who never take a chance.

Those who succeed are rewarded by a tax regime that allows them to keep more of their profits, so encouraging more people to try. By some estimates, the ratio of risk to reward in the US is the exact opposite of that which applies elsewhere in the world.

Those who fail are likely to be applauded for trying, which gives them the impetus to use the experience they gained from trying to help them try again. Business law also helps those who fail, providing a graceful way forward for businesses in difficulties. Companies can declare a form of bankruptcy, known as Chapter 11, which enables them to work with creditors to agree a way out of trouble. It helps reduces the investors' risk.

America's venture capitalists also help cut investment risk, since investors can put money into a fund that spreads it across several start-ups. Venture capitalists will take active steps to manage risk as stern judges of business plans and leadership skills, sifting investment ideas to find the combination of opportunity and character they think most likely to succeed. They promote the success of the companies they invest in by putting people on the board and by providing contacts that help grow the business.

US tax laws back business. Individuals who invest in a company for stock are taxed on it when it becomes tradable as a capital gain, at 15%, rather than as income, at 35%. This makes stock a more lucrative investment than almost any financial instrument, so long as the business thrives.

Government schemes help, too. An R&D tax credit provides a greater incentive for research spending than a normal write-off. The government also supports national laboratories and allows companies access to their unique facilities. Small Business Innovation Research grants provide up to $100 000 for feasibility studies and up to $750 000 for development work, without requiring matching funds. The Advanced Technology Program offers further funding, with small companies only paying a project's indirect costs. Even large companies can be awarded up to 40% of total project costs.

America's patent system helps innovation through its experienced handling of litigation, reducing the risk that a new technology will go unprotected. The academic system is well used to training indigenous and emigrant scientists for jobs in industry, and has clear rules about intellectual property that make it easier to transfer. But perhaps the greatest support for US innovation is its affluent, homogeneous home market, eager for the next big thing.

America's many advantages are balanced by two major drawbacks: an increasingly litigious approach to product liability, and the government's lack of a science and technology policy. America's global competitive position will be challenged by strong economies with stronger plans, such as Finland and China. It may be time the US considers not an industrial policy, which is political anathema, but a long-term commitment to build the world's best climate for innovation.

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Enabling entrepreneurial innovation

Why should venture capitalists get all the glory, asks Luke Collins

Companies and economies alike depend on a constant stream of innovation, be it in processes or policies, to thrive. This is hardly a new idea. Francis Bacon, the philosopher, said as much in the sixteenth century: "He that will not apply new remedies must expect new ills, because time is the greatest innovator."

What has changed is that innovation is becoming more important. As margins erode and expectations grow, companies need new ways to deliver greater added value. The paradox is that the demands of innovation often fit badly with the stable approaches of maturing companies and the attitudes that underlie core business competencies.

One way to face this paradox is to enable people within these companies to innovate beyond their science disciplines into the business realm, in other words, to become more entrepreneurial. The resultant combination of technical know-how and business savvy can be extremely valuable, especially if it is informed with a passion to make an idea into a success.

True to type

So are entrepreneurs born or made?

"It's something either you've got or you haven't," said Mandy Mayor, head of human resources for the Nuclear Sciences and Technology Services (NSTS) arm of BNFL, the nuclear services business. She says entrepreneurs need drive, energy and passion, a set of characteristics that you can't train into people. Fortunately, Mayor says, you don't need many entrepreneurs in an organisation.

Claude Mancel, former R&D vice president at Procter & Gamble, said: "Entrepreneurs are people who are thoroughly dissatisfied with the way things are done and want to change them." He says entrepreneurs are curious, persistent, passionate champions of their ideas, with good communication skills that enable them to attract backers. "An innovator is capable of turning a good idea into a product that sells."

Rebecca Ward, a doctoral student at Manchester University Business School, has been studying entrepreneurial activities in R&D. She has concluded that creating entrepreneurial spirit in R&D is about getting the right people in the right place doing the right jobs.

Ward says that the ideal entrepreneur should have 'T-shaped' knowledge, broad at the top level and with depth in a particular field. Just having this kind of understanding of the world is not enough to make an entrepreneur. She points out that the business networking that is essential to successful entrepreneurship can be traumatic for some scientists.

Entrepreneur or intrapreneur?

Ward distinguishes between those who are genuinely entrepreneurial and those who are simply motivated to address the needs of the business. A task-force of senior research managers that has been studying entrepreneurship has drawn a similar distinction.

It says that those who become their own bosses by starting a business from scratch, taking the risks and assuming the responsibilities are rightly called entrepreneurs. Those who want to create something new within an existing company should be known as 'intrapreneurs'. They need a sound business case that demonstrates how to create economic value for their company. Intrapreneuring also requires the skills to compete for management and financial backing against tried and tested alternatives, such as acquisitions. Success depends on being able to get other people interested and committed, to turn the entire team in a new direction.

These distinctions highlight the tension that introducing an entrepreneurial culture into an organisation can bring. A really successful entrepreneurial company may reshape or even destroy itself in a positive way, perhaps by making its major product line obsolete. Conversely, an unsuccessful entrepreneurial activity may simply destroy the company. Neither is comfortable.

Above left and centre: The BNFL Technology Centre, which Dr Sue Ion, director of technology and operations, described as "a place where people can interact and generate the free flow of thought" Above right: Developing lightweight cylinders increased demand at BOC's long-established oxygen business

It's the threat of going against the existing culture that stops many people from embracing the changes that entrepreneurial activities require. Mancel said: "Fear is always in the system. Trying to remove that fear is a way of increasing significantly the innovation capability of an organisation."

What's interesting is that entrepreneurs, motivated by their passion to do something new, appear to have a different understanding of risk to those who have to back them.

Why entrepreneurs won't take risks

Dr Bronwyn Elliot, founder and technical director of food ingredients company CréaVite has changed her outlook on what an entrepreneur is. She says that two years ago, when she founded the company, she believed an entrepreneur was someone with a passionate belief in a product. Now she says an entrepreneur wants to see a technology worked through a business process into a success.

She says the key characteristics of an entrepreneur are flexibility, stubbornness and the ability to let go of an idea.

"I don't understand the concept of risk," she said. "I understand there's a risk of failing."

Eddie Obeng, founder director of Pentacle The Virtual Business School, an e-learning business, agrees that an entrepreneur's idea of risk is different to most.

"Entrepreneurs never take risks. What entrepreneurs do is observe the options, try and remove the things that might go wrong, work out what could go wrong and have a plan B and a plan C," he said. "Entrepreneurs operate a 'think twice, act once' policy and thinking twice is probably not enough.

"Things seem to change faster than people can adapt. But entrepreneurs spend more time thinking about things that could go wrong than the things that are going to work," he added. Obeng says that this is a standard risk-management approach, which many people don't actually use.

"You need to actively manage the risks away from you. So the first thing you do is keep a very strict eye out for what could go wrong, so you're not just thinking about the good stuff but looking at the downside as well," he said. "Once you have done that, you fix it *now*. If you can't fix it now, you contain it. If you can't contain it, you keep an eye on it. If you can't keep an eye on it, then have a Plan B."

Mancel argues that entrepreneurs don't have a feel for the risks they take, and says it is up to other managers to feel that for them. He also cautions that although the entrepreneurial attitude to risk enables them to do things others wouldn't, it is not infallible.

"The biggest risk with entrepreneurs is around their conviction about something being right. They can become biased and their championing of something can become biased," he said.

Butterflies in a jar?

As innovation becomes more important, so does recruiting and retaining the right people. To attract entrepreneurs, organisations need to show that they will reward initiative.

David Leon, founder of the design and architecture consultancy DLP, which has helped develop research facilities for companies such as BNFL, Borax Europe and Solvay Pharmaceuticals, says organisations should also recognise generational differences.

"The generation leaving university now is the first fully digital generation," he said, which makes them independent, ▶

"People leaving university are independent, widely travelled and open to change"

David Leon

"Entrepreneurs never take risks – they operate a 'think twice, act once' policy"

Eddie Obeng

"It's something either you've got or you haven't"

Mandy Mayor

"Follow the leader fast, or use a new business model or technology"

Rob Margetts

environmentally aware, widely travelled and open to change. Companies that want to attract this generation need to recognise that it will consider a company's culture, leadership, rewards, flexibility and ability to communicate when choosing whom to work for.

Once recruited, entrepreneurial staff should be trained, encouraged and given incentives for the work they do. Peter Bleasdale, CEO of NSTS at BNFL, agrees with the old saying: recruit for attitude, train for skills. Staff with latent entrepreneurial skills should be coached to release these talents. They should also be taught communication skills so that they can sell their projects to management. Companies should lobby universities to improve the business teaching of scientists and engineers.

Part of making effective use of entrepreneurs is ensuring that they are close enough to the people who can be motivated to use their ideas, so they can act like yeast in dough. The hard part of enabling entrepreneurial spirit in an organisation lies in balancing change and control.

Ward said: "If you put energy into recruiting people you have to trust them."

Obeng says that this goes back to basic management skills: "You can't expect everyone to be an entrepreneur. That's why you have teams, so that you can bring people together with different capabilities."

Recognising the opportunities

A second critical part of increasing innovative activity is to recognise the opportunities. Spotting opportunities that others can't see is a key entrepreneurial skill, which can be enhanced using techniques to categorise them so that organisations can respond appropriately.

Rob Margetts, chairman of industrial gases giant BOC, says his company has adopted the Horizons concept, developed by consultant McKinsey, to categorise its innovation projects.

Horizon One projects involve selective growth with little risk in mature markets and businesses. Such innovations need not be small scale. BOC developed lightweight reinforced-plastic oxygen cylinders for the medical market. Their ease of use made them popular, increasing demand for both the cylinders and the gas to fill them.

Horizon Two projects mean growing existing businesses or businesses that are new to BOC, and involve developing the technology and the market in parallel. Margetts says Horizon Two entrepreneurs have two choices: to follow the leader fast, or attempt to gain competitive advantage using a new business model or technology.

"The success in Horizon One projects is generated by the employees' ability to develop innovative solutions by using internal and external technologies," said Margetts. "Horizon Two entrepreneurs must balance the promise of new business with the realisation that incumbent companies will protect their turf."

Horizon Three projects involve entering a totally new market. It is these projects that are meant to position BOC for the future, by broadening its options.

BOC drives Horizons One and Two projects from the businesses that initiate them, but uses corporate funds to back Horizon Three projects owing to the time and risk involved. The responsibility for Horizon One projects lies in the

business units. Horizon Two projects demand a one- or two-year plan. Horizon Three projects are so important that they are overseen by the chief executive.

Such principles are widely applicable. Tera Ojanperä, senior vice president of mobile communications company Nokia, points to the need for solid processes in R&D and the skill to recognise when actions outside these processes are needed.

"Trial and error is sometimes the only way to test the potential of new technology," he said.

Friedrich Pinnekamp, vice president of group R&D at ABB, highlights the need to keep the heat on, even in mature technologies. "Just because a technology is mature does not mean that there is no longer an opportunity to be entrepreneurial."

Environments to foster success

Once companies have found entrepreneurial people and the projects for them to work on, the next step is to create a context in which they thrive. This can mean changing not just organisational attitudes but the physical environment as well.

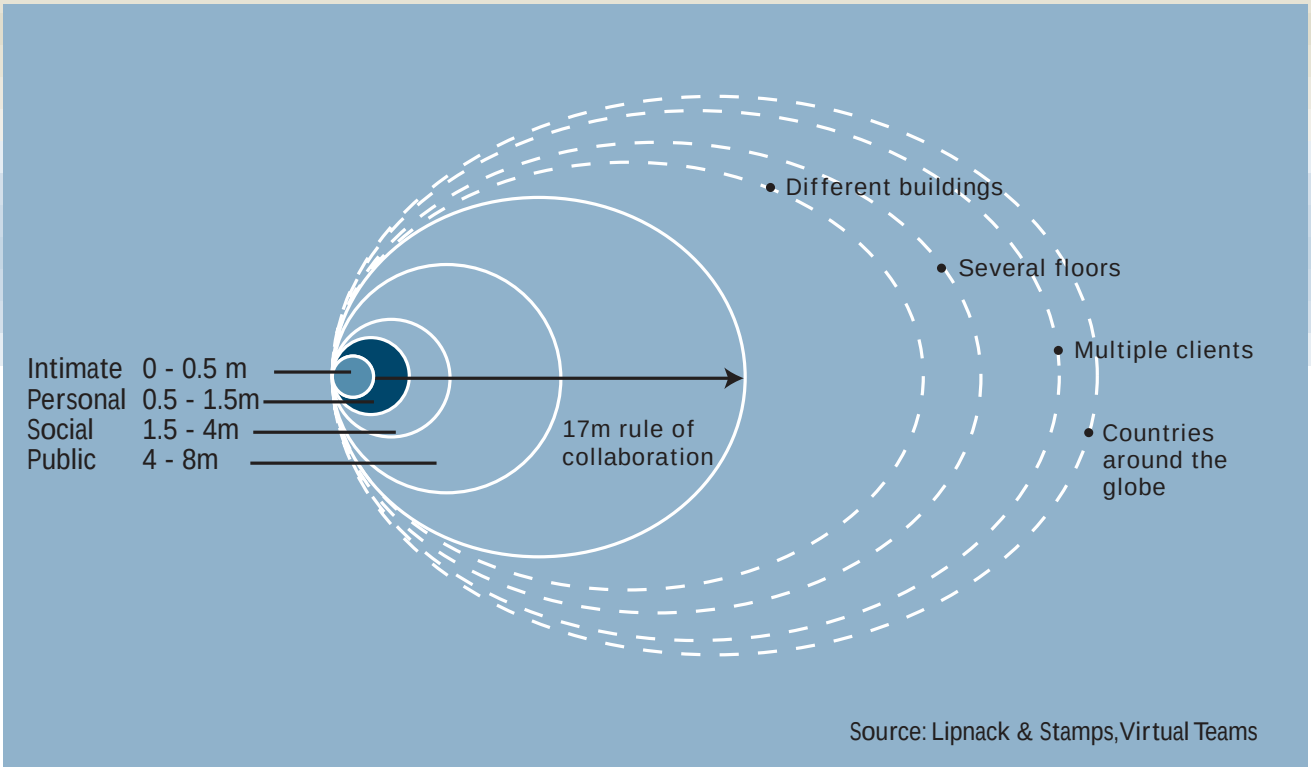
"I am convinced that the physical workplace is a very important tool for what management is trying to achieve," said Leon. He says that the relative cost of a building is small compared with precious staff time, and estimates that the cost of a facility is between 3% and 7% of the people costs on a net present value basis.

Using the physical environment to enable innovation is not about building edifices to the gods of science. "Entrepreneurial spirit is all about small groups of people working together. They need small buildings and modest buildings. Marble floors are not going to help."

Leon quotes studies that suggest that 55% of the value of a face-to-face conversation is expressed through visual clues, 38% by the way it is said and just 7% by the words used. The collaboration necessary for successful innovation demands that people are close enough to communicate effectively. Studies in the US have established that people will collaborate most effectively with those who are within 17m of them. Those beyond this 'collaboration space' might as well be in a separate building or on another continent.

Many companies use tried-and-tested ways to foster innovation, such as award schemes and giving each researcher a proportion of their time to follow personal interests. The task force found other structural changes can help. It says organisations should have a strong business development unit with an effective project selection process and the flexibility to extract value by using corporate venturing, licensing, acquisition or divestment.

Disruptive R&D projects should be protected from business interference, perhaps in incubation units, and entrepreneurial technology companies should be spun in to 'contaminate' the organisation's culture. High-risk, high-reward projects should be supported for their potential to deliver growth, while bottom-up projects should be encouraged to ▶



Research shows that people collaborate best with those who are within 17m of them

take advantage of the creative potential of the researchers. Large companies should make the most of their size by providing administrative support and by enabling entrepreneurial activities to access expertise inside and beyond the organisation.

Science into industry

Links between industrial and academic research are strengthening as companies realise they need to access as many skills as possible to support their innovation activities. Companies are also realising that partnering with academics creates new opportunities for entrepreneurial activities.

Some organisations strengthen these links by organising their corporate research along academic lines. Microsoft Research, for example, has a very flat management structure that encourages the formation of research groups with critical mass. Research is conducted openly, with an aggressive publication policy, frequent visitors and daily seminars. Microsoft also dedicates almost 15% of basic research funding to direct investment in university research, through grants and fellowships.

Claude Jablon, senior vice president of scientific development for oil company Total, argues that training at PhD level develops some of the capabilities that entrepreneurs need. These include the ability to solve leading-edge problems and to address unanswered questions in an original way. PhD training includes social aspects too, such as interacting with a diverse set of stakeholders during the research and selling its benefits at the end.

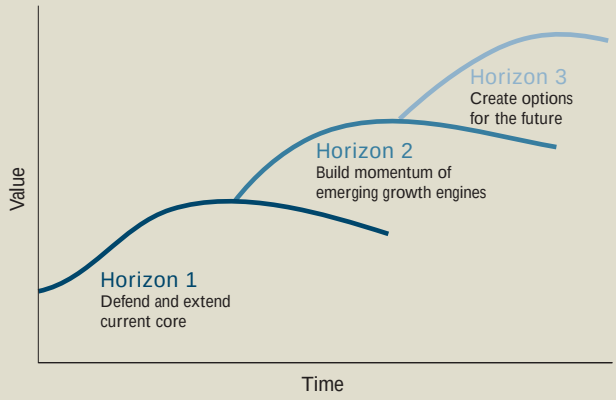
Jablon is also president of Association Bernard Gregory, set up to help PhDs enter business careers. PhD candidates that want to use ABG's services are asked to make a business case for their work, in order to introduce them to the discipline. They are also asked to assess their work as if it were a standalone project, to increase self-awareness.

The shift towards more collaborative approaches to innovation requires that companies take a responsible approach to working with public research organisations (PROs). Sustained, long-term relationships are important in order to make effective use of public IP, to develop the existing industrial base over the medium term, and to help create new businesses.

In the end, partnering is just another way of introducing a more entrepreneurial spirit into the innovation process. Doing so means creating tension within an organisation, as those whose outlook is all about opportunity clash with those whose outlook is about containing risks. So why do it? Bacon has the answer: if companies don't find better ways to innovate, such as entrepreneurship, others will.

Ten guidelines for enabling entrepreneurship in research

- Back entrepreneurship throughout the organisation. No amount of innovative talent will succeed unless management shows that it wants new ideas.
- Renewal is central to maintaining an entrepreneurial spirit. Renew through venturing, partnering, acquisitions, recruitment, technology transfer and exploration, but know the limits of these approaches within your organisation.
- Recruit carefully. Look for great people with deep knowledge of their specialist subject, an understanding of a broad range of other topics and counter-intuitive attitudes to risk.
- Trust your entrepreneurs: they are hired to push the envelope and have different attitudes. It's up to the organisations that hire or encourage entrepreneurs to keep an eye on the risks they are taking.
- Ensure that everyone understands the context in which they work: what customers want, what the company's priorities are and what it can do to support their activities.
- Build balanced teams and give them robust yet adaptable management. Apply the right tool at the right time – not everyone has to be an entrepreneur for an entrepreneurial spirit to thrive.
- Create reward schemes and career paths that support the behaviours you want. Train your managers to recognise and develop individual strengths.
- Encourage staff mobility and organisational flexibility, so that cross-functional teams can form easily and entrepreneurial projects can get support from established parts of the organisation.
- Celebrate success.
- Install a world-class coffee machine.



The McKinsey Horizons model of innovation helps companies match their behaviour to an opportunity

Europe plans for stronger research to meet Lisbon agenda

The European Commission has detailed its strategy for strengthening European research and development in a communication published in June*. The report lays out six major objectives for Commission policy that it hopes will help it fulfil the strategy, outlined in Lisbon in 2000, of making Europe the world's leading knowledge-based economy.

Incoming EC president Jose Manuel Barroso showed his commitment to the Lisbon agenda when he appointed a team of what he called "reform-minded commissioners" in August.

"We must reinvigorate the Lisbon strategy," he said. "I will personally chair a group of commissioners who will seek to boost the reform process and give new impetus to the economy."

Janez Potocnik has been appointed science and research commissioner (see story below).

Barroso's comments reflect growing commitment within the Commission to link research policy to the needs of industry and economic growth.

"The re-establishment of industry policy is important," outgoing research commissioner Philippe Busquin told a meeting of EIRMA members in June. "Previously, it has not been politically correct to deal with this."

Busquin highlighted the support of Erkki Liikanen, outgoing enterprise commissioner, for the strategy emerging from the six major objectives outlined in the June communication.

Key ideas

The first of these is to create European centres of excellence through collaboration between laboratories. The report says support for international collaboration has been shown to work, improving the quality of research and the sharing of its results.

The second objective is to create 'technology platforms', common research agendas that are so well-defined that they attract a critical mass of national and European resources from the public and private sector. Proposed topics for these platforms include energy, transport, mobile communications, embedded systems and nano-electronics.

The report's third objective is to stimulate the creativity of basic research through competition between teams at European level, by supporting competing research teams.

The fourth objective is to make Europe more attractive to the best researchers, through better training and career development; greater efforts to encourage women into science; better knowledge transfer to less advanced regions and companies; and more international exchanges.

Supporting role

The report suggests two more objectives to underpin these ideas. The first is the creation of European research infrastructure, like the nano-electronics facility proposed under the European Growth Initiative. Essential infrastructure and services, such as dedicated communications networks, archives and databases, would be supported in the same way.

The second supporting objective is to improve the international co-ordination of national research programmes, using money from the sixth Framework Programme as a lever.

The report recommends spreading the benefits of research more widely throughout the European Union through collaborative research projects involving new member countries and improved networking.

It also suggests adding space and security technology to the list of topics that ought to attract support at the European level, in part because they match the Union's political ends.

Doing better to do more

The Commission wants to ensure it uses the most effective techniques to implement research policy in a bid to decouple increases in its budget and its staffing. Projects meant to increase co-ordination between public and private research agendas will be managed by the member states, the Commission and the stakeholders as partners.

The report also suggests creating a European guarantee scheme for major technological research projects, drawing on loans from the European Investment Bank.

** Science and technology, the key to Europe's future*

Economist wins research brief

Janez Potocnik, 46, has been appointed EU science and research commissioner. He has been Slovenia's minister of European Affairs since January 2002 and helped negotiate its entry into the European Union.

Potocnik gained a doctorate in economics from the University of Ljubljana in 1993. He began his career at an economics research institute there, before becoming head of the Institute for Macroeconomic Analysis and Development in the Slovenian commerce and trade ministry.

Printed circuits

Princeton scientists have found a way to mass-produce electronic devices that are so small they are at the limit of what can be viewed by the most powerful microscopes.

In contrast to conventional chipmaking techniques, which rely on photographic mechanisms, professors Stephen Chou and Stephen Lyon used a method known as nano-imprinting, similar to the technique used to make CDs, to form the features.

The process involves pressing a mould into a layer of softened plastic on a silicon wafer. The patterns can then be transferred to the silicon where they could form the basis of miniature electronic circuits.

Lyon used molecular-beam epitaxy to grow flat sheets of crystals just a few molecules thick. Members of Lyon's lab grew alternating layers of two materials until they had a wafer hundreds of layers thick. Researchers in Chou's lab then cut the wafer, exposing the edges of the layers. They applied a chemical that ate away one of the two materials but not the other. The result was a very fine comb-like pattern.

"This work really pushes the limit down to a few molecules in size," said Chou. He says the team thinks it has made ridges narrower than 5nm, but could not confirm the results with existing microscopes.

Neutron beams focus on bio samples

A collaboration between a private company and the US National Institute of Standards and Technology (NIST) has led to the development of a new type of microscope that could yield better results than conventional microscopes on biological samples.

The microscope uses an intense beam of neutrons to analyse samples. The NIST scientists routinely use multiple lenses to focus neutron beams for other research.

Unlike other imaging methods, neutrons interact strongly with hydrogen, which is present in high concentrations in biological samples. The neutrons easily penetrate samples, thereby reducing artefacts produced with other techniques that require thin slices, staining or fixing.

In principle, neutrons can provide resolutions down to 1nm, but the demonstration microscope produced a 0.5mm resolution and a 10x magnification. Adelphi Technology, the private partner, hopes to substantially improve image resolution through research to reduce lens aberrations and to build a compact, laboratory-scale neutron source.

An x-ray of a rat's paw (left) and a false-coloured image created by neutron absorption

Praise for European research co-ordination and funding plan

The heads of 52 scientific organisations have backed plans for a European Research Council (ERC), in a letter to the journal *Science* (6 August 2004).

"The enlarged EU, a newly elected European Parliament, and a new Commission should now grasp the historic opportunity to establish without delay an ERC, with full participation of the scientific community," the letter says.

It highlights the importance of an ERC "to ensure that the best research is funded, to combat the prevailing fragmentation of research efforts, and to provide long-term commitment of policy in Europe toward the development of its science base at the highest level".

The letter praises the European Commission's work on strengthening basic science, particularly through its communications published in January and June. It warns against complacency and says industry should back an ERC: "Expanding and strengthening basic research in Europe is also in the interest of industrial innovation and competitiveness."

Andrew Dearing, secretary general of EIRMA, broadly agrees: "Strong science and strong industry are not at odds, provided the connections between them are also strong and the motives for doing each are clear."

The letter was organised by the Initiative for Science in Europe, founded in November 2002 to promote basic science at a European level.

Sandwich wrap good enough to eat

Researchers at Oregon State University have developed an edible coating for food that protects it from microbes but which can be eaten together with the food it protects.

Yanyun Zhao, a food technologist, and Mark Daeschel, a microbiologist, combined two naturally occurring products, a fibre from shellfish, called chitosan, and a protein from egg whites, lysozyme, to make the coating.

Zhao said the wrap is so thin that it does not interfere with the texture of the food it covers and the ingredients are themselves powerful natural antimicrobials, keeping fresh food from spoiling.

"You can use it as a film to wrap foods or you can use it as a spray or dip to coat foods," said Zhao. "And you can enrich the film or coating with extra nutrients, such as vitamin E and calcium."

Daeschel said: "The chitosan is derived from seafood shells, much of which is otherwise wasted."

Supercharger test brings heart surgery stress into view

A test used by wartime aircraft makers to analyse the stress on their engines is being applied by a research team at the University of Warwick to model the stress that surgery puts on potentially fatal problems in the aorta.

An aortic aneurysm is a dangerous bulge in the artery that can burst during an operation. The researchers wanted to give surgeons a way of trying different techniques during heart surgery without endangering patients. Surgeons have used tiny mechanical strain gauges for similar experiments, but these apply a strain of their own, making them unsuitable.

Led by Geoff Calvert, the Warwick team decided to use photoelasticity, the technique applied by engineers to look for problems in aircraft superchargers. The technique analyses the changing pattern of coloured light reflected from a surface as it is put under stress.

Instead of working directly on a real aneurysm, the team used rapid prototyping techniques to build a latex model of an artery. As the surgeon manipulated the model, the stresses could be picked up using an array of sensors feeding the data to a computer.

Calvert is seeking funding for further research to look at other materials that will more closely mimic the mechanical properties of an aortic aneurysm. He also wants to try to use photoelectric stress analysis equipment on a much less reflective physical artery that can act as a real-time stress monitor for surgeons as they operate.

Foiling forgers

A team from the Università degli Studi in Rome has created a virtual-reality system that could detect written forgeries more reliably than existing image-scanning techniques. The system creates a 3D view of a piece of handwriting, such as a signature, and analyses the tiny variations and bumps along the path of the ink.

Forged signatures or handwriting are usually detected by experts who analyse the sequence of individual strokes in a piece of handwriting using 2D samples. However, a good forgery can go undetected at the 2D level because it is not always easy to determine the sequence of strokes.

Professor Giuseppe Schirripa Spagnolo's team create 3D images of the path of a piece of writing, generating an image on a computer that looks like a ditch or furrow. This makes it easy to analyse variations or bumps generated by the writer's pressure on the paper at crossover points, for example the mid-point of the figure '8'. This is important because it is almost impossible for a forger to reproduce the exact variation of pressure used by the original writer.

Schirripa Spagnolo said: "Using image processing and virtual reality makes it easy to detect the presence of bumps at crossover points. Finding these bumps allows experts to easily determine the sequence of strokes in a piece of handwriting and the tell-tale signs of a forgery or original, without damaging the sample."

Pouring new wine from old bottles

How Procter & Gamble opened up its IP strategy

Procter & Gamble (P&G) began in 1837 as a family-operated soap and candle company. It is now a global business with sales of $51 billion a year.

Nine years ago P&G realised there was significant untapped potential in the intellectual property (IP) that supports its portfolio of nearly 300 brands. As a result, a small team was chartered to explore whether P&G's patents could be commercialised by outside parties. The group, led by Jeff Weedman, set out to mine P&G's IP portfolio for its ability to generate a monetary return.

"We had a lot to learn in those days," said Weedman. "Benchmarking was critical. It was important to tap into the expertise of those who had already been doing this work for a long time."

The group had early successes with out-licensing, but there were limitations.

"We had several organisational issues working against us," said Steve Baggott, part of the initial team and currently director of external business development. "We were a profit centre, so all the value we generated came back to the group. So it was very difficult to secure needed resources when the businesses received no credit."

There was little visible senior management endorsement of the work, and the licensing managers faced a 160-year-old P&G mindset that jealously guarded IP. Licensing was definitely counter-cultural.

The team realised that without help it would remain a small group delivering minimal value. By mid 1999, it had agreement from top management to fundamental changes. There were two key agreements. The first was that all P&G technologies would become candidates for commercialisation available to anyone, including competitors. The second was that all the value generated would flow back to the business unit that owned the IP.

These agreements formed a tipping point for the company's external commercialisation effort. Businesses created internal teams to mine their patent portfolios and work on external commercialisation. Deal productivity increased and income followed.

"We knew we had come into our own when we had business units buying slots in our group," said Weedman. "To get more of our services, a global business unit would put one or more of their people, still on their budget, into our shop to work on their portfolio."

As the external commercialisation of P&G's portfolio grew, the company realised that external connections could also speed up P&G's product innovation. It defined a four-stage approach to identifying external assets and capabilities that P&G could use to accelerate innovation.

The Connect strategy means considering licensing patents, partnering to access key capabilities, finding ready-for-market products and even buying emerging businesses.

During the *connect and develop* phase, P&G in- or out-licenses up-stream technology. During the *connect and evaluate* phase, early-stage concepts and products are vetted by P&G or an external partner.

Connect and commercialise brings in or takes out late-stage, ready-for-market products. Finally, *acquire and accelerate* brings in mature acquisition targets whose growth can be speeded up by P&G's scale.

What started as an experiment more than six years ago to get a return from under-used patents has become a strategic capability to extract value from P&G's IP. It also helps the company connect with external IP assets and capabilities to drive innovation and profitable sales.

"We started our group trying to make money from selling day-old bread," said Weedman. "We now have an important new tool for our businesses, called external commercialisation. We even changed our name a couple of years ago from Global Licensing to External Business Development, which more accurately captures the scope of the work."

Jeff Weedman
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Prof Dr Emmo Meijer

chief technology officer, DSM

Prof Dr Emmo Meijer runs research for DSM, the Dutch life-science products, performance materials and industrial chemicals company. DSM is expected to turn over €8 billion in 2004, and will spend €300m on R&D.

More than 2000 people work in R&D, in labs across the globe. Some of the labs were acquired during a series of transformations that converted DSM from a state mining company into a diversified public multi-specialty player.

"The most dramatic moments of change were in the 1990s, when we went into biotechnology, fine chemicals and performance materials," said Meijer. "Part of my job is to renew our technological competencies to support the strategic direction of the company."

Meijer says DSM transformed its portfolio in an interactive way, rather than according to a fixed plan, with R&D playing an important part.

"In most cases we had a technology platform first," he said, citing the biocatalysis expertise DSM built up in the 1980s ahead of entering the biotechnology business in the late 1990s. "This way of working gives you time to see if you are taking the right step."

DSM revised its R&D governance model in 2000 in response to its widening global research base and to achieve greater innovative power through market responsiveness. Meijer was appointed in a co-ordinating role as its first chief technology officer (CTO).

"My role as CTO is to have an overview of all our R&D activities," he said. He has three main responsibilities: the quality of research; human resources policies and external relationships.

Meijer keeps tabs on research quality through a network of global competence managers. He also oversees research councils, each representing a business cluster and chaired by an R&D director, which define longer-term R&D programmes.

He says his position as CTO allows him to steer the whole R&D activity through the research council chairmen. He uses his role as chair of a corporate research board to get an overview of the company's activities, so he can align R&D capabilities with business plans.

Meijer believes a strong HR policy for research is vital to DSM: "It's extremely important that we offer careers to people so we can retain good scientists in research."

DSM has defined three career paths for researchers: into business project roles; R&D resource management or increasingly senior scientific roles. Good researchers can now rise to senior executive levels with DSM, working as corporate scientists and steering the company's research.

The company has also embraced the open approach to innovation, in part to access talent from as wide a pool as possible. DSM is already involved in two of the Netherlands' Technological Top Institutes, partnerships between government, industry and academia which do pre-competitive research with a clear eye on future applications.

The Institutes host PhD students and Meijer is keen to extend DSM's links with academia by bringing students into its labs for a taste of real industrial research. He believes this could help overcome Europe's weakness at turning good research into successful businesses.

He points to his own experience with aspartame, the artificial sweetener, which he helped develop from a lab project right through to being managing director of the business unit that sells it.

"We need a frequent exchange of people between R&D and business, and we need people to return from business and talk about what they have learned.

"The most important thing for me is inspiring people in our research community," he added. "When you look at the transformation of DSM, the innovative success in the company is down to inspiring people."

Looking backwards

The technology gap between Europe and the USA

Bill Arrol, of UK company Joseph Lucas, told EIRMA's 1967 conference: "There is a strong tradition in the US of developing products irrespective of where the work they are based on is done. There is a tendency in the UK to concentrate effort on scientific research and to be bad at development. By far the most important reason for the recent surge in technological development is America's skill in managing complex research programmes. Joint efforts between firms in several countries may be the only way to achieve realistic goals. Flexibility, realism and a willingness to learn from practical experience are among the conditions for success.

"If individual European firms can strike a proper balance between internal research and purchased work then we, too, will have some ideas and inventions to sell."

Looking forwards

In our next issue

- How can firms assess the effectiveness of their R&D?
- Why is it so important to understand how R&D integrates with corporate strategy and processes?
- What are the right metrics of R&D effectiveness?

The December issue of *IQ* will examine these questions and look at companies that are handling them well.

Forthcoming EIRMA events

- Assessing R&D effectiveness
- The business environment in Eastern Europe
- The effective researcher
- New paradigms for R&D
- Business area R&D processes for shortening time lines
- From project to multi-project management
- The state of corporate R&D in the United Kingdom
- The global versus the local approach
- Effective transfer of R&D to the market
- Public procurement and R&D
- Knowledge management
- Learning groups will be organised on:
  - portfolio planning
  - market intelligence
  - technology monitoring
  - roadmapping

For full details, visit our website, www.eirma.asso.fr, which offers records of EIRMA meetings and all EIRMA reports

About EIRMA

"The best management development happens when experienced managers come together to learn from each other, to discuss common concerns and visit each other's companies" – *Financial Times*, 31 March 2004

The European Industrial Research Management Association (EIRMA) has 150 member companies based in more than 20 countries. Collectively they fund the major proportion of business enterprise investment in R&D in Europe.

EIRMA is an independent, not-for-profit organisation, which aims to enhance innovation through more effective market-oriented research and development. Unique features of the Association include the networking and personal contact that the *Financial Times* recommends. It's been offering this forum for nearly 40 years.

EIRMA provides a platform for discussing ideas and exchanging practical experience. Its activities support companies in benchmarking and improving their innovation processes through well-managed and well-organised research and development. These establish EIRMA as a natural first point of contact for policy makers and others seeking the business community's insight.

Facts and figures

- Gross investment in R&D exceeds €600 billion a year, more than 60% of which comes from the private sector *(OECD)*
- Five sectors (IT hardware, auto/parts, pharma/biotech, electro/electrical and software/services) account for three-quarters of private sector investment *(UK DTI)*
- The proportion of R&D outsourced to others fell to its lowest levels, of around 3%, in 1970. The proportion is now 10% or more, similar to the levels seen in 1920 but at much greater volumes.
- The EU produces more PhDs than the US, but only 25% of Europeans who go to the US to gain their doctorates return to Europe to work. However, US Senate leader Tom Daschle recently remarked that the number of papers published by American researchers has been flat for several years whereas Europe has increased its rate of discovery.

Credits

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