Economist Intelligence Unit

The Economist

Sharing the idea

The emergence of global innovation networks

A report from the Economist Intelligence Unit

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About the research

Sharing the idea: the emergence of global innovation networks is an Economist Intelligence Unit report that examines a new approach to managing global research and development programmes. It is sponsored by the Investment Development Agency of Ireland (IDA Ireland).

The Economist Intelligence Unit bears sole responsibility for the content of this report. Our editorial team executed the online survey, conducted the interviews and wrote the report. The findings and views expressed in this report do not necessarily reflect the views of the sponsor.

Our research drew on two main initiatives:

- We conducted a survey of senior executives in November 2006. Respondents represented a wide range of industries, including aerospace and defence, automotive, information technology (IT) and technology and manufacturing;
- To supplement the survey results, we also conducted a series of in-depth interviews with innovation experts from a range of companies and institutions.

Paul Tyrrell was the author of the report and Rob Mitchell was the editor. We would like to thank the many people who helped with this research for their co-operation and assistance.

Executive summary

The traditional process of innovation, whereby a company maintains and funds a centralised research and development (R&D) department, is gradually being superseded. In its place, companies from a variety of sectors are seeking ways to disaggregate their R&D departments and distribute the innovation process across a network of external partners and offshore sites. This enables them to allocate activities according to the strengths of particular countries and external organisations, and thereby make their R&D processes more effective and efficient.

The reasons for this approach—which can be termed a global innovation network—are many and varied. The increased cost and complexity of the innovation process is certainly a factor, as are regional talent shortages and the demand for localised products and services in emerging markets. The rapid development of skills and expertise in China, India and elsewhere are also important considerations, and are encouraging more and more companies to tap into these deep talent pools.

However, while global innovation networks undoubtedly have their advantages, there are also important risks to consider. Unlike many other business processes, R&D is often considered core to the company's identity and exposing it to outside organisations may require a loss of control that could erode competitive advantage. Global innovation networks are also subject to the same management challenges that affect all outsourced operations—for example, the objectives of partners can diverge, conflict can arise and there can be cultural clashes.

This survey and white paper, conducted by the Economist Intelligence Unit on behalf of IDA Ireland, examines current attitudes towards the global innovation network model and its implications for management. Based on a survey of over 300 executives worldwide, as well as a series of in-depth interviews with executives and innovation experts, the study identifies the following key attitudes and trends:

- **The drivers of the global innovation network model are many and varied**. Innovation is becoming more expensive and complex because of a confluence of disruptive forces. Meanwhile, customers are calling for higher rates of innovation and lower prices. Among respondents questioned for this survey, 77% say that the cost of innovation has increased over the past three years and 82% think that the complexity has increased. To extract more value from their R&D, companies must become more "customer-centric" and more efficient. The natural solution is to disaggregate the R&D function worldwide and share the burden of innovation with external organisations;

- **R&D is increasingly being offshored**. The past three years have seen a marked increase in the offshoring of R&D units. The US remains the most popular destination, thanks to its high-quality workforce and robust enforcement of intellectual property (IP) rights, but respondents consider that India offers the best combination of cost and quality, while Asia-Pacific is set to become the most popular destination over the next three years;

- **Innovation is increasingly "open"**. Companies are not only offshoring R&D functions, but outsourcing them, too. Over the next three years, respondents predict a marked increase in the proportion of R&D being carried out by external partners. In order

to realise the full potential of ideas, companies recognise that they need to let them flow out of their originating organisations to wherever they can be most efficiently handled at each stage of R&D. This process reduces time-to-market and maximises value for every organisation involved;

- **Disaggregating R&D worldwide creates major management challenges.** Intellectual property theft and a "loss of control" over R&D are the biggest concerns for respondents as they consider embracing the global innovation network model. Sixty percent cite the former as being a concern, and 44% cite the latter. The key to overcoming the management challenges associated with the model is communication—it is essential that every member of the network is clear about the strategy being employed. Online technologies can aid this process, but face-to-face interaction will remain vital to strategic alignment.

1. Drivers for a global innovation approach

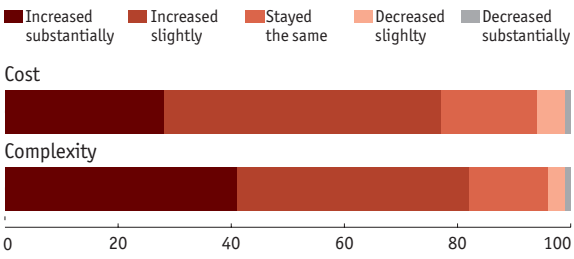
Companies have long recognised that it is inefficient to keep the entire manufacturing process in-house. In order to compete effectively, they accept that they must distribute the work across multiple partners and geographies, with raw materials being sourced in one location, components in another and final assembly happening in a third.

Until recently, however, R&D had largely escaped this trend and, in many companies, it was a centralised and jealously guarded department. Ideas sometimes trickled from production facilities in low-cost economies to R&D departments in the West, but the process was largely ad hoc.

In the past few years, however, companies have started to implement a more systematic and integrated approach to spreading the load of R&D. In industries as varied as pharmaceuticals, information technology and fast-moving consumer goods, companies are increasingly opening up R&D to external organisations and offshoring stages of the process to locations where it can be more efficiently handled.

One important reason for this trend is the increased cost of conducting R&D. Among respondents questioned for this report, 77% say that the cost of running a successful R&D function has risen over the past three years. At the same time, R&D executives are unsurprisingly under pressure to curb these soaring costs. Fully 70% say that their management "sees investment in R&D as vital to success, but is putting us under increasing pressure to curb our costs."

Over the past three years, how have the levels of cost and complexity associated with conducting successful research and development changed?
(% respondents)



Source: Economist Intelligence Unit survey, 2007.

The cost of complexity

Worldwide, the main reason why R&D costs are rising is complexity. Of those surveyed, 82% say that R&D has become more complex over the past three years. "We are going through a period where the number of disruptive forces is pretty high," says Jean-Charles Hourcade, chief technology officer at Thomson, a French provider of services, technologies and equipment to the media and entertainment industries. "That's why the importance of R&D investment and the need to leverage it more effectively is growing."

These "disruptive forces" are many and varied. They include the revolution in information and communications technology, the global harmonisation of business practices and the breakdown of traditional consumer categories.

Convergence between previously separate industries is an additional source of complexity, points out Andrew Gaule, director of H-I Network, a best-practice forum for senior executives at large organisations, and author of *Open Innovation in Action*. "Consider the mix of technologies taking place in response to the problem of ageing populations," he explains. "There, you're seeing biotechnology, nanotechnology, chemistry and IT converging to create a new breed of monitoring and therapeutic devices."

Levels of innovation are also increasing to keep

pace with new business models. "In the past," says Mr Gaule, "you used to deliver a product in a box and put it on a shelf. Now an increasing number of products have services bundled in with them. Delivery is becoming more complex."

Meanwhile, in mature industries, where advances in performance and functionality have reached a plateau, innovation is being directed towards the improvement of business processes, according to Henry Seddon, vice-president of UGS, a developer of product life-cycle software. He cites BMW, a car manufacturer, as an example of a company that uses innovation to optimise its factories, reduce its manufacturing costs and thereby compete more effectively with Asian rivals. Each BMW factory used to produce only one model in the range. "Now, they're trying to break that link with the ability to manufacture X5 and 5-series cars on the same production line," he explains.

Other sources of complexity are industry-specific. "If you look at the data on the pharmaceuticals industry as a whole, it is shocking to see how, despite annual increases in R&D investment, actual output in terms of approved medical entities has at best stayed the same," points out Oliver Fetzer, senior vice-president of R&D at Cubist, a US pharmaceuticals company. "Net productivity [in terms of innovation] is actually going down. This either means we've become inept at managing R&D or complexity is going up, and the first of these is certainly not true."

Improvements in safety assessments are chiefly responsible for rising complexity in pharmaceuticals, suggests Mr Fetzer. "Many of the analytical tools and techniques we use to detect impurities simply didn't exist ten to 15 years ago," he explains.

Yet, the biggest problem created by the disruptive forces mentioned above, in most industries at least, is a surplus of ideas. Mr Gaule of H-I Network describes this trend in terms of the "innovation funnel," the shape used by many innovation experts to illustrate the way a company eliminates weaker ideas during the R&D process.

"The bowl of the funnel is widening," he explains, "and the spout is narrowing. That is to say, companies are having to spend more money sifting through ideas at the beginning of the R&D process and are therefore finding they have less to spend on the ones they choose to take forward."

In other words, there is an abundance of ideas, but this does not necessarily translate into increased levels of intellectual property. "Ten years ago, you could bring maybe one in 100 ideas to market. Now, it's one in 1,000," says Peter Gommers, director of business development at Akzo Nobel, a Dutch developer of coatings, chemicals and healthcare products. As a result, he explains, Akzo Nobel makes it a priority to "be very critical [of ideas] as early as possible" at the beginning of the innovation process.

The importance of customer-centricity

Many of our respondents and interviewees agree that the best way to filter ideas is to learn more about what customers want and to calibrate overall strategy accordingly—to become, in other words, more "customer-centric".

Of those surveyed, 75% say that they agree with the view that "customers are becoming an increasingly important source of innovation". Similarly, 54% involve customers in the innovation process and 50% regard customers as an important type of external partner in the innovation process (see Section 3, "Open Innovation," below).

"We never start something without a customer in mind," says Mr Gommers of Akzo Nobel. For example, if the company makes a new fundamental discovery, then the earliest test of its development potential is to look around for the type of customer who might find it valuable. He adds that when Akzo Nobel defines the focus of its R&D functions, it does so in terms of markets and customer groups, not "technology fields". In other words, it focuses on "consumer pull"

rather than "technology push".

The migration from "technology push" to "consumer pull" has also been a priority for Qinetiq, the defence technology company that was previously a part of the Defence Evaluation and Research Agency (DERA), the exclusive R&D arm of the UK's Ministry of Defence (MoD). Stephen Lake, director of Qinetiq's New Business Accelerator team, says that, initially, the company pitched ideas to potential licensees or partners that were too specific in terms of technology and business proposition. Today, however, its approach is to identify the main problems faced by its potential clients and then talk through the underlying technical issues.

"The way to sell into client organisations is to tie what you can provide to their real world business problems," he explains. "You could show them something revolutionary, but if it's presented as a technical capability rather than the solution to a business problem then it may be too hard for them to make the connection."

An "iterative dialogue" is required, he suggests, in which you home in on an agreed approach to a specific problem. "When we talk to people for the first time, we will say: 'We think your top three problems are these…' and suggest broad ideas on that basis. The ideas may not be quite right, but we'll generally get the dialogue under way." This is a valuable approach to take no matter where an organisation is situated in a global innovation network, he says. The key thing is to always talk to partners "in the context of their business."

Customer-centricity is especially important for Western companies trying to move up the value chain in response to increased competition from Asia, says Mr Gaule. He cites the example of Tate & Lyle, a UK food and industrial ingredients manufacturer, which has been researching dietary habits, lifestyles and health aspirations for a number of years to help shift its focus from commodities to value-added products and services. Thanks to this research, the company now offers a raft of services designed to help food manufacturers use its ingredients to fulfil specific customer needs.

A lack of customer-centricity will push up R&D costs through wastage, adds Richard Scase, Professor of Organisational Behaviour at the University of Kent, in the United Kingdom. "A lot of the cost of R&D comes from over-research, over-prototyping and so on. Or it's the result of over-specification: designing something far beyond what the customer needs. The software industry has suffered from the latter problem in particular," he says.

Since most large companies now have a global customer base, it follows that they should benefit from a global innovation network that can track and respond rapidly to customer wants and needs. Indeed, 55% of respondents cited "The need for greater insight into customer requirements in overseas markets" as being an issue that global innovation networks address successfully.

2. R&D goes offshore

R&D offshoring is a trend that is already well underway worldwide. Our survey shows the proportion of respondents with at least some of their R&D function overseas is 65% today and is predicted to be 84% in three years' time.

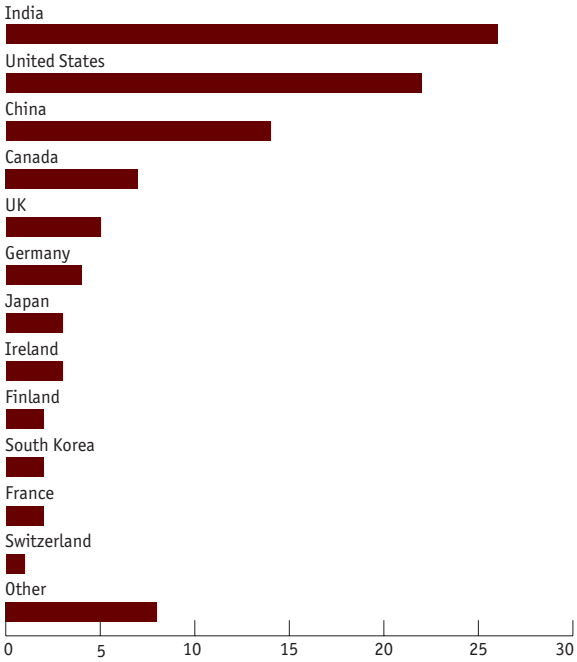
Proving the point that cost is not everything, our survey showed that the US is the most popular destination for offshore R&D—it accounted for the highest proportion of overseas R&D spend at 18% of respondent companies. As many of our interviewees point out, it is still the richest country in the world, with a high-quality workforce and robust intellectual property protection, and these considerations outweigh its relatively high labour costs.

Yet, India is catching up, thanks to improvements in the same areas—it was the second-most popular destination for offshore R&D, accounting for the highest proportion of overseas R&D spend at 17% of respondent companies. Mr Scase of the University of Kent says that he expects the talent pool of India quickly to surpass that of the West. "India produces 1m English-speaking graduates a year and, by 2008, it will have more technology graduates than the population of the UK," he notes (see "The Importance of People," below).

Asked which country they view as the best overseas location for R&D, our respondents rank India first (cited by 26%), followed by the US (22%) and then, by some distance, China (14%). Our interviewees note that China is still being held back by its relatively poor intellectual property protection and the vagaries of its legal system (see Section 4, "Managing a global R&D pipeline").

Nevertheless, Asia-Pacific as a whole will still receive more offshore R&D over the next three years than any other region, according to respondents: 30% say they expect to increase their investment there substantially, while only 14% say the same about North America.

Which of the following countries would you choose as being the best overall overseas location for research and development?
Please do not select your own country.
(% respondents)



Source: Economist Intelligence Unit survey, 2007.

The prospect of a huge middle class forming rapidly in Asia has encouraged companies in Europe and North America to consider how they can localise their offerings, and many are recruiting locals to carry out incremental innovation *in situ* (see Section 2, "R&D goes offshore," below).

At the same time, the improvement of higher education, infrastructure and business practices in Asia has encouraged Western companies to consider offshoring knowledge-based tasks on cost grounds

The importance of people

Any company wishing to implement an effective global innovation network needs a healthy supply of talent. This point is corroborated by the responses to several of the survey questions, and also resonates with several of our interviewees.

For example, 62% of respondents think that the global innovation network model is successful at addressing the challenge of "talent shortages in domestic markets". Similarly, when asked what they look for in an offshoring location for research and development (R&D), they rank "access to qualified staff" most highly (61% say it is "very important"), followed by local labour costs and access to first-rate universities.

"We would not go large-scale into a country where we could not recruit future [R&D] managers," says Mr Baujard of Alcatel-Lucent. Similarly, Mr Hourcade of Thomson says that he sets up overseas operations not merely for the purpose of brand localisation, but also to breed "a new generation of innovators" that will eventually be able to take on global R&D roles. He regards his operations in India and China as especially important. As Asia begins to influence the world's tastes and lifestyles more heavily, so he expects to be able to tap into a sustainable R&D talent pool that has originated in the region.

This kind of initiative is undoubtedly constructive from a customer-centricity perspective, says Richard Scase of the University of Kent. He points out, however, that companies may find that they can boost their ability to innovate simply by improving the way that they recruit and retain staff at home.

He explains that in the West and especially in Europe, given its ageing population, much of the so-called skills gap could be plugged if companies would only appeal more to women, ethnic minorities and older workers. "All these groups have yet to be tapped fully in the West," Mr Scase points out, "and all of them represent key emerging markets for most industries across the developed world."

for the first time. Meanwhile, Asian companies have become more competitive, putting pressure on their Western counterparts to cut costs. This has encouraged greater levels of offshoring to lower-cost destinations.

The governments of developing countries are also increasingly taking steps to build up their native R&D capabilities. "Countries such as India and China are used to welcoming foreign companies into their markets, provided [those companies] create local added-value. In the 1990s they concentrated on manufacturing. Now they require R&D activities and jobs to be created." So says Olivier Baujard, CTO of Alcatel-Lucent, the global provider of voice, data and video communication solutions.

Moreover, as Asian economies continue to grow in stature, companies will increasingly see the need to satisfy customer requirements in these markets as a priority. "The world's tastes are still influenced most heavily by Western culture and lifestyles, but we should expect the balance of power to shift to Asia in the near future," argues Mr Scase. "Corporations will increasingly need to shift their whole *identity* towards the east."

This kind of consideration is growing in importance according to our interviewees, who say that, in any offshoring initiative, cost savings should not be the highest priority. "We have set ourselves the goal of balancing our R&D resources between higher- and lower-cost countries," says Mr Hourcade of Thomson, "but the most important thing for us is to develop an 'R&D footprint' in emerging markets."

Thomson currently has around 20% of its R&D headcount situated in overseas locations, including China, India, Morocco and Mexico. It has set itself a target of 30%, and Mr Hourcade expects the level to rise to between 25% and 30% by the end of 2007.

Similarly, Akzo Nobel has longstanding R&D facilities in Sweden, the UK, Germany, the US, Mexico and Brazil, and has recently opened new

ones in Turkey, India and China. Why these countries particularly? "The drivers for us include: being close to emerging markets and following the movements of key customers," explains Mr Gommers. "There are also local product considerations. For example, in many performance-oriented coatings and chemicals, you have to take into account the peculiarities of local raw materials and substrates."

However, several of our interviewees believe it will be some time before Asia's emerging economies can compete with the West in terms of fundamental innovation. "IP is the competitive advantage that the West has got at this time," says Tony Butcher, managing director of Prodrive, an automotive engineering company based in the UK, with R&D facilities in the US, Thailand and Australia. "We expect innovation to flow back from Asia in the medium term but, for now, the levels of fundamental innovation there are relatively small."

Mr Butcher says that Prodrive's Thai operation, which was set up five years ago to provide localisation services for Western car companies operating in East Asia (excluding Japan), already has 100 staff. "The education system out there is very good so we're able to hire very skilled engineers, but what they don't have is experience," he says. "Once the unit is ten years old, I expect to get a lot more innovation from it that's fundamental and globally significant."

3. Open Innovation

Another key characteristic of the global innovation network is that it involves a variety of organisations. Long gone are the days when one central R&D department could monopolise knowledge and innovative capacity. Increasingly, companies are outsourcing R&D or forming partnerships with other organisations to share the work and spoils of innovation.

The term "open innovation" is commonly used to describe this approach—Henry Chesbrough of the University of California at Berkeley coined it in his 2003 book *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Open innovation refers to an environment in which ideas are allowed to flow outside their originating organisation, to wherever they can be most efficiently handled at each stage of the R&D process. Some ideas may flow back again to be scaled up and marketed, some may turn into joint ventures and some may simply be licensed. However, all should reach their markets more quickly and more efficiently than would otherwise be possible.

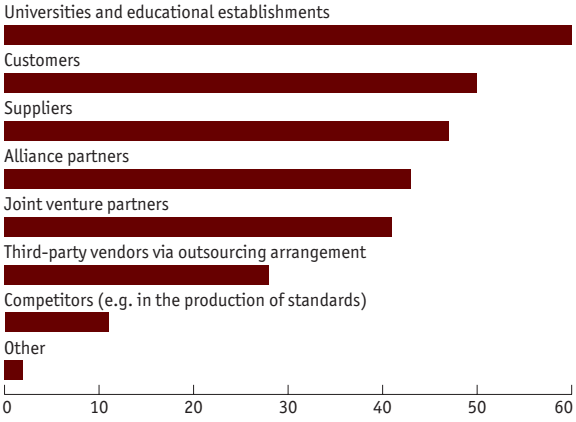
The popularity of open innovation is clear from our survey, with 59% of respondents saying that they already partner external organisations to develop new inventions and 64% saying that they already outsource at least some of their R&D. The latter figure is predicted to rise to 75% over the next three years.

The benefits of partnerships

Asked which type of external partners currently assist with their innovation processes, respondents rank universities the highest (cited by 60%), followed by customers (50%) and suppliers (47%).

Many of our interviewees stressed the importance of their relationships with universities as sources of both fundamental and targeted research. They also pointed out that universities are de facto recruitment pools, and that it was vital to establish a relationship with students to improve the quality of their graduate intake.

With which of the following external partners does your company collaborate in its R&D processes?
Please select all that apply.
(% respondents)



Source: Economist Intelligence Unit survey, 2007.

Mr Hourcade says that Thomson partners universities to research "advanced concepts", areas of emergent technology that have the potential to be disruptive, such as holographic data storage, peer-to-peer file-sharing systems and cryptography. The company has longstanding relationships with universities in Europe and the US, and is now starting to forge similar ones in China.

Within an established framework, academics can apply to have specific projects funded by Thomson, provided they adhere to a certain boundary conditions. "Obviously, an effective method that results in a prohibitively high system cost is of no use to us," explains Mr Hourcade. He suggests that the best results are obtained when there is a relatively

open framework, but when there is precision around the direction in which the research should go.

It is "precise direction" that has also enabled suppliers to become a more important source of innovation. In the past, a company producing raw materials or components would typically have innovated on a "technology push" basis, improving the properties of its existing products or developing new ones in the hope of finding applications at a later stage. Today, in the context of a global innovation network, the same company would be aware of the market objectives of its brand-owning clients and could funnel its own innovation accordingly.

Mr Gommers of Akzo Nobel says that innovations at raw material suppliers can have a dramatic impact on the company's products. He adds that when his key clients upgrade their machinery, or when the suppliers of chemical engineering equipment make a new breakthrough, demand is created for new formulations and processes. This can be a major source of incremental innovation. The better the communication between the various links in the supply chain, the more opportunities arise (see Section 4, "Managing a global R&D pipeline," below).

Indeed, the desire for stronger links between innovation network members has persuaded some companies to set up "open R&D campuses"—effectively, purpose-built innovation networks and industry clusters.

For example, the High-Tech Campus at Eindhoven, the Netherlands, is a 220-acre laboratory complex that used to be exclusive to Philips. Since 2002 it has opened its doors to other "R&D-oriented" high-tech companies that specialise in areas such as information and communications technology. Over the next decade its working population of 4,000 scientists and engineers is expected to rise to 8,000.

Peter Wierenga, chief executive officer of Philips Research, says the environment not only gives the company "synergies and a good view of the markets [it is] serving", but also enables it to spread the costs of fundamental research. "In the past, we [Philips] would do all this research by ourselves," he says. "Now the costs are shared by various partners and we can focus on designing applications."

Deciding what to outsource

The decision over whether or not it is appropriate to outsource a particular stage of R&D varies from industry to industry, according to our interviewees. For example, in pharmaceuticals, "R&D largely involves clinical trials and, once a drug has achieved Phase III approval [i.e. it is permitted by regulators to launch commercially], then its manufacture can be outsourced to anyone, more or less," says Mr Scase of the University of Kent.

Cubist Pharmaceuticals is a case in point. It is a mid-sized company by the standards of the pharmaceuticals industry, with 409 staff and a turnover of just under $200m, so it relies on both smaller and larger companies to do business.

The smaller partners have local expertise in specific markets, such as Israel, Taiwan and South Korea, explains Mr Fetzer. Cubist uses these companies to launch in their local markets; and to liaise with local regulators and "opinion leaders" in hospitals. "We still control the clinical development process, to ensure global consistency in terms of quality, but we encourage infectious-disease physicians—our ultimate customers—to design local trials," he explains.

In addition, Cubist currently partners with larger pharmaceutical companies in some major markets outside the US, as an alternative to scaling up its own marketing capabilities. Mr Fetzer explains that such companies have, in recent years, shifted their R&D investment away from the therapies aimed at "superbug" pathogens. Cubist's key product is an intravenous antibiotic called Cubicin, which targets such pathogens specifically. Thus, in this network, the larger companies are providing international marketing functions while the smaller ones are providing specialised R&D.

CASE STUDY: Intel

Intel may be the world's largest manufacturer of semiconductors, with sales of US$35.3bn in 2006, but it is not resting on its laurels as far as innovation is concerned. The company spent $5.8bn on R&D in 2006, up from $5.1bn the year before, and says its commitment to open innovation is continually making this budget go further.

Around one fifth of Intel's 94,000 staff are dedicated to R&D, and most of these are based in the US. However, overseas units have been a vital source of innovation to the company for decades, and their importance has grown considerably in recent years.

For example, the company has operated in India and China since the 1980s and, in the late 1990s, it set up major research centres in both countries, which are now responsible for leading global projects. Intel also has dedicated R&D facilities in Ireland, Russia, Malaysia and the Philippines.

Cost savings are a major driver for the network, says Chuck Mulloy, a senior spokesperson for Intel, but a bigger concern is the availability of talent. The ability to localise products and services is less important in semiconductors than for some other industries, but having an "R&D footprint" in an emerging market is essential to forge good contacts in academia, business and government.

"It's important to realise that around half of Intel's total R&D budget is dedicated to manufacturing process technology," says Mr Mulloy. This takes place mainly in the company's factories, where, for example, engineers look continually for ways to improve the number of chips that can be harvested from each silicon wafer. "Basically, the R&D process doesn't stop until the technology is old," he explains.

Open innovation between Intel and the suppliers of its manufacturing technology is therefore crucial. The company works with industry groups and universities, and helps its suppliers directly in their R&D efforts. A technique called extreme ultraviolet lithography, for example, was developed by Intel in a joint development effort with chipmakers AMD, Micron and Infineon; and with researchers from the Lawrence Livermore and Sandia national laboratories in the US.

Martin Curley, global director of IT Innovation at Intel, says that when the company embarks on a new open innovation initiative, its staff typically learn rapidly and "get back three or four times what we put into the initiative, in terms of knowledge".

A good case study for this effect, he says, is the Innovation Value Institute (IVI), a research and education body set up by Intel and the National University of Ireland at Maynooth, County Kildare. The IVI develops methodologies, tools and practices to help organisations extract more value from their IT and to "better deliver IT-enabled innovation". It counts over 20 major organisations as members, including Microsoft, SAP, Chevron and the Boston Consulting Group, as well as academic institutions. Mr Curley points out that the strength of the network derives in part from a "clearly structured research model," that enables thought leaders to envisage the benefits of making a contribution.

Applying this kind of structure to innovation is equally vital during product development, suggests Mr Curley. Arguably the world's most successful "ingredient brand", Intel goes to huge lengths to analyse the incipient demands of direct customers and end users, even going so far as to employ ethnographers. This research feeds back into the innovation process in the form of metrics used to identify the strongest ideas.

"We look at a number of different axes associated with each idea and try to 'quantify the qualitative feedback'," says Mr Curley. "For example, we might ask: 'Is this efficient and financially attractive enough? Are top customers asking for it? Is it going to improve their performance?' We can now take 1,000 ideas, plot them on a grid, and visually narrow them down to 20."

With so many scientists and engineers passionate about their research, the tool benefits from its vivid objectivity, says Mr Curley. "When we deployed it initially, we killed a lot of pet projects."

Other industries may require networks in which different links in the supply chain are more closely integrated. "If you're manufacturing an aircraft, where the process is very complex and successful manufacturing depends on large numbers of design iterations, prototypes and production-line innovations, then you have to ensure R&D and manufacturing are fully integrated," says Mr Scase. "Boeing, for example, constantly liaises with its subcontractors and has very hands-on relationships with them."

Mr Seddon agrees that this kind of integration is becoming more important. "What we've seen over time is an increasing need for manufacturing companies to collaborate with the rest of the supply chain, from sharing drawings to sharing innovation

in the production of materials or the designs of a component or a complete system," he says.

"Previously you would have exchanged and reviewed multiple iterations of the same documents; now you can work on the same design simultaneously in real time. If someone makes a change to a particular measurement then everyone else in the supply chain can see immediately what the impact will be."

Despite the perceived advantages of outsourcing aspects of R&D, the survey highlights wariness among many companies to expose their practices to outside partners. Sixty-seven percent of those surveyed say they think that "R&D is a core part of the business and so cannot be outsourced in the same way as activities such as manufacturing," while 48% say they think that the outsourcing of R&D will "erode competitive advantage over time".

Mr Hourcade of Thomson says that his number one priority in co-ordinating R&D is to "make sure that we do not outsource mission-critical activities that have a strong IP-generation potential". This means that no fundamental research is outsourced except as part of Thomson's framework agreements with universities. The ability of this stage of the R&D process to generate future value, and the risk that the company could be shut out of certain markets should it lose control of it are simply considered too significant.

Again, there are industry-specific factors to consider. Thomson's business, for example, depends on its ability to offer clients fully integrated systems, explains Mr Hourcade, so it tries to retain control of all the IP related to those systems. If a single module of a complex piece of software were to be developed under a licensing or IP-sharing agreement with an external organisation then it could restrict Thomson's ability to alter the system as a whole. "You cannot afford to give a critical point in the value chain to a third party," says Mr Hourcade.

Similarly, Mr Baujard of Alcatel-Lucent says: "In countries where we expect to have a long-lasting business interest, and where there are real R&D capabilities, cost-savings and flexibility, we would rather set up our own operations than sub-contract. This has a double benefit: to develop locally the efficient control and protection of our intellectual property, and to prove to the local country that we are serious about developing their R&D skills."

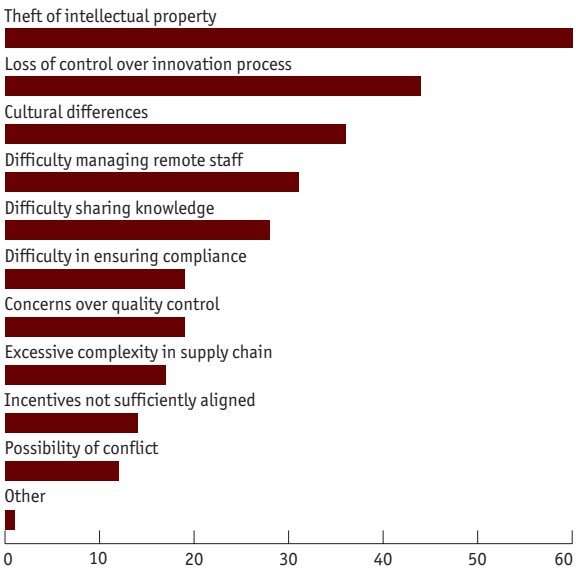
Companies should ultimately seek to retain the capabilities that are appropriate for their strategy, suggests Mr Gaule of H-I Network. "If your strength is in technological leadership, then you need a big R&D capability, albeit one that draws on primary research from external sources," he argues. "If your strength is in branding, marketing and distribution—i.e. the later stages of innovation—then you may be able to rely more on the R&D of other organisations. The key thing is to make sure that all the players involved are aligned with your strategy."

4. Managing a global R&D pipeline

Large companies have become experienced at dealing with the cultural and logistical problems of "going global" and most would be happy to offshore their production, provided certain safeguards were in place. Yet the disaggregation of R&D to multiple countries and external organisations is a different matter entirely. It is perceived to involve much greater challenges and carry much greater risks. And, as discussed, some of our survey respondents and interviewees believe its overuse can erode a company's very identity.

The biggest risk associated with the global innovation network model, according to our survey respondents, is intellectual property theft (cited by 60%) followed by "loss of control over the innovation process" (cited by 44%).

What do you see as being the most significant risks to developing global innovation networks?
(% respondents)



Source: Economist Intelligence Unit survey, 2007.

Our interviewees point out that while the former of these risks is more acute, it is easier to address. Thomson, for example, is typical of many high-tech companies in terms of its IP safeguards. It has a global patent team and three divisional teams for Europe, America and Asia. In-house patent attorneys from these teams visit every R&D site in the network on a regular basis—small facilities at least once a year and larger ones several times a quarter (the biggest even have their own, dedicated patent attorneys on site).

Mr Hourcade says that the key to addressing this challenge is the continuous development of a culture in which everyone is IP-aware. Accordingly, Thomson has policies and processes to protect innovation wherever it may arise. "It's part of the DNA of the company," he explains.

Our interviewees were also unanimous in their view that, while IP enforcement in Asia is still comparatively weak, it will eventually catch up with that of the West. "India has made great strides forward on this issue in recent years. The research organisations there know they would ruin their own future if they violated Western IP now," says Mr Fetzer of Cubist Pharmaceuticals. "My opinion of China is that it hasn't been as aggressive as India in solving the problem up to now, but it is moving in a similar direction."

Why control depends on communication

"Loss of control" is a more complex risk to manage, but here too our interviewees are in agreement about essential principles. Most important, they say, is the need for thorough, regular and targeted communication among the different players within the global innovation network.

"You need to encourage as much interaction as possible between all departments, and not just via the phone or the intranet," says Mr Scase of the University of Kent. "Technology alone can't provide global co-ordination. You actually need a lot of face-to-face contact."

Mr Gaule of H-I Network adds that you need policies in place to ensure that "when someone in your network discovers an interesting technology, a great new business model or a potentially fruitful partnership, you find out about it quickly." Equally, he argues, there must be total clarity throughout the network about the overall strategy: "R&D can be disconnected from customer-facing units at the best of times," he says, adding that "the danger as you move to more open innovation is that the gap can grow. You can get a prototype built very rapidly by an external partner in your network, but that's no good if the partner doesn't talk to your sales and marketing teams and therefore isn't clear about the intended business model."

Mr Hourcade highlights the need for high-quality dialogue between R&D and marketing to ensure that the technological efforts of the former are co-ordinated with the trendspotting efforts of the latter. This helps to ensure that products and services are released at the right time to meet specific customer needs. "I recently organised a day-long seminar where I brought together marketing and research managers," he explains. "For the first half of the day we shared technology demonstrations in which people could really touch and feel our latest technology. For the second half, we talked about how to … turn this technology into business propositions."

At Unilever, the Anglo-Dutch producer of fast-moving consumer goods, a vast online database is used to keep track of every innovation under development and to keep the network in alignment with overall strategy. Over 16,000 people have access to the system, including members of R&D, marketing, IP protection, finance, supply chain management and other related functions.

Mehmood Khan, global leader of innovation process development at Unilever, explains that each project is ranked in order of strategic and commercial importance so that everyone is clear about the company's priorities. "I co-ordinate this work, but we have many leaders worldwide: category boards, regional boards, country-specific teams and so on," he says. "Each of these gatekeepers needs transparency in the portfolio so that they know what project is serving what purpose."

The system helps to avoid innovation efforts being duplicated and prevents unsuccessful projects from being repeated. Most importantly, it speeds up decision-making: "Rapidity is the key," Mr Khan says. "We don't have to double-guess now—every decision is informed."

Communicating with external partners

Good communication is especially important when you are about to enter into an R&D partnership with an external organisation. "When you enter a partnership, you immediately share costs, but only if the development is a success do you share upside, so you need to be clear how the risks and rewards will be shared from the outset," says Mr Gommers of Akzo Nobel.

Companies need to be prepared, in particular, for the possibility that one partner will want to leave the project while the other may want to continue. If the initial, written agreement is not clear about what happens under such circumstances, then significant problems can arise. "Keeping these documents under 200 pages is an art form," says Mr Gommers. "However, they can be simple … the most important element is trust."

Mr Wierenga of Philips agrees, suggesting that flexibility, trust and cultural fit are the most important elements of a partnership agreement. "A good partnership is like a good marriage. You shouldn't need to look at the contract very often, but it's nice to

know it's there."

Mr Gommers adds that a healthy agreement will also go through several iterations throughout the course of a project. R&D is essentially a learning process, so the risks and rewards involved will change by the time the most appropriate business model for an innovation emerges.

Another layer of difficulty is added when you attempt to partner a university or other academic institution, according to our interviewees. Mr Gaule at H-I Network says that in recent years he has seen a "breaking down" of many relationships between corporations and universities, because the latter are often unrealistic about the short-term value of the IP they generate.

"Universities expect their inventions to be worth £1bn each, but realistically the maximum a venture capitalist is going to put into an idea before it's generating value is £3-5m," he says. Corporations must therefore work hard, he argues, to build long-term, strategic relationships with universities if they wish to generate a stream of genuinely valuable ideas. In particular, they need to educate academics about the steps required to take an idea to market, how to assess the risks involved, and branding issues. Their overall aim should be to dissuade the "one-off transaction models" in which universities attempt to sell patent rights to companies on an ad hoc basis.

Companies considering an innovation partnership with a customer should ensure that the customer is one of their best ones, advises Rob Kirschbaum, vice-president of innovation at DSM, a Dutch manufacturer of nutritional and pharmaceutical ingredients, specialty materials and industrial chemicals. "The more you innovate, the more mistakes you will make, so select only your best customers, the ones in front of whom you'd be comfortable to make a mistake." Only if you have a relationship in which mistakes are tolerated will you be able to "learn together" for mutual benefit, he suggests.

"We will only partner with organisations that we believe are world-class in their particular domain," agrees Dr Wierenga at Philips. "When you're trying to build up a new kind of business, a weak partner can easily break the value chain."

Several interviewees also point out that, for open innovation to work, R&D staff must accept that technology developed outside the organisation could be superior to in-house projects. "We do encounter the 'not invented here' issue," says Mr Butcher at Prodrive. "So if we have a technology that we think could suit a particular company then we will often approach that company at the top level, and form a philosophical, concept-level dialogue."

Mr Gaule points out that many companies now go one step further and employ "technology scouts, to track external sources of innovation from an impartial perspective.

Conclusion

The global innovation network model is growing in popularity for a variety of reasons. Offshoring gives companies the benefit of low-cost labour and, increasingly, high-quality facilities, infrastructure and manpower. It also gives them an "R&D footprint" in emerging markets, making it easier to localise products or services and increasing the likelihood that new ones with local appeal can be invented.

Meanwhile, open innovation enables companies to generate more value from ideas, regardless of where they originated, by directing those ideas to where they can be handled most efficiently at each stage of their development. Crucially, this accelerates the development of any ideas that companies choose to keep in house, enabling them to respond more effectively to shortening product cycles and changing customer preferences.

Implementing the model, however, does carry risks. In Asia, IP enforcement is still relatively weak and, if a company chooses to outsource as well as offshore R&D in the region, then its ability to protect its IP diminishes further. Executives therefore need to think carefully about which pieces of IP they expose to which markets and organisations, and about whether the cost of protecting that IP adequately will outweigh potential savings and market opportunities.

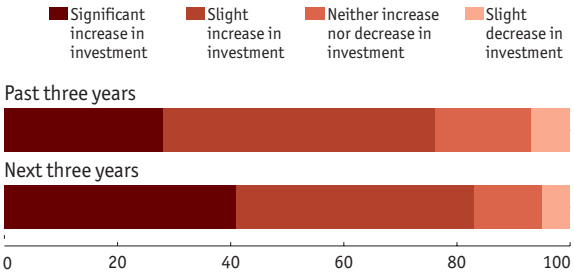
Companies also need to consider where the strength of their organisation lies. For example, a brand owner with powerful distribution and marketing capabilities may find it more appropriate to source early-stage innovation via its network. On the other hand, a company that generates copious IP, but that is not sure what to do with it may need to expend more effort sourcing partners whose strengths lie in the latter stages of R&D. The key is for companies to retain and strengthen the capabilities in which they are strongest and that give them their identity.

Good communication is essential for managing a disaggregated R&D function. Systems, processes and policies are needed to ensure that when someone in the network has a promising idea, the right people get to hear about it in a timely fashion. Above all, executives need to communicate their strategy to the other organisations in their network. If partners are clear about overall objectives, then they are more likely to recognise the sorts of innovations that the company will find useful. Ultimately, the network has to be led by customer-pull rather than technology-push: it has to be "customer-centric".

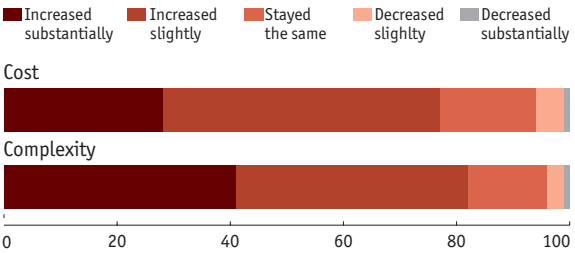
Appendix

In November 2006, the Economist Intelligence Unit conducted a survey of 300 senior executives. Our sincere thanks go to all those who took part in the survey. Please note that not all answers add up to 100%, because of rounding or because respondents were able to provide multiple answers to some questions.

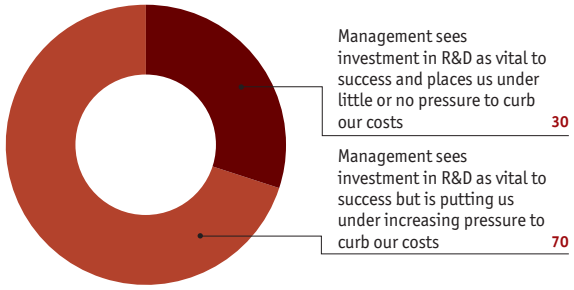
Please indicate how levels of investment in research and development have changed in your organisation over the past three years, and then indicate the change you expect over the next three years.
(% respondents)



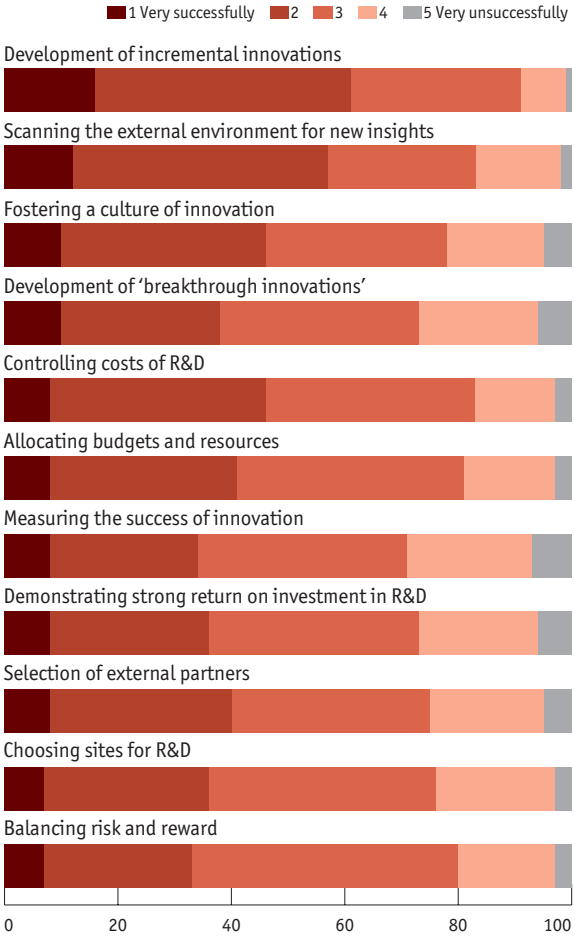
Over the past three years, how have the levels of cost and complexity associated with conducting successful research and development changed?
(% respondents)



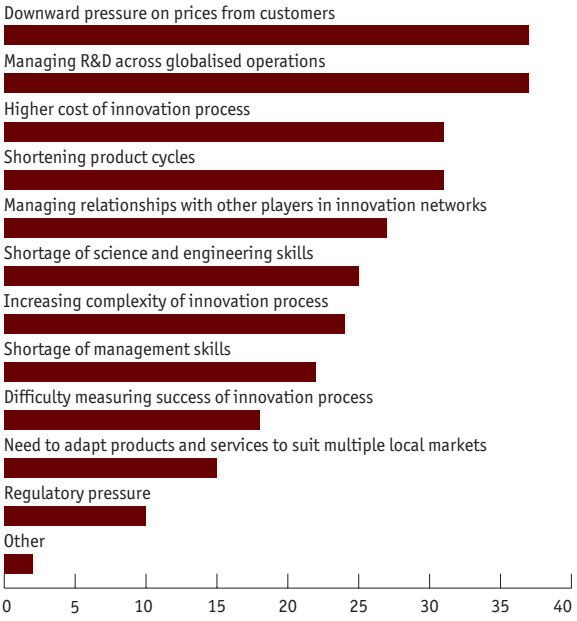
Which of the following statements best reflects your management's attitude to spending on research and development?
(% respondents)



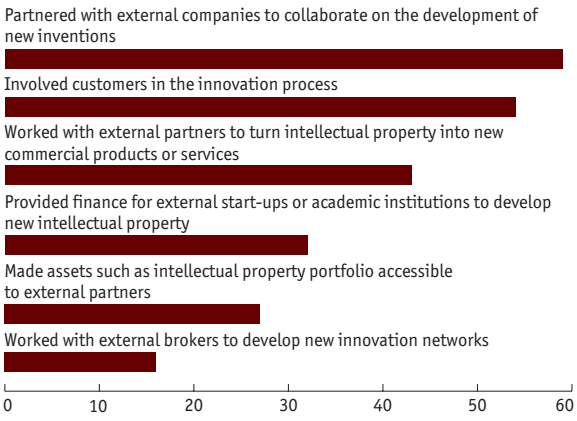
How successfully do you think your organisation conducts the following aspects of research and development?
(% respondents)



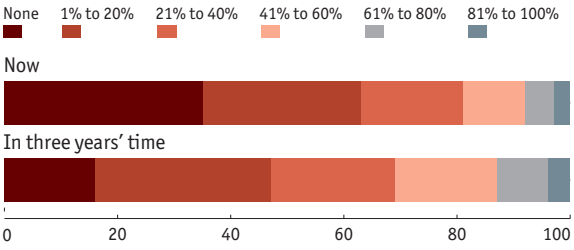
What do you see as being the greatest innovation challenges facing companies today?
(% respondents)



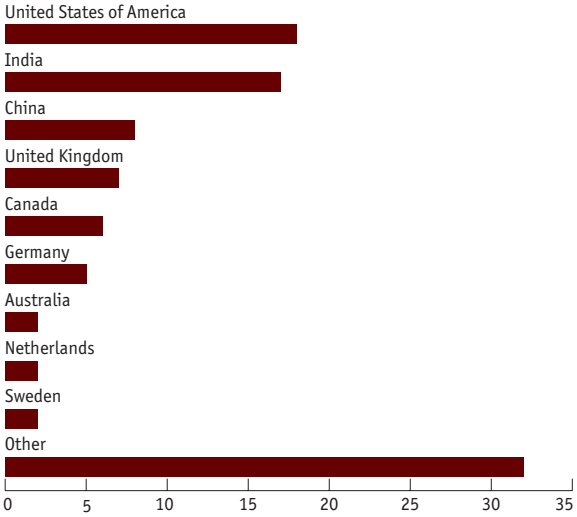
Which of the following activities has your organisation carried out in its pursuit of innovation?
(% respondents)



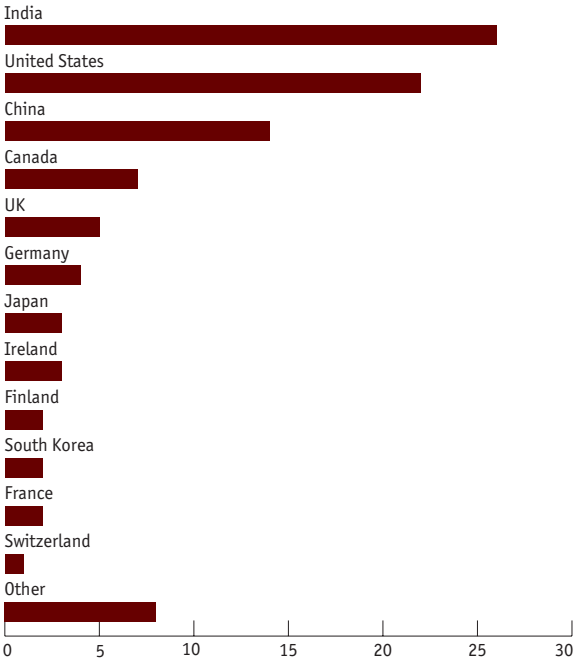
What proportion of your company's R&D sites (both internal and those operated by external partners) are currently located overseas and what proportion do you expect to be located overseas in three years' time?
(% respondents)



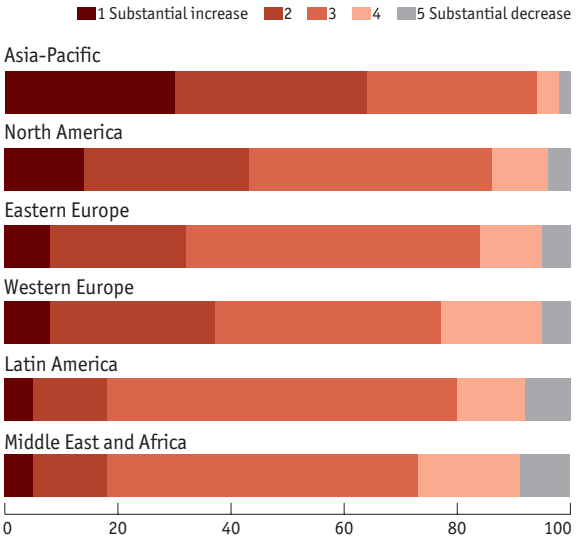
In which country is the highest proportion of your overseas R&D budget currently concentrated?
(% respondents)



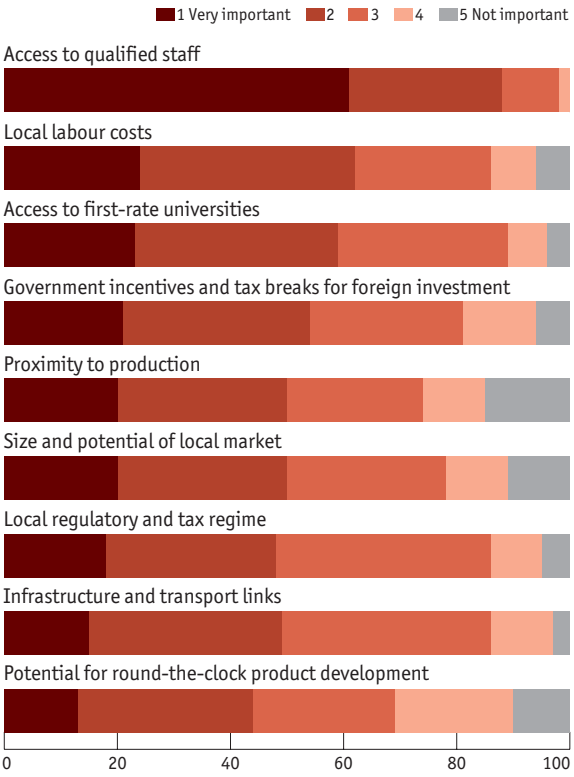
Which of the following countries would you choose as being the best overall overseas location for research and development?
Please do not select your own country.
(% respondents)



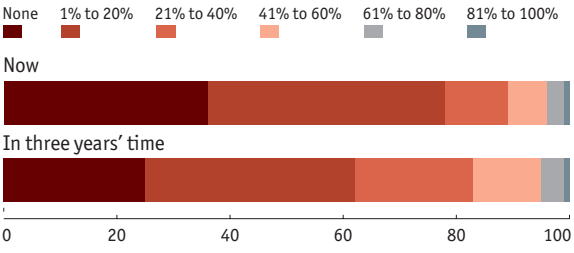
Over the next three years, what change do you expect to the levels of your R&D investments in the following regions?
Please rate on a scale of 1 to 5, where 1=Substantial increase and 5=Substantial decrease.
(% respondents)



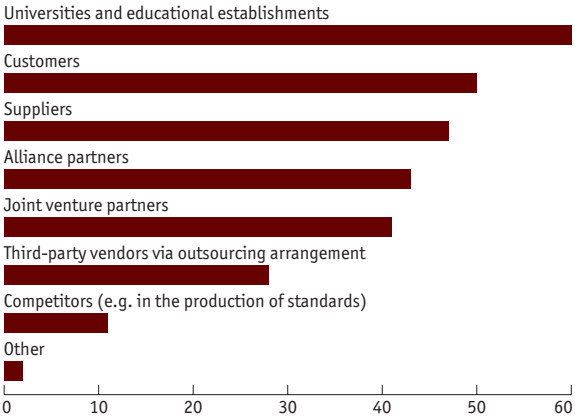
How important are the following criteria for your company when deciding where to establish an R&D site?
Please rate on a scale of 1 to 5, where 1=Very important and 5=Not at all important.
(% respondents)



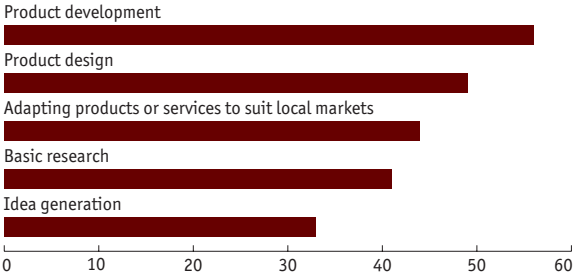
What proportion of your R&D is currently conducted by external organisations (partners, universities, customers etc.) and what proportion do you expect to be conducted by external partners in three years' time?
(% respondents)



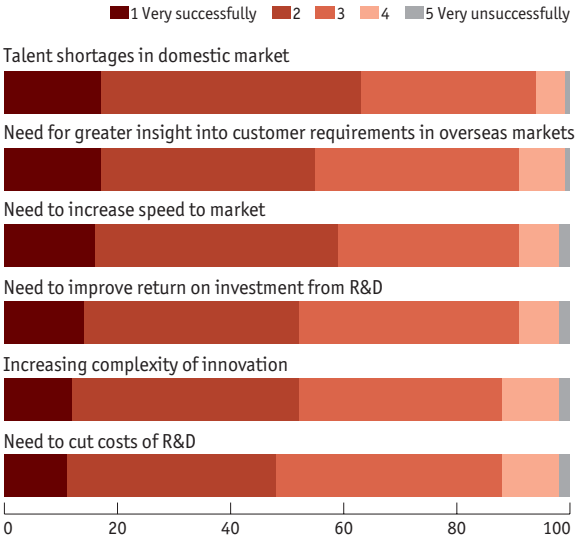
With which of the following external partners does your company collaborate in its R&D processes?
Please select all that apply.
(% respondents)



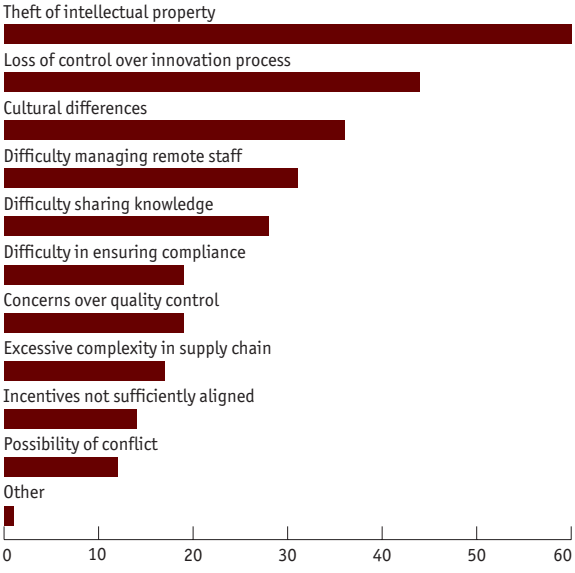
Which of the following innovation activities does your company currently outsource or collaborate on with external partners?
Please select all that apply.
(% respondents)



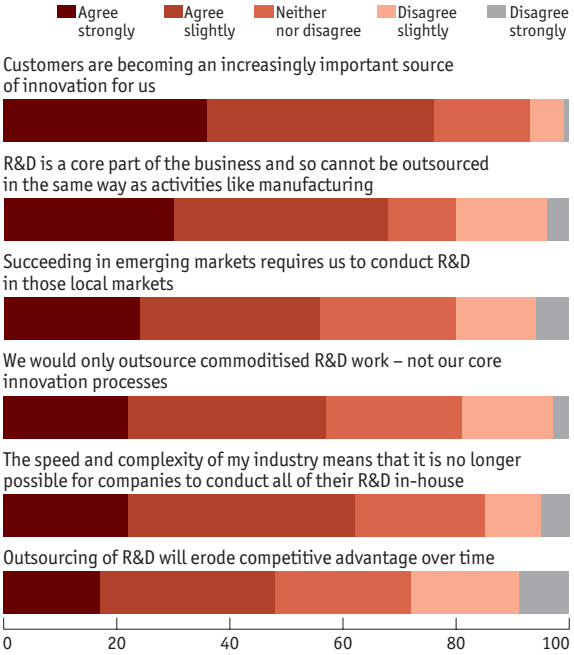
How successfully do you consider that the development of global innovation networks addresses the following issues?
Please rate on a scale of 1 to 5, where 1=Very successfully and 5=Very unsuccessfully.
(% respondents)



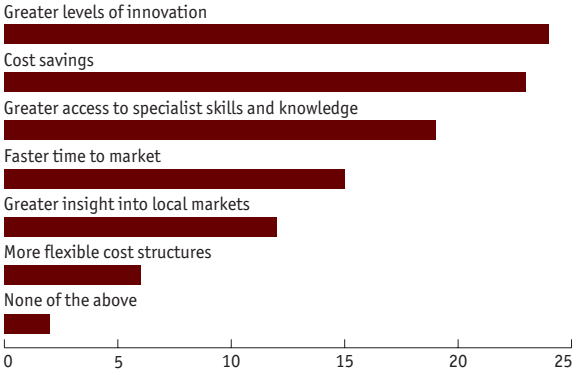
What do you see as being the most significant risks to developing global innovation networks?
(% respondents)



Please indicate whether you agree or disagree with the following statements.
(% respondents)

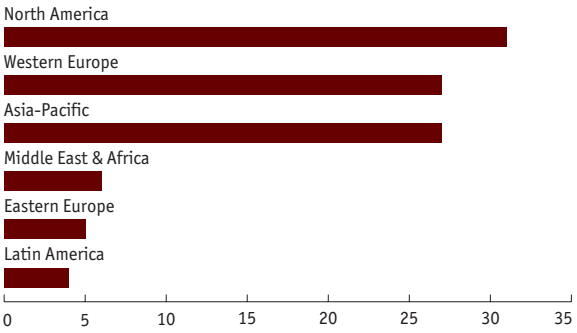


Which single benefit do you think is most likely to come from the use of global innovation networks in the R&D process?
(% respondents)

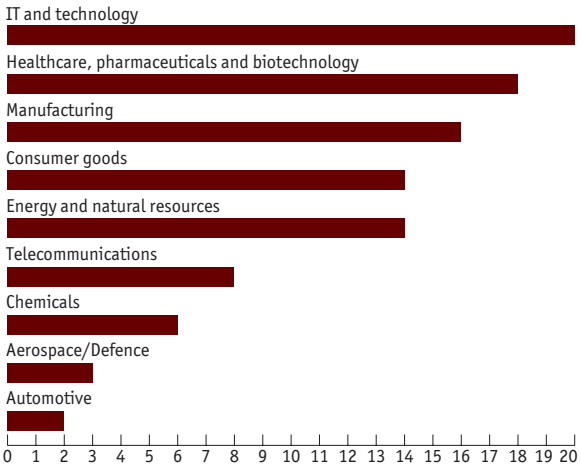


About the respondents

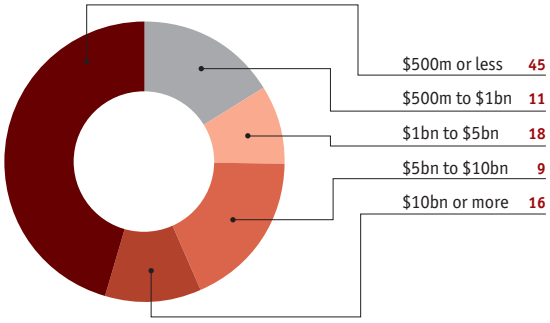
In which region are you personally based?
(% respondents)



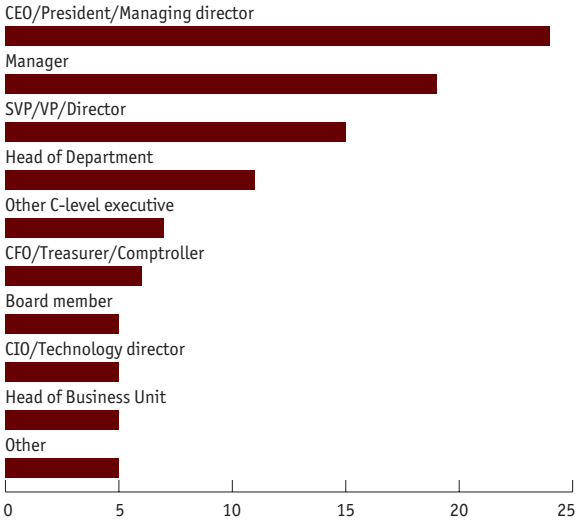
What is your primary industry?
(% respondents)



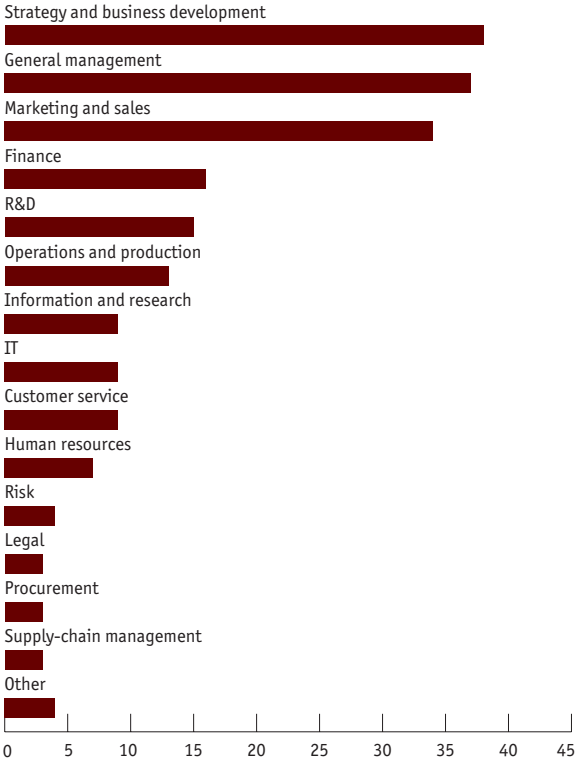
What are your organisation's global annual revenues in US dollars?
(% respondents)



Which of the following best describes your title?
(% respondents)



What are your main functional roles?
Please choose no more than three functions.
(% respondents)



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