Futures

Microsoft's European Innovation Magazine

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Forming **INNOVATION CLUSTERS**

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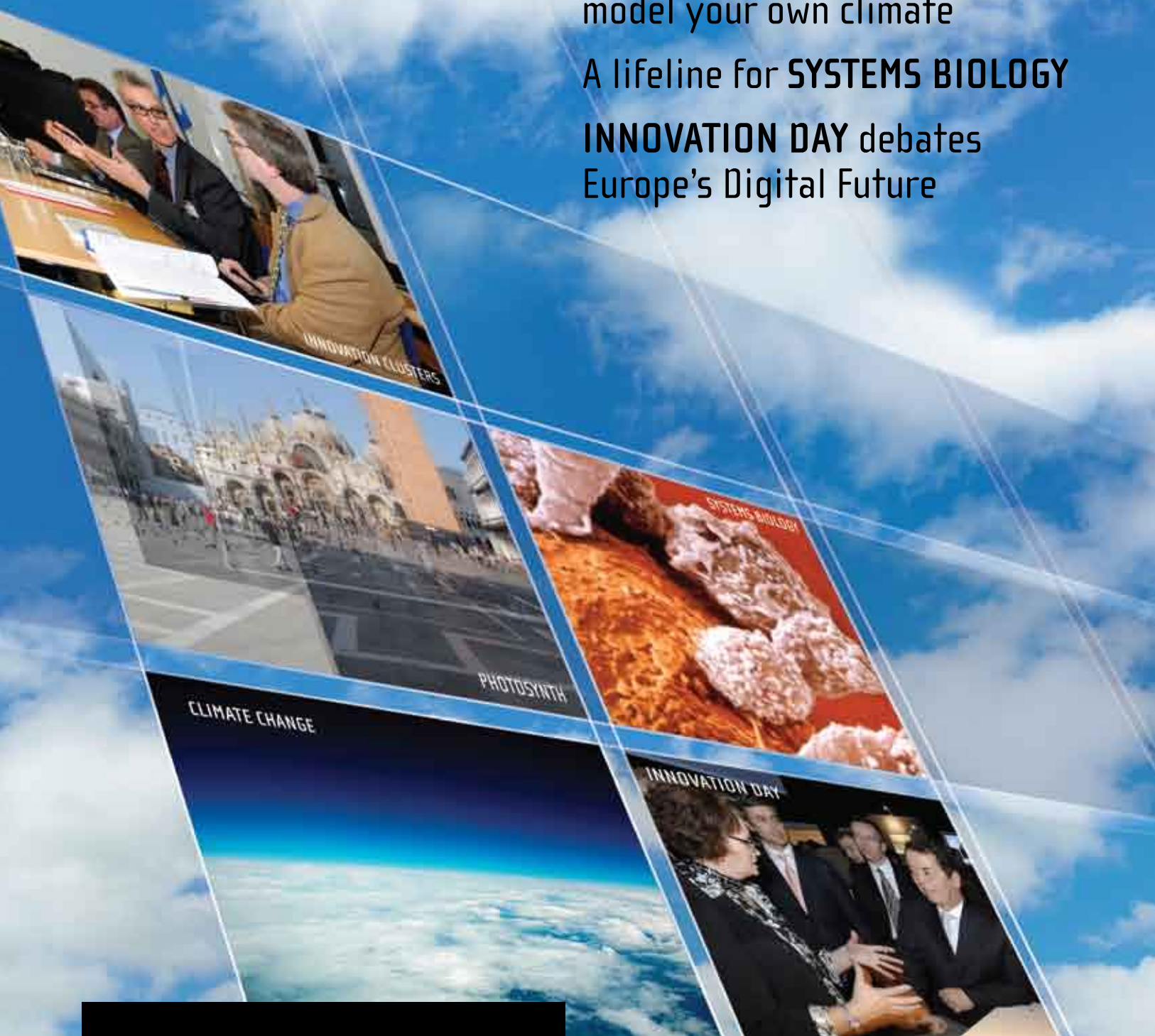
CLIMATE CHANGE: model your own climate

A lifeline for **SYSTEMS BIOLOGY**

INNOVATION DAY debates Europe's Digital Future



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Preface

Welcome to FUTURES – a magazine about innovation in the Microsoft ecosystem in Europe!

In today's world, innovation is both the engine and steering wheel for economic competitiveness, social progress and environmental sustainability. But successful innovation doesn't happen in a vacuum. It requires sound policy, effective incentives and an entrepreneurial attitude across the innovation cycle.

This edition of FUTURES looks at how Microsoft research and innovation in Europe is contributing to global scientific research in systems biology, genomics and proteomics, and climate change; as well as driving new applications in industrial robotics, archaeology, and entertainment.

It also reports on some of the key issues in the debate about what Europe needs to do to maintain and expand its innovation base. How can Europe create its own 'Silicon Valleys'? What does business, academia and government research collaboration mean in practice? How can Europe nurture and generate more high-growth entrepreneurs to take innovation made in Europe to the rest of the world?

The technology sector plays a unique role in innovation by developing new products and services that enable others to innovate: from science and medicine to education and leisure, as well as in business and industry. Technology also enables vital cross-border and interdisciplinary collaboration in the research arena.

Microsoft is a significant investor in research and innovation in Europe: more than 1,000 researchers and engineers covering the full spectrum of software development, from the earliest blue-sky concept to product implementation; an extensive European collaboration network of leading researchers; and joint research centres with several of Europe's world-class research institutes including INRIA in France, the University of Trento in Italy, and the Barcelona Supercomputing Centre in Spain. In addition, Microsoft Research Cambridge provides a range of programmes to develop European research human capital including internships, fellowships, major awards, symposia and reports – such as the April 2008 publication 'Being Human: Human-Computer Interaction in the Year 2020'.

As the FUTURES articles show, there is great potential, no room for complacency and a need to translate talk into more action, especially in the policy arena.

Jean-Philippe Courtois
President, Microsoft International

From left to right: Antti Ilmari Peltomäki, Deputy Director-General, Information Society, European Commission; Reinhard Büscher, Head of Support for Innovation Unit, DG Enterprise, European Commission; Andrew Herbert, Managing Director, Microsoft Research Cambridge

FORMING INNOVATION CLUSTERS

Cluster Stew: the European Commission is formulating an all-embracing strategy on cluster development to boost innovation and maximise returns from structural funds and related budgets. But what is the right policy recipe for a perfectly formed cluster?

By Nuala Moran, Science|Business

It is a given that clusters are a significant driver of high-tech growth. So it is curious that to date they have not featured as a specific focus of the Lisbon Strategy. That is about to change. The European Commission is preparing a policy statement on clusters that is due to be published in June. "When we started to discuss clusters at a European level two years ago, it was considered unusual," said Reinhard Büscher, Head of the Support for Innovation Unit, DG Enterprise. "Then they didn't make it to the top ten issues of innovation policy of the Commission. But following discussions with Member States now clusters are in the top nine of the innovation policy agenda."

Speaking at a recent high-level symposium, 'Successful Innovation Clusters: How to make them happen', organised by Science|Business and sponsored by Microsoft, Büscher said there is now a "strong mandate" for the development of an overarching cluster policy. The recent Spring Council meeting called for more work to promote world class clusters and regional development through clusters. Furthermore, France has indicated that it will make innovation one of the central themes of its upcoming EU Presidency and, said Büscher, "We have been encouraged to prepare for further discussions at Council level."

A conference devoted to the theme of innovation and clusters is to be held at Sophia Antipolis, one of Europe's leading and longest-established clusters, in November.

In the meantime, the symposium, held in Brussels on 16 April, weighed the views of leading academics, practitioners and policy makers to come up with policy recommendations to inform the debate and feed into possible European Union or Member State actions.

Although the EU has no central policy on clusters, it has, over several years, studied the factors that prompt their formation and the role they play in economic development. Building on this research the Commission recently established the European Cluster Observatory, a database to inform policy makers, practitioners and researchers on the broad range of national and regional cluster policies in place across the EU and the relative strengths of clusters in Europe.

According to the European Cluster Observatory there are at least 70 national cluster policies across the EU. Layered on top are hundreds of regional policies that often pit neighbour against neighbour, or put regional ambitions before national objectives.

For Büscher, one positive conclusion of the proliferation of national and regional policies is that there is plenty of money available to support cluster initiatives. "Our preoccupation is to make good use of this money in support of innovation," he said.

The inspiration behind an EU-level policy is to promote excellence, enabling clusters to look beyond regional or national boundaries, and become significant globally.

Given this, Büscher told delegates that one of the next moves in developing the EU's policy may be to set up an external group of experts to identify the scope for potential cooperation in support of clusters in the direction of world-class excellence.

The symposium debated the merits (or otherwise) of the unending stream of initiatives – across Europe and elsewhere – to foster Innovation Clusters. As Büscher commented, "It is indeed a cluster stew: nobody knows what exactly is in it. Clusters are supported for many different reasons and they all have their own rationale, whether it is the support of regional development, the valorisation of research or promoting SMEs."

The overall recipe may be obscure, but it is possible to pull out key ingredients – for which read policy actions.

Delegates mapped these actions across five areas: universities; knowledge transfer; global pipelines; small and medium enterprises; and regions, to generate a primer for policy formulation. The aim was to single out the most important and potent measures in the cluster policy stew, and add the spice that would heighten their individual contributions.

1. The University Sector: Universities are acknowledged as the engines of some of the world's leading clusters. How can all Europe's universities develop the same motive force? Here are some suggestions to help.

a. Create multidisciplinary universities. While there is a growing acknowledgement that different disciplines need to mix and communicate, inertia or unsuitable buildings prevent this happening.
b. Enlist undergraduate and postgraduate students to contribute through providing internships and grants to help them spend time with companies, enabling both the students and academic staff who supervise them to build links with industry.
c. Make universities compete for funding. Most are allocated public money under old-fashioned schemes that do not consider the standard of research. A possible model is the UK's system of assessing research excellence in different disciplines and funding accordingly. The European Research Council is trying to set a similar example in its system for awarding grants.
d. Consider the use of tuition fees as a route to making universities benchmark themselves and ensure the courses they offer are what people want to study.
e. Promote philanthropy as a route for European universities to raise funding. Most do not have strong alumni organisations, as is the case in the US. Universities need to get over the embarrassment of asking wealthy former students for funding.
f. Universities need to be set bold goals – both in terms of technology, but also in relation to the contribution they can make to solving social problems.
g. Universities must be places where serendipity can happen. This goes beyond an interdisciplinary approach to the sciences, mixing chemists and virologists, say; it is about designing campuses so that scientists, artists, economists and business students can interact. This action would also involve setting problems for such heterogeneous groups to discuss together, to try and spark serendipity.
h. Incentive structures should be changed so that academics get recognition and advancement for working with industry and not just for publishing papers.

2. Knowledge Transfer: If you don't have knowledge transfer you won't have a cluster. Universities are the source of much of Europe's knowledge. But how can this be tapped to feed cluster development, and how can companies be encouraged to share the knowledge and expertise they generate?

a. The process of knowledge transfer is different in different industrial sectors. The clusters policy needs to articulate and exemplify specific approaches to transferring knowledge sector by sector.
b. Knowledge transfer needs to be professionalised, not left as an ad hoc process.
c. Use cluster policy to encourage entrepreneurship as a channel for knowledge transfer.
d. Knowledge transfer also takes place from company to company. Policy must recognise and support this, by encouraging companies to discuss their respective technologies in neutral fora so they can understand how one technology complements another.
e. At one level knowledge transfer implies knowledge creation: the joint endeavour adds to what was there before. This requires policy to support a collective approach, and not just a one-way channel.
f. Ensure that the imperative on universities to patent research for technology commercialisation does not become a barrier to sharing knowledge.
g. Attempt to create metrics for measuring knowledge transfer.

3. Global Pipelines: current cluster policy operates on a national or regional level. How can an overarching EU policy shift perspectives and encourage clusters to focus on the global horizon?

a. Cluster policy should recognise the need for global sourcing of talent.
b. Set up 'Cluster Clubs' to provide a single source of expertise and access to global markets. For example, the Cambridge cluster has Chinese Business Services to help with access to the Chinese market.
c. Address the cultural issue of getting people to think globally.
d. Entice global companies to embed themselves in the local milieu.
e. Carry out foresight exercises to pull in information on upcoming developments from around the world.
f. Address the contribution that inward investment policy can make to building global pipelines.
g. Create policies that help people to go abroad, to bring people in and to collaborate with external partners.

4. Small and Medium Enterprises: Europe's high tech start-ups are the fountainhead of innovation clusters. The policy challenge here is to promote their formation and support their development without undermining their competitiveness.

a. Help SMEs get access to government procurement contracts for both high tech products and R&D.
b. Give SMEs access to education, training and consultancy through clusters.
c. Outlaw non-competition contracts, which exist in some parts of Europe (whether legally enforceable or not) because these inhibit the flow of expertise.
d. Reduce the costs and time taken to form a company.
e. Encourage venture capital culture to change so VCs become more interested in start-ups and seed funding.
f. Bring forward the European Small Business Act.

5. Regions: Much of the money potentially available for cluster formation is channelled through regional development policy. A unified European policy should set out to inspire regions to aim for global excellence.

a. Recognise that regions, and clusters, can cut across national and regional boundaries and ensure they can be funded and supported as single entities.
b. Reduce bureaucracy for regional development agencies applying for European support.

How to solve the cluster equation

Microsoft's European R&D chief – on building clusters of innovation

In 1997, Microsoft opened its first big European lab – and it placed it in what was then Europe's only serious answer to Silicon Valley: Cambridge, in the United Kingdom.

The Cambridge cluster today remains special: it has more than 1,200 tech companies employing 35,000 people and has created more than 200 millionaires, according to the university at its centre. Microsoft's lab there has also grown – to more than 130 staff, and works closely with a further 200 researchers and several joint research centres in Microsoft's European collaboration network. In all, the company has invested more than £100 million in the lab, says its boss, Andrew Herbert, managing director of Microsoft Research Cambridge.

So if one Cambridge is a good thing, how do you make many? That's a policy question of growing importance in Europe. In Brussels, the European Commission is preparing to announce this year a new set of policies to promote clusters. Herewith, in an interview with Science|Business, are some of Herbert's ideas on what it takes to make more clusters.

Why do clusters matter?

Clusters tend to spring up around new technologies and therefore have early-stage companies - and that's an environment that's full of risk. Clusters help manage the risk. For instance, if the message to a prospective worker is, 'come and join my start-up in some place you never heard of,' - you're going to think twice about it. If the message is, 'come and join my start-up in Cambridge, and if it all goes pear-shaped there are 20 other companies hiring,' – that's a less-risky proposition. With clusters, there's a de-risking and a mutual support that allows companies to grow faster than they could do on their own.

What makes clusters work?

There needs to be something that acts as a hub, and it's often a university or a university department. There also have to be some entrepreneurial people who know about turning research ideas into business plans; just having a science lab doesn't work if it's not entrepreneurial. You've got to have a core of people who share the view that there is a business to be made out of a technology. Then once there's a culture of mutual support and usually some kind of organisation to promote networking, like The Cambridge Network here, by putting on events for local companies. When a cluster is working, people help each other in business. If someone knocks on your door and you don't sell what they want, you will point them to someone else in Cambridge rather than have them leave empty-handed. That's important.

What's the role of a big company?

We add gravitas to a cluster. It sends a strong message that interesting things are happening if a major company sets out its stall in town. Those technology start-ups are potential partners in our own R&D activity. The big companies help with all those concerns people have about employability.

How do you make more clusters in Europe?

One thing needed is early-stage money. In the UK start-ups are often funded by business angels, and they tend to be people who have been through the previous cycle in the cluster and want to re-invest and help others with the experience. They lend people amounts from tens to hundreds of thousands to get their idea out of the laboratory and help them through the first few years – something the VCs and banks don't do these days, because they want so much risk taken out.

Another key thing is what government can do by reducing the burden on young companies. Tax credits for R&D are important, and relaxing employment laws for young companies, so that it's easier to hire and fire and you can manage employment with your cash flow. That's for central government.

Then there's local government. We want to be somewhere that people have heard of and believe is a good place to work. It needs to be a place where people see other, equivalent job opportunities. It has to be somewhere that has a lifestyle that people like. What are the schools like? What's the shopping and entertainment like? Some governments try to create clusters in areas of industrial deprivation: a coal district with a high-tech cluster – you're going to struggle with that one.

Another point: what is the government attitude to foreign inward investment? For many start-ups, the goal is to be bought by a big company. How is the French government going to feel if it pumps €10 million into a cluster, and one of the companies ends up with a Microsoft or IBM badge on the door? In Cambridge, we'd declare that a victory. But in many countries, there are a lot of tensions around that question.

Finally, you need a university culture in which academics are encouraged to exploit their ideas. There is a tension about whether exploitation is done by the university or the researchers. Cambridge has a hybrid of the two: the university has a technology transfer office and by default owns the IP, but if you want to exploit it you can do so with the university as a sleeping partner. Generally, the ability to exploit IP in any way that really works – that's very important.

WANTED: MORE 'GAZELLES' IN EUROPE

By Richard L. Hudson, Science|Business

The Science|Business Innovation Board says Europe's innovation policies need to change, to encourage high-growth entrepreneurs.

Forget the broad theories and abstract policies: it's people – individual men and women with an overwhelming drive to succeed – who are at the heart of innovation. People like Jean-Michel Aulas, a French entrepreneur who founded CEGID, now one of Europe's largest IT-service companies. Or David Bäckström, a Swede who spotted a health-market opening and turned Telemedicine Clinic into the largest telemedicine company in Europe.

These are high-growth entrepreneurs – a special group that, economic research suggests, are perhaps the most important creators of jobs and prosperity for an economy. They spot the market opportunities, develop the innovative products – and then go one step further: they think big. They get the financing, management teams and strategy to go global. They aren't afraid of risk.

And Europe needs more of them. That's the recommendation of a blue-ribbon panel of business, academic and policy leaders, the Science|Business Innovation Board, which has been reviewing what Europe needs to do to encourage more innovation. The board, supported by Microsoft, includes the former prime minister of Finland and the former president of the European Parliament; top executives of Spanish auto-parts maker Ficosa International, Belgian pharma company UCB, German VC firm TVM Capital, and Microsoft International; and the heads of three universities. The goal: to apply their wealth of experience in suggesting new approaches to Europe's crying need for innovation.

Certainly, the problem is urgent. With China and India rising in the global technology race, "We still don't have enough

Economic research suggests that high-growth entrepreneurs are perhaps the most important creators of jobs and prosperity for an economy.

entrepreneurs," said Janez Potocnik, the EU science and research commissioner, addressing the board at its most-recent meeting, on December 8, 2007, at ESADE Business School in Barcelona.

"We still don't have enough SMEs fulfilling their growth potentials and creating jobs," said Potocnik. "About 60 per cent of Europeans have never considered starting their own business. Only 5 per cent of European companies created since 1980 are now in the top-1000 companies in terms of market capitalization. In the US it's 22 per cent." For Europe, he says, the challenge is simple. "Either you want to be successful or not. You have to play globally: that's the way the world is turning."

The care and feeding of high-growth entrepreneurs has been a topic of intense academic study recently. Sometimes called 'gazelles,' this special breed was responsible for some 70 per cent US employment growth in the early 1990s.

But Europe has a problem. At present, according to Prof. Erkko Autio of Imperial College London – host to an earlier Innovation Board meeting – Europe has a third to half as many high-growth entrepreneurs as the US or China. That gap is economically profound. For instance, Autio calculates that if his native Finland had the same high proportion of gazelles as does more dynamic Sweden, it could generate 150,000 extra jobs over a five year-period – equivalent to 5 per cent of the adult working-age population. Significant unemployment in Finland would become a distant memory.

What's needed is a rethink of innovation policy to encourage growth companies, board members say. Coordinated action by government and industry is needed to pull emerging technologies to market faster. A lighter regulatory touch, and perhaps targeted tax incentives, are needed to help young, innovative companies grow faster. Innovation clusters, centred around strong universities and big companies, need fostering.

Then there's money. "You need financing to go global," says Jean-Philippe Courtois, president of Microsoft International. "There are many good, innovative companies in Europe with between €5 million and €15 million in revenue," he says. "The biggest problem is for a company to grow beyond the first €10 million" in revenue.

Then there's the cultural problem: "in Europe, we give too much attention to the safety net," says Xavier Mendoza, dean of ESADE. Teaching entrepreneurship in schools, talking about it in the media, and awarding prestigious prizes for it could help change Europe's aversion to risk. A 'noble failure' in business should be honoured, not reviled, notes Pat Cox, former president of the European Parliament.

A full report of the recommendations of the Science|Businesss Innovation Board will be published in June 2008.
Go to **www.sciencebusiness.net** for more information.

Jean-Michel Aulas: King of the Middle Market

By Fabrice Delaye, Science|Business

Critical size is an elusive concept: as soon as a company reaches it, the target changes. Few entrepreneurs have been chasing the ideal size more consistently than Jean-Michel Aulas, founder and manager of French software company Cegid.

With a two-year professional degree, Aulas started his first company in 1969 at the age of 20, selling it after three years and joining a computer services company. There he gained insights into the specialised software needs of companies in different sectors.

Aulas was also quick to understand the significance that the introduction of the personal computer would have for medium-size companies. Leaving his job to found Cegid, he thought the first beneficiaries of the PC revolution would be accountants. They were (and still are) among his best customers.

Cegid floated after only three years, moving up to the main market in 1989. Aulas spent most of the money raised on consolidating his market by buying small companies to enter new SME markets and offer vertical applications for specific sectors.

This strategy allowed Cegid to build a dominant position in fashion, construction, restaurants and various industrial sectors. As larger competitors introduced one-size-fits-all Enterprise Resource Planning applications, Cegid kept its market share with its specialist and sector-specific applications.

Competitors look on Aulas's little kingdom with respect, as when Microsoft CEO Steve Ballmer visited Cegid's Lyon headquarters in 2006 to sign a partnership to develop sector-specific applications in security and on-demand business.

Aulas was also an early mover into the application services market, where small companies rent applications rather than buy them outright. This makes it easier for customers to upgrade their systems and gains their loyalty.

He is, though, better known in France for his sporting connections than his entrepreneurial success. As president since 1987 of the top French football side Olympique Lyonnais, Aulas regularly uses the platform to argue for tax incentives and labour deregulation.

In football, Aulas is famous for his fighting spirit – he is always ready to complain about referees or to file complaints to football federations. It seems his approach also fosters teamwork in his company. Many of 2,000 Cegid employees have been there since the beginning. Now that R&D partnerships are growing and Aulas is looking to expand Cegid's operations outside France, the type of loyalty he commands will be invaluable.

Aulas's taste for detail has not stopped him from taking risks – unlike many French engineers and managers, whose intellectual grounding makes them risk averse. Maybe it's because like other prominent French entrepreneurs, such as commercial search engine Kelkoo founder Pierre Chappaz, Aulas is a true survivor.

David Bäckström: Your X-rays are in the (E)mail

By Michael Kenward, Science|Business

Radiologists are in short supply in parts of Europe but Telemedicine Clinic provides them by remote control, through its network of doctors who diagnose patients using medical images that arrive by email.

It is unlikely that David Bäckström was thinking about social networking when he started Telemedicine Clinic. After all, when he and his partner, Henrik Agrell, created the business, in Barcelona in April 2002, the term wasn't seen as a way to raise money for new internet ventures.

In effect though, with a growing global team of consultants, the company is a social network offering long-distance medical diagnostic services to health services throughout Europe. "We have created a community of radiologists," says Bäckström.

A Swede with degrees in Business Administration and Economics from the University of Umeå, Bäckström went to Barcelona in 2000 to open a branch of his second start-up, a Web site for consumers seeking the best deals from utilities. After selling the business, Bäckström was keen to stay in the city. He revisited an idea that he

had first investigated a few years earlier, telemedicine.

One of those 'next big ideas' that had been threatening to happen, telemedicine hadn't yet taken off. But with the development of 'Broadband Europe' and the growing use of digital imaging in medicine, the technology became available to send medical images from country to country.

Bäckström also knew that back in Sweden, and in other parts of Europe, radiologists and pathologists are in short supply. In the UK, for example, 'waiting for the X rays' is a common refrain in the country's hospitals. Bäckström saw the chance to offer services in teleradiology – the remote analysis of images from medical radiology.

The company reckons to take 36 hours to do what can take three weeks in hospitals. With customers in Sweden, Norway and the UK, it uses a secure communications network that connects to, for example, 95 per cent of the hospitals in Sweden through Sjunet, the country's healthcare network. The company was on course to process 200,000 cases last year, and hopes to reach 500,000 this year.

Bäckström estimates that telemedicine could eventually account for 20 per cent of all diagnostic radiology. No match for Facebook, but more than enough to create a large social network of radiologists.

Risto Siilasmaa: Fostering Innovation may mean being 'un-Finnish'

By Lori Valigra, Science|Business

The art of innovation – putting your ideas first, trumpeting your merits, taking on risk – is most 'un-Finnish'. To Finns, egalitarianism is the norm, modesty is a virtue and job security means success.

Risto Siilasmaa, the understated founder and chairman of the board of Internet and mobile network security company F-Secure of Helsinki, has succeeded at the balancing act of being an entrepreneur and a Finn. The facts speak for themselves: he's built a 19-year-old Internet security company with 540 employees.

Siilasmaa says that the key ingredient for entrepreneurship is people who don't give up. "That attitude is deeply ingrained into the way people in the United States think," he says.

The students who apply for teacher training at Finland's universities are very bright, he notes, but they also tend to be the most risk-averse people in the country. "How do you get very bright but risk-averse people to train young people to be more innovative?" he asks.

Government has a key role in encouraging this, and one of Siilasmaa's proposals is to get more angel investors involved. But, he says, government should not invest in companies unless there is already one angel investor. "If an entrepreneur can't convince one angel to invest €20,000 in his or her idea, the idea is bad or the entrepreneur cannot sell."

He also advocates mandatory overseas study by university students. Finnish students generally have been reluctant to do this: education is free and life is easy in Finland, he says.

But the bottom line is that to become an entrepreneur in today's globalised world, you really need to want to do it. "Every company will go through difficult times. An entrepreneur can never give up."

REWARDING ENTERPRISE ON CAMPUS

The first pan-European awards for **academic entrepreneurship** are launched

It's a familiar story: invented in Europe, commercialised abroad.

There's the iPod: developed and marketed from California, but based partly on discoveries by solid-state physicists in Germany and France. The Web: invented at the CERN nuclear lab in Switzerland, but turned into a social and economic revolution in the U.S. It's such a frequent pattern that it has a name in the economic literature: the 'European Paradox'.

One way to resolve that: get more European academics thinking about the market. Encourage them to work with industry, to commercialise their research. Help them form spin-out companies on campus. Encourage enterprise. And reward it.

Thus, the first pan-European awards for academic entrepreneurship are being launched. The Science|Business news service, in association with Microsoft, Sweden's Karolinska Institutet, France's INSEAD and other leading universities in Europe, is organising a series of prizes. They will give public recognition to those researchers, engineers, professors, students and government officials in Europe who have done the most in 2008 to foster a culture of enterprise on campus.

This can be through taking the risk of launching a spin-out company, developing a discovery into a marketable innovation (at the risk of the tenure-track publication record), or promoting policies that create a receptive environment for entrepreneurship on campus. Unlike other awards, it will focus on university enterprise and look across Europe – furthering the European Commission's goal of enhancing a European Research Area for the free movement of ideas and researchers across the EU.

The awards will be judged by the Science|Business Innovation Board, a blue-ribbon panel of CEOs, university presidents and policy leaders. It will culminate in an awards ceremony in Stockholm on 2 December 2008, hosted by Karolinska, which names the Nobel Prize for Physiology or Medicine.

Rules for the awards can be found at
http://www.sciencebusiness.net/
Nominations can be sent to **nominate@sciencebusiness.net**

ETH University, Zurich

DEVELOPING TOMORROW'S EMBEDDED COMPUTERS

Microsoft's European partnerships fuel innovation through academic and industry collaboration

Research and development in highly complex fields – such as embedded computer systems – relies heavily on partnerships in which the strengths of the partners complement each other and the different partners fill the various roles that lead to successful innovation.

MESDC and ICES are dedicated to pursuing R&D on Embedded Computer Systems in partnership with academia and industry, and Europe's strengths in both are why it was chosen.

Embedded computer systems consist of the increasingly miniaturised processors, sensors, storage devices and communication modules that can be built into all sorts of objects and equipment, including household machines, cars, clothes and other parts of the everyday environment. As such, embedded computer systems are developed in partnership with hardware manufacturers and suppliers of the parts they are embedded in and interoperate with, for example the automotive industry.

"Due to the immense engineering talent pool and high concentration of enterprise customers and key Windows Embedded partners in the region, we see tremendous growth opportunities for the Windows Embedded Business in Europe," says Kevin Dallas, general manager of the Windows Embedded Business at Microsoft.

Acknowledging this, Microsoft has chosen Europe as the location for two new investments in research and development on Embedded Systems - the Microsoft Embedded-Systems Development Center (MESDC), launched on 28 February 2008 in Aachen, Germany; and the Microsoft Innovation Cluster for Embedded Software (ICES), launched on 5 March 2008 in Switzerland. The two entities are dedicated to pursuing R&D on Embedded Computer Systems in partnership with academia and industry, and Europe's strengths in both are why it was chosen.

"The Microsoft Embedded-Systems Development Center (MESDC) is a significant part of Microsoft's ongoing investment in research and development in Europe," says Kevin Dallas. Located within the European Microsoft Innovation Centre (EMIC) in Aachen, the MESDC is a significant part of the US$ 75 million global R&D investment that the Windows Embedded Business is making in Europe this year.

Europe is the home of strong expertise in Embedded Systems and a strong industry in this space. There are many well known names in the automotive sector, in manufacturing, aerospace and defense and also industry automation, notes Kevin Dallas, adding: "Collaborating with the European partners surely benefits both the partners and Microsoft."

The MESDC is looking forward to engaging with European partners as much as it appreciates the highly skilled talents in Europe. "The MESDC will form an integral part of helping us recruit outstanding embedded systems engineers across Europe to perform R&D in Europe, and the MESDC located in the EMIC in Aachen provides a very conducive environment for these engineers to spearhead incubation projects and accelerate technology transfer and collaborative efforts within Microsoft," says John Lefor, director of the European Microsoft Innovation Center in Aachen.

The Microsoft Innovation Cluster for Embedded Software (ICES) in Switzerland has been set up in cooperation with the two leading national universities, the ETH Zurich and the EPF Lausanne. The ICES research program is due to run for five years and Microsoft will invest up to Swiss francs 1 million per year.

The collaboration and participation of researchers from various disciplines, involving both Swiss Universities, Microsoft Research Cambridge and partners from industry, is key to creating and expanding a pool of know-how that is accessible to all partners of the Innovation Cluster. An Industry Council is being established to better connect academia with industry, and to create a channel to industry for early-stage technologies that result from research.

"We expect the industry partners to provide impulses, ideas and feedback as well as actively collaborating in selected projects, so that overall we create a hub from which every partner will benefit greatly," says Willy Zwaenepoel, Dean of the School of Computer and Communication Sciences, EPFL.

EMIC: www.microsoft.com/emic
ICES: www.innovationcluster.ch

Jiri Plecity, a member of the Cabinet of Günter Verheugen

THE EU NEEDS CLUSTERS OF EXCELLENCE

Is the essence of a cluster physical proximity or, given broadband Internet and associated communications platforms, is it possible to create virtual clusters?

By Nuala Moran, Science|Business

For Jiri Plecity, a member of the Cabinet of Günter Verheugen, the Vice-President of the European Commission in charge of Enterprise and Industry, it is important to take a pragmatic approach, allowing for both possibilities. While direct personal contact is important in prompting innovation, new technologies can add value to communication and spur interactions.

"Our observation is that there are opportunities to be missed if you don't encourage clusters to communicate and build on synergies with other excellent clusters or business and research partners worldwide," Plecity said in conversation with fellow experts at an April 2008 conference on cluster policy organised by R&D news service Science|Business.

Another cause for pragmatism is that simply forcing clusters to work together may not be the best way to encourage excellence. "You have to ask, what is the right degree of incentive for cooperation between clusters - because without healthy competition, you do not get excellence," said Plecity.

However, he noted, some of the largest businesses now recognise there are occasions when cooperation, joint ventures, or exchanging technologies with rivals can improve the competitiveness of both parties. An example is the collaboration between the Asian electronics giants Samsung of South Korea and Sony of Japan. The two got together in 2001 to work on the development of memory sticks and by 2006 were setting up a $2 billion joint venture to manufacture liquid crystal displays.

"Similarly, if there is a good argument for cooperation, clusters will cooperate - if not they won't," said Plecity. Or, there may be one-to-one links between two companies in different clusters to access a particular technology in the same way that companies may cooperate in some aspects of their business, while competing in others.

Seen in this light, communications networks can be a way for individual clusters to build critical mass and to strengthen networking.

At the heart of the Commission's thinking on the role that communication networks can play in supporting a 'European Innovation Space' is the principle that national borders in Europe should not be an obstacle to interaction. Proximity will always be an advantage, noted Plecity: "The world can hardly become one big cluster. But at the same time regional cooperation alone may not provide clusters with all the ingredients they need to reach world class level."

CREATIVITY AND COLLABORATION

How creativity toolkits and virtual collaborative environments accelerate each other

Computing pervades everyday life: whether used in business or leisure, by individuals or communities, it offers opportunities for new ways of living and working together. It is also having a profound impact on human behaviour and thinking, and on interactions between people and with technology.

There are several options for responding to all the technologies around us, from being reactive and passive consumers, to being more proactive and personally creative by using technology to be participants rather than spectators, and to form new communities. Today, technology itself is enabling people to make that choice by putting in people's own hands the creativity toolkits and virtual collaborative environments to do things that previously were available only to professional experts – for example in photography, film-making, collective gaming and many other forms of shared creativity and problem-solving.

Combined with the power of the Internet, these tools are not only driving the democratisation of information and resources to empower more people with increasing capabilities, but also setting the stage for the literal evolution of innovation – by anyone, anywhere. This is not merely about new applications: it's about a revolution in how we create, share and refine anything that can be digitally encoded, be it news and information, art, scientific breakthroughs, personal communications, economic transactions and software itself.

This is not just about the next generation web: it's about the next generation world. Among the examples of this revolution featured here are innovations from domains such as High Definition web media, computer gaming, robotics and digital archiving.

At the same time, the increasingly pervasive and interactive nature of technology necessitates a strong focus, in the research and innovation cycle, on ensuring that technology unobtrusively enables and facilitates our lives in ways that make sense, that pervasive technology is not invasive, and that privacy is respected and protected. It is also about going further and putting human values front and centre in the technology research agenda - one that anticipates and shapes the impact of technology rather than simply reacts to it.

Microsoft is at the forefront in reflecting on, debating and helping to define such an agenda for human-computer interaction in the 21st century. In March 2007, Microsoft Research facilitated and co-hosted a forum entitled HCI 2020: Human Values in a Digital Age, in Sanlúcar la Mayor, Spain. The Forum, which gathered luminaries in computing, design, social sciences, and scientific philosophy, resulted in a detailed report, released in April 2008, called Being Human: Human-Computer Interaction in the Year 2020. For more information and to download the Report, please visit **http://research.microsoft.com/hci2020/**

COMING TO YOUR SCREEN: THE HIGH-DEFINITION INTERNET

In an era of continual Internet innovation, one of the biggest trends is the Internet's rapid growth as a platform for rich, high-definition content such as graphics, animation, video and film.

One of the key drivers of this growth is a new generation of Internet applications and user interfaces that make it easier than ever before to create and access high-definition multi-media content on the Web.

Take Microsoft's new Silverlight technology: an application that extends the capacity of web browsers to easily view high-definition content and also makes it much easier to use sophisticated user interfaces, such as simultaneous viewing of several videos. The goal is to enable rich, compelling, immersive, highly usable applications and content across the Web, the Windows desktop, mobile devices and the digital home.

Silverlight works as a 'plug-in', which means that it is compatible with multiple platforms and browsers, including Windows, Apple Macintosh and Linux, and utilises a specific design language, XAML. Based on an open XML format, XAML provides a 'common language' between designers and developers: two communities which usually do not share the same tools or language. Now, using Silverlight and the Microsoft Expression Studio design tools, more fluid working relationships are possible, with designers and developers working in tandem to translate visual ideas into user interfaces. As a result, Silverlight is driving significant innovation 'under the bonnet' by enabling for the first time a seamless workflow that drastically reduces cost, overhead and development cycles.

These features make Silverlight particularly relevant for the advertising and broadcast sectors, which are major users of innovation in high-definition and high-quality visual experience for the viewer. Furthermore, Silverlight provides new options for subscription and ad-supported business models, by providing a quality that scales from high-definition to mobile devices.

Among the first movers is the premium car sector: for example, in October last year, BMW was the first major German brand to launch their video archive based on Silverlight, combining rich content capability with enhanced brand value over the internet, with its own dedicated camera and editorial team.

Then there's the broadcast sector, where one of the first movers is Premiere, Germany's leading pay TV operator, which has a subscriber base of 3.4 million households. Premiere sees HD Internet technology as a key way to secure a competitive advantage in the marketplace. As Steve Wysocki, Managing Director, Premiere Interactive explains, "We want to participate in forward-looking technologies at an early stage to gain a competitive advantage while reaching new target groups and increasing awareness of our premium content. Internet Pay TV is an extension of our core business. Some target groups may only be interested in certain programming rather than a full subscription. It could be the first step in getting people in contact with our premium content without having a subscription."

Another example from Germany is one of the biggest video on demand (VOD) offerings in Europe, Maxdome, owned by German media group, ProSiebenSat1. Maxdome will use Silverlight through their video-on-demand portal, which currently stores around 10,000 titles. Silverlight will provide an entirely new look and feel for the site, allowing for additional contextual information around each title; while the functionality in terms of drag and drop, as well as playlist compilation, will significantly advance the user experience beyond what is currently possible. It also marks a significant investment in the future of web-TV and VOD over the internet, by the second largest commercial broadcaster in Europe.

The potential of HD Internet video-on demand to reach multiple audiences in new and innovative ways is tremendous with many more sectors likely follow the pay TV and advertising industries in exploring and innovating with these rich new content capabilities.

For more information, please visit **www.microsoft.com/silverlight/**

By Geoff Meade

THE NEW 'HD VIEW' OF PHOTOGRAPHY

Just when you thought there was nothing new in pictures, along comes HD View and explodes all your preconceptions about what photography can do.

Imagine a massive photograph. Then imagine being able to zoom in close on any microscopic aspect of that giant picture. Then, and here's the clever bit, imagine that there is virtually no loss of visual definition in even the tiniest detail.

That's what Microsoft researchers have achieved with HD View. The technology now exists to produce one vast, seamless image from a series of photos, a photographic panorama, or even a 360 degree vista.

Being able to pan across the picture or get up close with every aspect of the image makes this a revolution in photography. Many will think this kind of large-scale visual extravaganza is for the privileged few and the professionals. But, despite the scale of the gigapixel images, Microsoft has created the software to make HD View available to download. The resulting ultra-high resolution photos make close study of the details simplicity itself. HD View's advanced techniques for 'stitching' digital images together means you can't even see the joins. And it is now available to anyone with non-specialist computer equipment to produce vast pictures for viewing by most broadband users.

To develop HD View, Microsoft researchers experimented with typical 'local' photographs – for example, taking hundreds of photos of the Seattle skyline and 'stitching' them together into a panoramic single image. The delight was in the detail – tiny parts of the image, unseen when looking at the whole, come to light as the viewer zooms in to study the constituent parts.

Perhaps the biggest bonus for the brains behind HD View is the fact that it has a serious application which will indeed benefit the brains of the future.

Because, beyond the recreational delight of the amateur photographer, HD View is providing scientists at Harvard University with the makings of a brave new world in the creation and transmission of vast images of neural brain tissue, enabling the medical profession for the first time to map, store and, crucially, analyse at the highest-quality resolution, the circuitry of the central nervous system. This gives scientists used to squinting through a microscope the opportunity to study the micro-details of the body in a macro form never before possible – and to share this mega-scale imagery with colleagues over the web in an instant.

For the pioneers behind HD View, the potential important applications of the breakthrough makes the big-picture show they have created all the more worthwhile.

By Geoff Meade

PHOTOSYNTH: CREATING 3D PHOTOGRAPHIC EXPERIENCES OF TIME AND PLACE

The Photosynth experience justifies the use of the old truism: it has to be seen to be believed.

The technology contained within Photosynth means that a collection of otherwise unexceptional photographs can be turned into a three-dimensional experience via your computer.

Submit to the Photosynth software a series of photos taken of the same place - not necessarily at the same time - and the result will be a 3D photographic experience.

The pictures don't even need to be sequential - just linked by at least one point of overlap in each image, which is enough for Photosynth to juggle them into one merged scene. The photos could have been taken by different people at different times, in any lighting conditions and angles. The size of each image is immaterial, as is the number of separate photos.

All Photosynth needs to make sense of the whole is to find a series of common points linking them all. The viewer can then 'explore' within the 3D experience, bringing new life to even the dullest holiday snaps.

Photosynth's SeaDragon technology studies each picture, identifying the common points in them all and even recognising the point from which each picture was taken. Put simply, Photosynth then offers you a choice of viewing angles of the entire scene.

The possibilities are endless: not only can photos within your own collection be matched and given new life, but the technology offers the potential to combine your own photos with those of others online. An infinite number of images of the same scene can be merged together to give incredibly-detailed 3D experiences.

And, as with HD View, the technology behind Photosynth has applications way beyond leisure enjoyment: online information will be revolutionised when the ability to 'read' a series of images is applied to x-rays or Magnetic Resonance Imaging (MRI) scans, adding a new dimension, literally, to high-speed Internet consultations by medical professionals.

But to begin with, start searching those old discarded pictures from long-forgotten vacations, because Photosynth can bring them to life in ways you could never have imagined. Until now.

Geoff Meade is the European Editor of the British press agency the Press Association. He also writes for publications in Brussels such as E!Sharp.

Thomas Myrup Kristensen, Director, EU Internet Policy, Microsoft

ONLINE PRIVACY: A CONTINUOUS INNOVATION AGENDA

Innovation in the ICT sector has transformed how a large segment of the world's population works, communicates, learns, shops and plays. Today's online consumer benefits from unprecedented access to information and services - and most of it for free.

Online advertising is one of the main reasons why this is possible. Simply stated, the Internet would not be the extraordinarily diverse and useful medium it has become without advertising. This is because an important aspect of the Internet is the personalised experience it provides for users. To achieve this, businesses sometimes collect information relating to individual computers in order to provide Internet users with both free content and advertising tailored to their specific interests, particularly as expressed in the search terms they use to locate content. Although this enables great benefits, it may also cause consumer anxiety: many people feel uncomfortable that their online activities may be tracked and stored, including search terms and sometimes even the words they use in e-mails. This obviously undermines their confidence in the privacy of the wonderful new world of the Internet.

That is why Microsoft is working to create a 'new climate of confidence' in the Internet by empowering consumers with the knowledge and tools they need to take privacy protection into their own hands; build privacy-consciousness into the very way it runs the business; taking the lead with industry and governments to create greater protections for internet privacy; and helping safeguard the Internet with innovative technologies.

Thomas Myrup Kristensen, Director, EU Internet Policy at Microsoft, explains what this means in practice. "Microsoft was one of the first companies to appoint a Chief Privacy Officer, an action taken nearly a decade ago, and currently employs over 40 people who focus on privacy full-time, and another 390 people who focus on it as a part of their jobs. They help to ensure that privacy policies and guidelines are adhered to, and that customer privacy and data protection are systematically incorporated into the development and deployment of Microsoft's products and services," he says.

About six years ago, Microsoft launched the Trustworthy Computing Initiative, which made improving security, privacy, reliability and business practices a central focus when developing software and services at Microsoft. "A key element of this Initiative is a process called the Security Development Lifecycle, which is a rigorous development process that every piece of packaged and online software goes through to ensure that our products are 'secure by design, secure by default and secure in deployment'," says Thomas Myrup Kristensen. This process includes the Microsoft Privacy Standards for Development, which establishes a set of rules and guidelines to help ensure that privacy considerations are dealt with from the outset of software development. (For further information see www.microsoft.com/twc.)

"When it comes to search and online advertising, our efforts are based on five basic principles which aim to frame the three key concepts that should be part of every privacy policy and guideline: transparency, consent and security," says Thomas Myrup Kristensen. "Microsoft's privacy principles for search and online advertising reinforce our company-wide commitment to being transparent about, and giving customers more control over, the information used to personalise their online search experience."

The principles outline Microsoft's worldwide policies on the retention of search data. An important part of this is the commitment to make all Live Search query data anonymous after 18 months. This is done by permanently removing all cross-session identifiers, including the entirety of a device's IP address (a number that is assigned to a computer when it accesses the Internet).

Microsoft's privacy principles also spell out how the company works to make sure that customers' information remains safe. "We have designed our online advertising platform to only use data for ad targeting that does not personally and directly identify individual users. For example, Microsoft does not scan e-mails for advertising purposes and we store search terms separately from account information – such as names and e-mail addresses that personally and directly identify an individual," says Thomas Myrup Kristensen. The comprehensive list of Microsoft's principles can be found at http://www.microsoft.com/privacy.

The bottom line is this: data protection is a continuous journey, not a single destination. Protecting privacy is a core value of Microsoft's culture, and the company is committed to continuous innovation to bring the benefits of transparency, consent and security to the protection of consumers' data and privacy online.

For more information on Microsoft's position on privacy, please visit http://www.microsoft.com/privacy.


Conquerator


iSheep

HAIL THE CONQUERATOR AND RELEASE THE SHEEP

Earlier this year Microsoft Research Cambridge, in partnership with Microsoft's XNA Game Studio team, Lionhead Studios and Rare Ltd, brought together finalists from the international games development contest, 'Silicon Minds'.

The challenge set by the Microsoft collaborators was to invent and build a new game for the PC or Xbox 360 using XNA Game Studio 2.0 and with a focus on innovative artificial intelligence techniques.

Artificial Intelligence (AI) has always seemed to inhabit the realm of science fiction and fantasy in movies. It is already being used in the development of games and is seen as crucial for the future of gaming, by enabling game characters and virtual environments to react in more realistic ways.

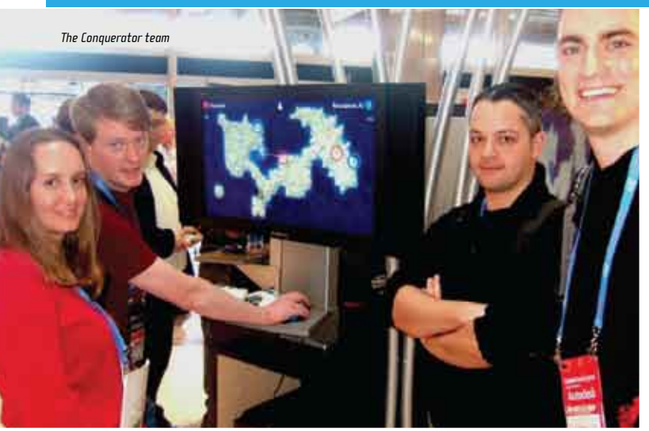
The three UK based Microsoft facilities and the XNA Game Studio team collaborate at different stages in the innovation cycle, but with the shared vision of developing next generation AI for gaming. By working together in the Silicon Minds challenge they hoped to encourage understanding of how gaming research, artificial intelligence and machine learning can contribute to innovative gameplay and more realistic gaming experiences.

For Joaquin Quiñonero Candela, from the Applied Games Group at Microsoft Research Cambridge, artificial intelligence is really the next frontier in computer games. "In the Applied Games Group at Microsoft Research Cambridge, we are pushing the state-of-the-art in Artificial Intelligence for games, and this competition has strongly reinforced our quest," he says.

Teams from around the globe were challenged to create a game using XNA Game Studio 2.0; a game development tool based on Visual Studio 2005 and .NET 2.0 technologies. The competition was targeted primarily at students, hobbyists and small independent game developers.

XNA Game Studio 2.0 contains tools that allow developers to more easily incorporate 3D content into their games. This was ideal for a competition, such as Silicon

The Silicon Minds competition unleashes the passion and talents of young developers and also inspires professional developers to see new and exciting ways of using Artificial Intelligence.


The Conquerator team


The iSheep team

Minds, that is focused on artificial intelligence. Many computer science departments across Europe - over 200 at the last count – also use the technology to underpin their game development curricula.

Over 600 participants took part in the seven week competition. Markus Jost and Remo Zehnder from Switzerland were among the winners with their game, iSheep. In this game, you are a sheepdog tasked with herding a flock of AI sheep into a pen. The challenge is to anticipate the behaviour of the flock before they run away. As you move through the progressive, timed levels, you are able to manage speed, change direction and alter the distance between animals.

There is no AI in the behaviour of the dog, as this is used as the user control agent, but the dog can influence the sheep in several overlaying ways. This is based on a well-known concept in AI, which looks to demonstrate behaviour of large systems that consists of many entities. The same type of analysis and modelling can be applied to study behaviour elsewhere in nature.

Conquerator, developed by Nicholas Barratt and Gillian Allen, is a two-player strategy game, with each player controlling nodes on a map. By defending nodes and attacking the nodes of the other player, the aim is to gain control of the whole map. Barratt and Allen created different gradients to allocate importance to each node, thereby affecting the ease with which each can be defended and attacked. In addition, they also developed a clustering model that varies the threat model, making some clusters easier to capture than others. The fun comes with deciding which nodes to defend, which ones to capture and how many units to allocate to both of these goals.

Kieran Connell from Rare Ltd said that he was blown away by what the contestants managed to achieve in such a short time. By unleashing the passion and talents of the young developers, the competition also proved an inspiring way for professional developers like Kieran to see new and exciting ways of using AI.

Joaquin Quiñonero Candela adds: "The results of the competition exceeded our expectations! Harnessing the power of XNA Game Studio 2.0, all winner entries managed to create fully playable games (often very addictive), built around a very creative use of very well executed Artificial Intelligence."

One of the challenges for the technology industry in Europe has been the falling numbers of computing science and engineering graduates. But, even as enrolment has been falling, Europe has become a hotbed for game development and production of some of the most exciting and marketable games and franchises in worldwide gaming.

XNA Game Studio 2.0 has been central to Microsoft's efforts to excite future gamers by providing an accessible way to get hands-on console programming experience. For Markus and Remo, the team behind iSheep, the experience convinced them that it is possible to build high standard 3D games in a short space of time. And for AI enthusiasts worldwide, iSheep and Conquerator show that the future just got a little closer.

For further information, please visit
http://www.dreambuildplay.com/main/winners.aspx
http://creators.xna.com

INTERFACING WITH ROBOTS:
DO ROBOTS DO WHAT WE WANT THEM TO DO?

Programming an **industrial robot** is still an annoying task that requires too many details and expert knowledge. Each robot unit needs to be installed and prepared for a particular task, which makes the introduction of robots an expensive and risky decision.

But what if everybody could program a robot? This was the main driver for Norberto Pires from the Mechanical Engineering Department at the University of Coimbra in Portugal, when he developed the programming by demonstration (PbD) system[1]. The basic idea of PbD systems is the possibility of programming a robot just by showing it what it is supposed to do and how it should do it.

Industrial robots perform actions that are programmed by engineers, a process that traditionally has not needed much human interaction. In Pires' PbD concept, robots and humans are co-workers and they cooperate to fulfill a shared goal. In effect, the human co-worker programmes the robot just by doing his job. Therefore, the robots have to be very anticipative of their environment while receiving inputs along many channels: speech (via speech recognition and speech synthesis), object or user detection and recognition (computer vision), and identification of gestures or gaze. The challenge is to map human behaviour to the kinematic model and capabilities of the robot.

"Even non-experts will be able to program robots, while the robot is learning on the job," says Miguel Sales Dias, the director of the Microsoft Language Development Center in Portugal. Thus the robot starts out like a totally unskilled worker, lacking much of the required background knowledge and skills, and one starts to tell the robot how things are to be done, just like a school for robots.

"PbD systems will constitute a major advantage for small and medium-sized enterprises (SMEs), since most of those companies don't have the necessary engineering resources to make changes or add new functionalities to their robotic manufacturing systems," says Pires. "Even at the system integrator level these systems are very useful as a way to avoid having specific knowledge about all the controllers they work with: complexity is hidden behind natural speech interface and portable interface devices."

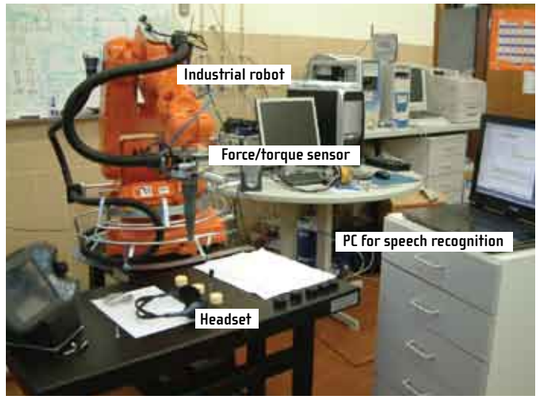


Figure 1 – Programming-by-demonstration system in the laboratory.


Miguel Sales Dias, Director of the Microsoft Language Development Center, Portugal


Norberto Pires, Mechanical Engineering Department at the University of Coimbra, Portugal

Once the robot has learned the basic skills - how to do things - one can then start telling the robot what to do, in the same way as with skilled workers who know the applications, devices, processes, and the general requirements on the product to be manufactured. Programming approaches in that direction are often referred to as 'task-level programming'.

Basic skills can be considered as building-blocks; high-level programming languages take those blocks as graphical symbols shown on the computer monitor and let users even with very limited programming skills create a program by intuitive actions such as dragging and dropping items on the monitor.

Having these objectives in mind and considering the co-worker scenario for SMEs, a robot system (see Figure 1) was designed to allow human-robot interaction both at the programming and task execution stages.

The interested reader can watch videos of this system in action at
http://robotics.dem.uc.pt/pbd

The speech recognition package is available at:
http://www.microsoft.com/portugal/mldc

The presence of robots and embedded computing devices in our environment and in the workplace, for example in manufacturing, is predicted to increase significantly. For example, Scientific American (SCIAM Observations) in its 11 January 2007 edition estimated that the market for robots will increase 30 fold by 2025, to a US$ 60 billion market by that time.

However, achieving this will require that the majority of workers without explicit programming skills are equipped with the ability to master these devices. Pires and Miguel Dias are convinced that the type of PbD systems described here will constitute a major component of that growth, in particular by enabling smaller companies to participate in the innovative use of this technology.

[1]This work has been partially funded by the European Commission's Sixth Framework Program (FP6) under grant no. 011838 as part of the Integrated Project SMErobotTM.

ARCHIVING FOR THE FAMILY

One of the current projects of the Socio-Digital Systems Group atMicrosoft Research in Cambridge is 'Family Archive'. This work arose from the team's fascination with the things that households keep - the objects, both physical and digital, that are meaningful and special to people in the home.

"These precious items include not only photos and videos, but physical things: children's artwork, a baby's first shoes, a collection of stones from a holiday, letters, ticket stubs and all kinds of other objects," explains Abi Sellen of Microsoft Research. "We discovered from talking to families that there are many reasons why we keep things: because they mean something to us personally, because they connect us to a shared past, because they honour those that we care about, and so on. Some of these special objects we keep hidden away in boxes or on our computers, and some we proudly display," says Abi Sellen.

At the same time, there are clearly some real opportunities to build on the way people archive in the home. For one thing, people express worries and even guilt about the way they archive the things that matter to them. For example, people want easier ways to capture and organise what they own. They feel a need to 'sort out' their growing collections of digital photos and videos alongside often large collections of boxes of paper photos, drawers of videotapes and all kinds of other paraphernalia. People also worry about keeping important, sentimental things safe: about not being able to access digital materials over time, about objects being lost or stolen, or about things being damaged due to fire or flood.

Aside from solving the storage and safekeeping problems people may perceive, there are also many new possibilities that digital technologies could open up. For example, if there are easy ways of capturing digital images of physical things, they can now be mixed together with existing digital photos and videos. (This doesn't mean you would dispose of the physical objects, only that you would have a new kind of record of those objects.) New kinds of materials that may also have sentimental value can also be captured and put into the mix, such as ambient sounds, webcam images, and even email and text messages that have special meaning. With the right tools, not only can we extend the range of materials we can capture, but these rich collections of digital materials allow new kinds of links to be made between them. This also opens up the possibility of recording and keeping stories about collections of objects, and for us to be more creative in what we capture and keep.

Microsoft Research is planning and building an interconnected set of prototype systems and devices to extend how we capture, organise, create, annotate and display family memorabilia.

With this in mind, Microsoft Research is planning and building an interconnected set of prototype systems and devices to extend how we capture, organise, create, annotate and display family memorabilia. One such system is an interactive archiving desk for the home. According to Abi Sellen, "Here we wanted a system that would allow you, after a trip to the seaside with your family, to upload not only your digital photos and videos, but that would also let you empty your pockets on the surface of the device and capture the seashells your kids collected, the postcards you bought at the shop, and the train tickets from the journey. It would let you capture all these things, easily manage them, annotate them, share them and store them."

With this prototype desk, putting digital capture devices such as cameras and mobile phones in the desk drawer automatically uploads their contents to a digital archive (and at the same time keeps them safe and charges them). The digital contents can be viewed, triaged, sorted and stored using two hands and multi-touch input on the surface of the desk. At the same time, an overhead camera allows you to place physical objects (either paper-based or 3D objects) and press a button to scan digital images of them. These can then be mixed with photos and videos and stored as loose collections of materials. The system will also allow you to annotate the objects in various ways such as through voice recording or handwriting. "At the moment we are in the early phases of designing a flexible, hands-on interface which will allow a rich array of ways to play with, view and manage these materials. The device will also be networked so it can allow easy sharing with remote friends and family, as well as the back-up of locally stored materials," says Abi Sellen.

For more information on the work of the Microsoft Research Socio-Digital Systems Group, please visit
http://research.microsoft.com/sds/

Turcsik Árpád, Managing Director, eSpirit IT Solutions

HUNGARIAN START-UP SECURES 100 PER CENT FUNDING FOR PHOTOSMART PROJECT

Budapest-based start-up eSpirit sought help from European Union Grants Advisor (EUGA) and applied for government funding to develop a new Web-based application. In just over six months, eSpirit received notice that it had secured a grant to cover 100 per cent development costs. The new product will result in significant rise in the company's market share.

In recent years, Hungary has accelerated its transformation from a centrally planned economy into a market place that is fast embracing global business trends. And to make this emerging knowledge-based economy a success, Small and Medium Enterprises (SMEs) play a key role in fostering innovation in business and in creating new jobs.

To help the SME sector realise its potential, the European Commission provides, across Europe, an estimated total of €117 billion (U.S.$141 billion) in grants for technology-related investments. Unfortunately, a critical hurdle to funding for small businesses in Hungary is the lengthy application procedure. A company has to participate in a tender process and approach several government officials to get consents for its proposal, resulting in high administration costs. But in 2007, a promising start-up firm based in Budapest found a solution to making successful grant applications and overcame these challenges.

Founded in 2003 by three young entrepreneurs, eSpirit provides IT services for data quality management, software development, and related design, consultation and project management tasks. It delivers high-quality solutions that are based on the latest technologies available in the market, including Microsoft.NET 3.5 Framework and Windows Presentation Foundation.

As a member of the Microsoft Partner Program for Independent Software Vendors (ISVs), eSpirit also receives Microsoft support for developing and marketing its software solutions.

After two years of excellent sales in the Hungarian technology industry, the company teamed with a German firm in 2005 to develop a photo-management application, PictureStar. Turcsik Árpád, Managing Director, eSpirit IT Solutions, says: "We wanted to provide a simple, user-friendly solution for consumers to import images to the computer from a camera, publish and search them on the Internet, and order prints from a photo service provider."

When launched, PictureStar was to be the first product developed by a Hungarian ISV which is based on the Windows Media Centre - the latest Microsoft product that helps users view slide shows with music, organise photos, and create albums.

However, the PictureStar project came to an unexpected halt in 2006 due to the German firm's limited financial resources. But eSpirit stayed in the game. Árpád says: "We did market research and found that more than 20 Web-based photo service providers in Hungary were interested in adopting our product. It encouraged us to go ahead and make our own application - which we renamed PhotoSmart - a resounding success."

But attaining the estimated development cost of €50,000 (U.S.$ 79,000) was not easy. "In the past, we had received EU grants which helped our growth and development," says Árpád. "But this time, we had little hope of help from the government due to the recession in the Hungarian economy."

"EUGA understands the full scope of the funding opportunities. It knew exactly how to interpret our requirements in the application to ensure it was successful. If it wasn't for EUGA, we wouldn't have received the grant at all."

Turcsik Árpád, Managing Director, eSpirit IT Solutions

http://www.espirit.hu/eng/index.htm

After talking to its Microsoft ISV manager, eSpirit heard about the European Union Grants Advisor (EUGA) programme. EUGA is an initiative supported by a number of community partners and industry leaders, such as Microsoft, Intel, and HP, to help increase SMEs' awareness of, and access to, dedicated EU funds.

The first step EUGA took was to choose a suitable grant scheme for eSpirit. INNOCSEKK 2006 aimed to support SME innovation projects and to stimulate the supply and demand of innovation services. To ensure that eSpirit could take maximum advantage of the opportunity, EUGA took responsibility for all the administration work and writing the funding application.

Marcell Toth, EUGA Project Manager, Microsoft Hungary says: "The awarding body, until then, wasn't supporting any IT-led projects. So we put in extra efforts to highlight the innovative aspect of this project and explained how the related research and development will help create a new market sector and help boost the country's economy on the whole."

In October 2006, EUGA submitted the proposal to the EU on behalf of eSpirit. Soon after, Hungary's Ministry of Economy and Transport implemented drastic budget cuts in the funds available to SMEs as a measure to cope with economic downturn. Árpád says: "We were worried about the government's actions and afraid that we wouldn't get the grant at all."

The situation turned in Árpád's favour in May 2007 when the funding body recognised the innovative nature of the PhotoSmart project with notification of a grant to cover 100 per cent of the development costs involved. Árpád gives the credit to EUGA: "EUGA understands the full scope of the funding opportunities. It knew exactly how to interpret our requirements in the application to ensure it was successful. If it wasn't for EUGA, we wouldn't have received the grant at all."

The grant paid for the external software development engineers and consultants hired by eSpirit to develop the application. The company plans to launch PhotoSmart with its first partner Web photo-service provider in June 2008.

Árpád says: "This new line of business will help us increase our market share significantly. Within the next four years, we expect to approach service providers all across Europe."

Árpád and his team feel motivated and have planned a business strategy to take the company to new levels of performance helped by EUGA: "Now, with access to financial resources from the EU, we can develop customised media applications for the new version of PhotoSmart," he says. "Moreover, we can also support our fast expanding business with in-house product experts."

Árpád strongly believes that with support from EUGA other SMEs, in countries such as Hungary, can gain a foothold in the global marketplace. "The EUGA programme comprises a highly professional, well-structured team that puts maximum effort into ensuring the companies like ours receive funds to help achieve their aims," says Árpád.

EXPLORING THE GLOBE

As more and more people share data and opinions over the Internet, geographic and location information is becoming an increasingly important dimension of the way people intuitively organise, view and analyse data.

This has great practical utility for services which are location focused, such as real estate services, climate and weather information or tourist information. Tools such as Microsoft Virtual Earth or Google Earth, which provide satellite data and aerial photographs as basic services for location information, enable partners and third parties to enrich and amend those data and photographs with more detailed information and applications of their own, thereby enabling new businesses and business models.

These tools also enable more and more data and images to be collected, both by professionals and hobbyists, in ways that allow 'virtual realities' to be constructed – whether of scenic panoramas or of important archaeological sites. In this respect, online communities are empowered to use the social web – Web 2.0 – to share large collections of digital images, which can then be 'stitched' together or zoomed around using tools such as Photosynth and HD View – as seen in the previous section.

Then there is climate change research, where geographic information systems are providing the means to link various data sources that are distributed across the world through location information. The growing discipline of environmental informatics - which combines research in fields of artificial intelligence, geographical information systems modeling and simulation and user interfaces - offers a new chance to understand major processes and patterns in our environment. Working with leading scientific institutions in Europe and around the world, Microsoft is part of several major research projects in this field.

The sum of these trends is that 'geographic intelligence' is becoming more and more widely available to scientists, business and service providers, and the everyday user.

BROWSING THE REAL WORLD

New geoweb applications such as Microsoft's Virtual Earth are at the confluence of two massive innovation trends – user-generated content and smart environments. To browse what the augmented reality of where virtual worlds collide with the real one, you need a good map.

By Fabrice Delaye, ScienceIBusiness

To see El Greco's masterpiece, 'The Funerals of Count Orgaz', you have to find the little church of Santo Tomé in the Spanish city of Toledo. But going there without digging for other treasuries hidden in the city that used to link Christian and Muslim cultures would be a waste. What else is there to see in what used to be the capital of sword making?

Thanks to a new online service developed by a French start-up, memo.fr, you can prepare a smart itinerary not only through the geography but also through the history of Toledo, Bologna and a growing number of cities. Memo founder Claude Richardet realised he could link the two disciplines of geography and history via a technology called mash up that combines data from different sources in one interface, a geobrowser.

Using the bird's-eye function of Virtual Earth, Microsoft's geobrowser, you can fly into the streets of Toledo and spot Santo Tomé as well as dozens of other museums, Roman gates, mosques and cathedrals. Each of the active tags marking the monuments offers hyperlinks to practical information such as schedules and tariffs, and also to detailed files made by amateur historians in the same way that internet users constantly enrich the online encyclopedia Wikipedia.

Real estate developers spotting the houses they have on sale, drivers looking for cheaper gas station networks - geoweb is all the rage in the participative internet called Web 2.0. Virtual communities of people around the world are creating their own location-specific content around, say, the most romantic hotels in France or the best Chinese organic restaurants in California.

Until recently, geotagging was limited to 2-dimensional digital maps. Memo.fr – as well as Tellmewhere.com and many other Microsoft and Google partners – is now transferring its user-generated contents to more immersive 3 dimensional maps.

The main reason for moving to 3D maps, says ABI Research analyst Dominique Bonte, is that they are more accurate. "Digital maps developed by Tele Atlas and Navtech are notoriously full of mistakes," explains Bonte. "That is why GPS devices companies such as TomTom are now encouraging communities to correct road signs or street names in real time."

In addition, 3D maps display more than just basic geographical information such as roads and city plans. High-resolution satellite imagery and thousands of aerial photographs are computed by software to yield exhaustive views of any building from any angle. With a 20 petabyte database built internally by 600 developers, Virtual Earth is now introducing 3D views of buildings with an accuracy of 7.5 centimetres in position and 25 centimetres in elevation.

The applications are already being used to browse relief maps of the real world and the information users 'mash up' on them via geotagging technologies. But they have also turned into a new operating system for developing new location-related applications that connect, for example, software-generated objects with a dynamic representation of reality.

While Google Earth's users enrich it with photos, texts and even advertisements to serve various communities, "We have chosen a more professional approach," explains Josef Kauer, Business Development Manager for Microsoft Virtual Earth in Central & Eastern Europe. "Our model is business to business to consumers." With partners such as Dassault Sytems, Virtual Earth is becoming a platform where computer-assisted design objects can be introduced: for example, architects are using it to introduce a planned building into the landscape to assess visual impact on the neighbourhood.

But for developers of geobrowsers such applications are probably only the tip of the iceberg. With navigation devices such as GPS increasingly embedded into cars or mobile phones, location-relevant content is getting easier to generate. "Coming soon," says Josef Kauer, "store owners will be able to locate their boutique on the map and make it visible for users."

This merger of navigation devices with mobile telephony and user-generated content is already turning into a red-hot investment field. Adding mobility into the geoweb equation enables an infinite number of location-based services – from locating your friends via your mobile phone, to geotagging almost anything that can be captured by a mobile phone camera by adding recognition software and GPS to a phone to generate links between digital maps and any objects or people filmed. Snap a building and you've got the list of all the business inside it. Snap someone in the street and their Facebook or LinkedIn identity pops up on the screen – at least, as long they are willing to appear on the geonetwork.

When these kinds of technologies start to be deployed, virtual maps will allow us to browse the real world just like the Internet.

The financial and business excitement mirrors the buzz about the potential of geobrowsers and geoapplications. Why stop with user-generated content about traffic, parking places or restaurant tips? Environmental data from the growing deployment of sensor networks look like a perfect candidate for next-generation mash ups. Already oil company BP is using virtual maps to monitor winds and ocean streams to optimise its drilling platforms and tanker fleet.

When those kinds of technologies start to be deployed, virtual maps will allow us to browse the real world just like the internet. Or even more: some, like Philippe de Passorio from Total Immersion, think that mixing the real world and the virtual life will trigger a kind of augmented reality.

True, there is not much of a difference between flying in virtual places like Second Life or games like Sims, and browsing geoapplications. In the real world, they still lack a user-friendly interface that will let people and objects pop up behind their avatars. But when stereoscopic augmented-reality goggles arrive, the geoweb and its location awareness and enriched content technologies will be the portal of choice, the place where the virtual and the real world collide. That'll be when you not only find San Tomé in Toledo as easily as if you've visited the city ten times, but you then get to interact with an avatar of El Greco and discuss his painting under the shadow of an old (and real?) fig tree.

THE 3-D CITY

Football supporters and other visitors to this summer's Euro2008 football championships in Austria and Switzerland can enjoy a new experience as they log onto websites in search of information to plan their trip.

By Rory Watson

Thanks to ground-breaking technology developed by Vexcel Imaging GmbH, a company with a strong pedigree in photogrammetry and remote sensing, and headquartered in Graz, Austria, the fans will be able to see their future surroundings in high quality three-dimensional format. The company, which provides aerial, bird's eye and street level imagery to a range of clients from government to corporate, was purchased by Microsoft two years ago.

Salzburg was the first Austrian city to be presented this way, enabling fans to get a real live feel, well before they reach the country, not only for the historic city, but also for the football stadium where they will be cheering their teams on to victory. The same techniques are now being used to display other major Austrian cities such as Vienna and Graz in a new light on a two-dimensional computer screen. This summer's events make Austria the showcase for the sophisticated technology, but soon this unique treatment will be given to other leading international cities.

Vexcel, which since the May 2006 acquisition has operated under the group name Microsoft Photogrammetry, plays a crucial role in Microsoft's Virtual Earth platform. Vexcel is involved throughout the complex process – from the initial hardware to the final product. It has developed the technology in the shape of the UCX camera system which enables aircraft to take the initial images and the software required to process these into a 3-D format.

Alexander Wiechert, the company's business director based in Graz - where some 45 employees closely involved in the process are located - explains how this new presentation of our surroundings is being achieved. "Our goal is to achieve fully automated 3-D models from the raw material provided by the cameras. We are already highly successful at it. We have developed an aerial camera that is very precise, geometrically accurate and stable and can provide high quality colour and pan images (i.e. grey-scaled images consisting of grades of black and white). Service companies around the world use the camera and collect data. Thousands of images go to our production process every day where our software extracts 3-D models."

This technological breakthrough can benefit the short-term visitor, long-term resident and the professional town planner or transport organiser alike.

"If an image is flat, you can recognise it from the top, but you can't navigate. To have a good impression of a city, you need a 3-D environment at street level. That way, a tourist can get the atmosphere and decide whether to be in that area. There are similar advantages for professionals. Planners can work on two-dimensional maps, but to see changes in the physical environment you need 3-D," says Mr Wiechert.

Replicating concrete 3-D structures in a lifelike way on computer screens does not come cheaply and Microsoft is investing heavily behind the project. First, there is the initial outlay of about US $1 million for the special camera and then the cost of hiring a plane to take the images – for even a relatively small city like Graz this is at least a two-day exercise. This is without counting the development and processing costs.

The UCX camera system is a key part of the process. While the actual production of the sophisticated piece of equipment is outsourced, Vexcel Imaging GmbH, in addition to the development, tests and, if necessary, refines each one before delivering it to the latest customer. In that sense, it is the manufacturer and responsible for the product.

With some 100 of the special cameras being used worldwide, the company is receiving increasing demands for customer support. It initially plans to provide this from Graz, but now a lab has also been opened in Boulder, Colorado and, down the road, aims to have similar facilities in South East Asia.

Mr Wiechert, who joined the company in January 2008, had previously worked in the aerial remote sensing business for several years. He provides personal proof of the usefulness of the new technology as he prepares to relocate his family to Graz.

"We are looking for somewhere to live and with this 3-D technology you get a better feel for an area and its atmosphere. You can feel the brick," he explains.

For more information, please visit:
http://www.ultracamx.com
http://www.microsoft.com/ultracam/default.mspx

Rory Watson is a Brussels-based freelance journalist. He writes for The Times and other publications.

Pompeii, Queen Caroline's House: view of the atrium in 2006.

Philippe Ortas

COMPUTERISED EXCAVATIONS IN POMPEII

Imagine a search engine capable of recognising the details of paintings rather than words. This is the challenge facing a joint Microsoft/INRIA research project to recreate, in 3D virtual form, a two thousand year old house in Pompeii.

Two hundred years ago, a group of travellers discovered the highly adorned walls of Queen Caroline's House, a Roman aristocrat's residence in Pompeii that had been buried and, over the centuries forgotten, under the ashes of the great volcano eruption in AD79. The wealth of decorative art included delicate paintings, rich with colour. In the intervening decades since the house was rediscovered, however, the splendid finds have been damaged by rain, wind and light, leaving bare and eroded grey walls.

Today, researchers are attempting to create a 3D virtual model of the Roman-era mansion, named later, in the nineteenth century, for Caroline Bonaparte, a former Queen of Naples.

This is just one of the goals of the 'Images and Videos Mining for Sciences and Humanities' project led by the joint research centre set up by Microsoft and the French National Research Institute for Computer Science and Applied Mathematic (INRIA). This centre, launched in early 2007, employs around 30 researchers in Saclay, south of Paris.

The Centre's objective is to pursue fundamental, long-term research in formal methods, software security and the application of computer science research to the other sciences. In addition to archaeology, the 'Images and Video Mining' project includes applications in the realms of the environment and the sociological study of the behaviour of characters in films or television advertisements.

The 3D reconstitution of a Roman mansion in Pompeii brings together computer scientists and archaeologists. To begin with, the project team has to collect about two hundred engravings, sketches, paintings and photographs made in the two hundred years since the building was unearthed from the ashes. Once correlated, these historical documents will help to bring the opulent residence back to life, just as it was at the time of its re-discovery.

Pompeii, Queen Caroline's House: view of the atrium circa 1810 after F. Mazois, Pompeii's ruins: second part.

This collection of icons will also see the development of a new computerised visual recognition application. This emerging technology is designed to automatically recognise a fragment of an image representing an architectural detail or a ceramic in a database.

"We are making our own computerised excavations," explains project leader Jean Ponce, a former researcher at the University of Illinois at Urbana-Champaign, who specialises in Computer Vision, Computer Graphics and Robotics. Jean Ponce currently heads the Willow research team, a joint project between INRIA, the Ecole Normale Supérieure (ENS) and the Centre National de la Recherche Scientifique (CNRS).

"We have three years to test a study protocol that is already applied to photographs, but not to paintings," adds Jean Ponce. "One of the greatest challenges lies in recognising objects whose appearance differs slightly from one document to another, especially in terms of the proportions. And sometimes, the artists add more details."

The researchers are planning to build a search engine in order to test the visual recognition technology. The goal is to locate the detail of an image in a multitude of archives in just a few clicks: an achievement that would revolutionise archaeological practices. "Currently, it can take months of research to find a document. And we have to remember that such and such a sketch corresponds to the same wall painting as the one we saw a few weeks earlier," explains Hélène Dessales, lecturer in archaeology at the ENS and a member of the project team.

By comparing the images, the researchers will also gain a better understanding of the working methods of ancient architects and their 19th century counterparts, and of how buildings decay over time depending on the climate and diseases affecting stone. "A computerised tool will greatly help us to take decisions on policies to conserve and preserve our heritage," says Hélène Dessales.

The goal is to locate the detail of an image in a multitude of archives in just a few clicks: an achievement that would revolutionise archaeological practices.

By Michael Kenward, Science|Business

COMPUTER MODELS OFFER THE ONLY WAY OF ANTICIPATING HOW MANKIND'S MASSIVE EXPERIMENT WITH THE PLANET'S CLIMATE MIGHT PLAY OUT

MODEL YOUR OWN CLIMATE

Few research issues are as significant as trying to work out how climate change might affect the environment. Unlike many scientific experiments, this isn't something that we can try in a laboratory several times to see how things pan out under different conditions. Nor do we have the luxury of being able to wait to see which of the many theories on offer is the most scientifically complete. This is why computer modeling is so important to understanding climate change.

Computer models of the climate have a major bearing on public policy debates and directions. For example, much of the discussion within the Intergovernmental Panel on Climate Change (IPCC), which produced its Fourth Assessment Report late last year, hinges on analysis and interpretation of models.

Naturally enough, given the importance of climate change, in particular, and environmental issues in general, the world's research labs are awash with data. And that data comes from many places. For example, environmental data is collected from space, using satellites, as well as from terrestrial sources including sensors measuring weather, the oceans and terrain.

These data fuel the growing discipline of environmental informatics which combines research in fields of artificial intelligence, geographical information systems (GIS) modeling and simulation and user interfaces. The challenge is to find the best ways to combine data and to feed it into the various models of the climate. This is where the Environmental Scenario Search Engine (ESSE) comes into play.

ESSE is a test bed in more ways than one. Not only does it provide a tool for environmental research, it is also a real world use of 'fuzzy logic' in databases. In this way, it gives researchers at Microsoft Research's laboratories in Cambridge, UK, an eye into the potential use of fuzzy logic in searching conventional databases, for example.

Fuzzy logic offers a way of translating search questions from human language, with all its uncertainties, into something that computer systems can handle. Dr Vassily Lyutsarev, Manager of Scientific Computing at Microsoft Research Cambridge, UK, explains that environmental data is held in different forms in databases all over the place. "It is hard to analyse this data using conventional database techniques,"says Dr Lyutsarev. Fuzzy logic, he adds, is a good way to work with large databases.

"What makes it so different from conventional text-based search engines is that it actually searches inside the numeric datasets. With ESSE, scientists will be able to find specific parameter values, conditions and scenarios among the huge amount of available environmental data. ESSE will help you find useful data even if you don't know exactly what you are looking for."

Vassily Lyutsarev, Manager of Scientific Computing at Microsoft Research Cambridge, UK

ESSE is part of Microsoft's European Science Initiative. "The idea of the initiative," says Dr Lyutsarev, "is to bring together computer scientists and researchers from the natural sciences, in particular, biology and environmental sciences." The objective, he adds, "is to build new kinds of tools that can revolutionise how science is being done."

As well as Microsoft Research Cambridge, UK, the ESSE team also includes scientists at the Geophysical Center of the Russian Academy of Sciences in Moscow, Moscow State University, the National Geophysical Data Center in Boulder, Colorado – part of NOAA, the US National Oceanic & Atmospheric Administration and the world's largest provider of publicly available geophysical data. The researchers describe ESSE as "a set of algorithms and software tools for distributed querying and mining large environmental data archives." As they put it, "ESSE acts as a bridge between questions a user needs to ask of the environment and the data which describes it."

Dr Lyutsarev explains that the team in Moscow, led by Dr Mikhail Zhizhin, in the Geophysical Center of the Russian Academy of Sciences, is developing software and building databases. The group at NOAA, led by Dr Eric Kihn in the National Geophysical Data Center, provides expertise on environmental data.

Dr Lyutsarev describes ESSE as 'work in progress'. It has, though, already started to deliver results. "We are moving from developing computer tools to doing some real environmental research," he explains.

A new Microsoft backed project that is about to get under way brings together the ESSE team, the Geophysical Center and the Space Research Institute of the Russian Academy of Sciences in a new project called Climate Induced Vegetation Change Analysis Tool. "The idea is to use tools developed in ESSE to analyse climate data, together with satellite images to find dependencies between climate and vegetation, particularly in Russia," says Dr Lyutsarev.

ESSE's tools also underpin a new NOAA project as a part of the Comprehensive Large Array-data Stewardship System (CLASS) system. NOAA describes CLASS as a "web-based data archive and distribution system for NOAA's environmental data. The system is NOAA's main way of distributing environmental satellite data." As Dr Lyutsarev puts it, CLASS is about providing remote access to vast amounts of data, which is where ESSE comes in.

Another project with backing from Microsoft addresses the issue of what you do with environmental data and how to run computer models to see how the climate might change under different conditions. The complexity of climate modeling requires considerable computer power. ClimatePrediction.net, which describes itself as "the largest experiment to try and produce a forecast of the climate in the 21st century," makes it possible for anyone with a computer to contribute to the number-crunching.

Based in the Atmospheric, Oceanic and Planetary Physics group at Oxford University, climateprediction.net, called CPDN for short, addresses one of the challenges identified by the IPCC as a high priority: the need to "improve methods to quantify uncertainties of climate projections and scenarios, including long-term ensemble simulations using complex models." As well as support from Microsoft, the main funding for CPDN comes from the Natural Environment Research Council and the UK Government's 'e-science' programme.

Modelling needs plenty of computer power so that researchers can run their models many times, making small changes to see how they affect the outcome. Dr Suzanne Rosier, coordinator of CPDN, explains that thanks to distributed computing, climate modellers have access to "more computer power than they could get from sending their work to the world's biggest computers."

The Oxford group works with models from the Met Office in the UK, one of the world's leading climate monitoring and modelling organisations. The data crunching then goes out to a growing network of nearly 50,000 'hosts': people all over the world who give CPDN some of their computer time to run climate models. Experiments run in the background on the host PCs.

"It all relies on volunteers," says Dr Rosier. "We package the models up so that people can download them over the Web," she explains. "All the data comes back to Oxford and gets handled here."

The project, now in its fifth year, recently achieved a landmark of 30 million 'model years'. Like ESSE, CPDN is moving on to a new level. After running global models of the climate, the group is about to start regional modelling. For example, it plans to release a model of one region in the very near future.

Another objective for CPDN is to feed into the scientific work of the IPCC. Like ESSE, now that the Oxford project has proved that its approach works, it hopes to become a part of the wider global modelling community and to contribute to the IPPC's next Assessment Report.

With so many years under their belts, and several published papers, both projects are now in a position to help to achieve the IPCC's goal of better models of the climate. By signing up for climateprediction.net, you can also do your bit for research into climate change.

For more information, please visit

ESSE: **http://research.microsoft.com/ero/biosciences/esse.aspx**
http://esse.wdcb.ru

IPCC: **http://www.ipcc.ch/**

CLASS: **http://www.osd.noaa.gov/class/**

ClimatePrediction.net
http://www.climateprediction.net/

WHEN GEOGRAPHIC INTELLIGENCE GOES MAINSTREAM ...

"When I'm making plans for my spare time, the most convenient way to do it is to ask for the location and places of restaurants, tourist sites and service stations," says Dragan Tomic, Principal Development Lead at the Microsoft Development Center Serbia in Belgrade. "But even when it's not obvious that I'm asking for location information, I'm probably interested in that information, because it's key data."

'Key data' is data that links other data so, for example, 'identities' link the data of a person, while 'locations' link data that is specific to a point in space and time. More than two decades ago, in the early days of Geographic Information Systems, the handling of geographic data was done by large enterprises: the utilities sector, governments, municipalities and the military.

Today, geographic and location information is an increasingly important dimension of the way people organise, view and analyse data. Geographic location maps directly with human intuitive cognition. Tools such as Virtual Earth are being embedded in many applications while being enriched by lots of data that provides intelligence to the location. And lots of that data – for example, photos, reviews and insider tips - is being collected and provided by everyday users rather than enterprises.

Consequently, geographic data requirements today go far beyond traditional concepts of objects as single points, lines or simple areas: today, a geographic object can be an almost infinitely variable collection or combination of any of these forms.

"Handling complex geometries that refer to objects in the real world is the realm of Geographic Information Systems," says Dragan Tomic. "My team in Belgrade is currently working very hard to introduce the capability of handling those objects in the next version of SQL Server database software."

However, the approach that Dragan Tomic and his team are taking differs from conventional approaches to Geographic Information Systems in several ways.

"With the previous SQL Server release we have paved the way for a new generation of database software," says Dragan Tomic. "Before that time, relational databases consisting of tables were most popular. The novelty in what we are doing now is that we can lift more advanced concepts – thereby allowing for much richer objects that cannot be described in tables - out of the research and put them into the product. So now we have much greater flexibility to incorporate complex geographic objects and their behaviour," explains Dragan Tomic.

A second innovation by Dragan Tomic and his team relates to topological analysis tools. "These are tools which provide answers to questions about 'what is where' and 'where is what' – and by ensuring that they are not only in the software that runs on the server for large enterprises, but can also be used by every user on their own computer, we are addressing the fact that geographic intelligence is becoming mainstream."

Dragan Tomic explains that Microsoft is very active in the Open GIS consortium and is eager to conform to the specifications developed by Open GIS. Furthermore, Microsoft is active in sharing ideas and participating in the development of emerging Spatial standards. "This allows partners to develop standards-based analysis and visualisation tools," he explains. "We have a partner programme, and many large and small providers of Geographic Information Systems software have tried early versions of the software. We have received very positive feedback which has been very encouraging for us during the development process."

As a result, Dragan Tomic expects a range of applications will soon come together, including mobile location-aware services based on global-positioning-system (GPS), rich virtual realities that are based on tools like Virtual Earth, scientific and other complex analysis tools which require a wide range of data, and so on. "We are trying to address increasing numbers of use scenarios where spatial data is combined with traditional data in tables," he says. "There are so many scenarios that we think there is a lot of space for our partners to take advantage of the new database software, and we are happy that we are able to accelerate our partners and, in the end, every user."

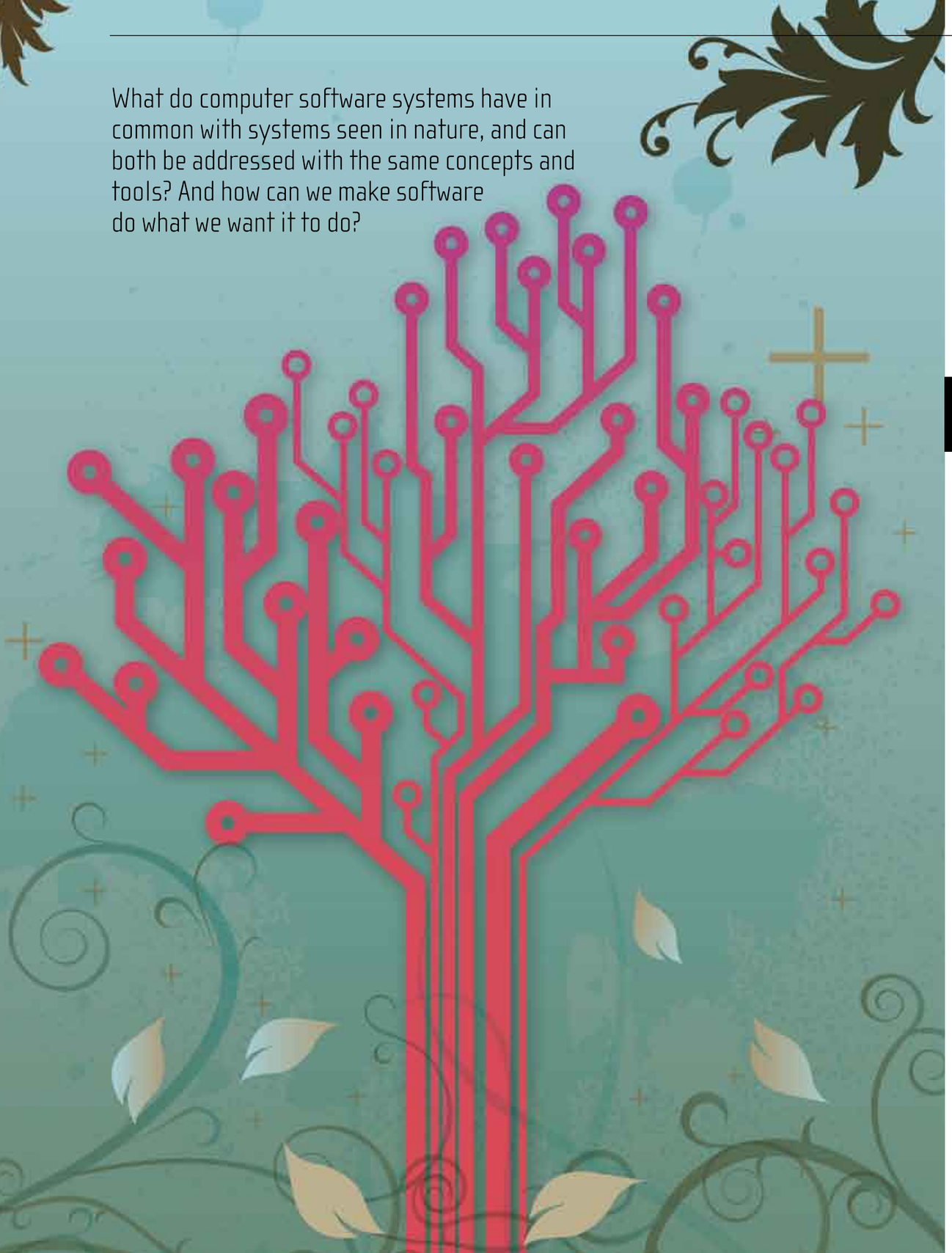
Dragan Tomic spent many years with the SQL server product development team in Microsoft's headquarters in Redmond, United States before returning to Serbia to start a development team. "We acknowledge that much of the theory that today's GIS is based on has been developed in Europe, and we certainly know about the potential of Europe in our field. So I am proud to work with an enthusiastic team of highly recognised experts originating from all over Europe, coming together in Belgrade and bringing their knowledge to bear on technology that we provide globally."

Microsoft SQL Server is the premier Database Management System in the industry providing reliable data storage, management and processing for various data domains.

SQL Server 2008: The next version of the SQL Server database software will contain support for specific geographic objects and their projection to the Earth's surface, indexed so they can be found very fast, as well as specific queries.

Microsoft Development Center Serbia (MDCS) in Belgrade, opened in September 2005, focuses on the application of the most modern machine-learning technologies in their respective domains.

What do computer software systems have in common with systems seen in nature, and can both be addressed with the same concepts and tools? And how can we make software do what we want it to do?



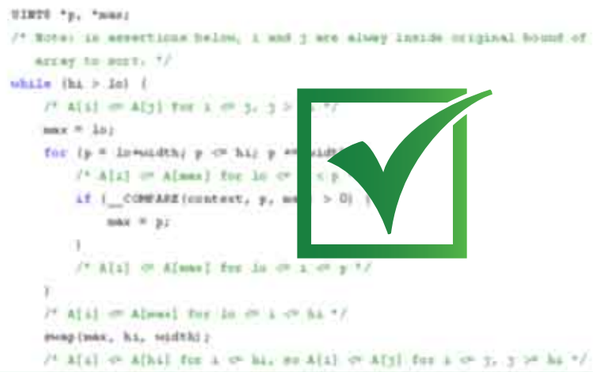
COMPLEXITY: TACKLING LARGE SYSTEMS IN SCIENCE AND ENGINEERING

Large systems feature in both the natural sciences and in computer science – and in both fields, the demands are increasing. For example, better understanding of biological systems will unlock further improvements in healthcare, a field where more data is available than ever but new methodologies are needed to aid analysis and innovation. And as computer systems become increasingly complex and multi-device, the challenge of reliability is paramount.

In the natural sciences, large systems present a challenge to traditional methodologies. Yet if we postulate that large systems in nature, such as cells or ecosystems, yield computational behaviour, then new analytical concepts can be formulated by making use of concepts that are fundamental to computer science and using the tools that have been developed for computer systems for decades. Working with leading scientific institutions in Europe and around the world, Microsoft is part of several major inter-disciplinary research projects on biological systems.

Mathematics is another key domain of large systems research where Microsoft is at the forefront of interdisciplinary collaboration in Europe. For example, Microsoft is working with academic researchers in Germany on the application of mathematical approaches for software quality verification, to ensure that software in large computer systems is doing exactly what it is supposed to do.

These and many other examples show the great potential benefits for Europe and the world of innovation based on interdisciplinary research and transferring concepts from one scientific domain to another.



VERIFYING 50,000 LINES OF C CODE

WHAT DOES "FORMAL VERIFICATION" MEAN?

It's possible that before too long, software products will be labelled 'quality verified'. That's because increasingly complex processor architectures, diverse machine and software configurations, and the implications of parallel software, call for a new methodology to prove that software is of high-quality and matches its specification.

Current practice in software development focuses on 'testing'. A good analogy is with building a house, where 'testing' compares how the building looks with an elevation in the blue print, and whether high-level functionalities such as opening the doors match the high-level design of the house. Sometimes that's good enough, but increasingly it isn't - because the demands of complex software and end-user requirements are increasing as well.

However, there's a glimpse of hope, as a methodology called 'verification' is adopted more and more in software development. "With increasingly complex software, we need a formal and automated methodology that allows operating system developers to do the necessary verification," says Stephan Tobies, a software development engineer who leads the development of verification tools at the European Microsoft Innovation Center in Aachen, Germany. "Bugs get harder to find. By using a mathematical approach, we can prove the absence of certain bugs." Again, using the analogy of building a house, it means checking that what has been built matches exactly with what is in the detailed building plan, including all the plumbing, electrical wires and reinforcements that are not directly visible.

For the development of software, this idea means that if there is a precise specification for software, it is possible to check with logical methods whether the software code fulfils the specification. Every single step of the software code is broken down into logical expressions and is checked to confirm that conditions described in the specification are met.

This approach to proof of correctness allows for much more accuracy compared with simple tests which only check examples of the system's behaviour. However, this kind of proof is hard to automate. Thus, computational proof methods are primarily used today for mission-critical systems such as aircraft electronics, and the impact on the overall software industry has so far been limited.

ACADEMIA AND INDUSTRY JOINING FORCES TO WORK ON REAL-WORLD SOFTWARE PRODUCTS

Microsoft and the University of Saarland in Saarbrücken, Germany, have joined forces in a programme supported by the German government to develop formal verification of software to a new level and to foster the role of this methodology in the software industry. The project VERISOFT and its successor VERISOFT XT aims at the creation of methods and tools for automated formal verification of software.

The collaboration of Microsoft's verification research groups in Redmond, USA, and at the European Microsoft Innovation Center (EMIC) in Aachen, Germany, with Wolfgang Paul, professor for computer architecture in Saarbrücken, Germany, who is the scientific project lead for VERISOFT XT, fascinates both sides.

Professor Paul had already used mathematical theory to verify small operating system kernels with 5,000 lines of code in the project VERISOFT. For their collaboration, the partners chose a real-world product, the Windows Server 2008 'Hyper-V', to be verified – software which acts as a super-operating-system that can run different operating systems on one computer [see accompanying box]. With Microsoft on board, the research project was now tasked with verifying ten times the amount of code, about 50,000 lines, something Professor Paul says hasn't been done before – hence his view that this collaboration is a key milestone.

Prof. Wolfgang J. Paul, Saarland University, Germany

Stephan Tobies, Software Design Engineer, European Microsoft Innovation Center (EMIC)

Thomas Santen, Software Design Engineer, European Microsoft Innovation Center (EMIC)

This second phase of the VERISOFT project, called VERISOFT XT, started last year, with both parties, Microsoft and the University team in Saarbrücken, keen to combine their knowledge and tools. Professor Paul remembers jumping at the chance to apply his research on validating complex computer software to a real-life operating system. "It was like a childhood dream, to work with Microsoft Research and EMIC on the Hyper-V with the aim of removing all programming errors," says Professor Paul.

"Our task at EMIC is to collaborate with academia for mutual benefit. This project is one of the few exceptions where verification technology is being applied to a real product. This is a major step forward for the whole field," says Thomas Santen, a software development engineer who leads the verification group at EMIC.

THE WAY FORWARD – LOT TO BE DONE, AND LOTS OF OPPORTUNITIES

The verification of hardware has advanced greatly during recent years, but software verification has to catch up, and will do so rapidly. Professor Paul emphasises the enormous potential of this approach, given that much of the theory in computer science and mathematics has already been developed and is ready to be applied: "This is not technology in its infancy. We are shooting with all that we have; all theories will be applied." At the same time, today's mathematical models are lagging decades behind the state-of-the-art of current computers and software. "The textbook theory isn't developed enough to deal with multiple processors running in parallel and complicated memory systems," Professor Paul says. "We have to close this gap." Also, the complexity of tackling the hypervisor's code running on high-end parallel processors, such as those from Intel and AMD, is creating the need for more efficient tools to handle the sheer amount of code.

According to Stephan Tobies, "Being able to verify the Hyper-V is still an order of magnitude away from the verification of a full operating system. The work could be extended to verify certain parts of the Windows operating system in the future, such as the memory manager of the Windows operating system, which, by itself, is already more complex than the complete hypervisor."

"Eventually it may be possible to verify complicated application programs as well," says Professor Paul, who adds that the Verisoft XT project aims to establish a new software industry.

In the future, we may see 'correct' software in the sense that it fulfils its specification. But there may still be 'misbehaviours' of software, in situations where the requirements of the software or the conditions of its use for the environment or the users are not adequately described, such that the specification does not match reality. But we are nearly there ...

For more information see **www.microsoft.com/EMIC**
EMIC has openings for experienced scientists/engineers:
http://www.microsoft.com/emic/joboffers.mspx

WHAT IS THE HYPER-V?

Hyper-V is a hypervisor, which serves as a virtualisation feature to enable multiple guest operating systems to run at once on the same machine. Hypervisors first emerged in the mainframe world, but they are having a renaissance in main stream computing because advances in hardware capabilities leave many powerful servers idling most of the time – time that can more beneficially be spent serving other tasks for other users.

Running multiple operating systems allows the consolidation of servers and getting more work from a single system, reducing costs through less hardware, energy and management overhead. Hypervisors also help to improve the computer system's security and reliability by providing isolation between its guests. This ensures that a crash or security breach of one guest does not compromise the other guests although they all share the same hardware.

"Most of the time the server isn't fully booked, so it makes sense to run different tasks on the same server at the same time," explains EMIC's Thomas Santen. "But you have to make sure the different tasks don't interfere with each other." When multiple operating systems access the same memory at once, it is the Hypervisor's task to ensure that these accesses do not interfere with each other.

Hyper-V is in beta test. It will be sold both as part of Microsoft Server 2008, which started shipping in early March, and as a stand-alone product starting this summer.

Mateo Valero, Director of the BSC

BARCELONA SUPERCOMPUTING

CENTER AND MICROSOFT CREATE JOINT RESEARCH CENTRE FOR PARALLEL COMPUTING

On 18 January 2008, Microsoft and the Barcelona Supercomputing Center (BSC) announced the creation of the BSC – Microsoft Research Centre, which focuses on the way microprocessors and software for the mobile and desktop market segments will be designed and interact over the next 10 years and beyond.

The advent of many- and multi-core processor computing architectures will make it possible to deliver enormous computational power on a single chip, with profound implications for the way software is developed. Researchers from BSC and Microsoft are addressing the challenges and opportunities that massively parallel processing presents, and are specifically focusing on optimising the design and interaction of hardware and software architectures to take advantage of the new computing power.

Futures recently asked Mateo Valero, Director of the BSC, about the work of the BSC-Microsoft Research Centre.

QUESTION: It is becoming increasingly impossible to build faster processors; and at the same time, more miniaturisation of processors brings heating problems that possibly we are not able to handle. Is the innovation of computing hardware and with it, computing itself, slowing down?

MATEO VALERO: We narrowly averted crashing onto a wall head-on: the power-density wall. It was a narrow miss, the thousands of engineers that worked on cancelled processors can testify on that. We can talk about other walls as well: the memory wall, the Instruction Level Parallelism (ILP) wall, etc. The way around those walls is multi-core architectures with many processors running in parallel.

So now, rather than having one monolithic fast processor, you have 128 processors. Each of those processors is definitely much smaller in area, dissipates much less power and is somewhat slower when compared to the large monolithic way. However, it is the aggregate performance that matters. You break down a large problem into 128 smaller problems that can then be executed much faster in parallel – and then you have a winner. We will also see more heterogeneous architectures; and high performance processors will adopt a systems-on-chip approach with many specialised cores; those architectures will likely reorganise themselves based on application needs.

Multi-core architectures open up new horizons. You can do neat tricks such as over-clocking the frequency of some cores even beyond the single core Thermal Design Power (TDP) limit; whereas if most cores are idle, you will still be substantially below the chip TDP. In this era, it becomes possible to run today's supercomputing applications on those hundreds of cores on chip; but we need further research into how the interconnection mechanisms influence this mapping. This is one of the topics we are working on in the Barcelona Supercomputing Center (BSC).

QUESTION: If getting a large number of processors to run in parallel is a way out, isn't it limited by how many we can get to run in parallel? And doesn't it become increasingly complicated for engineers to develop software that matches the requirements of those systems with many processors?

MATEO VALERO: The aim is to apply latest concepts from research in computer science, such as transactional memory. It also means that theoretical concepts from computer science and programming concepts will guide the design of processors. For a single application, we are limited by Amdahl's Law, i.e. by the inherently serial section of the application. More research is necessary at both the algorithm and application levels, since we always come up with penalisations of sub-problems that we thought were inherently serial before.

There is increased pressure on the software engineers to write code that efficiently utilises those new many-cores. We can say that if we leave things as they are, we may be facing a new wall: a software efficiency or performance wall. The key to scaling this wall is to overhaul the way we design processors. Processor design in the many-core era needs to be driven by software needs and requirements. Theoretical concepts from computer science and programming concepts will be the stars in this new era - for example, transactional memory. Hardware support for transactional memory enables software developers to write many-core code more efficiently.

Sophisticated run-time environments will provide an abstraction layer between the computer hardware and infrastructure on the one hand and the application layer on the other hand. However, it is important to shield the complexities of the hardware from the programmers. Carefully thought-out programming models could lead the way to making the life of the programmer easier. At BSC, we are working on programming models such as the Cell Superscalar which makes it easier to parallelise applications for one of the current multi-cores, the Cell Processor.

QUESTION: It seems that, by combining software concepts and hardware architecture with the software concepts guiding hardware design, software and computer science innovation is at the edge of an exciting era. Do you agree?

MATEO VALERO: Absolutely, the old Chinese curse 'May you live in interesting times' is our motto. I believe that we are witnessing another revolution in computing, one that will fuse software and hardware researchers firmly together in holy multidisciplinary matrimony forever! We are certainly proud to be one of the contributors to this revolution.

WHEN COMPUTERS COME TO THE AID OF MATHEMATICS

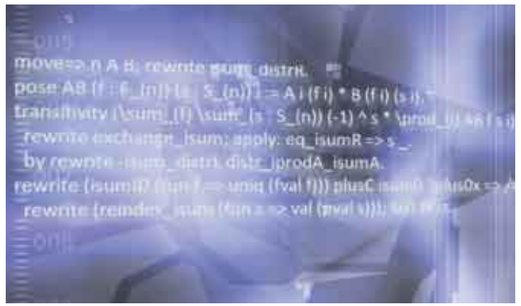
Georges Gonthier, Senior Researcher, Microsoft Research Cambridge

"Mathematics must make a great leap forward": this is the challenge that Georges Gonthier has set himself.

Since the autumn of 2006, the Microsoft Research Cambridge researcher has been leading the 'mathematical components' project at the joint research centre set up by Microsoft and the French National Research Institute for Computer Science and Applied Mathematics (INRIA). The 13 researchers working on the project are tackling the thorny problem of computer proof, which proves that a mathematical demonstration is thoroughly accurate. A problem that, according to Gonthier, "becomes increasingly difficult as the theorems become more complex."

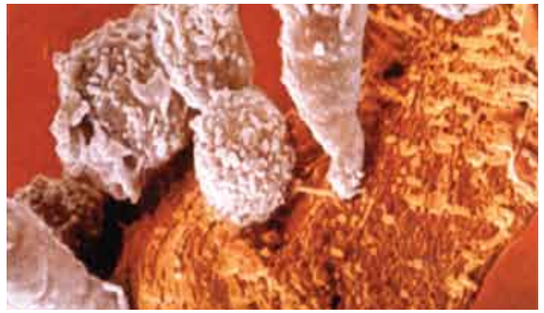
To achieve their ends, the research team is developing a computerised representation of mathematical theories. In other words, a detailed description, not only of this theory, but also of the way it is used, that will enable a computer to automatically check the accuracy of the theorems. It's a field where much remains to be done.

"In most cases," says Gonthier, "when mathematicians describe a theory in an article or a paper, they present a formal description, but they do not explain how to use the theorem." With this work, Gonthier, a former INRIA researcher, is continuing research that started at the beginning of the new millennium: in 2005, he was the first to demonstrate by computer the Four Colour theorem,



which states that regions on a map may be coloured using no more than four colours in such a way that no two adjacent regions are of the same colour. Gonthier's present work takes some inspiration from the unprecedented development of software components, which was made possible by modern computer languages.

The joint Microsoft/INRIA project aims to foster the use of increasingly sophisticated formal mathematics. Ultimately, it will improve the certification of software - with possible applications including air traffic control, radiotherapy and banking. "Today, the construction of proof is done in a rather 'artisanal' way," observes Georges Gonthier. "Our aim is to provide proof that the theories used are reliable, rather than assuming this is the case based on the authors' fame or the claims made for the product."

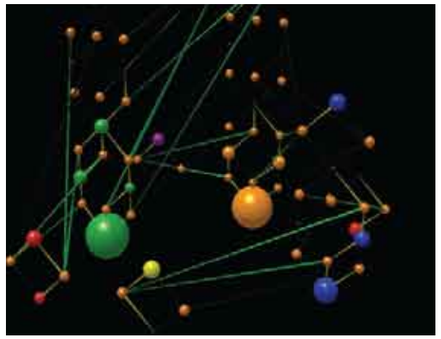


Electron micrograph of a swarm of cytotoxic T cells (white) attacking a tumour cell (orange)

A LIFELINE FOR SYSTEMS BIOLOGY

It is a fact universally acknowledged: the pharmaceutical industry needs a new drug development paradigm. Systems biology promises the ability to place drug targets in the overall physiological context - offering a possible route out of the destructive cycle of spiralling R&D costs and low productivity that is hitting the pharmaceutical industry – but it will take new tools and programming languages to underpin the vision of computerising biology.

By Nuala Moran, Science|Business



3D simulation of a protein cascade, which acts as an ultrasensitive switch (using Network 3D)

'Divide and Conquer' was the rallying cry of molecular biologists over the past five decades, as organisms were broken down into their component parts and each studied minutely. A wealth of knowledge, no doubt, but in the past ten years the ultimate – practical – value of such baroque detail has been called into question. Or rather, it has become evident that understanding discrete biological components is a staging post, and not the ultimate destination.

Nowhere is this better illustrated than in the pharmaceutical industry, where the marriage of combinatorial chemistry, high-throughput screening, and the torrent of new targets unleashed by sequencing the genome and proteome has fomented a huge increase in productivity in the discovery phase.

However, as Adriano Henney of AstraZeneca plc told delegates in a keynote address at the Future Challenges for Systems Biology conference in Tokyo in February, "This has not been matched by success in development, with a number of well-publicised failures recently of drugs in later stages of the development pipeline."

The point was reinforced by Kenneth Kaitin, Director of the Tufts Center for the Study of Drug Development, who noted the US Food and Drug Administration approved just 16 novel drugs in 2007 – the same number as in 1983. Speaking at the American Association for the Advancement of Science meeting in Boston on 16 February, he said, "The industry is spending a lot of money to bring fewer and fewer drugs to market." Thirty years ago when the Tufts Center first examined the cost of getting a new drug on the market the price tag was $54 million. Last year the (inflation adjusted) price was $1.3 billion.

Why has the increase in productivity in the discovery phase failed to translate to more approvals? At the margins are issues such as increased scrutiny and risk-aversion on the part of regulators. But the essence is a lack of understanding of novel targets beyond the isolated snapshot captured through the reductionist prism of molecular biology.

According to Henney, current evidence indicates the main reasons for failure of compounds directed at such novel targets are preclinical toxicity, lack of clinical efficacy and inadequate clinical safety. "In combination these factors account for up to 60 percent of development project failures," he says.

What is missing from genomics and proteomics targets is an in-depth understanding of their place within the overall biological system, and the part they play in triggering, maintaining and progressing disease.

The march of molecular biology has reached the point where we can look inside cells and see how molecular components meet and greet each other. This molecular communication underpins all biological processes, and is analogous to communication within computer networks. The central challenge of systems biology is to take the individual components of molecular biology, capture the dynamics of their interactions and form them into end-to-end physiological pathways, tissues, organs, and ultimately, complete organisms.

The vision has been further accelerated by technological advances in the computer industry which make it possible to produce systems that are as large, complex, scalable and distributed as the practical application of systems biology will demand.

As yet, researchers are nibbling around the edges, but there are projects that give a flavour of what will be possible. For example, one of the major reasons why drugs fail in clinical trials is liver toxicity. Hepatosys, a German project started in 2004, aims to understand all the biochemical processes taking place in human liver cells and use this as the basis of a computer simulation of the liver that can be used for virtual screening.

Liver toxicity not only leads to drug candidates failing in development, it is also the most common reason for drugs to be withdrawn from the market. ALERT, a pan-European project funded by the European Union's Seventh Framework Programme, began work in February on a computerised system to detect adverse reactions. A key objective is to distinguish false alarms and to do this, ALERT will develop in silico models and simulations of the behaviour of drug and biological systems.

Meanwhile, at least a dozen efforts are under way worldwide to build virtual models of cells to predict both the beneficial and harmful side effects of a new drug.

But if the failure rate of drugs in development exposes one thing, it is that current generation simplified models are a liability. Drug candidates are failing both because the complexity of the pathway in which the target is involved is unknown, and because there is barely a drug in the formulary that only works on one target.

Researchers at Microsoft are turning their attention to the development of a new generation of computing tools designed specifically for systems biology.

On the one hand, this says that models and simulations need to be constantly reinforced with data from 'wet' experiments to increase their predictive power. On the other hand, it exposes the shortcomings of the tools that are available for developing models.

One approach that is starting to make a real difference is based on a simple, yet revolutionary observation: if biological systems have the same characteristics as large and distributed software systems, with processes running in parallel and data passed from one process to another, then we could use the same techniques that have been developed for a long time to do software engineering – programming languages and development tools – in order to re-engineer and model biological systems.

Based on this assumption researchers at Microsoft are turning their attention to the development of a new generation of computing tools designed specifically for systems biology. Heading this push is the University of Trento / Microsoft Research Centre for Computational and Systems Biology at the University of Trento in Italy, directed by Corrado Priami, and other colleagues at Microsoft Research in Cambridge, UK.

They are currently dusting down Pi-calculus, a parallel processing programming language, and adapting and enhancing it to meet one of the key requirements of systems biology – the ability to capture concurrency.

The variant Stochastic Pi-calculus developed by Priami can assign rates to interactions and has been used, for example, to simulate the well-known RTK MAPK pathway involved in gene expression, and in cell cycle control. A further variant, Ambient Calculus, developed by Luca Cardelli and Andrew Gordon at Microsoft Research in Cambridge, can be used to represent molecular localisation and compartmentalisation.

Meanwhile, Jasmin Fisher, also of Microsoft Research Cambridge, is using a new way of modelling biological systems in which all processes and biological states, and transitions from and to them, are represented as an executable set of instructions. This so called 'Executable Biology' technique also has the advantage of ensuring that models and predictions are testable and verifiable.

Building on his colleagues' work on Pi-calculus, Andrew Phillips at Microsoft Research Cambridge is developing the Stochastic Pi Machine (SPiM), a simulator that can be used to execute models of biological systems.

Phillips is applying SPiM with collaborators at Southampton University to model aspects of the huge information-processing machine that is the human immune system. The researchers want to model one of the key pathways, MHC Class I antigen presentation, in which the immune system signals that a cell is infected by a foreign body, such as a virus, and marks it out for destruction.

Eventually, says Phillips, it should be possible to build a library of independent modules that can be plugged in to create any biological system. Such an approach has the advantage of hiding complexity from the user and accommodating the fact some elements of a system may not yet be understood, allowing new information to be added without compromising what went before.

"You could take these modules and change them without affecting anything else in the system," says Phillips. "You can test hypotheses by taking a module and plugging it in elsewhere."

The irony, of course, is that molecular biology's divide and conquer approach also turns out to be the fastest and easiest route to reconstructing biological processes in silico.

GENOMICS AND PROTEOMICS: THE EMERGING ROLE OF MACHINE LEARNING

Computing and communication technologies have already had a massive impact on today's healthcare system. Even so, there is great potential for these technologies to not only improve, but profoundly change healthcare in several ways.

Sensors and mobile devices have entered into our everyday life, collecting information about our environment and ourselves. For the ill, elderly or people with disabilities, wireless sensors in the environment or attached to the user's body enable analysis of vital information, rapid detection of emergencies, and increased independence and personal freedom.

The amount of data collected through sensors, clinical tests and scientific experiments is vast. The intrinsic information in this data can most often not be observed by the human eye. It requires sophisticated statistics, and computers that apply the statistics and learn about the specifics of particular data sets while processing, which we call 'machine learning'.

My genes – my health?

The Human Genome Project resulted in the mapping of the human genome. One of the most surprising outcomes of this project was that the number of genes that carry information for each person is only about 25,000 – it is hard to believe that this relatively small number of genes can explain the complexity of a person's body and mind. And yet it is small differences in these genes, and in other regions of the genome that control how they are used, that create the many variations of mankind. Unfortunately, some of these genetic variations can lead to a person having a much higher risk of getting certain diseases.

"Common diseases such as cardiovascular disease, cancer, obesity, diabetes and psychiatric illnesses are caused by multiple genetic and environmental factors," says John Winn from Microsoft Research in Cambridge (UK). "Understanding how these factors interact with each other would allow better prevention, diagnosis and treatment of these diseases. It would allow personalised treatment based on the genetic make-up of the patients. Almost all existing approaches for studying the genetic causes of disease look at the effects of a single gene, and thus cannot capture the subtle interactions of many genes and the environment."

Microsoft Research Cambridge is collaborating with researchers at the Wellcome Trust Sanger Institute to investigate how genetic variation affects disease. Data is key: the genetic information from the International HapMap project and from experiments at the Sanger Institute drives the understanding of the biological mechanisms involved.

"We are integrating two data sources: on the one hand, the variation of the gene sequences and, on the other hand, gene expression data, which means how active the genes are in the cell," says John Winn. In fact, recent results from the project show that more subtle relationships between gene variation and gene expression can be detected than was previously possible.

John Winn is very enthusiastic about the value of this research: "Our goal in this joint project with the Sanger Institute is to analyse these multiple sources of genomic data using machine learning tools developed at Microsoft Research. By combining the expertise of the Sanger Institute and Microsoft Research Cambridge, we aim to gain new insights into genetic networks and the pathogenesis, diagnosis and treatment of human disease, whilst also driving the development of machine learning tools usable by the wider scientific community."

The Case of the Bloody Fingerprints

The blood contains a very diverse mix of proteins – and this mix varies across the population. There are many individual differences; however, there are also protein patterns that correlate with specific diseases.

This is the basis for a new type of diagnosis. A new test would check for these protein patterns, often referred to as 'fingerprints', and could then detect diseases in very early stages, long before symptoms are apparent, early enough to reduce costs and negative impacts that would be imposed in late-stage treatments, and increasing the likelihood of the patient's recovery.

In 2003, an article in NATURE on such a test for early-stage cancer diagnosis drew much attention and we saw the rise of the age of 'Clinical Proteomics'. However, the results at that point were unreliable and NATURE commented "Running before we can walk?" The reason for the setback was that the specific fingerprints of diseases were still unknown. Identifying these fingerprints means comparing the common protein patterns of those who are affected by a disease and those who are not, and then extracting the difference.

To accelerate research in identifying fingerprints in blood serum, mathematicians from Freie Universität Berlin and DFG Research Center MATHEON, medical scientists from University Hospital in Leipzig and computer scientists from Microsoft Research have joined forces.

"We think that reliable identification can be achieved along two dimensions: latest statistical techniques and a high number of patients," says Christof Schuette from Freie Universität Berlin. Doctors collect health status data of thousands of patients, including the protein mix in blood serum through new and standardised methods. This creates lots of new data, and one could imagine the value of a worldwide repository that medical scientists would contribute to and statistical analysis would benefit from.

The data of the protein mix is collected through highly complex machines, mass spectrometers that fire at blood serum samples with a laser. The fingerprints that the researchers are looking for are overlaid and hidden by many tiny molecules, some of which are fragments that emerge when the laser is fired, often referred to as 'noise', but some of this 'noise' includes molecules that are worth detecting.

"The most important point is: we don't accept noise, we still search for information in that region which others reject as noise," says Christof Schuette.

A reliable identification of that pattern in research and later its detection in clinical tests is not easy, but the results of this joint research project are very promising: The resolution of the identification of patterns could be increased by 40-fold. Researchers will continue looking for fingerprints that identify if a person is affected by a disease, accelerated by this improved 'magnifying glass'.

"We are planning to extend this approach to include even more data sources, such as genomic information, to create what we call a BioPrint," adds Tim Conrad, a researcher in Schuette's group. With this 'multidimensional fingerprint' it might become possible to detect even more types of diseases in early stages than possible with current state-of-the-art techniques."

Prof Schuette and part of his team

EUROPE'S DIGITAL FUTURE: THE CHALLENGES AHEAD

Panel discussion: The Digital Lifestyle has arrived. Is Europe ready?

The Lisbon Strategy's aim is to make the EU 'the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010'.

It highlights the need for Europe to play a leading role in innovation and focuses on better policies for the information society facilitating the transition to a knowledge-based economy, stepping up the process of structural reform for innovation and competitiveness, an upgrade in the necessary investment in R&D, and the reduction of red tape in the promotion of entrepreneurship, growth and jobs.

In line with the strong innovation thread of the Lisbon Strategy, Microsoft designed Innovation Day around the concept that global businesses, governments, academia and start-ups can work together on innovation and promote the already existing talent in the ICT sector and software economy in Europe.

Speaking at the 4th Innovation Day in Brussels in December 2007, Jean-Philippe Courtois, President of Microsoft International, in reference to the key value-added measures laid out by the Lisbon Strategy, made the point that although Europe may count 7 of the 10 leading countries in ICT, contributing 25% of GDP, technological breakthroughs bring serious security implications for an online digital lifestyle. While the Lisbon Strategy is key in highlighting the role of innovation in the future of Europe, the panel discussion at the event chose to look at the issue from a different angle. Through a lively panel discussion that focused largely on the online gaming community, high level stakeholders debated the issues surrounding technological advances and rising security risks in the new digital age.

Gaming highlights one of the modern world's biggest security issues: child safety. How do people protect their children from the virtual world of the internet?

Two main points were made: Robbie Bach, President Microsoft Entertainment and Devices and Alexander Alvaro of the European Parliament both spoke of the essential need for parents to have the tools to be able to manage how their children are interacting with content and entertainment online; and that grading systems which allow parents to judge the appropriateness of games available to their children would only work if they adhere to a common standard already in place for companies such as Microsoft Xbox, Nintendo and Playstation.

These issues of online child exploitation were not only discussed, but the new technologies developed to combat such crimes displayed in an exhibition accompanying the event; amongst others, the Child Exploitation Tracking System – CETS.

Microsoft worked in collaboration with international law enforcement agencies to develop the system so that police agencies could communicate in real-time and work together in the investigation of online child exploitation.

The system is now being implemented across Europe, with Romania becoming the latest EU country to sign up. And the programme's success can be directly judged by more arrests and convictions against people who try and use the Internet to lure or harm children.

In a broader keynote address, former Vice President and European Commissioner for Justice, Freedom and Security Franco Frattini focused on the challenges of new technologies and the issues they raise in relation to cyber crime, and most importantly child protection, saying: "Cybercrime and child abuse have sadly become common crimes. However, technology can also help us to tackle problems. Cybercrime comes in many forms, but one of the biggest issues it raises is that of child safety."

Mr Frattini emphasised the important role of education in the fight against cyber crime. New technology leads to a constantly evolving situation, but can also have a role to play in fighting cyber crime. Mr Frattini highlighted the importance the Commission places on Privacy Enhancing Technologies (PETs) saying that the Commission "will provide money for data protection and privacy projects, studies on PETs' economic benefits and standards for using PETs."

"We are committed to building critical partnerships with others to help Europe meet its most important goals," concluded Jean-Philippe Courtois. "It has become evident that technology plays an increasing role in accelerating economic growth and promoting development."

Jean-Philippe Courtois, President Microsoft International (left); Franco Frattini, former Vice-President and Commissioner for Justice, Freedom and Security (centre) and Robbie Bach, President of Microsoft Entertainment and Devices (right)

Innovation Day exhibition

After debating some of the key points of the Lisbon Strategy at Innovation Day, Microsoft takes the next step in the challenge to make Europe a leading knowledge economy at the upcoming SME Day. In its fourth year, the event on the future of Entrepreneurship in Europe will highlight some of the points raised by Mr. Manuel Pinho, Portuguese Minister of Economy and Innovation, at Innovation Day.

Four particular areas were mentioned during the Minister's keynote address which will be debated on June 12th in Brussels; namely the need to reduce the burden of administrative costs for SMEs; improving skills; facilitating SME access to the external market; and promoting modernisation and technology.

Find out more about SME Day at www.smeday.eu.

Trainees in the Business Through Computers course at FIT's Springvale Learning Centre in Belfast

INNOVATION IN IT TRAINING: THE FIT APPROACH IN IRELAND

Working with Ireland's most disadvantaged communities, the Fastrack to IT (FIT) is a successful example of an industry initiative which brings together government organisations with companies such as Microsoft to couple IT skills with a structured programme to help individuals to secure full-time employment. The initiative enables the unemployed and people with low or no education qualifications to acquire the skills necessary to compete effectively in the increasingly knowledge-based economy.

For more than a decade, Michelle Donegan focused on raising her three children. However, as they grew older, she found herself wanting to go back to work. Intent on improving her job prospects and finding employment, Michelle chose to enrol in the FIT 'Business Through Computers' course offered at the Springvale Learning Centre in Belfast. "I had been unemployed for nearly 13 years and I didn't even know how to turn on a computer," Michelle explains.

Through FIT, Michelle has become proficient in word processing, databases, spreadsheets and computerised accounts, and she is also applying these skills in an office setting every week. Michelle is one of more than 6,000 people who have changed their lives by participating in FIT training programmes, and she hopes to join the more than 4,500 FIT graduates who have gained successful employment as a consequence of the IT skills learned through FIT.

Assisting the long-term unemployed to enter the workforce is the primary objective of the Business Through Computers course. FIT offers 20 different ICT curricula covering themes such as office administration, design, PC maintenance, networking, programming and web design. To facilitate career development, FIT incorporates CV development and interview training into the curriculum, and provides ongoing career support for a period of up to three years.

Paul Rellis, general manager at Microsoft Ireland, explains: "Microsoft first partnered with FIT in the 1990s when the project was focused on addressing the high levels of unemployment in Dublin city. It quickly became apparent FIT had pioneered an innovative partnership approach to solving the issue of long-term unemployment and social inclusion." FIT's focus on employability has a strong alignment with Microsoft's corporate citizenship goals and programmes: "Microsoft was one of the first companies that expressed an interest in social and economic inclusion and digital inclusion," says FIT CEO Peter Davitt.

Currently, the FIT programme is looking to expand across Europe, and there is already a pilot project underway in Finland. Paul Rellis explains: "The fantastic thing is that this partnership model is completely portable. FIT have successfully expanded their services to centres across Ireland and Northern Ireland, and are bringing the programme to the rest of Europe. That expansion is a testament to an industry initiative that is solving a real social need."

A trainee in the Latvia@World project being congratulated on completing the training

SUPPORTING LATVIA'S INNOVATION ECONOMY THROUGH TECHNOLOGY TRAINING FOR SMEs

Through its Digital Skills for SMEs program, the Latvia@World project is providing special training for small and medium sized enterprises and enabling entrepreneurs to make use of the latest technologies, thereby enhancing their business skills and overall competitiveness.

Through a network of community technology learning centres, the Latvia@World initiative, coordinated by the Latvian Information Technology and Telecommunications Association (LIKTA), aims to help the Latvian populace learn the ICT skills required to live and work in a knowledge-based economy. Microsoft provides grants, software and training resources to nine centres across Latvia.

The Digital Skills for SMEs programme is a feature of the Latvia@World project, as Sandis Kolomenskis, Country Manager of Microsoft Latvia, explains: "This project continues the expansion of Microsoft's Unlimited Potential-Community Technology Skills programme. Acquired technology skills will help to provide equal opportunities to everyone and to raise productivity in small and medium enterprises. ICT as a tool is important to every SME in order to keep it up to date and competitive in an ever changing market."

Planned to launch in 2008, the SME training programme will adapt Microsoft Unlimited Potential curriculum modules to enhance the IT skills of people working in marketing, records management, medicine, tourism, the service sector and construction. As well as teaching core skills on the handling of information such as saving, transmitting and archiving data, the curriculum includes modules on the Internet, text processing, spreadsheets and presentations.

CURRENTLY, 273 EMPLOYERS, EXECUTIVES AND STAFF, REPRESENTING 170 SMES, HAVE ATTENDED initial seminars for the new programme; while pilot programs in two Latvian cities, focusing on doctors and medical workers, have generated very positive feedback and highlighted key areas of IT in which professionals in these sectors are most interested.

Based on this and other feedback, and with the help of dedicated partners, the existing Microsoft UP modules will be extended further. In partnership with Hansa Banka Latvia, a special chapter on SME internet banking (including direct connection to accounting software) will be developed, while a chapter on e-business and e-commerce will be designed in collaboration with the Latvian Ministry of Economy.

Under the SME training scheme, Latvia@World is aiming to train 5,000 individuals across the country. This ambitious goal is supported by the Latvian government, and strategic corporate partners such as Microsoft, which provides important expertise and training to LIKTA.

Currently, 15 Unlimited Potential training centres exist in Latvia, of which 9 receive grants, software and training resources from Microsoft. "As an NGO we do not have enough funds to finance a project of that scale," says Imants Freiberg, President of LIKTA. "We have developed a very special cooperation with Microsoft Latvia because Microsoft aims to promote a knowledge-based society and so do we."

Food supplies are unloaded from an ASF plane in the Democratic Republic of Congo

FLYING HIGH: A TECHNOLOGY VOLUNTEER'S STORY

Ali Tarabit has been a volunteer with the charity organization Aviation Sans Frontières (ASF) for almost three years. With his help, ASF has revolutionised its office operations, improving its efficiency and opening up new possibilities.

His story illustrates how much valuable impact any Microsoft-led volunteering initiative can have on local communities.

When Paris-based Microsoft employee Ali Tarabit received an e-mail about the company's employment involvement programme, he already knew that he wanted to work with an organisation that makes a practical impact on the lives of disadvantaged people. Inspired by his African heritage, Ali Tarabit chose to support Aviation Sans Frontières (ASF), which provides NGOs in Africa and beyond with airborne transport to facilitate the dispatch of rescue and emergency aid in difficult access areas.

With the agreement of Microsoft France management, Ali has spent two days a week for the past three years working with the ASF office team based at Paris' Orly airport, from where the organisation's missions are co-ordinated. Since his arrival, he has been lending his support to setting up a new IT system for ASF. When he joined, the organisation was relying heavily on paper-based work. Consequently, communication between ASF's more than 2,500 member organisations was slow and difficult to co-ordinate, and aircraft safety checks were based on paper documents which had to be reviewed frequently to ensure safety standards.

Since the arrival of 35 new computers, half of them sponsored by Microsoft, and ten new servers, the ways in which ASF operates have changed beyond recognition. The arrival of e-mail communication and access to a shared electronic calendar means that planes can be booked more quickly by NGOs in need, leading to faster turnaround and more efficient services - which can often literally be a lifesaver for those dependent on aid and transportation.

In addition, the digitisation of data means that aircraft can be more easily serviced and parts in need of exchange can be identified quickly, improving aviation safety. Furthermore, ASF now has access to a constantly expanding database comprising past and current projects, which allows the organisation to analyse and review its performance, set itself new targets and undertake new projects.

One of these new projects, to be rolled out soon, is the e-aviation scheme, which allows French children from schools in disadvantaged areas to spend a day at ASF, learning about the basics of aviation and career options in that sector. A total of 30 PCs, equipped with flight simulation hardware and software, enable the aspiring pilots to take part in a 'virtual mission'. As a teacher leading a pilot group remarked: "The training day is a tremendous opportunity for us to get these children interested in geography, maths and physics: our teaching job begins where ASF's project ends."

ASF ground operations have undergone a small revolution, and Ali Tarabit believes this is just the beginning. Soon, the arrival of new SharePoint servers will allow ASF to run joint operations with similar organisations in other European countries, jointly raising the profile of their services. "It will enable us all to get connected and bond. I am very proud to be working with people that bring such passion and dedication to a job that makes a real difference everyday," says Ali Tarabit.

Ali Tarabit's story is just one of many successful volunteering projects which are undertaken at Microsoft, and the new Microsoft Employee Volunteering Program is expected to generate many more successful partnerships which will make an important contribution to local communities in the future.

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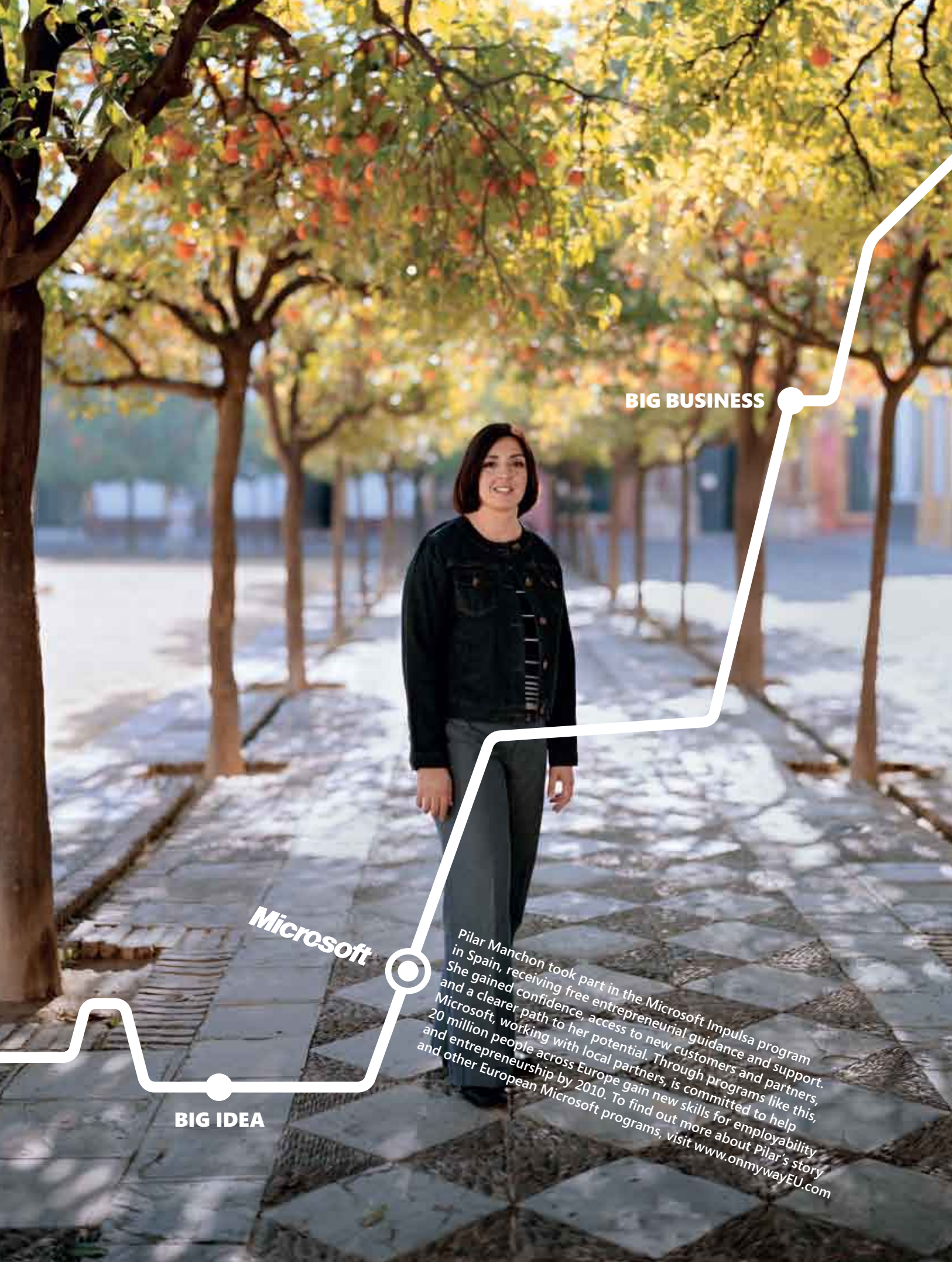
The advent of mobile devices has not only drastically changed the way we communicate, it's also changing who we communicate and collaborate with in our social environment – both within existing communities such as families and workplaces, and by creating new communities as well.

Following the acceptance and adoption of the Personal Computer as 'one-tool-can-do-it-all' in the past decade, today the number and variety of small and specific-purpose computing devices is ever-increasing and, seemingly, limited only by the imagination; a trend in which Europe is at the forefront.

New tools and devices have already radically changed the work environment and more change is on the way:

Digital books and libraries not only allow for much more rapid and broader dissemination of information, with huge benefits for those who lack access to traditional information channels, but will also change the way that books are published and libraries operate.

Work environments for high-skill science & engineering jobs will embrace computing devices more than today, providing a unique opportunity for these jobs in Europe.



Pilar Manchon took part in the Microsoft Impulsa program in Spain, receiving free entrepreneurial guidance and support. She gained confidence, access to new customers and partners, and a clearer path to her potential. Through programs like this, Microsoft, working with local partners, is committed to help 20 million people across Europe gain new skills for employability and entrepreneurship by 2010. To find out more about Pilar's story and other European Microsoft programs, visit www.onmywayEU.com