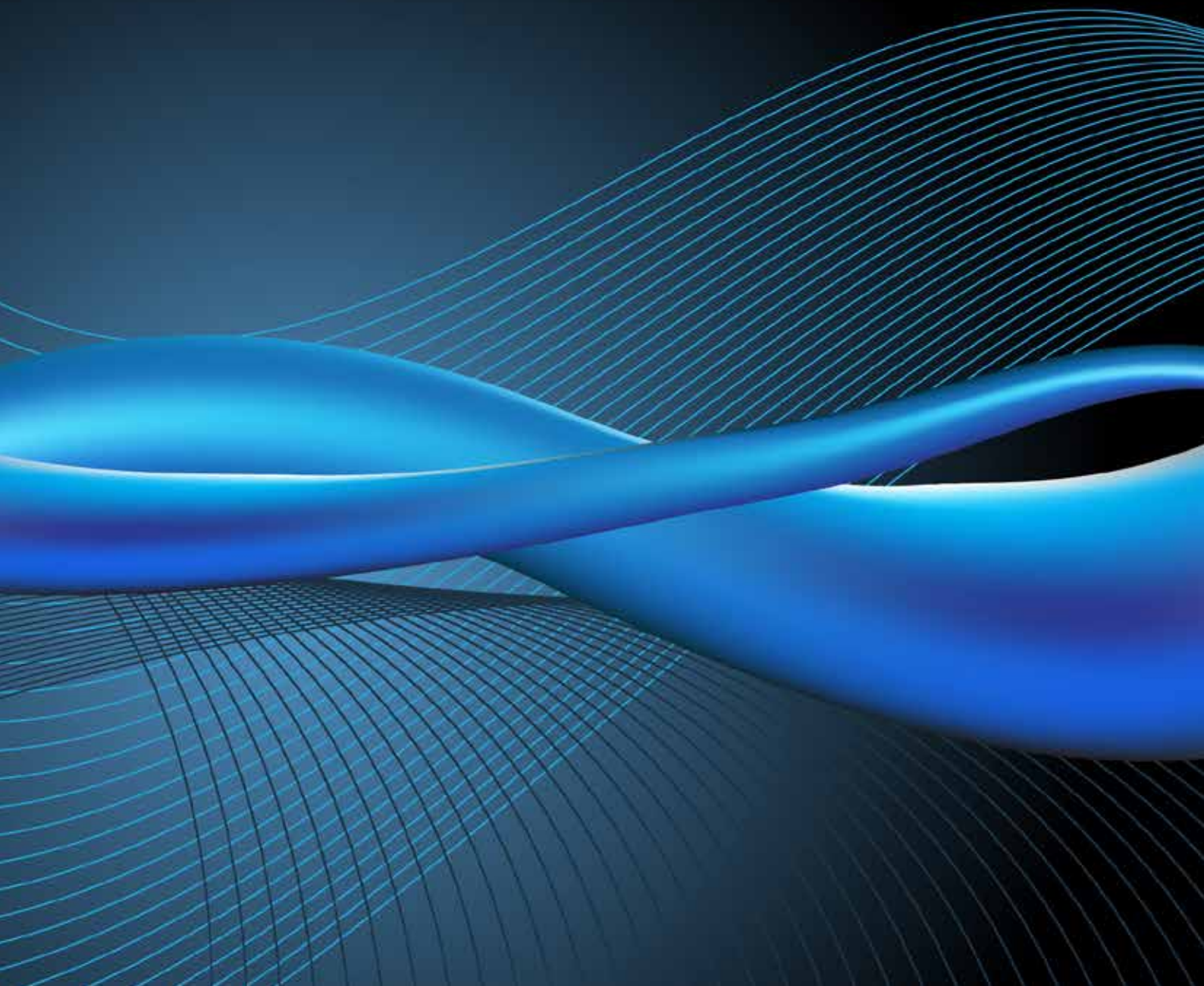
SCIENCE|BUSINESS

Views of 2030:
Transport, health, manufacturing and education

A foresight report for the Science|Business Network



In October 2014, members of the Science|Business Network of universities and companies met in Berlin to compare notes about the future of four key sectors in Europe. This is what they see coming.

Table of Contents

Chair of the Science|Business Foresight Group and Editor of the report
Daria Tataj, Founder & CEO, Tataj Innovation

tataj innovation

Contributors
Richard L. Hudson, CEO & Editor, Science|Business
Éanna Kelly, News Editor, Science|Business
Muriel Desaeger, General Manager, Technology, Trends Analysis Division, R&D, Toyota Motor Europe NV/SA

Design
Giulia Biasi

Photos
Yehuda Swed, Bigstock

Printer
PMR

Part I. Distributing the future more evenly

"The future is already here — it's just not very evenly distributed." William Gibson

The world is changing fast. Research and innovation policies in industry and academia need to focus on many aspects of socioeconomic change – in demographics, resource consumption, consumer expectations, technological disruption and more. Many experts are studying these problems separately, but in Berlin on October 6th, 2014, Science|Business gathered leading members of its university-industry network from across Europe to share their knowledge and debate how these changes will affect their industries and disciplines. In short, what will Europe 2030 be like for its leading companies and universities?

The ambition of the Europe 2030 Science|Business Foresight Report is to capture insights that emerged during the expert roundtable session that day in Berlin. The value-added of this foresight exercise is its fresh perspective on selected industries, rather than a comprehensive analysis. These new insights could form a frame for subsequent discussions of required policy actions to better prepare for the future.

The meeting participants expressed their opinions about the future, emerging trends, disruptive technologies, business models, discontinuities, and social challenges. They debated and questioned their assumptions, perceptions, knowledge gaps and biases which shape the strategic decisions they take as leaders and influencers, and thus shape the world of tomorrow.

The expert discussion revolved around the following key questions:

1. What are the major changes in business, technology and society that will affect Europe by 2030?
2. What fundamental innovations are likely to originate in Europe and affect the world by 2030?
3. How will these societal changes or innovations affect core industries such as transport, value-added manufacturing, education and healthcare?

The debate was co-hosted by Daria Tataj of Tataj Innovation, and Richard Flaye, Chairman of Science|Business. The discussion was introduced in the context of emerging mega-trends. Some of them, presented later, originate from a new book by Tataj, 'Innovation and Entrepreneurship. A Growth Model for Europe beyond the Crisis', with a preface by Manuel Castells.

Major trends in business society and technology

Emerging mega-trends	Challenges and opportunities for Europe in 2030
Growth of middle class: opportunities & risks	1. Working population in Europe will decline by 21 million by 2030 2. Radical shift in workplace will require new work design, organisational structure, and leadership style
'Blue sky' research	1. 21st century will be defined by convergence of difference disciplines, with research in biology as a key component 2. Main research directions: human brain and next generation robotics
Disruptive technologies & disruptive business model	1. Growth will be based not on cutting-edge technology but on business model innovation 2. Business model innovation will be driven by growing social networks including networks of suppliers, producers, customers, users and employees
Complex systems: integration & volatility	1. Events at the peripheries of the network could cause a failure of the complex system and change the logic of whole industries 2. But the system could just as quickly rebound
Digital society: communication & power	1. Content will be available on-demand and produced by users 2. Mass self-communication across horizontal networks with interactive virtual and real-time exchange will empower individuals

Megatrend 1. Growth of the middle class: opportunities and risks

The size of the global middle class is expected to increase dramatically by 2030. This growth will be driven primarily by emerging markets; the middle class in the Asia Pacific region, for example, will become bigger than the US and Europe combined by 2015 (World Bank). This trend will create huge consumer markets and drive economic growth creating, in the process, growth opportunities for European companies as well as universities.
In contrast to the positive demographic and development dynamics in emerging markets, Europe will face a number of demographic challenges: a shrinking population, ageing society and a shortage of qualified labour. As of 2013, the working population in Europe stopped growing and by 2030 it is projected to shrink by 21 million (Eurostat). This will affect consumer trends, market size and employment.

Despite high unemployment, 40 per cent of employers in the developed world say they face difficulties in finding the right talent to match business needs (OECD). Europe-based organisations will face radical shifts in workplace design, agility of employees and leadership styles. Managing diversity and exploiting multicultural talent will be key challenges. These workplace shifts will lead to a call for more innovation and different organisational designs. To face demographic challenges, the European Union (EU) will need to deploy new policies regarding youth unemployment and mobility, education and life-long learning, gender diversity, inclusion, emigration and retirement.

Megatrend 2. 'Blue sky' research

In terms of research as a driver of industrial growth, physics and chemistry were especially important in the past. The 21st century will be defined by research in biology. Basic biological research, with a strong focus on human biology and metabolism, will merge with ICT technologies, genetics (full genome sequencing, all the 'omics technologies), nanotechnologies, and probably also photonics.

The coming decades will be shaped by the process of converging technologies through interdisciplinary developments across physics, chemistry, biology and health. New technology platforms will drive industrial development where scarcity of resources and societal challenges prevail. The social challenges will shape the research agenda through public funding mechanisms.

Megatrend 3. Disruptive technologies and business models

Technology-driven innovation – meaning new products or services are invented simply because the technology permits them – no longer provides companies with a sustainable competitive advantage; instead, successful innovation happens in a continuous dialogue between what people want and what technology can supply (think of the iPod or iPhone). Innovation, which serves people and societies, fulfils the needs of markets and is able to create a "tipping point", disrupting something fundamental about a market, an industry or a society. The consequences will be varied. It may lead to higher contributions to R&D by the

private sector, an increased concentration of high-tech manufacturing or a smaller average size of manufacturers. It may lead to more start-ups or spin-offs in fast-emerging sectors, or higher R&D intensity in small and medium-sized companies (SMEs) so they can expand internationally.

This trend in innovation is mirrored by the natural life-cycle of an industry. The core competencies in the traditional manufacturing industries came from patents, hardware technologies, and technical know-how. Applied research and innovation still define new configurations for products, systems, processes, or services. Adopting outcomes of the scientific and technological research and building new solutions on top of the existing technology is a natural maturing process of an industrial sector. However, as industry matures, its technology often becomes a commodity and the differentiating competencies come increasingly from its service components, switching the innovation paradigms from product innovation to service innovation and experimenting with open innovation models. All this affects business models, of course. And successful innovators are increasingly taking advantage of many new kinds of business networks to help them develop the right models. These networks include:

- Suppliers' networks: manufacturing is organised around networks of subcontractors - often SMEs, as in South East China and the Romagna district of Northern Italy.
- Producers' networks: co-production cooperatives allow the pooling of resources (production capacity, human resources, finances) in order to integrate across value chains and offer solutions rather than products or components;
- Customers' networks: client management, including marketing, sales, and partnerships with distributors and resellers, takes place through combined real and virtual channels where costs are lowered;
- Users' networks: online social networking sites provide interactive spaces for community building, user-driven innovation, and learning, thus diminishing the cost of marketing research, and increasing the speed and quality of innovation;
- Employees' networks: flexible, part-time, labour-sharing management practices are based to a large extent on the company Intranet;
- Strategic alliances: a network of companies engages in temporary, contractual collaboration agreements in various business projects, which allows them to share information and jointly develop new knowledge and technologies, especially at the pre-commercial stage. Strategic alliances offer companies optimised value chains and access to market segments;
- Standards coalitions: networks of companies engage in standards-setting for an industry, as in telecommunications, which allows them to lock-in particular technological or design solutions, thus enabling sharing of generic knowledge, research, and development costs.

Organisations will need to learn how to innovate better and faster. For this they should look into leveraging open innovation environments and deploying new organisational cultures and leadership styles. Rather than excelling in designing innovation processes, they will need to find creative ways to turn into vibrant innovation-driven, open and entrepreneurial community cultures.

Megatrend 4. Complex systems: integration and volatility

The world is more complex – quite literally so, with greater inter-dependencies among more parts of a global economy. The results: Volatility is up on financial markets, economic crises are more frequent. Often, these are triggered by 'black swan' events, highly improbable occurrences, often at the peripheries of networks. How to monitor for and manage them?

The risks of this complexity are illustrated by the recent history of the telecommunications industry. The business model of the industry relied mainly on subscriptions for regulated services. But now, with increasing competition, the telecommunications companies complain that the price for their services is dropping every quarter to a level at which the operating profits do not cover the costs of the existing infrastructure, not to mention investment in a new one. At the same time, the emergence of mobile applications, and in particular of social networking sites, has created a totally new industry with its specific business models taking advantage of the existing telecom infrastructure built before the mobile app boom.

Megatrend 5. Digital society: communications and power

The Internet has transformed traditional communications by the on-demand availability of content on portable devices, and by integrating the virtual into our real life presence. E-mail, blogging, social networking sites, online news, reservoirs of personal photos and vblogs, and Really Simple Syndication (RSS) feeds create a multichannel, multimodal system of digital communications. These systems enable "mass self-communications".

South American "digital Latinos", African women entrepreneurs, and Asian migrant workers are ready to pay a premium for access to the Internet, for the quality of mobile connectivity, and even for the brand of a mobile device – as in the case of an iPhone. Across the world, owning a mobile device often allows consumers to fulfill basic human needs—earning a living, but also belonging to a social group. At the same time, social media such as Facebook and Twitter permit the young generation to construct new social norms and forms of media literacy in networked public spaces. It goes beyond immersion in an experience, toward internalisation of social norms, roles, and values. It defines relationships with others and creates a digital identity.

Free broadband Internet gives access to an abundance of resources. This is an experiential model of learning: contextual, with immediate feedback loops, and peer-to-peer interaction. This leads to a tacit form of knowledge - or rather, knowing how a community of knowledge functions. This instinctive knowledge, digital identity and access to a mass audience turns every individual with a smartphone into a potential revolution leader.

Part II. Industry insights

The emerging mega-trends presented already will create collisions within a number of fields relevant for European industry, academia and policy makers. Some of the most frequent themes linking emerging mega-trends with selected industries are presented below, and reflect the group's discussions in Berlin.

Transport: Commuting across smart cities

2030 Highlights

- While old modes of mobility will continue to co-exist with the new, there will be a change in commuting patterns across European cities driven by culture, demographics and policies.
- Changing demographics, e.g. a growing number of elderly people and 'millennials', will bring about a redesign of public transport systems and cities' infrastructure to embrace radical innovations such as self-driving cars, new concepts of car ownership and a shared economy.
- Digitalisation of city data will allow new services to people.
- Changing work patterns will lead to an emergence of new types of "3rd spaces" – that is, spaces for work and collaboration which are neither home nor office.
- A new value chain for the transport industry will emerge driven by the sharing economy, technological advances and user-driven innovation.
- Up to now, the transport industry has been pushed by regulation. Will it remain like this?

Commuting across a city is most often a question of need, not desire. The ability to commute means having access to opportunities such as jobs, education, daycare, healthcare or entertainment.

Shift in commuting patterns

The key question regarding mobility of the future is how necessary it will be to commute at all in Europe's smart cities. Usually loosely defined, a smart city is an urban organism in which information and communication technologies (ICT) are merged with traditional infrastructures. ICT is used to coordinate and integrate urban systems.

New digital technologies will affect co-existing modes of transportation. We will witness a shift in cultural attitudes spreading across the digital society and manifested by ownership and usage of the means of transportation. This will also fundamentally change how and where cars, trains, buses or bicycles will be designed and manufactured.

By 2030 we will see even greater variety in metropolitan transport than we see even today. We know that it will be still important to commute from urban to suburban areas, and within expanding metropolitan areas. Extrapolating trends of commuting patterns across European cities suggests that various modes of mobility will continue to co-exist with the new. What will change is their share in the total mobility structure. At the same time, there will be differences between cities. This will be due to local climate effects, but also to culture shift, demographics and policies such as fostering green growth. While in the UK, commuting for an hour and a half is not unusual, in Scandinavia it would be virtually unheard of. In Copenhagen, bicycles are the main mode for getting around a city.
In London, it's the Tube, the city's underground artery. In some countries and cultures, car ownership is a matter of social status rather than convenience. In some social groups, the car will remain the main means of transportation. In others, as in the young generation, not owning a car is a value statement.

Changing demographics and mobility

Europe's population is shrinking and ageing, while population and urbanisation in the rest of the world are growing fast. This urban expansion must have implications for all countries.

Europe's cities are structured into urban and suburban areas, and this design has implications for mobility. For example, the growing share of the elderly population that wants to commute independently requires either changing public transportation, or redesigning cars to assist older drivers in analysing data and making decisions.

Advanced commuting technology will affect both the nature of vehicles and the environment in which they are used. The former will include expansion of support functions, such as driver's assistance systems or self-driving cars. The latter will include digitalisation and multimodal functionality of city systems infrastructure, and intelligent networks gathering all sorts of data including traffic control, incidents, safety and security. The technology will also affect the environment: for example, self-driving cars will require city planners to index every city sign and continuously monitor their accuracy.

Changing labour patterns such as telework, flexiwork and part time work will affect commuting. We may also witness the spread of a new type of "3rd space" – that is, spaces for work and collaboration which are neither home nor office.

Sharing economy

Another disruptive trend is the so-called sharing economy. The question is how new business models of car sharing, such as Uber or BlaBlaCars, will evolve in the future. Sharing implies that cars will spend less time idle. Individual car ownership will decrease, but the cars themselves may go through their mileage life faster. That means the cohort of cars on the

road could be, on average, younger – replaced more rapidly because they are used more heavily. The paradoxical outcome: the output of cars sold in the world could remain constant, even though fewer individuals actually "own" one. And the shortening of the life span of cars may have interesting consequences for car design and car manufacturers' operations.

The policy environment

While the automotive industry is interesting to discuss in the 2030 timeline, it should not be analysed as a stand-alone sector but in the context of transportation as a whole value chain. The horizon to 2030 will be marked by many developments in science and technology including energy, big data mining, artificial intelligence and internet-of-things – all of which affect transport. And in Europe, the high cost of energy is a special issue for transport planning. There are great opportunities ahead, for clean energy technologies and new storage breakthroughs. But in the meantime, every time a country like Germany adds more renewables to the grid, energy gets more expensive due to building interconnectors.

Thus, the automotive industry faces a heavy innovators' dilemma, especially in Europe. Europe continues to heavily invest in internal combustion engine systems. This collides with increasing uncertainty as to what will be the split between fuel and electric engines. While technological progress in the energy sector will drive innovation, it is impossible to predict the path it will take. It could evolve into a unique model of minibuses, as seen in Johannesburg, or fast trains, seen in China or Japan. Cities may choose to allow car usage only on a few selected days, returning to the core meaning of a city as a citizens' meeting point.

However, while cities will increasingly become centres of gravity, the countryside will not lose its relevance for the automotive industry. It will continue to cater to the needs of people living outside cities; but the challenge will be how to provide worthwhile jobs for people living away from major metropolitan hubs.

The role of urban planners and policy makers will affect the future commuting experience of European citizens in smart cities. Will every city in Europe require bicycle lanes? Will there be incentives for electric cars? More rewards for people who exclusively use public transport? The depth and speed of changes will depend on a converging effect of technology, business model innovation and changing social values. We know for sure that Europe's future will not be car-centric but multimodal and green.

Key figures:

• Half of Europeans use a car everyday (50%) which is more than the proportion that cycles (12%) or uses public transport (16%) combined.
• Around four in ten Europeans encounter problems when travelling within cities (38%).
• A substantial majority of Europeans believe that air pollution (81%), road congestion (76%), travelling costs (74%), accidents (73%) and noise pollution (72%) are important problems within cities.
• More than half of Europeans believe that better public transport (56%) and lower prices for public transport (59%) would be the best ways to improve urban travel.
• Less than a quarter of Europeans believe that the urban traffic situation will improve in the future (24%) and most believe it will stay the same (35%) or get worse (37%).

Attitudes of European Towards Urban Mobility, Special Eurobarometer 408, December 2013, European Commission

From the Berlin discussions…

• Masaaki Iwasaki, coordinating executive, Toyota: "We're afraid people in future cities won't use cars anymore."
• Matt Ganz, President, Boeing Germany: "The demand for air travel continues to grow faster than the rate of GDP growth. As people enter the middle class they want to travel before they want to own a car or a home."
• Mark Turrell, CEO, Orasci: "Small single-person observations have made big impacts in the past. Today, we need to reflect on what Tesla means for electric cars of the future."
• Patrick Bressler, executive vice president, Fraunhofer USA: "Your next car will be a 'cyber-physical system' – maybe a self-driving google car. It will communicate and exchange data to improve your mobility. How will "Data-Space" or "Big Data" services change our behavior, change our lives?"

Value-added Manufacturing

2030 Highlights

- Value-added manufacturing, or a cyber-physical system with myriad embedded technologies, will reinvent manufacturing in Europe.
- Cost reduction will be achieved by shortening supply chains and time to market, rather than rising production volumes. Consumers will favour made-in-Europe products.
- Thanks to technological advances such as 3D printing, internet-of-things, artificial intelligence, or "brain2brain" communication, Europe will return to its industrial origins.
- Convenience will beat quality. We will witness a move to more personalised / easy to consume products, adaptive manufacturing, and short-batch series.
- Products should be thought of in terms of the services that they can be combined with, using open source manufacturing for cost reduction.
- Europe can lead in the development of standards in this field.
- Talent shortage and inadequacy of skills will become a major limitation to value-added manufacturing in Europe.

Manufacturing plays a central part in the European economy; and with technological advances, Europe has a chance to return to its industrial origins.

One-off mass production

Several trends are changing the nature of manufacturing. First, global sourcing, resources depletion and low production costs have put great pressure on manufacturers. Second, global value chains of interconnected sectors have created something new - what some have called a 'product-service economy": the value of a manufactured product isn't so much in the object itself, but in the services sold around it. For instance, the value of a modern airplane is only partly in the wings and engines; it's also in the servicing. All this coincides with the development of value-added manufacturing: using embedded computing, networking and distributed supply chains to deliver a product, and a service, more efficiently.

The result is a new kind of manufacturing – one-off, mass production. It will allow more and more individualised and personalised products. There will be smaller batch sizes, to the point that a car will no longer be based on mass production but made to individual order. This will encourage lean supply and production chains that can be run at a competitive price. The end product will be a better product, that gives rise to all sorts of different services. At the same time, robotics will become increasingly based on complex and interlinked embedded systems. Robots of the future will also provide healthcare and support for active ageing. In this context, standardisation by 2030 is a window of opportunity for Europe and its 28 member states, which have a tradition of finding consensus.

Returning to industrial roots

The key idea is that value-added manufacturing is an opportunity to reinvent manufacturing in Europe. Approximately 16 per cent to 20 per cent of EU GDP is contributed by manufacturing; yet this sector underpins all services in the extended value chain. It also permits disruptive innovation in other sectors: We wouldn't have the explosive growth in the "app" economy if we didn't also have the smartphones and tablets to run the apps. These and other value-added manufacturing products have already transformed the economic landscape.

Value-added manufacturing will gives rise to resource efficiency and will require a highly educated and flexible workforce to operate it. It will affect people, processes and technology. It will require new skills and work patterns. At the same time, it will be driven by consumer expectations and demands for small batch, individualised, one-off production. In terms of process, it will alter in-factory organisation and influence the eco-systems around a factory affecting sourcing, design and production. The service industry, especially, will face challenges with small batch production and logistics. Value-added manufacturing could give a big boost to open source manufacturing.

Value-added manufacturing ranks at the top of nearly any list of upcoming disruptions to global value chains. Its emergence builds on Europe's highly educated workforce. While there seem to be many opportunities for creating jobs in value-added manufacturing sector, talent shortage and inadequacy of skills will become a major limitation. Europe will have to adapt to and compete with skills outside Europe. Education will become more and more focused, not just on knowledge, but on strategic skills that students need to get a job.

Convenience versus quality

In our future megacities, we could see a new market pattern developing: 'convenience beats quality'. A quickly available and downloadable product or app will beat the product or app which is of higher quality yet requires a gap between purchase and consumption. The expectations towards instantaneous consumption will be a major challenge for product manufacturers and service providers.

From the Berlin discussions…

- Patrick Bressler, executive vice president, Fraunhofer USA: "I think convenience will beat quality. In certain instances it already has."
- Muriel Desaeger, general manager, technology trends analysis division, R&D Toyota Motor Europe: "The success of EU will be in a smart rebalancing of its manufacturing and service competences."

Education: Learning environments of the 21st century

2030 Highlights

• We will witness a dramatic change in the job market, employment models and work patterns - leading to a redefinition of strategic skills and life-long learning.
• Talent shortages and demand for technical competences will push a return to professional and vocational training, devaluing generic university degrees.
• The traditional university model will coexist with hybrid learning environments and hubs beyond MOOCs.
• A funding model for new multidisciplinary research will be radically different and driven by citizens' expectations and industry needs.
• University labs will be more open to industry, SMEs, and individuals, who will have more influence on what equipment to finance.
• Some European universities may remain reluctant to embrace the 'third mission' - that is, to drive economic development, foster entrepreneurship and entrepreneurial education.

Creation of a balanced economy will have to be underpinned by a redesign of the education system. One way to understand education in 2030 is to think about how best to educate people who will themselves be educating the next generation. In such a perspective, we are almost two generations ahead in our thinking.

A key point in the discussion on education in the 21st century is the role universities will play, and how they will embrace research, education and driving economic development. While early schooling is critical since it shapes attitudes for the future and teaches basic skills and habits, a quality university-level education is unquestionably a must-have for European knowledge economies.

The future of universities

Speaking about the university sector in Europe in 2030, there should be a distinction between local, regional, national and global universities. They will increasingly work in quite different geographic and business domains. While Europe had a long tradition of professional and vocational training, a shortage of talent in its job market may create a desire to return to the model of two to three-year training programmes. A new pride would need to be infused in having technical competences, and not a university degree.

It can be foreseen that the job market will change dramatically. People will be working for longer; they will find it necessary to have multiple careers; they may choose to follow diverse professional paths simultaneously; or decide to start working in different areas. Moreover, this employment pattern might span across different countries at the same time, which is one of the benefits of connectivity, both physical and virtual.

A workplace shift

A changing job market and demographics are major drivers of education sector change. With emergent new models of employment, we witness increasingly flexible forms of contract between employer and employee, which is driven on one hand by the requirements of the job market, and on the other hand by the changing expectations of younger generations. The millennials, even more so than Generation Y, demand more flexibility from employers. They value independence, search for meaning rather than purely financial rewards, and are much more open to taking a risky career choice such as self- or part-time employment, or building micro-multinational enterprises and cooperatives.

Despite technological advancement in areas such as robotics and machine learning, it can be assumed that physical location - bricks-and-mortar universities - will still matter for education in 2030. But there will be challenges. First, it is a question of efficiency. Current physical assets are under-utilised, and university directors will want to exploit them longer. Second, there may be an opportunity for technology platforms to become more concentrated and this will come with more opportunities for partnerships between big research focused institutions. Moreover, remote access and distance learning are not appropriate for every scenario. There are psychological and social dimensions to this. On the one hand, parents send young adults away to learn about life, become independent and mature. Socialising with a peer group is important for success on the job market or in business. Lastly, the reason bricks-and-mortar universities are likely to remain is that distance learning cannot substitute the student-teacher interaction or replace the life-enhancing experience that campus life is for most of the students.

Distant learning

The wide dissemination of MOOCs and other remote education programmes will continue. However, while MOOCs often appear good in theory they have limits in implementation and delivery. Their spread and impact will be limited by the fact that, unlike music with a long-tail business model, only a limited number of MOOCs will attract massive audiences; they will rely on the personalities of a relatively few well-paid and entertaining teachers. The future of online education is ‘edutainment’.

There are voices saying that teaching will not stay in universities but will be conducted in hybrid learning environments and hubs beyond MOOCs. It means that different teaching models will emerge and either coexist or to a meaningful degree replace the traditional campus model – even the one supplemented or replaced by distance learning. If this is the case, the result will be a dissociation between research and teaching. Some professors say that even today, this trend can be witnessed. A computer programme scans publications and teaches students better than they do. This could worsen the under-utilisation of university labs today.

Funding research

Increasing the return on public investment in labs, incubators and other innovation facilities is important. A rational solution would be to share existing labs with industry, small businesses

and individual researchers or inventors. This common-sense good practice is not trivial in implementation, since it would require a new system for university administration to be rewarded or punished depending on performance.

The 'crowd' will also affect university research. Let's assume, as many have argued, that governments establish a crowd-funding process for research, and citizens can vote on which projects should get funding. Individual citizens would post their preferences online. For those who do not speak English, their votes will be immediately translated. This process – as far as it concerns EU funding – would be transnational. But if that happens, will universities remain as centres of research in the future? Why should the crowd-voted research happen at a university? A dynamic company, entrepreneur or NGO might win more votes.

From the Berlin discussions…

- Mischa Dohler, Head of the Centre of Telecom research, King's College London: "I believe that in the future, very long term unemployment will be the status quo but have a different societal connotation than today. Exactly. That's only the beginning."
- Tuula Teeri, President, Aalto University: "For me research and education go hand in hand in universities. Research environments in universities will be sustained to give a forward looking education and constant societal and industrial renewal. Vocational training cannot do this."
- Mika Aalto, Ministry of Employment and the Economy: "The border between employment and unemployment will not be a sharp line. I see people who want to work six months and then want to go to the Bahamas for six months. Then come back for more employment. This might be called a freelance economy."
- Patrick Bressler, executive vice president, Fraunhofer USA: "The workforce market will be much more competitive for everyone in 2030. We hope we adapt, but we need to improve education."

Health: Digi-Care and Big Data

2030 Highlights

- Colliding demographic trends will drive technology, new business models and social innovation, creating a myriad of entrepreneurial opportunities.
- Personal data and family data will have value for the development of new medical practices, and for health insurance
- The cost of healthcare services, a shortage of qualified workers and technology advances will lead to radically new business models such as the 'uberisation' of healthcare.
- Hybridisation of healthcare will be a new paradigm, with the automation of procedures, artificial intelligence-assisted diagnostics and machine-assisted care.
- Future healthcare will be based on customised rather than personalised models, driven by big data and integration with the insurance industry.

The healthcare industry is on the verge of a paradigm shift. Medical personnel, patients and technology face the challenge of adapting to radical transformations of the industry value chain. While issues of privacy, data protection, affordability and quality of healthcare polarise public opinion, the digital society, technological advances and entrepreneurial innovations will shape how healthcare services will be provided in the future.

10 truths about the future of health*

Source: European Commission/Kairos Solutions, The Data Explosion and the Future of Health, 2011
**The 'issue landscape' has three main themes; the blue issues are about the transformation of the formal, established healthcare system; the orange are about the data explosion and its consequences for patients; the green are about the new informal system and its relationship to the formal.*

Affordability of healthcare

The cost of healthcare services has been systematically rising, and is currently at the level of 10 per cent of GDP in Europe. If the trend continues for the next 15 years, it will rise to 30 per cent of GDP, meaning it will no longer be affordable for a large number of people. The key question regarding the future of healthcare is then a matter of cost: what factors will or should influence the system to make it at least as affordable as in 2014?

This is a tough problem for Europe, since it faces colliding changes in the population structure. On the one hand, innovation is resulting in people living longer than ever before. On the other hand, baby boomers are ageing. These two trends will have a prime effect on the shape of the future health sector and on market demand for healthcare services. While ageing will be an increasingly salient social and economic problem, at the same time it will drive technology development and innovation.

Digital nurses

Ageing has already increased demand for medical care. At the same time there is a shortage of qualified healthcare workers.

Robotics will be a vital domain which will change the healthcare model. Robots will be expected to take care of non-vital, non-human tasks. We will be able to witness the automation of procedures. Routine tasks in nursing can be done by robots and they may or may not be personalised. While machine-assisted healthcare will become a rule, it will be important that doctors keep some time for human contact – and not just for those who are able to pay for it.

ICT will certainly be part of the solution. For example, IBM has developed an artificial intelligence machine called Watson that can already take in patient data and in many cases provide a better diagnosis than expert medical doctors. That will continue. Artificial Intelligence superiority is based on big data and it will be instrumental in preventative medicine.

Crude data

It's a modern cliché: Data is the crude oil of tomorrow. It can create products and services in a way that has not been experienced before. But there is a danger. Let's assume that a product of a small company is dependent on a cyber-physical system – that is, combining computing and a real-world device. A company like Google, with access to vast amounts of data the device requires, could drive this company out of the market. At the same time, the issue of data protection is a growing public concern that will affect how patient data is used in such devices. In 2030, a key question will be how to connect 'small data' with big data? The individual's data is small; feeding it into a big data system will be a legal and ethical challenge.

Personalised medicine, or rather customised medicine, will be executed at scale in 2030. As of today, the analysis of people's DNA and genomes can provide information on the

probability of a given illness and its cure. Three things will be different in the world of personalised medicine of 2030.

First, family data will become valuable. When a person participates in clinical trials in the future, he or she will not be required to travel to the hospital or lab. All that will be required will be a click on an end-user license agreement to allow data gathered by all appliances and devices to be sent.

Second, insurance companies will become deeply embedded in patients' interaction with the medical system. An insurance company will call a patient to offer a discount in certain cases such as, for example, when a parent agrees to talk to a 'Watson', or sophisticated computer, before taking a child to a pediatrician. In the future, going through algorithm filters before a patient sees a doctor will become standard. As a result, it means insurance companies and doctors will be competing on algorithms.

Third, machines and humans in the medical system will act more closely together than ever before. Doctors will become more like airline pilots in their work. The result will be less human and more machine error. This will create a backlash in society.

A possible response to cost barriers may be business model innovation - a sort of 'uberisation' of healthcare. Sharing at scale demands instant access to information. This touches upon the issue of identity. People may have multiple personalities and a fundamental lack of privacy, which will come as a price to share the cost of medical care. In all likelihood, a data-collecting healthcare company might be founded in a Google lab. A founding team will leave the parent company, raise the €200 million and set up a business like Uber. It is a space that is missing and someone will surely take it over.

From the Berlin discussions…

- Reinhard Busse, head of department of healthcare management, TU Berlin: "Nurses will concentrate on key tasks. Non-vital jobs will be done by robots."
- Ramon Wyss, vice president, KTH: "A comment about healthcare. Take Facebook – what is the value of Facebook? It's the data we supply to the social network. And healthcare, that will go the same direction."
- Pertti Hermannek, PH-Projektmanagement & Beratung: "Healthcare is trust-based. I wonder if I really want to give my data to a private company? Why should I give my data – especially health data – to a company that makes profit with it?"
- Mark Turrell, CEO, Orasci: "When predicting the future, it's good to think: Where did we start from? Some people were early getting smart phones, some were late. Some have Facebook accounts, others have none. The future is likely to be led by the young generation and they have a refined notion of privacy; it's different from someone who's 40 or 50."

References

1. Castells, M. (2008). Notes on Creativity and Innovation. Personal manuscript.

2. Castells, M. (2010). Globalisation, Networking, Urbanisation: Reflections on the Spatial Dynamics of the Information Age. Urban Studies.

3. Chesbrough, H. (2011). Open Services Innovation: Rethinking Your Business to Grow and Compete in a New Era. Jossey-Bass.

4. Cohen, S., and Zysman, J. (1987). Manufacturing Matters: The Myth of Postindustrial Economy. New York: Basic Books.

5. Christensen, C.M., Anthony, S.D., and Roth, E.A. (2004). Seeing What's Next: Using the Theories of Innovation to Predict Industry Change. Boston: Harvard Business School Press.

6. Florida, R. (2004). The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life. Basic Books.

7. Gołebiowska-Tataj, D. (2013). Entrepreneurial Innovation Networks. Knowledge Triangle and Emerging Business Models, Warsaw University of Technology Publishing House, Warsaw.

8. Kharas, H. (2010). The Emerging Middle Class in Developing Countries, Working Paper No. 285, OECD, Paris.

9. Lieberthal, K., and Prahalad, C.K. (1998). "The End of Corporate Imperialism," Harvard Business Review.

10. Manuyika, J. et all, (2013). Disruptive technologies: Advances that will transform life, business and the global economy, McKinsey Global Institute.

11. Megatrends, 2014, PWC. http://www.pwc.co.uk/issues/megatrends/index.jhtml

12. Outlook on the Global Agenda 2014, World Economic Forum. http://www.weforum.org/reports/outlook-global-agenda-2014

13. Pavitt, K. (2005). "Innovation processes," in J. Fagerberg, D.C. Mowery, and R.R. Nelson (eds), The Oxford Handbook of Innovation. Oxford: Oxford University Press.

14. Radiou, R., Prabhu, J., Ahuja, S., and Roberts, K. (2012). Jugaad Innovation: Think Frugal, Be Flexible, Generate Breakthrough Growth. San Francisco: Jossey-Brass. A Wiley Imprint.

15. Redesigning Business Value: A Roadmap for Sustainable Consumption, 2010, World Economic Forum and Deloitte Touche Tohmatsu.

16. Salter, A., and Tether, B. (2006). Innovation in Services: Through the Looking Glass of Innovation Studies. Background Paper for AIM Grand Challenge on Services. Oxford: Oxford University.

17. Taleb, N. (2010). The Black Swan: The Impact of the Highly Improbable. Random House.

18. Tapscott, D., and Williams, A. (2006). Wikinomics: How Mass Collaboration Changes Everything. Portfolio.

19. The Future Role of the Civil Society, 2012, World Economic Forum and KPMG. http://www3.weforum.org/docs/WEF_FutureRoleCivilSociety_Report_2013.pdf

20. Tataj, D. (2015) Innovation and Entrepreneurship. A Growth Model for Europe beyond the Crisis' with a Preface by Manuel Castells, Tataj Innovation Library, New York.

Recommended reading

Transport: Commuting across smart cities

Recommended reading

1. Siemens, Facts and Forecasts: Where Mobility is Going, http://www.siemens.com/innovation/en/home/pictures-of-the-future/mobility-and-motors/urban-mobility-facts-and-forecasts-where-mobility-is-going.html and full dossier http://www.siemens.com/innovation/en/home/pictures-of-the-future/mobility-and-motors/Urban-Mobility-Dossier.html (2014)

2. OECD, Green Growth in Cities, http://www.oecd-ilibrary.org/urban-rural-and-regional-development/green-growth-in-cities_9789264195325-en (2013)

3. McKinsey, Mobility of the Future, http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/automotive%20and%20assembly/pdfs/mobility_of_the_future_brochure.ashx (date unknown)

4. Catapult UK, future cities report https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/337549/14-820-what-are-future-cities.pdf (June 2014)

5. RAND Europe, mapping smart cities in Europe, http://www.europarl.europa.eu/RegData/etudes/etudes/join/2014/507480/IPOL-ITRE_ET%282014%29507480_EN.pdf (2014)

6. Carnegie, Rethinking urban mobility, http://carnegieendowment.org/files/urban_mobility.pdf (2013)

7. Arthur D. Little, The Future of Urban Mobility to 2050, http://www.adlittle.com/downloads/tx_adlreports/ADL_Future_of_urban_mobility.pdf (2011)

8. UCL, Smart cities of the future, https://www.bartlett.ucl.ac.uk/casa/pdf/paper188 (2012)

9. RAND Europe, societal trends to 2030 http://europa.eu/espas/pdf/espas-report-societal-trends.pdf (February 2013) (full disclosure: I was involved in research assistance for this report)

Worth reading

1. BBC Future series, Solving transport headaches in the cities of 2050, http://www.bbc.com/future/story/20130617-moving-around-in-the-megacity

2. BBC Future series, Smart cities: the future of urban infrastructure, http://www.bbc.com/future/story/20131122-smarter-cities-smarter-future

3. McKinsey, the urbanisation solution, http://www.mckinsey.com/insights/public_sector/the_urbanization_solution

4. McKinsey, the smart cities solution http://www.mckinsey.com/insights/public_sector/the_smart-city_solution

5. Eurobarometer survey, Attitudes of Europeans to urban mobility http://ec.europa.eu/public_opinion/archives/ebs/ebs_406_en.pdf

6. Toyota, 2030 Mobility project, https://www.eu-ems.com/event_images/Downloads/Toyota.pdf

7. Co.Exist, The top 10 smartest cities in Europe, http://www.fastcoexist.com/3024721/the-10-smartest-cities-in-europe

Value-added manufacturing

Recommended reading

1. World Economic Forum/Deloitte, The Future of Manufacturing, 2012, http://www3.weforum.org/docs/WEF_MOB_FutureManufacturing_Report_2012.pdf

2. UK Government Foresight Report, The Future of Manufacturing, 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255922/13-809-future-manufacturing-project-report.pdf

3. McKinsey, Manufacturing the future: The next era of global growth and innovation, 2012, http://www.mckinsey.com/insights/manufacturing/the_future_of_manufacturing

4. Atlantic Council, Could 3D printing change the world?, 2011, http://3dprintingindustry.com/wp-content/uploads/2013/05/Atlantis-Report-on-3D-printing.pdf

5. Siemens, The Future of Manufacturing, series, http://w3.siemens.com/topics/global/en/industry/future-of-manufacturing/pages/future-of-manufacturing.aspx

Worth reading

1. The Economist, Factory of the Future, 2013, http://www.economist.com/blogs/schumpeter/2013/10/manufacturing

2. MIT Tech Review, Business Adapts to a new style of computer, 2014, http://www.technologyreview.com/news/527356/business-adapts-to-a-new-style-of-computer/

3. MIT Tech Review, Are Telepathy Experiments Stunts or Science?, 2014, http://www.technologyreview.com/news/532436/are-telepathy-experiments-stunts-or-science/

4. University of Washington, UW study shows direct brain interface between humans, 2014, http://www.washington.edu/news/2014/11/05/uw-study-shows-direct-brain-interface-between-humans/

5. Huffington Post, The future of open source: speeding technology innovation, 2014, http://www.huffingtonpost.com/fred-simon/the-future-of-open-source_b_5479678.html

6. Forbes, Will 3D printing change the world?, 2012, http://www.forbes.com/sites/gcaptain/2012/03/06/will-3d-printing-change-the-world/

Education: Learning environments of 21st century

Recommended reading

1. European Commission, High Level Group on the Modernisation of Higher Education, 2014, http://ec.europa.eu/education/library/reports/modernisation-universities_en.pdf

2. Pew Research Centre, The future impact of the Internet on higher education, 2012, http://www.pewinternet.org/2012/07/27/the-future-of-higher-education/

3. Robert and Toni Bader foundation, Building the future of education, 2014, http://www.aam-us.org/docs/default-source/center-for-the-future-of-museums/building-the-future-of-education-museums-and-the-learning-ecosystem.pdf?sfvrsn=2

4. Microsoft, the Future of the classroom is here, 2012, http://www.microsoft.eu/2012/04/26/the-classroom-of-the-future-is-here/

5. Dominik Antonowicz, Europe 2050. New Europeans and Higher Education, 2012, http://www.academia.edu/5891445/Europe_2050._New_Europeans_and_Higher_Education

6. European Commission, Global Europe 2050, 2012, http://ec.europa.eu/research/social-sciences/pdf/global-europe-2050-report_en.pdf

Worth reading

1. The Economist, The Digital degree, 2014, http://www.economist.com/news/briefing/21605899-staid-higher-education-business-about-experience-welcome-earthquake-digital

2. Wired, Why free online courses are still the future of education, 2014, http://www.wired.com/2014/09/free-online-classes-still-future-education/

3. BBC Futures, Future education series, http://www.bbc.com/future/tags/futureeducation

4. Forbes, Fewer Teachers, More Data In The Schools Of The Future, 2014, http://www.forbes.com/sites/nickmorrison/2014/12/18/fewer-teachers-more-data-in-the-schools-of-the-future/

Health: Digi-Care and Big Data

Recommended reading

1. European Commission/Kairos Solutions, The Data Explosion and the Future of Health, 2011, http://ec.europa.eu/digital-agenda/futurium/sites/futurium/files/futurium/library/TheDataExplosionandtheFutureofHealth%5B1%5D.pdf

2. McKinsey, The Big Data Revolution in Healthcare, 2013, http://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/healthcare%20systems%20and%20services/pdfs/the_big_data_revolution_in_healthcare.ashx

3. PwC, Healthcare delivery of the future: How digital technology can bridge time and distance between clinicians and consumers, 2014, http://www.pwc.com/en_US/us/health-industries/top-health-industry-issues/assets/pwc-healthcare-delivery-of-the-future.pdf

4. Robert Wood Johnson Foundation, Health and Health Care in 2032, 2012, http://www.rwjf.org/content/dam/farm/reports/reports/2012/rwjf402050

5. Janssen/ Economist Intelligence Unit, The future of healthcare in Europe, http://www.rwjf.org/content/dam/farm/reports/reports/2012/rwjf402050

Worth reading

1. The Guardian, How big data could be used to predict a patient's future, 2014, http://www.theguardian.com/healthcare-network/2014/jan/17/big-data-nhs-predict-illness

2. Coexist, In The Hospital Of The Future, Big Data Is One Of Your Doctors, 2013, http://www.fastcoexist.com/3022050/futurist-forum/in-the-hospital-of-the-future-big-data-is-one-of-your-doctors

3. Forbes, Creating The Data-Inhaling Health Clinic Of The Future, 2014, http://www.forbes.com/sites/davidshaywitz/2014/10/18/creating-the-data-loving-health-clinic-of-the-future/

4. WSJ, Data Analysis and the Future of Healthcare, 2013, http://www.wsj.com/articles/SB10001424052702304692804577285821129341442

5. Public Health Perspectives, Health in hand: mobile technology and the future of healthcare, 2014, http://blogs.plos.org/publichealth/2014/10/13/health-hand/

6. Hayashi, Ch. Et all (2010). Transforming Pensions and Healthcare in a Rapidly Ageing World: Opportunities and Collaborative Strategies, World Scenario Series, World Economic Forum, 2010, http://www3.weforum.org/docs/WEF_Scenario_TransformingHealthcare2030_Report_2009.pdf

7. Exploring the Future of Cloud Computing: Riding the Next Wave of Technology-Driven Transformation, 2010, World Economic Forum and Accenture, http://www3.weforum.org/docs/WEF_ITTC_FutureCloudComputing_Report_2010.pdf

List of participants, Berlin Roundtable, October 6th, 2014

Mika Aalto, Head of Division, Strategic Growth Branches, Enterprise & Innovation Department, Ministry of Employment and the Economy Finland
Christine Ahrend, Vice President for Research, TU Berlin
Benjamin Brake, Head of the Liaison Office -Director Governmental Programs IBM DACH, IBM Germany
Patrick Bressler, Executive Vice President, Fraunhofer USA
Tim Broyd, Professor of Built Environment Foresight and Honorary Professor of Civil Engineering, University College London
Reinhard Busse, Head of the Department of Health Care Management, Faculty of Economics and Management, TU Berlin
Quentin Compton-Bishop, CEO, Warwick Ventures Ltd
Nicholas Davis, Director, Head of Europe, World Economic Forum
Muriel Desaeger, Senior Principal Technologist, R&D, Toyota Motor Europe
Michael Dobis, Deputy Head, Division 111 - Innovation Policy Issues, German Federal Ministry of Education and Research
Mischa Dohler, Head, Centre for Telecom Research; Chair Professor, King's College London
Gail Edmondson, Editorial Director, Science|Business
Maryline Fiaschi, Director, Science|Business
Richard Flaye, Chairman, Science|Business
Howard W. Fogt, Partner and Antitrust Lawyer, Foley & Lardner LLP
Enric Fossas, Rector, Universitat Politècnica de Catalunya
Matthew Werner Ganz, President, Boeing Germany and Northern Europe; Vice President, European Technology Strategy
Daria Tataj, Founder and CEO, tataj innovation
Pertti Hermannek, Freelancer, PH – Projektmanagement & Beratung
John Einar Hustad, Pro-Rector for Innovation, NTNU
Risto Ilmoniemi, Professor, Department of Biomedical Engineering and Computational Science, Aalto University
Masaaki Iwasaki, Coordinating Executive, Technical Affairs Planning, Toyota Motor Europe
Candace Johnson, President, European Business Angels Network (EBAN)
Éanna Kelly, News Editor, Science|Business
Ross Melzer, Director, Science|Business
Russ Merbeth, Chief Policy Counsel, Intellectual Ventures
Gunnar Muent, Head of Division, European Investment Bank
Kenan Poleo, Regional Director: UK Science and Innovation Network – Europe, Russia and Turkey, British Embassy in Berlin
Maya R. Said, Vice President – Head of Strategy, Science Policy & External Innovation, Sanofi Global R&D
Philipp Schmaelzle, Entrepreneurial scientist, Google, California
Tuula Teeri, President, Aalto University
Isabelle Thizon-de Gaulle, Vice President European Strategic Initiatives & Scientific Relations, Sanofi
Mark Turrell, Founder & CEO, Orcasci
David Urry, Deputy Head Science & Innovation, British Embassy in Berlin
Ramon A. Wyss, Vice President of International Affairs, KTH Royal Institute of Technology
Daniel Zimmer, Director Innovation, Climate KIC

Picture from the dinner held on 6 October hosted by Simon McDonald, British Ambassador to Germany

Academic members

Aalto University, Finland
Chalmers University of Technology, Sweden
ESADE Business School, Spain
ETH Zürich, Switzerland
Imperial College London, UK
INSEAD Business School, France
Karolinska Institutet, Sweden
King's College London, UK
KU Leuven, Belgium
Medical University of Warsaw, Poland
Nencki Institute of Experimental Biology, Poland
Norwegian University of Science and Technology, Norway
ParisTech (association of 12 Grandes Ecoles), France
Politecnico di Milano, Italy
Royal Institute of Technology (KTH), Sweden
TU Berlin, Germany
University of Bologna, Italy
University of Cambridge, UK
University of Pisa, Italy
University College London, UK
University of Luxembourg, Luxembourg
University of Warwick, UK

Industry partners

Boeing
BP
Foley
Microsoft
Biogen idec
Sanofi
SKF
Speedo
Toyota
Nickel Institute

Other members

COST
CERN
ATTRACT
BASTION, FP7 Project
Catalan Association of Public Universities (ACUP), Spain
European Space Agency (ESA)
Innovate UK (Technology Strategy Board), UK
Tataj Innovation