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Shaping Corporate Future through Innovation. Experiences with Corporate Foresight from Europe

Abstract

The knowledge economy is an innovation-driven economy. Crucial for the success of a company is no longer production as such, but to implement innovations sooner and more efficient than the competitors. In the race for innovation, companies use different tools: They integrate foresight into the innovation process, they search for emerging technologies, emerging consumer trends and societal demands, and they promote their own visions. Not finding, but implementing innovations is the decisive task. As a rule, technological innovations have to be accompanied by organizational innovations to become a success.

Within the next decade, the whole wave of innovations will transform almost all industries, including the chemical one. Nanotechnologies and biotechnologies, new materials, new process and fabrication technologies – to mention only some – combine with dynamic consumer markets and the demands for more efficiency and ecological sustainability. In the long run, it is our visions and values which shape the innovations that in their turn shape corporate future.

Introduction

We live in an age of innovations. Every year companies show their competitive edge by putting new products on the markets. Some succeed, some – perhaps even a larger number – fail. Some companies earn windfall profits, others have to struggle with sunk investments, some simply vanish. Is there a formula for success?

First of all, not every vision, not every invention will mature to an innovation. There are hundreds of examples where company researchers had really good ideas – and nothing resulted but frustration. On the one hand, a sure way to failure is insufficient support. Take as an example Germany. My country is praised for its high technological standards, but a closer look reveals a more complicated picture. Originally the fax machine was a German invention, it did however not find any advocates and promoters. Years later this innovation was re-imported from Japan. The same seems to happen with our maglev train, the "Transrapid". After thirty years of experimentation, the first connection was inaugurated in 2003 – not in Germany, in China. Innovations go where they find a promising social environment.

On the other hand, hype is another rather sure way to frustration. Take e. g. fuel cell cars. About ten years ago, car makers predicted substantial market shares for what they called zero emission vehicles: 5 to 10% in 2005. From an ecological point of view, fuel cell cars really are a valuable concept. But technological obstacles and difficulties turned out to be much higher than expected. It will take more time, more money has to be spent... In the

worst case, disappointment leads to the abolition of the whole project. Fortunately, this is not the case for fuel cell cars.

Certain visions follow not just life cycles but hype cycles: From disbelief to hype, from hype to disappointment, from disappointment (perhaps) to real progress.

Another near miss are e-books, electronic books. Already for some time these devices are on the market. They have the size of a paperback and they can display the content of hundreds of books – and despite this advantage nearly no customer is buying them. E-books lack the usual haptic qualities of books made from paper, reading and browsing has to be done not in the usual way, and you cannot put them on the shelf and admire the beautiful back. E-books therefore simply fit not really well into our reading and book-owning habits. Innovations fail if they do not sufficiently fit into our culture.

So at least we have some formulas for failed innovations: underrated inventions, hyped inventions, and last not least culturally unfit inventions.

Drivers of Innovation

Innovations are driven by forces more complex than technology push and market pull. Academics have identified a „seamless web" of actors who drive and shape innovations (Bijker et al. 1987): inventors and company R&D people, entrepreneurs and managers in favor of or prejudiced against certain innovations, customers with their wishes and habits and fears of real or imaginary risks, the administration with its inclination to regulate. Paradoxically, sometimes even regulations give rise to innovations like security belts and catalytic converters in cars.

Surely, the most important driver of innovation is technology itself. This is particularly recognizable in information and communication technologies, which permeate as generic technologies all technical systems and all areas of life, trigger innovations in other technological fields and through which a substantial part of economic growth is created.

While incremental innovations carry with them solely a continued improvement of performance characteristics, revolutionary or basic innovations which are founded on completely new principles represent fundamental, qualitative advances in the development of technology. They can be best described not in trends, but in technological "road maps" (chronological sequences of technological breakthroughs).

Over the past two or three decades we have experienced tremendous changes in the national innovation systems (see Caracostas/Muldur 1998). For a long time, defense and defense related R&D – and therefore public spending – has been a major force behind innovations. As the focus of innovation activities has shifted from the government as client to the private customer, R&D spending has shifted from public research institutions to companies. The defense related technological research race between the Western and socialist blocs of nations has been replaced by an "innovation race" between companies. The USA continues to dominate global innovation dynamics, followed by the EU and Japan. Other Asian nations – and prominently among them India – are attaining increasing significance, taking into account the increasing level of education and the continuing attractiveness to investors. It is therefore a rather sure prediction, that an increasing part of the global innovation activities will take place in Asia.

Shortening of Innovation and Product Life Cycles

Since the markets in the industrialized countries are mostly saturated, major enterprises are attempting to increase and/or safeguard their market share through a process of continuous innovation. At the same time, start-ups are forcing their way onto the market with new products. In both the consumer and business ends of the market, product life cycles have become shorter over the last few decades, and the deciding factor in the success of a product is increasingly its time-to-market.

At the same time, product life – the length of time a product is present on the market – has shortened considerably. In the 1970s these were typically between ten and thirteen years for products from the plant & equipment and vehicle manufacturing industries, but also in the electrical engineering and chemicals sector, whereas in the 1990s this had reduced to five to nine years. The shorter the innovation cycle is, the higher the share of research and development in the value of the product. For new materials and mechanical products the share is about 10%, for electromechanical engineering 30%, and for software and electronics 60%. Products with the shortest innovation cycles have the highest development and market-launch costs. These high costs must however, be recovered during ever-shorter phases during which the products are present on the market. The level of sales which was previously achieved over many years must today – depending upon the sector – be achieved in just a few months or in one or two years at most. Today, the difference made by just a few days or weeks in the market-launch of some high-tech consumer items can decide the commercial success of the product and indeed whether the competitor's product will triumph or not. For this reason, some companies resort to the often risky marketing strategy of the "pre-announcement", making consumers aware of the product before it is actually available for purchase. With software products – and consumer electronics too – the change between product generations is often so rapid that potential customers simply wait for the next or even the next but one generation of the product ("leapfrogging").

According to estimates, the innovation rate, i.e. the share of turnover attributable to new products, is in Europe just above 50%. The proportion of companies introducing innovative products and/or services has increased in practically all sectors, as it has in many other industrialized countries. Two-thirds of German industrial enterprises report that they have implemented product or process innovations in the last three consecutive years.

During the 1990's innovation cycles became markedly faster. The time lapse between scientific discoveries and their practical implementation has shrunk in comparison to the 1970ies to about one half. In other words: The way from fundamental research through invention and development to products has become much shorter. Today, the typical innovation cycle takes around seven to ten years in the modern materials and mechanical products sector, four to six years in the electromechanical industry and less than one to three years for software and electronics. In comparison, the development of the steam engine took 85 years, whereas the transistor only required five years form invention to market (Grompone 1997). Linear extrapolation of the statistical data currently available is however only of limited use: By 2060 the cycle would have reduced to zero! Viewed from a different angle, the quality of historical data and the legitimacy of such comparisons over such long periods of time are questionable. However, it remains certain that time-to-market is only getting faster.

One driving force behind this acceleration is the dynamic competition and the acceleration of development and market introduction processes through information and communication technologies. Firms are engaged in a race against the clock to introduce new products. They rely on the increased effectiveness of innovation processes through, amongst others,

a closer dovetailing of basic and applied research, simulation technology (particularly CAD), rapid prototyping and co-operation between research centers around the world ("global engineering"). In addition, time to market is also being accelerated thanks to new concepts in factory planning (simulation, the "digital factory") and in the construction of production facilities.

Foresight as an Innovation Tool

In recent year, a growing number of European companies is relying on foresight to support their innovation activities: Siemens, BASF, Deutsche Telekom to mention a few from Germany, Philips, Ericsson, British Telecom, Swiss Re, to add some large European ones. Companies like DaimlerChrysler are engaged in foresight since twenty years, Shell has done scenario studies since the 1960s.

In general, foresight is a reaction to the growing complexity of the business environment of companies and the increasing speed of change. But not only corporate foresight is on the up and up, governmental foresight activities are likewise spreading. The reasons for this can be easily named: increasing challenges caused by globalization, and the fear of "dislocation" of industries to emerging economies like India, the central significance of innovation for economic growth and, last not least, increasing uncertainties in the global political environment. A classical foresight field as well for companies and nations is the early detection of emerging technologies, in order to select promising inventions and to support innovation processes. Examples of governmental technology foresight are numerous: Delphi surveys as they have been carried out in Japan since the 1970ies, during the 1990ies they had also a boom in Europe. Since that time the focus has shifted from the classical Delphi studies to more open and continued foresight processes with large participation of industry and public research experts (Martin 1999, Steinmüller 2000). Examples are "British Foresight" and the German research dialogue "Futur". Recently, there has been increasing activity – particularly in the EU – in the field of regional foresight, by means of which regional innovation potentials shall be better understood and furthered to the benefit of integrated regional development.

Foresight as a Knowledge-Based Service

"Foresight can be defined as a systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilizing joint actions." (HLEG 2002: 14) It is not a traditional scientific discipline, we can characterize it as a knowledge-based service for the preparation and support of strategic innovation activities. Its main features are

- Medium to long-term orientation (not the next innovation cycle, but the following)
- Scientifically founded approach (with a combination of futures studies methods)
- Holistic and discipline overlapping approach (including all STEEP[1] areas)
- Clear orientation towards activity

This includes:

- Provision of methods for the perception, analysis and assessment of relevant developments in markets and environments

[1] STEEP – Society, Technology, Economy, Environment, Politics

- Development of scenarios of alternative plans for courses of action, from which strategic decisions can be derived
- Initiation and accompaniment of innovation processes, which not only emphasize technical, but also social and organizational aspects on these innovations
- Organization of internal communication and transfer processes in order to put the future orientation of the company on a wide corporate culture basis

Foresight as an Instrument for Companies

Despite its importance, foresight has no defined place as an individual field of action in most companies (Burmeister et al. 2004). Exceptions like DaimlerChrysler, where a separate foresight unit is in operation for more than twenty years, prove the rule. On the other hand, companies need foresight for dealing with uncertainty and insecurity. It serves as a preparatory instrument for long-term oriented and pro-active action. Foresight offers a useful approach to this, as it follows an action and practice oriented working approach, the focal point of which is networked, inter-disciplinary thinking, oriented towards long-term developments in the business environment with an eye on innovation potentials. Faced with an increasing flow of information of varying quality regarding possible future developments, foresight is occupied with a systematic analysis of social motives (basic trends) and therefore lends a helping hand to the stabilization of corporate development. Principally, foresight simplifies conscious, pro-active future planning concepts or even makes them possible at all. At the same time, foresight helps to open up new horizons and to overcome mental barriers. Empirical surveys (Burmeister et al. 2004) show that foresight can perform these tasks all the better, the deeper foresight instruments are embedded in corporate activity and the better their tasks, questions and results are communicated within the company.

Usually, a foresight-based innovation process runs through the following steps:

- Definition of the task: aims and goals, topical field (so-called “bounding”)
- Analysis of the future business environment and its main driving forces by means of trend analysis and/or scenario construction
- Identification of relevant fields of action (technology fields, application areas) most often by means of a prioritization process
- Finding of concrete ideas for innovations in the selected fields, usually done by brainstorming workshops of different formats or specific creative methods like “visioning“
- Further selection of the most promising ideas, sometimes done in combination with a SWOT[2] analysis
- Elaboration of the innovation ideas in view of implementation, e. g. by means of back-casting and/or the establishment of road maps
- Implementation

According to our experience, the integration of customers (corporate clients, private customers) and stakeholders (e. g. local public, even trade unions) can be crucial for the whole process. Customers know best what they really need, they bring their own wishes and visions into the process. Furthermore, they know best which features of new products or ser-

[2] SWOT – Strengths, Weaknesses, Options, Threats

vices they would use and which ones would only provide obstacles for acceptance. Of course, whether it is possible to invite "outsiders" into e. g. visioning workshops depends on secrecy considerations.

Implementing Innovations

Innovation is the commercial application of knowledge in a new context, it has in most cases a technological side, but in all cases also a social or organizational one. Success of an innovation therefore depends primarily on its social and organizational dimensions. This is expressed sometimes in the "5 C Model" of corporate foresight (Burmeister et al. 2004: 53f; Daheim 2004: 120). This model highlights five factors needed for corporate foresight activities in order to be successful:

- Competence: Competence in methods, contents and processes (with transparency of methods as a central factor)
- Creativity: Deliver inspiring and new results, not only "business as usual scenarios"
- Communication: Find and use new ways of communication apart from reports ("shelf-ware")
- Cooperation: Include a variety of participants in the activity (guaranteeing a variety of perspectives as well as providing better chances of implementation)
- Continuity: Establish a learning culture, adapt ways of working to needs, optimize methods and results continuously

We estimate that about half of the effort of an innovation-oriented foresight process has to be spent on communication, on reaching consensus and commitment. According to our own experience, new presentation tools can be very helpful: from internet sites to comic strips (as in the Siemens magazine "Pictures of the Future") and to short animation movies (Philips "Connected Pl@net"), form implementation workshops to intra-corporate road-shows.

There are many potential obstacles to innovations within a company and in its environment. Problems with intellectual property rights and subsequent litigations belong to these "show stoppers", and lack of consumer acceptance due to wrong market introduction campaigns. But market studies often are not the best means to assess future customer acceptance. Some experts even express it very pointedly: "If you want to kill an innovation, make a market study." Private customers – at least in most European countries – will be hesitant when asked about their acceptance of new products, which are perhaps only described to them in vague terms. They see little benefits, and they fear yet more complexity of their lives. It is much better to organize consumer labs, to let them experiment with models or prototypes. In these labs one can learn a lot about their wishes and habits and about necessary and unnecessary product features. Sometimes even completely new ideas originate.

Since product as well as process innovations usually imply also organizational change, innovations need strong advocates within the company. The most important show stopper is still NIH – "Not invented here", not invented in my unit, my department. You need therefore high-ranking advocates in the company, preferably at the board level. Ideally, these powerful advocates should be well acquainted with the foresight-based innovation process. As a rule we try to make them join the first important workshop and the final stage of the process. Furthermore, the innovation activities should have a formal connection to the strategic planning process. Other factors of success are that the foresight process itself

is transparent and understandable, inclusive for interest groups from within and from outside the company, and a sound combination of quantitative and qualitative methods (comp. Glenn 2003, Introduction: 14f).

The Next Wave of Innovations

According to the theory of the Kondratieff cycle (conceived by the Russian economic historian Nikolai D. Kondratieff in the 1920ies) the world economy is following a cycle of approx. fifty years with phases of fast and slow growth driven by the implementation of ever-new basic technologies. These cycles are regarded as rather stable; even the World Wars only slightly disturbed them. A Kondratieff cycle is divided into four phases:

- Preparation: Scientific discoveries and technical inventions give rise to innovations, which are put on the market by pioneering entrepreneurs.
- Expansion: Growing implementation causes large investments, particularly in new infrastructures. The whole economy is rapidly expanding.
- Decline: Market saturation becomes apparent. Innovation and investment activities decline.
- Recovery: The potentials of the existing innovation are exhausted; the next innovation wave slowly sets in.

Up to now, five Kondratieff cycles have been identified: The first, marked by steam engines and the textile industry had its peak around 1825. The "Railway Cycle" reached its height around 1875. The next one, characterized by electric power and chemicals, came to a climax just before the First World War, followed by a cycle based on electronics, automobiles, oil and plastics, which peaked around 1965. The current cycle is based upon the expansion of communication networks (internet, wireless communications) and TIMES[3] applications. Catchwords such as "information society", "knowledge-based economy", and till recently "new economy", highlight the fundamental changes taking place in society and economy. Althought somewhat controversial, the theory of the Kondratieff cycles provides a useful hypothesis for the long-term replacement of technologies as the engine of the world economy.

One could speculate that a sixth cycle will follow on from the fifth. This "Sixth Kondratieff" (Nefiodow 2001) is likely to be based largely on innovations driven by life sciences. The Human Genome Project was an important milestone to it. As a complement to biotechnologies, the cycle will also be shaped by nanotechnologies, possibly intelligence technologies (neuro sciences) and quantum technologies. Fields of application will be found in the "mega-market" health: medical engineering, pharmaceutical industry, food industry, spa and healthcare sectors, psychotherapy, etc. The high research intensity associated with biotechnology start-ups – mostly by firms that have not yet made the leap from product development to market introduction – allows the conclusion that a new wave of innovation is currently in preparation in this sector. Following the Kondratieff theory, its peak will be reached in about twenty years.

Independently, recent trends in technological development will continue:

[3] TIMES – Telecommunications, Information, Media, Electronics, Security

- Miniaturization of all kinds of technical systems from MEMS[4] to micro-reactors and labs-on-a-chip
- Innovations in the fields of "smart materials" and material design
- Increasing integration of technical systems up to whole infrastructures
- More, mostly wireless, communication between devices, combined with ambient intelligence
- Increasing role of simulation technologies, including the concept of "digital factory"

In general, there will be a shift in emphasis within innovation dynamics over the coming decades from information and communication technologies to biotechnologies. But the most pervasive development is to be seen in an overarching convergence of biotechnologies and physical technologies in the largest sense, of biotechnologies and cognitive sciences with nanotechnologies and information technology. The building stones of the new wave of innovation are as well atoms and bits, as neurons and genes. It is not daring to suppose that molecules will form the bridge between these "four new elements". Profiting from innovations in the nano and info, bio and neuro fields, the chemical industry will be redefined in the next decades from its very roots in molecules and processes to its most far twigs of business processes and market relations (Dröscher et al. 2003).

Winning Through Foresight

"Winning through foresight" is the slogan of the British foresight process. Considering the growing uncertainty, fiercer competition and at least constantly high innovation speeds, foresight instruments will play an increasingly central role in early detection, systematic strategy formation and innovation management.

There is no simple formula for success in foresight-based innovation processes. There is only a rule-of-the-thumb: successful innovations have to be "Murphy-proof". According to Murphy's Law, everything that can go wrong will go wrong. And as a corollary, each project will take twice the time calculated – even if you take this rule into account. Talking no longer with tongue-in-cheek, innovations need support and commitment, they need sufficient time and resources. But innovations are the only way for a company to survive in competition and to grow and prosper.

References

Bijker, W. E. / Hughes, Th. P. / Pinch, T. (eds.): The Social Construction of Technological Systems, Boston 1987

Burmeister, Klaus / Neef, Andreas / Beyers, Bert: Corporate Foresight. Unternehmen gestalten Zukunft, Hamburg 2004

Caracostas, Paraskevas / Muldur, Ugur: Society, the Last Frontier. An European Vision of the Research and Innovation Policy in the 21st Century, Luxembourg 1998

Daheim, Cornelia: "Corporate Foresight: Practical Experience and Results from a German Study", in: CESES Papers 11/2004, pp. 115-124

[4] MEMS – Micro Electro Mechanical Systems, including sensors and actuators

Dröscher, Michael / Festel, Gunter / Jager, Martin (eds.): The Power of Innovation. How Innovation Can Energize the Chemical Industry, Hünenberg 2003

Glenn, Jerome C.: Introduction to the Futures Research Methods Series, CD-Rom of the UNU Millennium Project „State of the Future" Report 2003

Grompone, Juan G.: "The Zeno Event. Science and the Acceleration of History", in: Futures 6/1997, p. 519-31

HLEG (High Level Expert Group): Thinking, debating and shaping the future: Foresight for Europe, Final report prepared by a High Level Expert Group for the European Commission, European Commission, DG Research, April 2002

Martin, Ben: "Research and Technology Foresight in Europe", in: Forward Thinking. Keys to the Future in Education and Research. Conference Proceedings, BMBF Bonn 1999, pp. 47-63

Nefiodow, Leo A.: Der sechste Kondratieff. Wege zur Produktivität und Vollbeschäftigung im Zeitalter der Information. 5th revised edition, Sankt Augustin 2001

Steinmüller, Karlheinz: "Technologies of the future: What can we know? Alternative technological pathways in the 21st century", in: Zenon J. Pudlowski (ed.): Second Global Congress on Engineering Education, Melbourne 2000, pp. 105-110

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