

From Idea to Innovation Success Factors and Challenges in the Innovation Process

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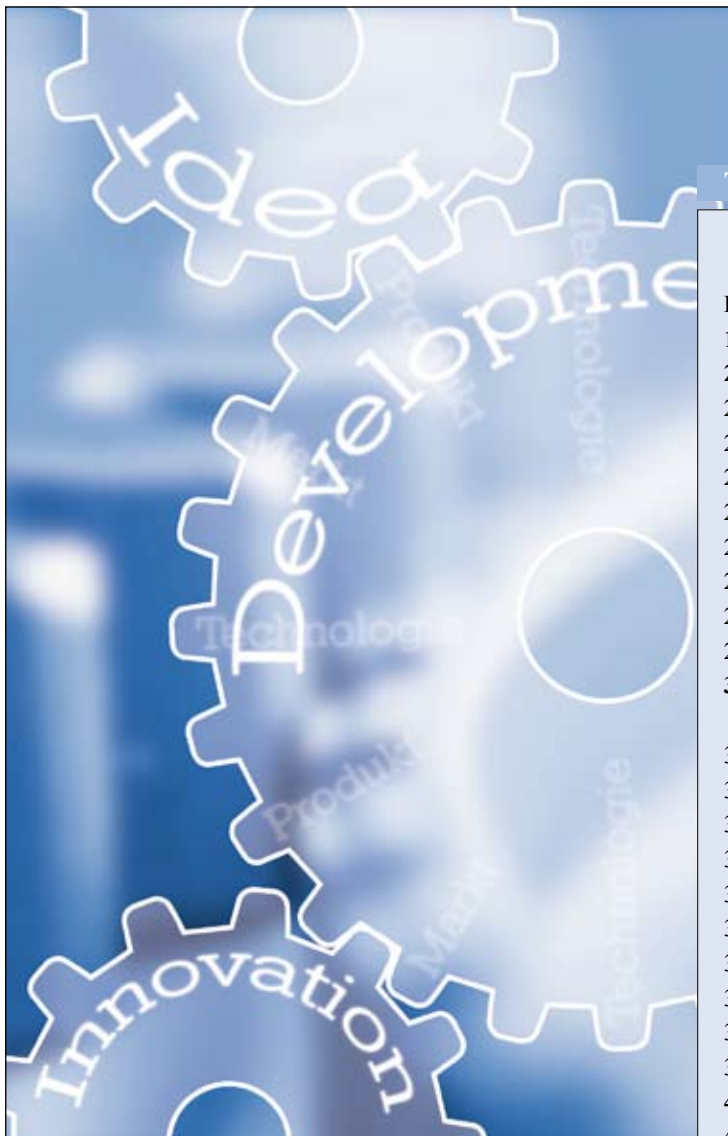


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Dear business partners

“From invention to innovation”. That was the title of the lecture which Dr. Stark delivered at Freudenberg’s annual shareholder meeting on 30 June 2007 in front of a large number of interested shareholders. The theme forms the basis of this edition of FNT Info. In it Dr. Stark very carefully explains the value placed on innovation at Freudenberg – which is also firmly anchored in Freudenberg’s Guiding Principles.

The accomplishments made in the field of innovation clearly show that there is a long, difficult and risky journey to be made between the generation of an idea and economic success, i.e. the innovation itself; and that it is certainly true that the idea forms the pre-requisite for innovation, but that unfortunately only very few ideas result in the desired economic success. The effort and expenditure required to innovate is by no-one so aptly defined as by the famous inventor Edison who said “Genius consists of 1 percent inspiration and 99 percent perspiration”.

The presentation hinted at the challenge that whilst many like to talk about innovation, they recoil from the consequences of putting it into practice, especially when the aim is a so-called “significant” or even “radical” innovation. Schumpeter, who was the first to coin the concept of innovation in the teaching of business studies, speaks in this respect of “creative destruction”, i.e. the planned destruction of that which already exists in order to replace it with something new. This is a painful, risk-consumed and lest we forget, often an expensive process.

The history of our company shows, however, that it is worth making this difficult journey. Freudenberg has proved time and again that new, successful products can be brought to the market, that a leading market position can be consolidated through innovation and that through innovation in technology, the quality and competitiveness of our products can be increased. To put it bluntly: innovation secures the future of our company.

I hope you will enjoy reading this magazine and that it gives you a lot of food for thought.

Yours



Dr. Thomas Barth

1 The Meaning of Innovation for Freudenberg

What has been decisive in transforming Freudenberg from a tannery into a successful, internationally oriented and globally competitive technology company over the last 160 years, were and are the persistent readiness to innovate, and to develop high quality standards, as well as the skills and wealth of ideas of its employees. This striving for innovation is firmly anchored in the “Guiding Principles“ of the company.

“Our established tradition of innovation and renewal benefits our customers. Constant innovation in everything we do is essential for our long term financial success”.

A look back at the history of innovation at Freudenberg supports these “Guiding Principles”. After all, the success story of the company is characterized by the development of new products and technologies. Some of the most important innovations have altered the technical possibilities of entire markets.

Freudenberg’s rise to being a leading supplier of the automotive and of general industry began in 1929 with the production of the first seals made of leather and several years later with the introduction of the legendary Simmerring. The processing of new materials such as elastomers or non-wovens ignited, in the 1950s, the potential for progressive applications. And the current developments, among them nanotechnology, mechatronics and sensor technology, as well as fuel cell technology, already offer the solutions to tomorrow’s needs.

In this paper, the meaning of innovation for competitiveness, its various developments as well as the innovation process itself and the associated challenges will be examined.

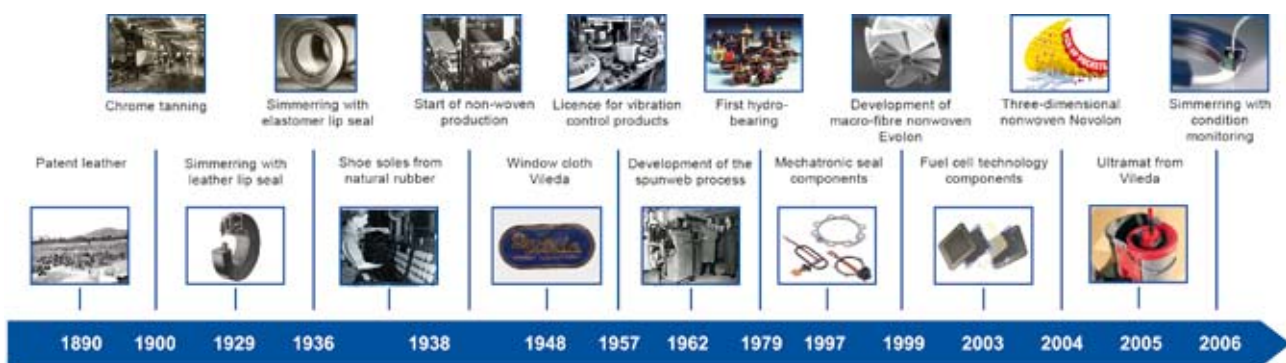


Fig. 1: History of the most essential innovations at Freudenberg from 1890 to 2006.

2 The Journey From Idea To Innovation

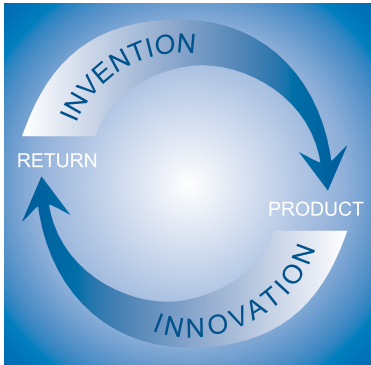


Fig. 2: The cycle of success.

“What does innovation mean for our company?” Even a successful company which has a lot of knowledge and experience about the innovation process ought to ask itself this question on a regular basis. It is only through preoccupation with this fundamental question that we find a new sense of direction that enables us to adapt to change in the market and to new technology with the help of which new, ground-breaking innovations can be advanced and the cycle of success continued.

2.1 Definition of invention and innovation

The concepts of invention and innovation differ from each other in their economic interpretation. The prevailing definition is that of the Austrian-American economist Joseph Schumpeter:

The invention itself is simply the idea, or rather, the first application of a new product or of a previously unknown technology, for example. An invention can be a new idea, a prototype or the tangible development of a concept in the pre-marketing phase. On the other hand, the innovation itself is the successful implementation or application of an invention in the market.

2.2 What characterizes Freudenberg’s innovations?

If we are to explain the concept of innovation at Freudenberg, we need, first of all, to consider the position of the company in the value-added chain. For a traditional supplier, i.e. a manufacturer of semi-finished products, innovation cannot and should not just be a matter of pure product innovation. The essential strengths of Freudenberg and thereby the source of the company’s economic success rather lie in the areas of materials development and process know-how or technology, but also in new processes or services.

“Innovation is the development of new ideas and their implementation to achieve added value for our customers and economic success, through the knowledge and expertise of individual employees or teams at Freudenberg”.

Fig. 3: Definition of innovation at Freudenberg.

The example of the Simmerring clearly demonstrates the meaning of these three dimensions and their correlation with each other. The Simmerring would not be so successful today, had Freudenberg only replaced leather with rubber. The most important factor for success is the core skill of Freudenberg to produce an elastomer, which ideally fulfils the requirements of the respective Simmerring in relation to its special area of application. Essentially, these requirements arise from the environmental circumstances, such as the temperature as well as the mechanical constraints. Running parallel to

the development of the material is the adjustment of process technology. Stringent requirements, for example, in respect of life-span and friction reduction, led to the development of new sealing geometries and a new product design, respectively. The three dimensions of innovation, i.e. product, technology and process are quite clearly illustrated in this example.

2.3 The influence of the technology life-cycle

“What steps does Freudenberg go through from an initial idea to the development of a technology which is ready to go into production or to a product ready for production?” Given that the mastery of a product, material as well as the process technology is vital for the success of the company, this question is perhaps best answered by taking a closer look at the technology life-cycle curve.

Just as any product, every technology, too, is subject to a life-cycle. This comprises the time taken from the first idea, in other words, the emergence of an idea, through the growth and maturity stages to the ageing stage. In the last phase the possibilities for development are exhausted and are at some point replaced by new, more innovative technology. Such a leap in technology can be initiated, for example, by new requirements, price, quality, scarcity of resources, or changing political or economic conditions.

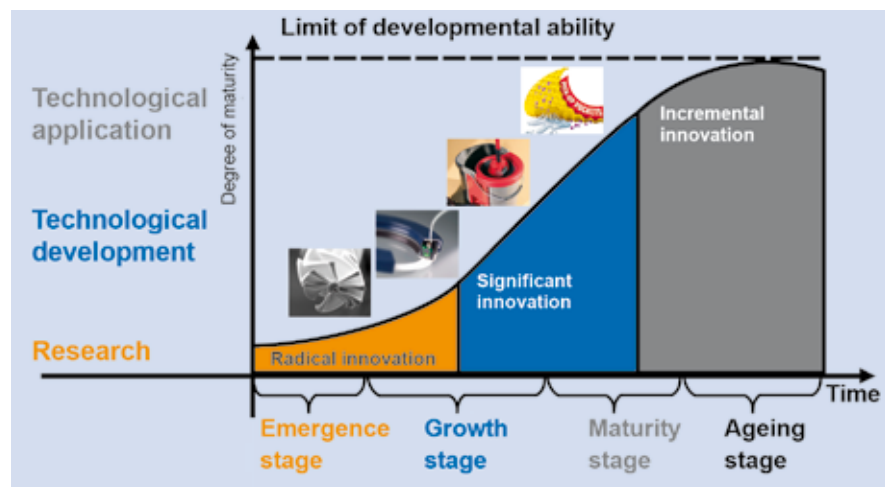


Fig. 4: Life-cycle curve for technologies.

2.4 Categories of innovation

In the field of innovation management, there are generally three categories of innovation. This is also the case at Freudenberg.

2.4.1 Incremental innovation

Incremental innovation represents gradual and consistent further development or rather, improvement of existing products and techniques.

The Business Units at Freudenberg develop numerous products, materials and process technologies on a daily basis in their core businesses. One example of incremental innovation is the Simmerring (see 2.2) mentioned above. A further example is the “leather” window cloth by Vileda, as a result of which Freudenberg Household Products KG (FHP) has brought a considerable number of product variations and new product improvements to the market since 1948.

2.4.2 Significant innovation

If, during the course of technology maturation, clear improvements are achieved through innovation, but no fundamental new technologies or methods are employed, this is known as significant innovation, e.g. materials with clearly improved or additional characteristics.

At Freudenberg, an example of a significant innovation is the use of specially-lined non-wovens in thermal clothing (change face material). Here additional materials are intelligently integrated into the nonwovens, to achieve significant new characteristics, such as automatic heat regulation whilst maintaining the ability to breathe.



Source: Freudenberg Dichtungs- und Schwingungstechnik KG

2.4.3 Radical innovation

Radical innovations leave a previously well-trodden path in the emergence stage through both method and technical improvement.

An example of a radical innovation at Freudenberg is the elastomer multipole encoder, which was developed as a result of collaboration between mechanical engineers, materials specialists, process technicians and electronic engineers. The encoder itself is an active signal transmitter wheel that consists of a metal carrier, onto which a rubber track filled with ferrite particles is moulded. By a magnetization process, a magnetic field can be produced in the elastomer and this is analyzed during rotation using a relevant sensor.

This encoder offers an entirely new performance spectrum as far as precision, assembly tolerances and its limit of application are concerned. Areas of application for this product can be found wherever the speed or the angle of rotation of the rotating machinery components needs to be established with a high degree of precision. As a seal is generally also required in these systems, Freudenberg has achieved a technical leap in the integration of the signal transmitter function in the field of seals using a combination of multipole encoders with Simmerrings.

The Freudenberg Group spent 14 million Euros in the research and development (R&D) of radical innovations in the year 2006, from a total of 204 million Euros, i.e. around 7 percent of the total R&D expenditure. The course of the technological life-cycle curve (see fig. 4) explains why Freudenberg invests so comparatively little in this area. The company operates primarily in technologically mature markets. In this field, however, only those companies are successful which are able to make continual improvements and developments. In other words those companies able to generate significant or incremental innovations remain successful. It is for this reason that the Business Units at Freudenberg put the lion's share of their investment expenditure in this area.

2.5 The influence of the digital revolution

Innovation is influenced to the same extent as product and technological developments change. The digital revolution has consistently had an impact upon the development of the world in much the same way as the industrial revolution 200 years before. The digital revolution is based on the invention of the micro-chip and its steady improvement in performance, the introduction of flexible production automation, computerization in all areas of our lives and the development of global communication networks, such as the Internet.

Gordon Moore, a co-founder of Intel, explains what underlies the development of this digital revolution. According to Moore's Law (of 1965) the number of transistors per surface area of chip doubles every two years. The first successful micro-processor from Intel fitted into a child's hand. Today's processors are smaller by a factor of 1,000 and at the same time are faster by a factor of 10,000.

Not only did the drawing board for the construction of components and manufacturing processes disappear at the start of the digital revolution. Today, all significant developments are digitally processed or rather, simulated, on the computer. Consequently, the developer maintains control of construction data, unit lists, and each minute alteration which is so important for ensuring quality. Meanwhile, it is technically possible for every entitled employee to gain access to product and technological data from every work station worldwide.

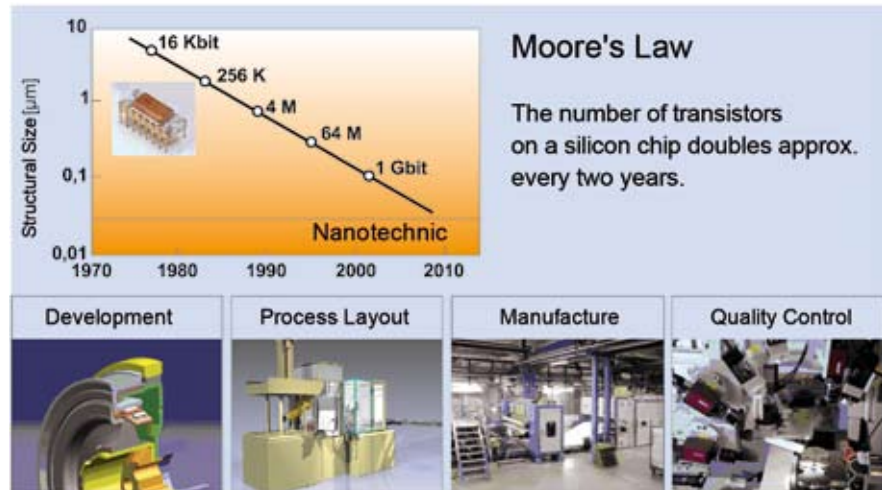


Fig. 5: Digital revolution according to Moore's Law .

Product variety, too, increases continually and at the same rate as products can be modified according to changing customer requirements. Today Freudenberg household products develop and offer 35 percent more products than three years ago. Freudenberg Seals and Vibration Control Technology (FDS) on the other hand currently actively manufactures around 100,000 products with 2,000 production variations. This corresponds to an increase by a factor of 3 in the past years.

It is not only the amount of data and of products that is exponentially increasing. The processes themselves are becoming dramatically faster, which leads to the reduction of a product's life-cycle by one third on average. For example, where the development of a car used to take from between six to seven years, today it is estimated that only three years are needed to production. Where, in 1980, a new model was introduced once every nine years, today it's once in six years. The life-cycle in entertainment electronics is shorter still. Here it reduces by a factor of four, i.e. it reduces from two years to six months. This increase in speed could not be maintained without the foundations laid during the digital revolution.

The speed of production has also considerably increased. In 1970, Freudenberg Nonwovens were producing nonwoven materials at a rate of 25 metres per minute on a basic plant. Due to the use of computers, but also on the basis of improved processes, staple fibres can now be manufactured at a rate of 120 metres per minute and spunwebs at a rate of 500 metres per minute. One can assume a doubling of the production speed every twenty years.

Furthermore quality requirements have also considerably increased, i.e. today, faulty products may no longer be delivered. For suppliers of Toyota the maximum failure rate stands at 20 parts per million of manufactured parts. That equates to one word incorrectly spelt in one volume of an encyclopaedia.

3 Success Factors in the Innovation Process at Freudenberg

3.1 The holistic approach

The tasks of innovation management are becoming ever more complex. Not just because more data are accumulating that must be processed more and more rapidly. In fact, new functions must be integrated into components and/or manufacturing processes and furthermore the information from and the activities in the areas of development and production, sales and marketing must be combined.

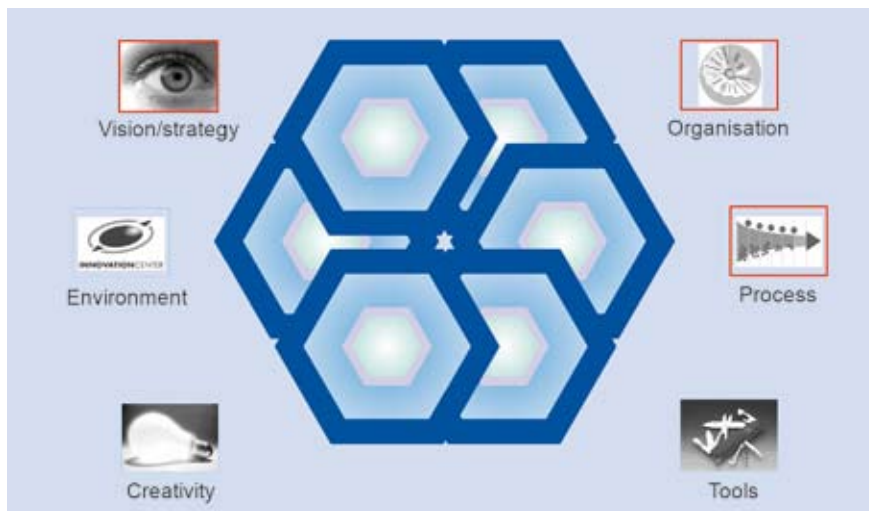


Fig. 6: The holistic approach

Faced with these general conditions, only those companies taking a holistic or integrated approach will be successful. Contemporary innovation management comprises all aspects, from intensive monitoring of the market and technology environment to an innovation strategy, the organisation and excellent development processes to the modern tools made possible by the digital revolution. Invention can and will continue to occur often by accident. However, the probability that an idea is transformed into a successful product or a promising technology can be greatly increased by means of a systematic and structured approach.

3.2 Core aspects of innovation management

The three core aspects of integrated innovation management at Freudenberg are strategic planning, the organisation and the innovation process.

3.2.1 The strategy

With the introduction of strategic planning, referred to as “strategy review”, the topic of innovation and innovation strategy was also taken up as a central aspect at Freudenberg. For the new strategy period of five years Business Units define major projects that generate revenues with new products. The key statements concerning radical and significant innovations are summarised in an innovation portfolio for each Business Unit.

- How much sales revenue is to be generated by the project?
- How good are the chances that this goal will be attained?

Only those projects that fit into the strategic specifications are included in the innovation portfolio. These comprise the markets, applications and technologies in which the company wants to invest and are discussed in the Management Board together with the management of each business unit. By the year 2012 Freudenberg anticipates at total of approx. 200 defined innovation projects with an expected sales volume of approximately billion Euros. The sustainability of proposed innovation projects will be tracked by the management of each business unit and reviewed by their advisory boards.

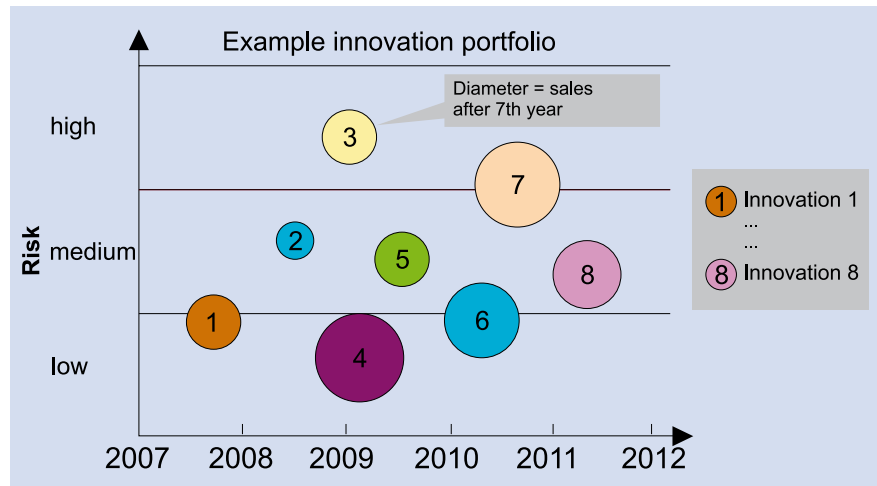


Fig. 7: The strategy process at Freudenberg.

3.2.2 The organisation

The interaction of distributed innovation efforts at Freudenberg can be visualised especially well by means of the 3-pillar innovation model (see Fig. 8).

➤ The most critical pillar and the main driving force of innovation, not just by financial expenditure, are the Business Units. These are in close contact with customers and know about their needs. Innovation strategies are devised and technology roadmaps are defined in the Business Units. They make a considerable contribution towards Freudenberg’s innovative power by having sole responsibility for the further development of their own product market segments. In 2006 the Business Units invested 193 million Euros for this and employed a staff of approx. 2,000 in the area of R&D. This means that a total of 95 percent of expenditures go into this pillar. This makes clear how directly innovation at Freudenberg is linked to the core business.

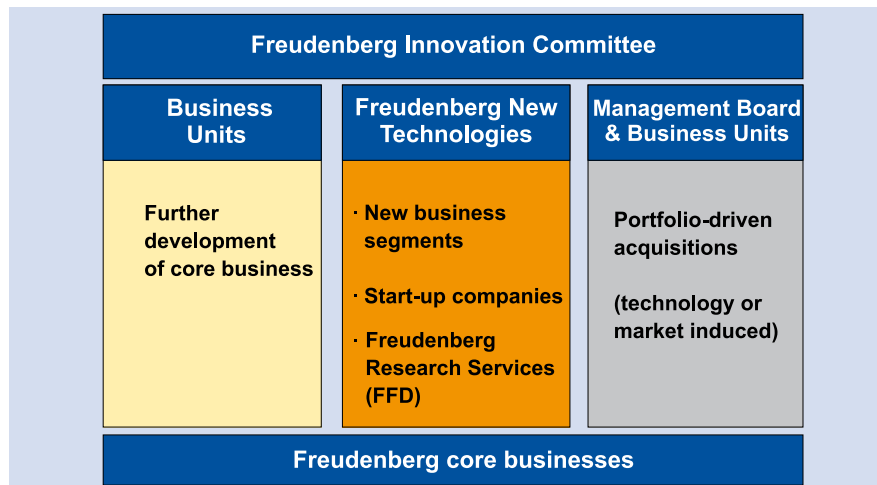


Fig. 8: The organisation structure at Freudenberg – the three-pillar innovation model.

➤ The middle pillar represents Freudenberg New Technologies KG (FNT), founded in 2006. All Business Unit independent, innovation-related activities were combined in FNT. In addition to the classical services of Freudenberg Forschungsdienste (FFD = Freudenberg Research Services) the divisions of “New Business Development”, “Venture Capital” and “Innovation & Public Funding” as well as the start-up company Freudenberg Fuel Cell Component Technologies KG (FFC-CT) were integrated here. The goal behind this is to bundle group-wide technical know-how, especially interdisciplinary technologies, to examine and develop new applications and business areas as well as to discover new technologies that are interesting or that could even be dangerous to Freudenberg and by doing so ultimately strengthen the innovative power of the group in the long term. FNT currently employs a staff of 240. The Business Unit spends 16 million Euros for R&D activities – excluding the services from FFD – corresponding to eight percent of overall R&D expenditures at Freudenberg.

➤ The third pillar represents the targeted acquisition of companies that complement the portfolio. Because every acquisition project puts the spotlight on technology-related issues, company acquisitions have become a source for increasing innovative power at Freudenberg. Burgmann and Chemtrend are examples of companies successfully added to the portfolio, as is Lederer, acquired for reasons related to strategic production and materials technology.

The Freudenberg Innovation Committee (FIC) was formed in order to promote a culture of innovation across Business Unit lines. Business Unit managers in charge of technology meet on this committee to confer on the fundamental issues related to innovation for the group as a whole. This is where megatrends and their impact on the company group are discussed. Even fundamental questions such as “How is innovation managed at Freudenberg?” and “How do we measure success?” are on the agenda. Another vital task is to promote the development of the next generation of technology professionals and to create an open and innovation-friendly atmosphere.

3.2.3 The innovation process

Ideas and plans evolve from general trends, market analyses and the targeted pursuit of business and product potentials. This is called an innovation funnel, but the more proper name for it would be innovation filter, used to filter out many unrealistic approaches while further concentrating others. According to the Institute of Regional Innovation Research (IRI), an average of 430 ideas have to be seized upon for one single product to be successfully launched on the market. This results in the formation of about 80 “scouting” projects in which ideas are further analysed and examined for feasibility. And experience shows that this results in six specific development projects from which one single successful innovation emerges.

Because of this impressive relation the innovation process cannot be left to chance. It has to be efficiently controlled in order to keep the time from invention to innovation as short as possible, to keep development costs under control and to achieve a high level of quality. Managed processes, also called “stage gate” processes, have since been defined for development and implemented in all Business Units. At the end of a development phase or “stage” a decision is made as to whether and how the process will be continued. In practice, the advantages of introducing stage gate processes lie in the systematisation of ongoing development and the avoidance of ad hoc decisions without placing limits on entrepreneurial freedom. What is different from the past is that by the involvement of every player the functional separation of marketing, sales, development and production is removed in the stage gate process.

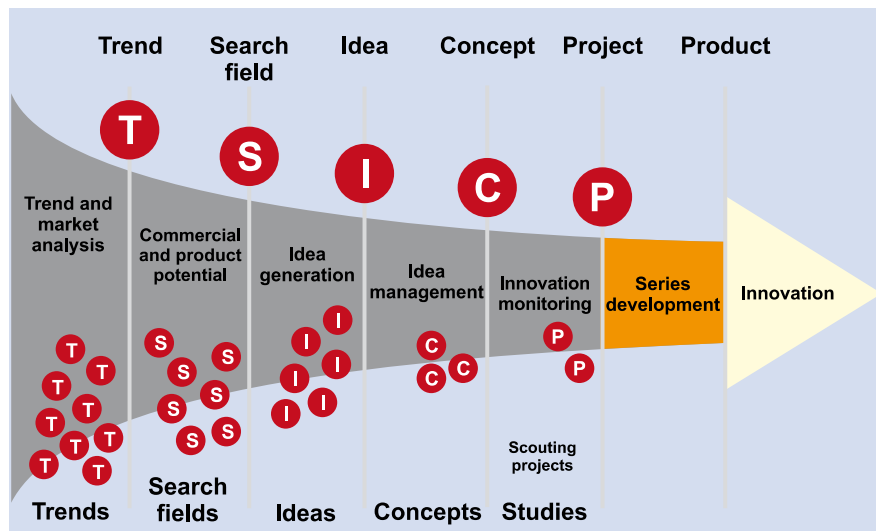


Fig. 9: From trend to invention and innovation.

Through this “forced guidance” – a technical term from control technology – information and facts are documented, the process becomes transparent and a shared understanding of the status is created. This facilitates communication within the team, with top management and with the customer. The development speed of the overall process also goes up by this, despite increasing complexity. Even the quality of new products and technologies is higher than before. But this alone is no longer enough for an excellent development process. To be able to successfully place products on the market, technology today must be fully developed, i.e. close coordination between product and technology development must take place. For Freudenberg in particular this is an important step.

To do this, product and technology roadmaps are developed. By using them, the technologies required for future products can be systematically prepared. On the one hand, technology roadmaps identify technology-related projects in the areas of product development and production. On the other, they visualise complex cross-links among these products. These analysis and control instruments can be used to reveal development paths of products, services and technologies and they can also systematically record and bundle expert knowledge. With the consequence that also future developments in a particular sphere of activity can be predicted and rated. This method helps to work out specific courses of action for a company and to control their implementation.

These roadmaps have become enormously important for technology companies. The massive quality-related problems in automobile electronics a few years ago can be traced back to the fact that essential technologies used in individual products and features were not fully developed, i.e. prior to their commercialisation. In contrast to this, the excellent quality at Toyota can be explained by the fact that only mature, selected technologies are permitted for parts development (key phrase: “Toyota Production System”, see section 3.3.3).

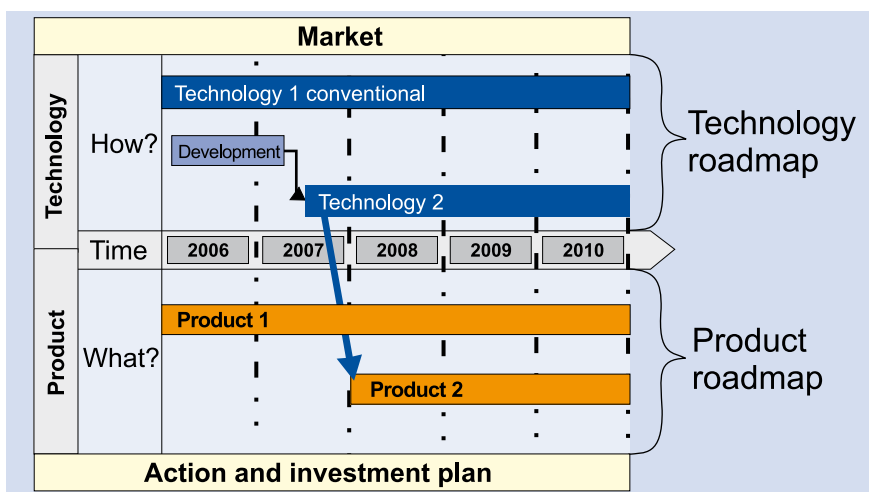


Fig. 10: Technology roadmap.

The time window for the overhauling of its entire product portfolio can also be an indicator of a company’s innovative capability. Particularly innovative companies that are the front-runners in the area of product innovations, revise their product portfolio on average after only ten years. The complete renewal of the product portfolio at Freudenberg takes place after 21 years. This rather slow revision can also be explained by the position of the company in the value chain. As a supplier company approx. 40 percent of sales are realised in the automobile industry, and in this

area, for example, a spare parts guarantee over 20 years is demanded. Furthermore, the company group is active in general industry, including the markets of oil, gas and energy, i.e. it is active in mature markets where it is essentially involved with significant and incremental innovation that also has a larger time window.

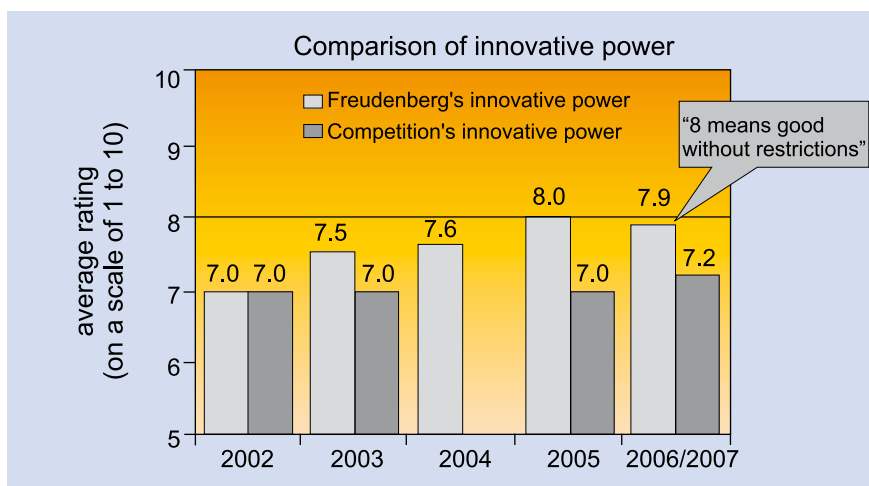


Fig. 11: Customer rating of Freudenberg’s innovation activities.

Customers acknowledge to Freudenberg that the approaches resented here for integrated innovation management are bearing fruit. In regularly conducted surveys companies confirm to Freudenberg that its ability to successfully place new products, new technologies and materials on the market has risen significantly in the past few years when compared to the competition.

3.3 Act proactively – identify megatrends

If a technology-oriented company wants to have mature, fully developed technologies and thereby new, top-quality products in its portfolio in sufficient time, it needs to quickly and proactively seize on major technology trends. From the mega-trends relevant to Freudenberg, four major trends are being given a closer look in the following:

3.3.1 New materials/nanomaterials

New materials such as nanomaterials are not only the drivers for new products, but can also drastically change the characteristics of previously existing products. By 2015 a gigantic market will arise from the mastery of the smallest structures virtually down to the atomic level of one nanometre, i.e. one millionth of a millimetre. According to the German Federal Ministry for Education and Research (BMBF) rough estimates currently anticipate a worldwide market volume of 100 billion Euros influenced by nano-technological findings. This volume is expected to have increased tenfold by the year 2015.

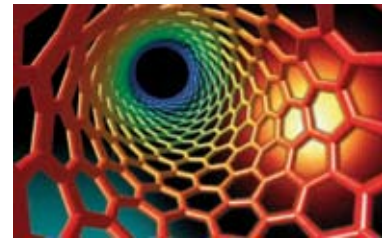
Examples from Freudenberg’s product range are nanofibres with a diameter smaller than 1,000 nm for breathable, water-resistant clothing, functional fibres for odour absorption and cleaning cloths with anti-bacterial coating. In the Nonwovens Division nanofibres smaller than 500 nm in size are developed which will be used in surface filtration for dust removal or liquid filtration up to membranes for bioreactors.

At Klüber work is currently being done on improving the chemical stability and properties of lubricants with additives made of nanomaterials. Another object of Freudenberg’s research are nano-fillers that are “intelligently packaged” and incorporated into classic production processes for elastomers in order to increase their durability and/or resistance to environmental influences. Examples of applications are seals for alternative cooling agents in air-conditioning compressors (e.g. CO₂) or seals for alternative fuels such as biodiesel and ethanol.

On the subject of new materials the Nonwovens Division is examining the development of spunwebs made of natural resources such as polymers based on lactic acid. New processes for surface treatment and modification that are becoming more and more important in the field of seal technology are also a part of this area.

3.3.2 Mechatronics

“Mechatronics” describes the penetration of mechanical components with electronics and sensor technologies. In the automotive area alone this market will experience seven percent annual growth by 2015. Freudenberg’s seals, bearings and pneumatic springs with sensors were developed for this and are in increasing demand. The company concentrates on the further development of these components, their integration into existing and new products and associated production processes. A further field of activity are the basic materials for mechatronic products. Freudenberg is currently the leader of a consortium in an EU development project for elastic supports for fluid-related mechatronic systems (fluidtronics).



Source: Bergerhof-Studios, Cologne, Germany



Source: FNM Mechatronics



Source: Copyright: BMU / Bernd Müller

3.3.3 Limited resources

Water as a resource has moved to the centre of the debate on the “limited availability of resources” in the past few years. The UN has identified the provision of water in sufficient quantity and quality as well as the distribution of water as the greatest challenge of the 21st century. The recovery and treatment of water is currently one of the fastest growing markets. Goldman Sachs, the US investment bank, estimated the volume of global water activities in 2004 at 265 billion Euros, rising to approximately 440 billion Euros by 2010.

Major companies such as Siemens, General Electric, 3M, and ITT have invested heavily in this area over the past few years. For water treatment alone acquisitions in the 3 to 4-figure million range have been made. Freudenberg is functioning as a supplier in this area: FV is the main supplier of membrane supports for bioreactors, primarily used in waste water purification. At FDS new elastomer compounds are being developed for this segment. In addition, Freudenberg took a stake in a start-up company two years ago: Condias is involved in the manufacture of diamond electrodes for the sterilisation and treatment of ballast water, among other things.

It is not just rising energy prices that are forcing companies to conserve energy and materials in production. Material-saving manufacturing processes and the reduction of waste are in fact instrumental in determining economic success. Especially in the degree of material efficiency there is great potential for improvement in numerous companies. The “Toyota Production System” deserves mention here as exemplary and promising. The Japanese car maker developed this production process for series production and has successfully implemented it there. It combines the productivity of mass production with the quality of job shop manufacturing. The goal is production based on customer demand with minimum waste of resources of all kinds in the production process.

In the field of renewable energy Freudenberg Fuel Cell Component Technologies KG has been actively involved for five years in the development of fuel cell components such as gas diffusion layers, seals, humidifiers and filters.



Picture credit: BVMed Picture Pool Source: B. BRAUN MELSUNGEN AG

3.3.4 Medical progress

Higher life expectancy, but also increased health consciousness have brought about considerable growth in the medical market. Health-related expenditures in the EU, US and Japan average approx. twelve percent of gross domestic product and will continue to rise.

Freudenberg has already become a major factor in the segment of moulded plastic parts made of silicon for specific medically-related applications. The intensive use of technological excellence in the design of tools for silicon injection die moulding, which is already present in the company at FDS subsidiary Lederer, can pave the way towards technology leadership. Freudenberg has also been able to increase its innovative power through acquisitions: FNGP acquired Jenline in 2004 and HelixMedical in autumn 2006, both manufacturers of medical plastic parts based on silicon with revenues totalling approximately 25 million Euros. FV is involved with the development of medicinal aids, e.g. at FNT initial attempts are being made towards the development of dressings made of gelatine gauze produced in a special manufacturing process.

4 Challenges of the Innovation Process

As part of its innovation process Freudenberg does not just have to deal with technical possibilities. Eminently more important for successful innovation management is to face the current global societal challenges, which today are:

4.1 Globalisation in development

Of Freudenberg's 2,256 R&D employees worldwide only three percent currently work in Asia. Because the company group is registering an average of just under 20 percent growth in this part of the world, the need for local technically adept employees and contact persons will increase, especially since Chinese automobile customers already require advice and support today for adjustment developments. The Nonwovens Division has already put 30 employees to work on development in Asia and in future will be setting up further capacities, especially in China and India.

Against the background of already existing development capacities in Europe and North America as well as the expansion of the same in Asia, questions arise at Freudenberg in connection with the international cooperation in research and development: "To what extent can the division of labour as already established in other industries distributed across the triangle of US-Europe-Japan/Southeast Asia be transferred to the development work being done at Freudenberg?", "How can know-how be transferred efficiently?", "How can data for an efficient development process be made available worldwide?" and "How can development data and know-how be protected in the long term?" Answers to these questions must be found in the coming years.

4.2 Competition for the next generation of talented professionals

Due to the drastic acceleration of the innovation process, the knowledge needed is becoming obsolete more quickly than in the past. Whereas the half-life of knowledge at the beginning of the 20th century roughly corresponded to the lifetime of one generation, it is now barely more than five years. In some industries it is even shorter. Consequently, it is the next generation of professionals that will bring the latest developments, the state-of-the-art into the company. The competition for the next generation of talented professionals, also called the "war for talents" is in full swing, not just in Germany, but across Europe.

One aggravating factor in Germany is the lack of qualified young professionals. It's not just due to the demographic trend, but also because of a latent scepticism of technology in Germany that we are seeing declining numbers of students in natural science-related subjects: Whereas at the beginning of the 90s, one in two male graduates received a degree in mathematics, engineering, the natural sciences or technical subjects, today it is only about 40 percent. For women the rate has fallen from 22 to 19 percent. In Asia by contrast, a trend in the opposite direction can be observed. In China, for example, 400,000 engineering students graduate from university every year. That is, in absolute terms, ten times as many as in Germany. This also spurs the internationalisation of development.

The task will be to tie both developments together and to replace the existing “not invented here” syndrome with inquisitiveness and openness for ideas and new approaches independent from their place of origin. Any company wanting to maintain or expand its technology leadership must strengthen its desirability as an innovative employer for engineers, chemists and technicians in equal measure across Europe and America. For technicians and engineers in development and production who have already worked in the company for more than ten years it is advisable to set up an advanced training programme that will enable these employees to seize upon new technologies and transform them into rises in productivity. A general appeal for life-long learning will not suffice here.

4.3 Cooperation in development

Freudenberg’s cooperation with its Japanese partner companies NOK and JVC is exemplary. The general technology exchange and the agreement regarding prioritisation and the division of labour for development activities have reached a good state. But in order to achieve a higher speed in product and technology development, improved communication alone will no longer be enough. The goal will rather be to more strongly bundle competences and to define and implement development projects jointly.

Professor Milberg, Chairman of the Supervisory Board of BMW and the President of Acatech, the future German academy for engineering science, has said: “Have the courage to be innovative - this is certainly easier said than done. For acting innovatively always means letting go at the high point of success and starting something “new” – with no guarantee of success.” And this precisely describes the entrepreneurial challenge.



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