10.02.09
Or.: Deutsch / GDV

Extract (shortened) from the monthly periodical "Positionen" of the German Insurance Association (GDV), No. 63, December 2008

Editorial by Rolf-Peter Hoenen, President of the German Insurance Association (GDV)

Technological innovations as an 'engine of progress' – unthinkable without support by Engineering Insurance

Dear reader,

In our society, technological achievements have always involved the question: what risks are directly associated with their application? The more reliably risks may be assessed, the more likely it is that practical use of technological innovations becomes actually possible. Therefore, with its know-how in the field of risk research, the German insurance industry pleads for reliable risk assessment to be able to assist people and companies as a partner for successful forward planning and provision for the future. Without insurance cover, the development and introduction of new technologies would be hardly conceivable in a modern society, because – in fact both – investors and users need security. Yet, risks must be calculable even for insurers. The cover story "**The world machine CERN – Technological innovations as an engine of progress"** provides insights on how insurers participate in technological and scientific progress and on how they are trying to control still unknown technological risks.

Rolf-Peter Hoenen
GDV President

Extract from the monthly periodical "Positionen" of the German Insurance Association (GDV), No. 63, December 2008

The world machine CERN – Technological innovations as an engine of progress

Authors: Mauritius Much and Marcel Roth, Munich [i]

The particle accelerator of CERN in Geneva is intended, inter alia, to prove the existence of so-called "God particles" – a unique scientific challenge. Insuring such technological innovations is an equally challenging task.

The worldwide applause was followed by gloating: after only nine days the new particle accelerator of CERN, the European Organization for Nuclear Research in Geneva, had broken down. Newspapers wrote that the most efficient particle accelerator in the world had fallen into a black hole. For more than 20 years, over 10,000 scientists from 85 countries, 500 academic institutes and companies had been planning the machine, which had cost approximately three and a half billion Euros, before launching the Large Hadron Collider (LHC) on 10th September with a wide media coverage.

Robert Aymar, Director General of CERN, called it a discovery machine. In any case it is a machine of superlatives: a 27-kilometre-long circular tunnel has been built in the Franco-Swiss border area up to 150 metres below ground level. In this tunnel, physicists may, for instance, accelerate beams of protons at minus 271 degrees Celsius and make them collide at near speed of light. Each beam has about as much energy as a car at 1600 kilometres per hour and each collision is a little big bang.

Any such technological innovation like the LHC always involves unknown risks. In fact, for every new technique even scientists are not always able to exactly predict whether or not it will prove its worth or what problems may arise. Especially in the case of expensive new technologies, such as that of a particle accelerator, operators try to protect themselves against as many risks as possible so as to avoid being left with enormous costs in the event of loss. "The risks due to technological innovations are always the highest where great heat, great pressure and high speed may occur," says Utz Groetschel, Secretary of IMIA, the International Machinery Insurers' Association.

However, for every technological innovation, also insurers face the question whether to incur the risk of supporting new technologies which could bring progress. "Each time this is a balancing act for insurers," says Utz Groetschel. Also Jork Nitschke, who is dealing with

reinsurance coverage for innovations in the field of renewable energies at Munich Re, wants to protect new technologies and thus help finance them. “Otherwise, there would be none because investors need security. However, naturally, the risk for insurers must not be incalculable.” Altogether, this can be expressed by the formula: the higher the risks, the higher the premiums for policyholders.

In the LHC in Geneva, beams are crossing about 30 million times per second, so that the protons or ions are colliding up to 600 million times per second. For dealing with the immense amounts of data resulting from the experiments, scientists have specifically developed a worldwide computer network. After all, the LHC provides one billion snapshots of the particles per second while only one good shot out of ten trillion is of use to physicists. Thus, mankind’s greatest experiment provides 15 million gigabytes of data per year. Alluding to Neil Armstrong’s words during moon landing, Canadian physicist Nigel Lockyer shouted with joy when the LHC was inaugurated. “That’s one short trip for a proton, but one giant leap for mankind.”

For the layman this enthusiasm may be hardly understandable, but what particle physicists are hoping to achieve with their experiments is no less than being able to explain the world and the universe. What scientists are hunting for most eagerly are the Higgs particles, named after British physicist Peter Higgs. According to theory, these “God particles” are supposed to provide all other elementary particles with a mass. According to the theoretical standard model, Higgs particles are the only ones the existence of which could as yet not be proven by way of experiment, although this has been tried by scientists for 44 years. If one does not succeed in doing so in the Geneva particle accelerator either, the standard model seems invalid.

Surprisingly, hardly any physicist expects to discover only the “God particles”, because this would make accelerator physicists superfluous and establish the standard model as being irrefutable. Therefore, many physicists assume that in addition to Higgs particles new particles will be found, which have already been devised in theory. In fact, theories going beyond the standard model, such as supersymmetry and string theory, have existed for a long time – after all, the standard model can actually explain only five per cent of the universe. Therefore, the community of physicists is hoping for a “sign from God on how to get out of the mess,” physicist Wolfgang Rhode of Dortmund University said to the German nationwide weekly newspaper “Die Zeit“. What is at stake is the future of modern physics.

There were actually some people who were concerned about the future of the earth before the first launch of the LHC. They feared that it would create black holes which could swallow up the earth. Even the European Court of Human Rights and the Administrative Court of

Cologne were concerned with this issue. For Rolf-Dieter Heuer, the designated Director General of CERN, such fears were incomprehensible. According to him, the LHC does not represent any danger. “The existence of the earth, of the solar system and of the entire universe are proof enough for me,” says Heuer. “After all, in the earth’s atmosphere alone, there are billions of nuclei that collide with much greater force.” “The experiments which we are conducting here have taken place in nature for billions and billions of years,” says Jos Engelen, CERN’s scientific director. “If there was some risk involved in this, we would not exist.”

Scientists largely agree: the particle accelerator itself and the experiments involve little risk. “Even radiation risks are not higher than in any hospital,” says Lorenz Stampfli, who is in charge of insurance matters at CERN. “If the LHC has been switched off, there is no radioactivity at all.” Stampfli, who is also Vice-President of the Swiss Association of Insurance und Risk Managers, said, however, that the operating risk arising from the particle accelerator was borne by CERN alone.
Nevertheless, CERN has protected itself against external risks, such as natural disasters, flooding and industrial accidents of its staff members. Also hazards due to damage caused to research laboratories, the computer centre and CERN’s property as well as liability risks are covered. Stampfli says that ultimately CERN is insured similarly to an industrial plant. Due to the high value of the machine, all these insurance contracts provide for the maximum amount of cover, however, with a high deductible.

A high deductible is one possibility to keep the risk of new technologies low for an insurer if an innovation causes a loss. A second possibility consists in not covering the actual risks of the innovation, but insuring only known components. In the field of tidal and wave power plants, technology is often still being tested. For instance, it is not unusual that insurers exclude parts of generators of plants floating directly on the water or the rotors of which turn vertically under water from insurance cover. “This is a very untested technology,” says Jork Nitschke of Munich Re. However, other components of wind generators are indeed insured.
Before insurance companies are prepared to bear the risks of technological innovations, their experts take a close look at their prototypes, assigning them to one of three categories. Prototype one are known technologies used, however, in an unknown environment, such as wind power stations built not only on shore, but offshore off the coast. Due to high waves, the risk of collision with ships and the salinity of the sea air, other risks prevail. A climate wind tunnel for the car industry belongs to the second category because the environment “wind tunnel” is known, but climate technology is still new. The risk which is the most difficult to assess is that of type three when an unknown technology is to be used in an unknown

environment. One example of this are those generators operated under water in the case of tidal and wave power plants.

A great many technological innovations are offered by wind energy – precisely in the offshore area. Off the German North Sea coast, a rising number of increasingly large wind parks are being built, with up to 80 wind generator units. Meanwhile, they are also being erected farther and farther away from the mainland, up to 100 kilometres off the coast. And the water where they have been erected is 40 metres deep. Moreover, they are becoming more and more powerful. The older 2-megawatt units are replaced by 5-megawatt units. “The fact that more powerful turbines are installed at more and more exposed locations involves significant risks,” says Utz Groetschel of IMIA. “Especially the question concerning the durability of the material is becoming ever more important.” In fact, in the past, wind energy has not been the most lucrative area for the insurance industry anyway because often the gearboxes of turbines were damaged in great numbers.

In the case of unknown technologies, insurers split up the overall risk into different components. Then it is analysed whether such individual components are not already known – for instance, in the case of the particle accelerator, there are conventional switchgears. “Here, insurers are fully aware of weak points and existing risks,” says Utz Groetschel.
These risks are then insured according to standard terms. After that, for the other individual components, insurers are looking for empirical values from the past which could be compared with the new technology. For instance, magnetic fields of fusion reactors in Germany, France or Japan operate similarly to those of the particle accelerator. Thus, according to Groetschel, some experience has already been gathered with magnetic fields used in fusion technology, which guide proton beams. “By assessing each individual component, the risk posed by the particle accelerator can be inferred to some extent.” Natural risk components, such as damage caused by severe weather conditions, pipe burst or a storm, and manufacturing problems concerning the material are included as well.
However, in the case of novel technologies, insurers are not just in demand when such technologies have reached marketability or are on the verge of doing so. Experts of insurance companies are already dealing with innovations which are still at the experimental stage, such as the “CO2 Sink“ pilot project of the Geo Research Centre of Potsdam, which pumps carbon dioxide into an underground reservoir so as to prevent the climate-damaging gas from entering the atmosphere. That is also the reason why the energy company Vattenfall has developed a prototype for lignite-fuelled power plants. In the town of Spremberg in Brandenburg, carbon dioxide is already being separated, liquefied and also conveyed to underground reservoirs in the lignite-fuelled power plant. “This is a very

interesting, new approach," says Utz Groetschel. "However, it is a very complex technology and involves the risk that carbon dioxide leaks from the reservoirs." This would be hazardous not only to climate, but directly to people. If the share of CO2 in the breathing air exceeds eight per cent, any person dies after 30 to 60 minutes. Also, with this concentration, any internal combustion engine becomes silent because the CO2 displaces the air needed for combustion.

Whether it comes to carbon-dioxide-free coal-fuelled power stations, offshore wind parks or particle accelerators – precisely if the possible maximum loss is almost incalculable, insurers try to spread risks. For this purpose, direct insurers very often form risk pools with other direct insurers and reinsurers. "The motto 'A problem shared is a problem halved' is particularly true when it comes to insurance of technological innovations," says Utz Groetschel. "However, ultimately, the developers of technical innovations must be prepared to help repair the damage themselves. Therefore, policyholders must be ready to accept a high deductible," says Utz Groetschel. "With CERN Big Science is the actual entrepreneurial risk," says Lorenz Stampfli. "And this cannot be transferred automatically to insurance." Therefore, the repair, which may cost up to 15 million Euros, is presently not covered by any insurance and is financed out of CERN's ordinary budget. The defect analysis made after the trouble in September found out a defective electric connection between two magnets which had caused mechanical damage resulting in the release of liquid helium. To avoid any such incidents, the LHC is currently being inspected. In early summer 2009 it is expected to be operational again and look for God particles.

Whether their existence will be proven or whether physicists will have to develop a new theory to explain the world cannot be foreseen. However, it is hoped that in the end scientists will not stand as helplessly before their gigantic world explanation machine as the characters in Douglas Adams' novel "The Hitchhiker's Guide to the Galaxy". For these, in fact, the super computer "Deep Thought" calculates for seven and a half million years and replies to the question about life, the universe and virtually everything by giving a shockingly irritating answer: 42.

[i] Mauritius Much and Marcel Roth are journalists in Munich and Berlin