TAKING IT TO THE TOP

How insurance companies ensure that everything runs smoothly on large building projects and often make “Made in Germany” possible
**The Hong Kong–Zhuhai–Macau bridge**
**Pearl River Delta, China**

The longest ocean bridge in the world spans a distance of 23 kilometers over open water. The complete structure is around 55 kilometers long and 6.7 kilometers of this is an underwater tunnel.
LONGER, HIGHER, FURTHER

Experience is useful, planning is crucial, and trust is essential – how ENGINEERING INSURERS make the construction of record-breaking structures possible.

TEXT: WIEBKE HARMS AND JANEK SCHMIDT, WITH MICHAEL GRIMM AND VOLKER KÜHN
From 2018 onwards, up to 150 million passengers will pass through the largest airport in the world. The site covers 76 million square meters and is large enough to accommodate six runways and 150 airlines. Flights from Istanbul New Airport will travel to 350 destinations.
They wanted to build a tower so tall that its top would reach heaven. They wanted to create a monument that would demonstrate what they could achieve. A whole people wanted this tower. They baked the bricks, cemented them together with pitch, and laid them one on top of another, row by row, to stretch up to heaven.

It was bold.
It was utopian.
It was arrogant.

The Bible story ends with God being so offended that he takes away the Babylonians’ common language, scatters them throughout the world, and stops them from building the Tower of Babel.

However, divine ill humor is not generally what makes things go wrong on building sites. Where cranes are lifting steel beams for a skyscraper high up into the air, tunnel drilling machines are making holes through layers of rock, or special ships are erecting wind turbines in the sea, there is no shortage of potential problems. A failure to pay attention for a few seconds can lead to construction work being stopped for days and one wrong movement of a machine’s joystick can cause damage amounting to millions of euros. Where so many people are working together on a Babylonian scale – and this is where the Bible story and reality diverge – anyone could make a mistake. In the meantime, the technology has also become slightly more complex than bricklaying.

More things go wrong on Friday afternoons

The approach of the weekend is often enough to trigger mistakes. More things go wrong on Friday afternoons. “On around half of the claims we are paying out for human error,” says Friedrich Scholz, Director of Engineering Insurance at Axa.

Engineering insurers could be described as anti-Babylonian. They make sure that even the most ambitious projects are started and completed. It’s always a case of longer, higher, and further. Mistakes are a taboo subject, because they cost money. This is why almost every project has an insurance policy which confirms that it can be done. Germany would not have become the world’s leading exporter if the insurance companies had not added their seal of quality to the “Made in Germany” brand to show that “Yes, they can do it.”

No insurer says something like this lightly. The plans must be right and the figures are just as important as past experience. Otherwise no insurance company would accept the risk.

And no contractor would either. No one would have become involved in the project to build the Hong Kong–Zhuhai–Macau bridge with a span of 23 kilometers over open water and a seven-kilometer long tunnel if the work had not been insured. The new airports in Berlin and Istanbul would not have been constructed, there would be no new cable car on the Zugspitze, and Hamburg would have had to manage without its new concert hall, the Elbphilharmonie.

When complex machinery and new technology is being used and when the risks of the project have to be assessed and its feasibility evaluated, this is where the specialists from the insurance companies come in, as Friedrich Scholz from Axa explains: “We insure everything, from tunnel boring machines to satellite assembly processes, from PCs to steam engines.”

And it all began with steam engines. Their pistons were what powered the industrial revolution, provided that the steam boilers did not burst. In 1845 a boiler exploded in a spinning mill in the English town of Bolton. Ten employees died and the five-story factory partially collapsed. Since then machinery has been insured. Shortly after the tragedy, engineers banded together to prevent accidents from happening.

The engineering insurance business is still based on the expertise of engineers today. According to Hans Mahrla, Secretary General of the IMIA, Germany has played an important part in developments in this area over the last one hundred years. When the organization was founded in 1968, IMIA stood for International Machinery Insurers’ Association. Nowadays, engineering insurance companies have a much more wide-ranging role. They insure the operation of machinery, structures, and electronic equipment and also consequential losses if construction work has to be stopped as a result of an accident. The fact that German insurers are major players in engineering projects throughout the world is largely because many of the world’s leading mechanical engineering and plant construction companies form the backbone of the German economy and have turned “Made in Germany” into a well-known brand.
companies have not only brought in insurance companies from their native country to protect their projects abroad against the risk of losses. They have also trained the majority of the many technical experts and engineers who now work for the engineering insurance companies carrying out risk assessments and preparing cost estimates. These specialists have acquired so much expertise that they are involved in almost all large-scale engineering projects throughout the world.

According to the IMIA’s statistics, the majority of claims are due to human error, material defects, and fire. The German figures for 2016 show that around 656,000 claims were made against 4.64 million insurance policies, with the largest claim costing 19 million euros. Engineering insurance companies in Germany received premiums amounting to around 2 billion euros and paid out 1.4 billion euros in damages.

Although this seems like a substantial profit margin, it does not take into account the costs of the assessors who play an essential role in analyzing the risks and enabling the projects to be insured. IMIA General Secretary Mahrla explains that the key factors for survival in this market “are undoubtedly experience and technical knowledge, together with expertise in insurance and loss adjustment.” And this is where Germany is among the leading nations worldwide.

Ensuring that skyscrapers are not built on sand

The insurers become involved in the planning process long before the first excavators arrive on site. For example, Olaf Buttkewitz, Head of Engineering Insurance at VHV Allgemeine Versicherung, worked on the construction of the Elbphilharmonie in Hamburg. His first question came when he saw the site of the new concert hall. Had the risks of the harbor–side location been taken into consideration in the planning process? “If a building site is on the water and there is a link to the open sea, we always look into the potential risk of storm surges, for example,” says Buttkewitz. The subsoil is an equally important consideration.

“It’s no coincidence that there is a saying about not building on sand,” says Scholz. The weight of the buildings pushes them into the ground. “Skyscrapers always need time to settle, but they must settle evenly.” This is why the foundations are so important. Geological surveys and risk assessments alone are responsible for gigabytes of data and have to be constantly updated, revised, and monitored during the construction process.

It’s no surprise to learn that engineering insurance companies have engineers, geologists, physicists, and chemists on their teams who inspect building sites and assess the local situation. In the 17 years that it took to build the new Gotthard base tunnel, one expert from Allianz alone wrote 127 reports on construction site inspections. The tunnel was another record-breaking project. With two tubes, each 57 kilometers in length, it is the longest rail tunnel in the world. More than 28 million tons of rock were removed from the mountain and the tunnel ceiling caved in more than ten times in the Faido section alone because the rock there was too porous.

What sort of company can insure something of this kind? On very large projects there are ultimately only five or six providers who are in a position to take on the role of leading insurer and they often have to think outside the box in order to be able to assess the risks. In these cases, insurance companies make use of knowledge from other industries. Elevators in skyscrapers have to be able to reach the top of the building very quickly. The elevators in the Burj Khalifa, which at 828 meters is currently the world’s tallest building, travel at a speed of up to ten meters per second. In technical terms this is a major achievement, but the insurance companies have seen it all before. “For years, mine cages in the mining industry have been traveling distances of up to two kilometers below ground level,” says Scholz. From an insurer’s perspective it makes no difference whether an elevator goes up or down.

The construction site on the Zugspitze covers three climate zones

A new cable car on the Zugspitze, Germany’s highest mountain, will take visitors to a height of almost 3,000 meters. The building work is already causing a sensation among those who travel to the top of the mountain. They crowd around the windows in the café of the mountain station to watch the construction workers outside.

Over the noise of the construction machinery, a phone can be heard ringing. Martin Hurm, the site manager, answers it and discusses the progress of the work with a colleague. “We need to make sure that we stay on schedule with the concreting today,” he says. There is planning and then there is the unpredictability of nature. This causes considerable problems on the construction site, which covers three climate zones. While good progress is being made in the valley in perfect weather conditions, a sudden fall in temperature on the summit can soon bring work to a standstill. In the middle of summer, the construction site was snowed in for several days in a row. “We have no choice but to shovel snow,” says Hurm. “But when the next weather front brings another 50 centimeters of snow, it really starts to cause problems.” Up on the mountain, organizational skills are just as important as a head for heights. Hurm has nerves of steel, and he needs them.

“AN IMPORTANT QUESTION FOR US IS: DO WE BELIEVE THAT THE PLANT CONSTRUCTOR CAN COMPLETE THE JOB?”
FRIEDRICH SCHOLZ, Director of Engineering Insurance at Axa
HEAD IN THE CLOUDS

Jeddah Tower
Jeddah, Saudi-Arabia

The tallest building in the world will be 1,007 meters high. The highest viewing platform in the world is planned for a height of 652 meters. When it is completed, the Jeddah Tower will house offices, apartments, and a hotel over a floor area of 500,000 square meters.
In 2015, specialists erected a construction crane on the summit with the help of a helicopter. Since then other unusual objects have made their way into the airspace normally only occupied by alpine choughs. The material cable car brought up an excavator and now steel beams are dangling from the crane cables outside the window behind Hurm. He takes a look over his shoulder and says, “The building work is on schedule.”

“You only build a cable car like this once in your lifetime”

Right from the outset, the plan was an ambitious one, because the new cable car on the Zugspitze breaks three world records. In only one section it transports passengers over a height difference of 1,945 meters. In addition, the two pillars of the old Eibsee cable car have been replaced by one new pillar, which is 127 meters high and dominates the northern flank of the mountain like a skyscraper on a city skyline. This structure also allows the span, in other words, the length of the unsupported cable, to be extended to 3,213 meters.

In April, Hurm had the old Eibsee cable car dismantled. A week ago, his team connected the cable of the old system to the new one in the valley station using a conical spelter socket. Then they pulled the two cables slowly to the top using a linear cable engine. “The forces at work are so powerful that we can only raise the cable at a rate of two meters per minute,” explains Hurm. “It will be a real milestone when it reaches the summit.”

Time is short, because the opening of the new cable car is planned for December 21. The new cabins will be fitted with floor-to-ceiling panes of heated glass and will accommodate 120 people, instead of 44. The new cable car will be able to transport 580 passengers to the summit every hour, more than twice as many as the old system. This should significantly reduce the queues in the valley station on days when the weather is good and as many as 3,500 people want to travel to the top of the Zugspitze.

The new cable car will cost a total of 50 million euros. The costs of the insurance policies for assembly, construction work, and business interruption are more difficult to calculate. With the help of Teko, the reinsurance pool management company from Düsseldorf, Allianz and Ergo have underwritten the risks. And these could be considerable. For example, if structural damage delays the completion of the project, the insurance companies will compensate the Bayerische Zugspitzbahn for the loss of earnings from ticket sales and the restaurant, in the worst case for up to 18 months. The amount insured is 22 million euros, which presents no problem for Franz Scheich, a senior engineering insurance underwriter at Allianz. He was impressed by the client’s professional approach. “It gave me confidence in the
With more than two million visitors in six months, the “Elphi” is the most popular tourist attraction in Germany. The glass façade covers an area of more than 16,000 square meters. A total of 1,100 different curved and printed glass panels were produced to create the façade and each of them weighs 1.8 tons.
SUPPLYING ELECTRICITY THROUGHOUT GERMANY

Bard offshore wind farm
North Sea, Germany

Germany’s first commercial offshore wind farm in the North Sea is 89 kilometers northwest of the island of Borkum. A total of 80 wind turbines have been erected in water that is 40 meters deep and they produce around 1.6 billion kilowatt hours of electricity every year, which is enough to supply about 400,000 households.
THE EXPERTS HAVE ALREADY BEEN PAID

Premium income and insured damage for engineering insurers in Germany in billions of euros

2.0 Income

1.4 Damage

Source: GDV, date: 2016

The experts have already been paid

Project, which is on a scale that we don’t encounter every day.”

It’s not only the scale, but also the weather that is out of the ordinary. Steffen Greiner, a claims engineer from Allianz, found himself caught in a snowstorm during his first inspection of the planned construction site on the summit. As a structural engineer, Greiner is particularly interested in the steel structures on the mountain-top. “There is hardly any space for storage up there. Concrete, steel, and equipment must all be delivered and used exactly on time. If you add in the extreme weather conditions and the visitors arriving every day, it means that very careful planning is needed.”

The decisive moment will be the first test run with the new cabins. “The risk of damage is at its greatest during testing,” says Greiner. “If something does happen in this phase, it will set the project back months.” At the moment, however, things are looking promising. Greiner is confident that the planners and the cable car operators know what they were doing. “We have to as well,” says Hurm. “You only build this kind of cable car once in your career. We have no choice but to be successful.”

No experience available

This is the situation that insurers find themselves in whenever they get involved with new technologies that have only been in existence for a few years. They cannot rely on past experience, because there is none. “This makes our technical expertise in assessing the extent of potential risks even more crucial,” says Scholz. Insurance companies also have to trust in what the manufacturers write in their manuals about operation and maintenance. “We must not pretend to know more about how machines or technical systems work than the people who designed and built them,” explains Scholz. He also says that one of the important questions is: “Do we believe that the manufacturers can do what they say?”

On the basis of this trust in the engineers, machine designers, and researchers, Scholz and his colleagues have seen whole industries flourish, with one example being renewable energy. “Only twenty years ago people were saying that wind turbines could not generate more than two megawatts,” he remembers. “Now we’ve reached the ten megawatt threshold.” Scholz has become someone who is hard to impress.

The same applies to Thomas Raatgering. The specialist in renewable energies from the engineering insurance department at R+V sees taller towers, larger turbines, and longer rotor blades all the time. He knows that the records broken by the industry would not have been possible if insurance companies like R+V had not covered the risks. Behind Raatgering the white tower of a wind turbine gleams against the green landscape of Germany’s Wesermarsch region. Above his head, the huge rotor blades are whirring. He has come to a wind farm outside Oldenburg to take a look at the turbines that his company is insuring. Together with Ralph Müller from Projekt GmbH, which operates the wind farm on behalf of the owner, he goes inside the tower. The two men climb into the elevator that takes them 60 meters up to the nacelle at a snail’s pace.

The dramatic success of wind energy

In the same way that wind energy technology has become more advanced, the trust of the operators in the insurance companies has grown. One example of this is condition monitoring. Sensors identify damage before it occurs and the relevant components can be replaced in good time. “Insurance companies aren’t prepared to cover foreseeable damage,” says Müller. The policies have now been modified because foreseeable wear and tear can be prevented by the monitoring process and the constant maintenance. “For us as insurers, it’s always about the bottom line,” says Raatgering. The costs ultimately have to be kept as low as possible.

Fame and glory are not important and this is where the constructors and the insurers differ. The experts must not allow themselves to be dazzled by the aspect of large-scale projects that often accompanies the practical benefits, in other...
STRAIGHT TO THE TOP

Zugspitze cable car
Garmisch-Partenkirchen, Germany

The cable car that goes to the summit of Germany’s highest mountain has broken three world records: a steel pillar 127 meters high and an overall height difference of 1,945 meters in one section have been made possible by an unsupported span of 3,213 meters.
words, the need to make a big impression. The insurers are not expecting a share of the prestige that the developers and architects are seeking with their ever more dramatic projects. After all, no one puts up a sign on a skyscraper recognizing the company that insured the construction process, as Scholz says with a grin.

The competition to break records with skyscrapers is leading to significant technical advances. In 1913, the 241-meter-high Woolworth Building in Manhattan was the first tower to be built in concrete with a steel frame. At 443 meters in height, the Empire State Building is almost twice as tall, but even it looks modest beside the Burj Khalifa in Dubai, which is 828 meters high.

**The race to be higher, faster, further**

In 2019, the top of the Jeddah Tower in Saudi Arabia will pass the one kilometer mark. This will earn it the title of the tallest building in the world. Originally, the owners planned to construct a 1.6-kilometer-high structure, but the structural engineers and geologists warned that the ground would not support its weight. The construction of buildings this tall throws up new problems on every floor. For example, the concrete is likely to solidify if it is pumped above a height of 500 meters, because it takes more than half an hour to arrive at its destination. For this reason, chemical additives are used, together with ultra-high-pressure pumps.

It is possible to identify immediately whether the concrete is still wet, but many problems only emerge at a later stage. While the top stories of a skyscraper are being constructed, work on the interior of the lower floors is already starting, which includes laying pipes, for example. If one of the connections is not correctly fitted, it will later cause a leak and could trigger a whole series of problems, because the pipes are behind the plaster and several cubic meters of water could have trickled into the wall space before the damp patch is identified. If the walls are made of plasterboard, mold will quickly form. “In the worst cases, the bathrooms on the lower floors are being renovated before the building’s roof has been finished,” says Friedrich Scholz from Axa and adds jokingly, “It’s worse than Cologne Cathedral.”

Once, the building work rested almost three centuries for Cologne Cathedral. When the first construction phase ended in 1560, engineering insurance companies did not yet exist. The first insurance firm in Germany was established in 1676.
Ensuring that everything runs smoothly on Germany’s highest building site: German engineering insurers are world leaders and their services are increasingly in demand. Without them there would be far fewer bridges, airports, and wind farms and it would not have been possible to build the **CABLE CAR ON THE ZUGSPITZE**.

**ZUGSPITZE: UP TO THE TOP AND BACK AGAIN**
- **LENGTH**: 4,467 meters
- **HEIGHT DIFFERENCE**: 1,945 meters
- **SUPPORTING CABLE**: 153 tons per cable
- **TRANSPORT CAPACITY**: 580 people per hour
- **OPENING**: planned for December 21, 2017

**MOUNTAIN STATION**
- **Height**: 2,944 meters above sea level

**PILLAR**
- **Height**: 127 meters

**LONGEST UNSUPPORTED SPAN**
- **Length**: 3.2 kilometers

**ON THE ROOF OF GERMANY**
KEEPS THINGS MOVING
Premiums for engineering insurance worldwide in billions of dollars

TWO CABINS
Capacity: 120 people each
Speed: 10.6 m/s

VALLEY STATION
999 meters above sea level

GERMAN EXPERTISE IN DEMAND
Premiums for engineering insurance in millions of dollars

IF IT’S NOT ONE THING, IT’S ANOTHER
Major damage* by cause in millions of dollars

Source: IMIA (full year 2015)

Source: IMIA (2015)

* Claim amount over 1 million dollars

INHERENT DEFECTS (DECENNIAL) INSURANCE
Machinery breakdown, boiler explosion, loss of profits

INERTIAL DEFECTS (DECENNIAL) INSURANCE
Contractors’ all risks, erection all risks, advance loss of profits

ELECTRONIC EQUIPMENT INSURANCE

FRACTION 398
UNITED KINGDOM 421
FRANCE 398
ITALY 444
TURKEY 501
UK 421
SPAIN 511
JAPAN 663
CANADA 531
MEXICO 703
USA 783

2013
2012
2011
2014
2015

Source: IMIA

Faulty operation
Faulty material and workmanship
Fire
Natural hazards
Faulty design
Explosions
Others

2013
2014
2015

GERMANY 1619
FRANCE 398
UNITED KINGDOM 421
ITALY 444
TURKEY 501
SPAIN 511
JAPAN 663
CANADA 531
MEXICO 703
USA 783

2011
2012
2013
2014
2015

Source: IMIA (full year 2015)