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PROPERTY MATTERS

Property Insurance Risks for Distribution Warehouses

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Risk situation

Until recently, the global economy has been driven by continuous growth and prosperity through optimization of production and trade processes. At the same time, efforts were made to achieve efficiencies and cost reductions as well as greater market penetration. Just-in-time and globalization are just two key concepts in this context.

These business models have been eroded by several events in recent years, like the increasing damages due to climate change and growing political uncertainties leading to conflicts and global tensions. Examples include the war in Ukraine, increasing tensions between the U.S. and China, and the Covid pandemic and related lockdowns. Also notable is that local events and damages can increasingly have global impacts and implications. Typical examples are the flood in Thailand in 2011,[1] the blocking of the Suez Canal due to a shipping accident in 2021,[2] the fire at a semiconductor plant in Asia in 2021,[3] and bottlenecks in the availability of containers and means of transport in 2021/2022.[4] One of the main reasons for this is the ever-increasing global interlinking and automation of production and trade processes, especially in recent decades, triggering complex chain reactions and cascade effects in the event of disruptions.

The consequences of these events are rising inflation and recession trends, leading to changes in consumer purchasing behavior, supply bottlenecks for raw materials and intermediate products, rising prices for economic goods, and more and more corporate insolvencies.

These situations are causing many companies to rethink their previous strategic and operational goals and to look for new solutions. A wide variety of solutions are being discussed, such as de-globalization through greater geographical differentiation in the procurement of goods, reduction of the default risk for a company through diversification of the business model, improved transparency in production and trade processes, and resilience in the supply chain. Increasingly, the realization that process optimization and cost reductions lead to a stronger increase in risk is gaining ground, i.e., in the event of a disruption to processes, there are no or only insufficient alternatives available to compensate for the potential consequences of a loss.

Content

About This Newsletter

Created for our clients, our Property Matters publication provides an in-depth look at timely and important topics affecting commercial and personal lines of property insurance.

One way to strengthen the resilience of companies from disruptive events can be an improved risk management and preventive measures. One such measure is to reduce dependence on raw materials and intermediate products by increasing stockpiling.

This article will discuss some of the challenges for Property insurance associated with increased warehousing and highlight possible alternative courses of action.

Distribution warehouses

Warehouses are premises for the storage of goods (materials and merchandise) that will be needed later, e.g., to produce goods (raw materials warehouse) or to deliver to customers (finished goods warehouse). They can be part of a production plant, but they can also be independent facilities.

According to the respective main function of the warehouse, a distinction can be made between procurement, forwarding/transshipment, intermediate, finished goods, sales, and distribution warehouses. Warehouses can be single or multi-story and have storage areas of more than 100,000 m² and storage heights of up to 50 m (e.g., high-bay warehouses).

Knowing their properties and functions, warehouses can be classified by:

- Type of storage (e.g., bulk, block, shelf storage)
- Type of product stored
- Type of building (open air storage, halls, basements, silos or depots, cold storage, clad-rack warehouses)
- Material flow (warehouse for raw materials, components or semi-finished products, finished products, intermediate storage, depot warehouse, distribution warehouse)
- Location (e.g., central warehouse, regional warehouse, transit warehouse)
- Degree of automation (manual, semi-automated, fully automated)

Typical activities in a warehouse include receiving and inspecting goods, storing, commissioning, and shipping goods to customers.

Loss examples

In January 2023, a fire occurred in France in a warehouse complex with three storage units of approximately 6,000 m² each.[5] According to press reports, the fire started in a unit that stored 12,500 lithium-ion batteries for automobiles. From there, it spread to the other two storage sections; in one, approximately 80,000 tires were stored, and in the other, textiles and wooden pallets. Extinguishing the fire took the combined skills and efforts of 137 firefighters with 60 emergency vehicles.

Back in 2021, a fire involving lithium-ion batteries occurred in the U.S.,[6] which took firefighters about two weeks to completely extinguish using 20 tons of Portland cement. Batteries for "uninterruptible power supply systems", telecommunications systems, renewable energy, utilities, and emergency lighting systems were stored in the warehouse, a total of approximately 90 tons, including approximately 45 tons of new and used lithium-ion batteries and approximately 22 tons of defective, damaged, or recalled lithium-ion batteries.

The fire at a modern robot-operated distribution warehouse for an online grocery retailer in the United Kingdom caused a stir among experts.[7] One of the robots, equipped with lithium-ion batteries, started to burn and set fire to other vehicles and to the warehouse. Ultimately, 200 firefighters were needed to extinguish the blaze. The warehouse suffered a total loss.

Furthermore, the scale and associated value of the warehouses continues to increase. In 2022, for example, a U.S. warehouse of approximately 112,000 m² storage space was completely destroyed in a fire despite an existing sprinkler system.[8] Three hundred and fifty firefighters were unable to prevent losses in the high triple-digit millions. Several other disastrous warehouse fires occurred in Russia (2022),[9] Taiwan (2022),[10] Korea (2021),[11] and the U.S. (2021).[12]

Statistical findings

There is limited usable statistical data for property insurance on losses in storage areas. In the U.S., there was an average of approximately 1,400 fires in stand-alone warehouses from 2016 to 2020.[13] In the UK, approximately 300 warehouse fires occurred in recent years, with an increasing trend during the 2020 to 2022 observation period.[14]

In Germany, warehouse fires are registered by the German Insurance Association (GDV).[15] Currently, only data from claims until 2020 are available. Since a peak in 2020, the number of fires has dropped from about 400 fires to about 220. However, if one follows the press closely, we can expect that, like in other countries, the number of losses will rise again.

Novel challenges

In the following section, some of the challenges for property insurance and possible preventive fire protection measures will be described, i.e., the success of automatic storage systems, in particular so-called TL-ASRS (top-loading automatic storage and retrieval systems), the increasing storage of lithium-ion batteries, and the growing value of stored goods in general.

Warehouse storage

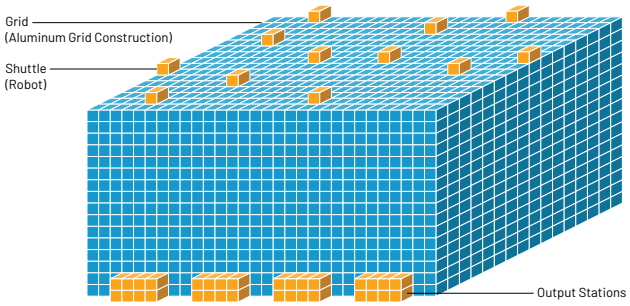
TL-ASRS

Warehouse technology has changed significantly in recent years. Warehousing costs are usually seen as reducing profits for companies ("dead capital"), which is why people started looking for ways to minimize these costs. For example, just-in-time concepts were implemented to reduce warehouse space. Additional efficiency gains were achieved by optimizing packaging and warehouse management as well as centralization and outsourcing to warehouse service providers. At the same time, this increased the dependency of companies on the required goods being delivered on time and in sufficient quantities.

More specifically, warehouse management was automated in order to reduce costs. Another cost-saving measure was to increase storage density by changing warehouse designs. One example is the development of automated, robot-operated warehouse concepts known as auto storage retrival systems (ASRS), which initially were used predominantly in small parts warehouses but have increasingly found their way into general warehouse management.

In the top-load system (TL-ASRS), one of the best-known concepts,[16] a base frame made of extruded aluminum profiles forms the framework for the storage system. Four supports form a storage shaft into which plastic containers can be stored on top of each other, accessed from above. The removal and storage of the plastic containers from and into the storage shafts is carried out by battery-powered robots that move along a rail system forming the upper edge of the base frame. The robots lift the required containers out of the respective storage shaft via a lowering and lifting mechanism. The robots then take the plastic containers to workstations where the goods can be stored or retrieved. As a rule, system containers made of polypropylene or polyethylene plastics are used. They are available in various dimensions (width 445 cm x length 65 cm x height 22 cm, 33 cm or 42.5 cm, suitable for a maximum load of 35 kg). Currently, the industry is pursuing improvements to further increase the height of a storage container.

Figure 1 – Schematic diagram of an ASRS storage concept



Source: Leo Ronken, Gen Re

Although in the past only smaller warehouses were equipped with this technology, ASRS systems have now become established in large warehouses. In Sweden, an e-commerce company for fashion and lifestyle operates a warehouse with a total of 1,243 shuttles and 1,245,000 storage bins; the storage area covers more than 20,000 m² with a maximum height of 6.3 m.[17] The warehouse is equipped with an ASRS system. In Brazil there is an ASRS textile and household goods warehouse with dimensions of 116 m x 106 m x 14.5 m for approximately 8 million items, set up in the middle of a large warehouse of 75,000 m² with 300 robots and 450,000 storage containers.[18] A large (6,000 m²) warehouse for textiles with 169 robots and 196,000 storage bins was built in Germany;[19] and in the U.S., a warehouse for sporting goods and textiles with a size of 12,356 m², with 175 robots working 305,000 storage bins was erected.[20]

There are many advantages of this storage technology. It can be easily installed in existing buildings, where available areas and room dimensions are optimally utilized by dispensing with rack aisles; this storage system makes it possible to accommodate up to four times the storage quantity in the same storage area and to double the storage volume. The modular design, which can be easily adapted to any storage space, allows flexible expansion of the self-supporting rack structure. In addition, high throughput and picking speed due to the automation, and significant cost savings for the operation of the warehouse, can be achieved because of the effective energy utilization of the robots and the realization of 24-hour operation. In addition, since it is a closed system, other influencing factors such as theft or contamination of the products are excluded.

At the same time, the value load per square meter increases, which leads to significantly greater losses in the event of a fire. Due to the high degree of automation, a large number of electrical systems and thus potential ignition sources are to be expected. In addition to the stored goods, the containers, which are made of polyethylene or polypropylene, represent an enormous fire load. Due to the vertical shaft formation, a fire can spread rapidly. As a result of the poor accessibility and the cramped conditions, the fire department will have enormous difficulties in fighting a fire and preventing a total loss of the warehouse.

Moreover, due to the storage density, conventional fire detectors on the ceiling will only provide delayed alarms, if at all. The effectiveness of a conventional sprinkler system will also provide little or no support due to the extreme storage density and the closed bottoms of the stacked storage containers. Ultimately, in order to control a fire in such a storage facility, a mining technique has to be applied when dismantling the storage unit at the cost of extensive damage, if not total loss, and at considerable risk to the personnel involved. If such a warehouse is lost, it is usually not possible to find an adequate replacement in the short term, which has negative implications on a company's ability to deliver and may cause a business interruption. As a result, considerable additional expenses are to be expected for maintaining the company's ability to deliver.

For effective firefighting, experts currently recommend the installation of a stationary oxygen reduction system coupled with an area-wide smoke aspiration system/detection fire alarm system. Factory Mutual (FM Global) and VdS Schadenverhütung have also investigated concepts using a sprinkler system in a large number of real fire tests and determined boundary conditions under which control of a fire in an ASRS warehouse is considered promising.[21] A first good overview of fire protection measures for an ASRS warehouse can be found in FM Datasheet 8-34 ASRS (January 2023).[22] It should be mentioned that according to this FM datasheet, based on experimental findings, extinguishing a fire in such a warehouse is considered possible if the sprinkler system is designed in all aspects according to the specific FM specifications for an ASRS warehouse.

In addition, an ASRS storage area should be located in its own complex or at least fire section to minimize the risk of fire spreading to neighboring sections. Subdivision into several smaller storage areas is also advisable. If possible, the building in question should be constructed entirely of noncombustible materials and components. Inside an ASRS warehouse, vertical metal panels can be placed to divide the warehouse structure into smaller bay segments to impede the spread of a fire. For potential manual firefighting (by the fire department), in addition to good accessibility to the warehouse in question and good set-up opportunities for the fire department equipment, there should be platforms/walkways above the warehouse system from which the firefighters can inspect the warehouse and fight a fire as safely as possible.

In the event of a loss, all robotic vehicles should be moved independently to a predetermined fail-safe position (collection point) and automatically shut down. It is recommended that the local fire department is informed about the existence of an ASRS storage.

In addition, the media considers and discusses various firefighting scenarios,[23] though the effectiveness of these scenarios must be doubted. Among other things, there has been some suggestion that an installed sprinkler system is a useful addition to a fire department operation. However, as mentioned above, it is questionable whether an existing conventional automatic firefighting system can control or even completely extinguish a fire. An interior attack by the fire department will only be possible with full respiratory protection equipment, whereby the difficult accessibility, the expected instability of the warehouse scaffold structure, and the extreme warehouse density pose considerable risks to life and limb of the emergency forces and raise doubts about any effective possibility of fighting the fire. The clearing out of such a warehouse in order to reach the suspected source of the fire will also mean more time spent as well as a considerably increased risk to people. After the operation, such a warehouse will have to be completely cleared out, which is ultimately equivalent to a total loss.

The prevention of a total loss in a large warehouse with conventional fire protection measures (e.g., fire alarm and sprinkler systems) thus appears to be unfeasible; major damage to the goods, the warehouse technology, and the building are therefore to be expected.

Storage of lithium-ion batteries

Due to the energy transition (towards sustainable energy systems) and increasing electromobility, the erection of more warehouses for lithium-ion batteries can be expected for the future. According to Logivest,[24] an additional approximately 7 million m² of storage space will be required in Germany alone by 2030 (and thus about 1,000 new storage buildings). Since there currently are no special

storage regulations under public law, different storage and security concepts can be found in manufacturer/logistics service providers and retail warehouses.

Lithium-ion batteries are sold and stored in different sizes and power classes, and it has to be noted that the fire risk increases with the power (kWh) of the stored accumulators. Furthermore, they represent a high fire and value load. Warehouses with storage areas of 20,000 m² and more already exist.

Unfavorable storage conditions (e.g., incorrect temperature, mechanical stress) can lead to a fire event. Such accumulators must be stored at defined temperatures (6–15 degrees Celsius) and states of charge (30–50 %) as well as ambient conditions (dry) in order to reduce a potential fire risk.

The causes of damage (see Fig. 2) for a fire event can be manifold:

- Internal manufacturing defects (material, construction, contamination)
- Physical damage (during assembly, shipping, handling, waste disposal)
- Electrical abuse (under discharge, over charging, short circuit)
- Thermal abuse (exposure to high temperatures)
- Defect of the separator due to dendrite formation (by undetected aging and subsequent internal short circuit)
- Self-reinforcing, chemical exothermic reaction, the necessary oxygen is generated by the chemical reaction inside the cell (thermal runaway)

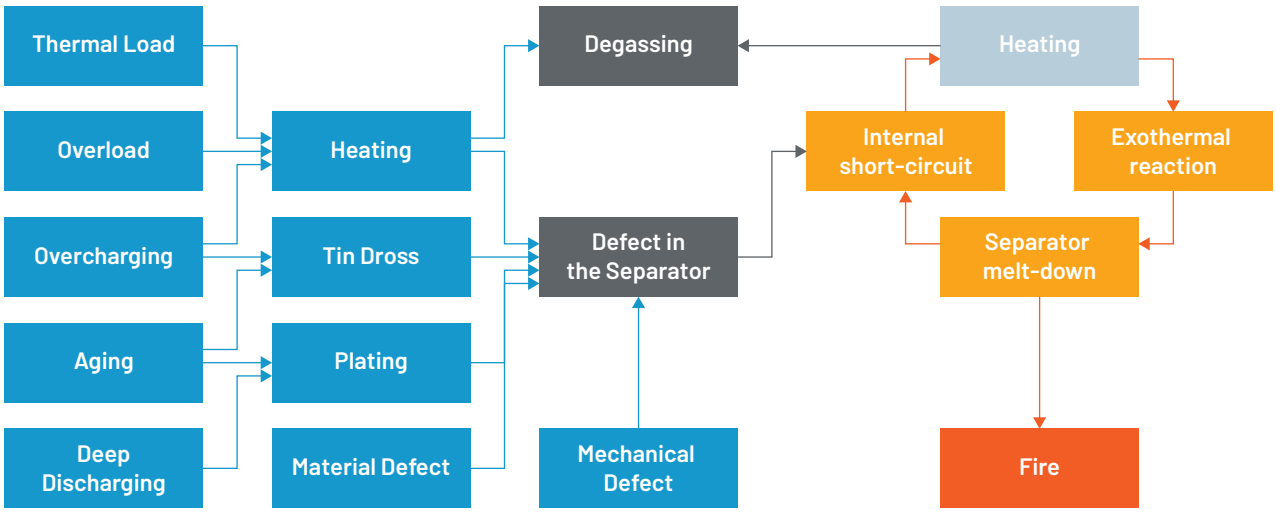
In the event of a fire, flammable and toxic gases as well as hazardous substances are released, which pose a considerable risk of contamination and endanger people and the environment. Due to the chemical reactions within a lithium-ion accumulator, a rapid progression and spread of a fire is to be expected. Due to the reaction speed in a thermal runaway, there is only a small chance to detect an incipient fire early enough for countermeasures to be taken without danger. In addition, it is impossible or at least extremely difficult to extinguish burning lithium-ion batteries with water, which means that firefighting systems can only be expected to have limited effectiveness, especially in the case of high-power lithium-ion battery storage.[25] However, the fire can be controlled through the associated cooling.

According to fire departments' findings to date, lithium-ion battery fires cannot be extinguished by firefighters, or only with enormous effort; only cooling effects can reduce the chemical reactivity of the batteries until all of the chemical energy has been released.

Fire protection measures for lithium-ion battery storage include:

- Accommodation in a separate building, complex, fire section

Figure 2 – Relationship between cause and effect in lithium-ion battery events



Source: Leo Ronken, Gen Re

- Non-combustible buildings or fire-resistant construction methods
- Observance of the storage conditions according to the manufacturer's instructions and no mixed storage with other goods
- Subdivision of the warehouse into smaller fire compartments or at least storage of the lithium-ion batteries in their own fire-resistant separated storage compartments or buildings
- Subdivision of rack storage by horizontal and vertical metal barriers between the individual storage bins (note: problem with fire extinguishing systems), avoiding storage higher than 3 m
- Equipping the warehouse with effective and optimized sprinkler/water spray firefighting systems in accordance with the specifications of the relevant VdS/FM guidelines
- Installation of a smoke suction fire detection system as well as gas detectors (detection of particles in an electrolyte gas) and thermographic detection equipment for monitoring the storage area temperature
- Separation of new, returned, damaged, or defective goods
- Provision of sufficient water for fighting fire since cooling is essential to contain the fire
- Informing the fire department about the storage of lithium-ion batteries (e.g., marking in the fire department plan) and ensuring good accessibility and set-up options for firefighting equipment
- Adequate provision of initial firefighting equipment such as fire extinguishers and wall hydrants
- Installation and maintenance of extinguishing water retention system

FM Datasheet- 8-1 Li-Ion (January 2023)[26] and VdS 3103 (Lithium Batteries)[27] provide initial guidelines for appropriate and necessary fire protection measures.

Value load

Not long ago, some stock fires reached magnitudes that previously had been considered unusual. The increasing desire to be prepared for events such as supply chain disruptions, political uncertainties in supplier countries, and shortages of raw materials and goods as well as rising procurement prices, suggests that significantly larger quantities of raw materials and of intermediate and finished goods are being stockpiled in warehouses than in the past. The rising demand for warehouse space,[28] an increasing shortage of warehouse space, and rising rental costs for warehouse space indicate stockpiling is already happening.

At the same time, attempts are being made to minimize growing storage costs through new warehouse designs, larger warehouses, and expansion of existing storage areas, while simultaneously increasing the density of storage spaces and warehouse heights. Due to the increased use of automated, complex, and investment-intensive warehouse technology as well as the larger storage volume, the value load of a warehouse per square meter continues to increase substantially. The fire load also rises due to the greater use of plastic packaging materials and storage aids. Additionally, it should be remembered that stored goods are increasingly sensitive to smoke and the repercussions of fire, and that after a fire the entire stock of stored goods is often billed as a total loss.

Following a fire that may also have caused lasting damage to existing buildings, current market conditions means that the costs of reconstruction or strengthening salvaged buildings are expected to rise, which will also be reflected in higher insurance sums. Further increases in value can be expected through supplementary measures like the installation of a photovoltaic system or other measures to improve energy efficiency.

Protective measures include:

- Optimization of the supply chain under risk management aspects
- Several spatially separated warehouses
- Non-combustible construction/fireproof construction of the storage building
- Structural division of a warehouse into fire compartments/ complexes by fire walls/complex partition walls
- Reduction of bearing density/storage height
- Installation of automatic fire detection/firefighting systems (e.g., according to VdS, FM)
- Measures to prevent the spread of smoke (smoke compartments, smoke and heat extraction systems)
- Storage of hazardous materials (goods, auxiliary materials) or particularly valuable goods in fire-resistant sections or separate, spatially separated buildings
- Business Continuity Plan

Notes on underwriting

In industry and trade, a growing tendency is to move away from just-in-time concepts. This is accompanied by a trend towards increased warehousing, largely driven by the supply chain crisis, but also by political changes, an increase in natural hazard events, the consequences of the pandemic, and the development of new warehousing technology.

In addition to a growing number of warehouse fires, there are massive price increases for stored assets, and also for warehouse building values. These trends require property insurers to carefully analyze and evaluate the developments and the associated new risk situation, and to take them into account in their underwriting. In particular, the following points should be considered:

Bearing type

- Own or rented warehouse (sole or several tenants)
- Storage type (i.e., rack, block, bulk, mixed, hanging, cold, high-bay, gallery, hazardous materials, ASRS)
- Products stored, packaging material, and storage aids used (e.g., degree of packaging, pallets, cardboard boxes, plastic packaging)
- Storage of potentially hazardous materials (e.g., flammable gases, liquids, lithium-ion batteries)
- Susceptibility of the goods to smoke, fire, moisture, water, heat, etc.
- Storage process (automated or manual)
- Continuous or intermediate storage, distribution warehouse
- Dimensions (i.e., square meters, height) and location of the warehouse
- Photovoltaic system on the roof
- Cold stores (cooling temperature, cooling technology) used

Insurance values

- Value of the building and equipment
- Value of stored products (i.e., annual average value, maximum value)
- Compensation basis of the stored goods (i.e., selling price, wholesale price, manufacturing cost, fixed price/ agreed price, incl. or excl. taxes)

Inventory turnover rate

- Yearly, monthly, or weekly
- Constant/sporadic supply to customers
- Possible replacement time of necessary stock goods
- Seasonal dependencies (e.g., procurement of goods)
- Importance of different customers for the supply of goods

EDP of the warehouse

- Intended use of the EDP
- Replacement time required in the event of damage
- Backup procedure (e.g., hourly, daily, weekly)
- Storage of backups outside the warehouse

Existing protection and safety measures

- Type of construction of the storage building as well as the building materials and components used
- Design measures (e.g., fire protection walls, distance to other buildings, fire protection rooms, fire protection of openings, flood protection, burglary protection, type of construction)
- Technical measures (e.g., automatic fire detection, automatic fire extinguishing, smoke protection, burglar alarm, alarm forwarding)
- Operational protection measures (e.g., BCP, maintenance, order and cleanliness, smoking, plant security, fencing, employee training)
- Preventive fire protection measures (e.g., company/ plant fire department, public fire department, hydrants, water supply)
- Necessary/recommended loss prevention measures
- Other (e.g., replacement time of buildings, contents, inventory, financial position and order situation with respect to a reconstruction, expected downtime after a loss, expected impact on customers/markets, estimated time for necessary reapplication for operating permits)

Business Interruption exposure

- Understanding of the insured's storage and distribution process
- Existing "bottlenecks" as well as possible alternatives/ substitutes (e.g., IT, transportation/storage systems), delivery schedules for key equipment

- Replacement of stored goods (permanent or limited availability on the market)
- Turnover rate of stocked goods over the course of a year
- Seasonal peaks/distribution of stockpiles over the course of a year
- Alternative storage options (e.g., own warehouses, third-party suppliers, direct delivery from producer to consumer)
- Expected effects/implications in the event of a loss (e.g., ability to deliver, financial impact, additional expenditures, interactions, contractual penalties)
- BCP/Emergency Response Plan in place (current, reviewed regularly).

Underlying wording/insurance contract

- Standard wording or manuscript wording
- Scope of insurance, including insured perils (e.g., named perils, all-risk coverage, or carve-out coverage for the supply chain), basis of determined insured values (e.g., original price, current value, market value, replacement price)
- Warehouse liability coverage (e.g., all risk coverage, machinery breakdown, ICOW/ AICOW, unexplained disappearance of inventory/inventory discrepancies/ shortages, stock put through policy, spoilage of goods, theft/robbery)
- Basis of compensation in the event of a claim as well as any existing underinsurance provision
- Agreed maximum loss limits, deductibles, waiting period, sublimits
- Agreed costs/first risk positions/extra costs
- Agreed amounts for new purchases and materials
- Agreed extended reporting period
- Agreed liability period

Other

- Loss history
- Exposure to natural hazards (e.g., flood, earthquake, windstorm)
- Attractiveness of the stored goods in terms of theft exposure
- Political stability in the region as well as potential risk of arson attack
- Multiple owners
- Subjective risk of the policyholder

Insurance exposure

- Maximum loss definition/scenario of surveyor/broker/ insurers used vs. company owner
- Maximum possible damage (MFL/ PML divided into property and business interruption, costs, salaries and wages)
- Evaluation of the consequences of the loss due to potential seasonal influences (e.g., worst case/best case, when, how long, description of the considered scenario)
- Identification and evaluation of existing interactions
- Evaluation of potential existing hazards from the neighborhood
- Natural hazards risk assessment (e.g., earthquake, volcanic eruption, flood)
- Consideration of any existing insurance accumulations (e.g., from other policies such as liability, environmental impairment, electronics policies, and also from insurance contracts of neighboring risks)

Summary

Recent events around the world such as natural disasters and the COVID-19 pandemic, increasing political and financial risks, and failures in the transport sector and in key industries due to losses have highlighted the risks of value chain globalization.

Delivery delays, failures, and shortfalls caused considerable production and financial difficulties in many companies. In addition to a variety of strategies to compensate for the effects of supply chain problems, these problems led the industry to abandon just-in-time concepts (production/storage only after incoming orders) in favor of just-in-case protocols (advance production/delivery/storage of raw materials and finished goods), achieved through needs forecasting, and to expand buffer stock on-site warehousing. Other measures include increased investment in digitalization and automation of warehousing and commissioning efficiency/energy), and in future risk management.

These industry adjustments fundamentally increased the risk to the business owner and the property insurer for

substantial property and business interruption losses due to inventory destruction. Key factors increasing the risk are:

- High fire load due to the stored material or packaging
- Type of storage, storage area, storage height, arrangement of the stored goods
- Lack of subdivision into complexes and fire compartments
- Lack of fire extinguishing systems (e.g., sprinkler systems)
- Use of combustible building materials (e.g., composite panels) in building construction
- Significant risk of business interruption following fire damage

For Property insurance, careful underwriting evaluation should ensure that you know and take into account the appropriate risk exposure. In particular:

- The contractual conditions on which the insurance policy is based, including any additionally agreed special conditions (clauses), are well known
- The agreed sum insured corresponds to the actual/effective value of the warehouse, as well as additionally agreed first-risk positions are taken into account for the determination of the possible maximum loss and also within the framework of the insurance premium to be calculated
- The extent of preventive fire protection measures in place is known, and the extent to which these measures are adequate for the risk exposure
- It is known what other insurance contracts may exist for the insured object in question (accumulation situation)

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Endnotes

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