



Case study

Challenges in a Volatile Business Environment – Fundamentals and Case Study of Risk Management in a Manufacturing Company

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ABSTRACT

The production of goods is carried out in production networks. However, this international economic and technical interdependence is subject to numerous risks that are predominantly economic, business, and regulatory in nature, but also brings with it a wide range of technological, environmental, and financial risks.

This article describes the effects of such risks on production networks. A case study of an automotive manufacturer illustrates the risk management system for identifying, assessing, and mitigating risks. Risks arising from operations include production, technology, supply chain, and information security risks.

Key words: polycrisis, risk management system, production networks, case study, operations, technology.

1. POLYCRISIS, SIGNIFICANT RISKS AND LEGAL REGULATIONS

1.1 Polycrisis

Crisis has become the new normal. In 2022, Collins Dictionary designated the ‘Permacrisis’, a port-manteau of “permanent” and “crisis”, as its word of the year. Immediately after the Covid19 pandemic, Russia launched its devastating invasion of Ukraine. The ensuing energy and cost of living crisis placed further strain on a weary population, which, in turn, contributed to the growing political disaffection. All of this unfolded under the specter of other long-running crises, chief among them being climate change and the ecological crisis. A growing number of authors [1, 2, 3] have identified the present era as the emergence of the polycrisis. In 1993 the French sociologist and philosopher E. Morin characterised a polycrisis as high complexity circumstance

where several, interconnected crises converging and reinforcing each other. Rooted in complexity science and systems theory, the polycrisis serves as an acknowledgement that global systems have become increasingly interdependent (as well as complex) and are linked through numerous feedback loops. A shock in one system thus triggers an adverse response in another system, which, in turn, affects other systems, creating a chain reaction that loops back at various intersections, further amplifying the polycrisis. Each constituent crisis and system must therefore neither be seen nor treated in isolation.

1.2 Significant risks

Since the end of the Cold War, Germany and Europe have once again had to grapple intensively with the threat of war, geopolitical risks, and natural and environmental disasters. Unforeseen political developments and

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geopolitical instability increase the likelihood of unforeseen risks. Companies are exposed to strategic, tactical and operational risks [4, 5].

- **Strategic risks:** These are of a higher-level nature and affect long-term objectives; they relate predominantly to megatrends and the business model, but also to a lesser extent to external influences such as geopolitical, military and regulatory risks, and extreme weather events resulting from climate disasters, etc.
- **Tactical risks:** Are of a medium-term, transaction-related nature with moderate impacts and relate to the implementation of strategy, the achievement of overarching goals, and the execution of projects involving risks to budget and schedule.
- **Operational risks:** These predominantly concern internal processes controlled by the company. They represent day-to-day problems at the operational level, such as disruptions to equipment, workflow, systems, staff or processes.

Based on the findings of the Global Preparedness Monitoring Board (GPMB), the global pandemic and epidemic risk in 2024 was made up of political, social, technological, economic, and environmental issues [6] and the evolving global crisis environment and thus requires new approaches to dealing with both traditional and new types of crises [7].

Geopolitical risks for enterprises in 2026 include, for

example, the wars between Russia and Ukraine, Iran and Israel/the US as well as unrest in Lebanon, Afghanistan and Pakistan, the tensions (and resulting global implications) between Russia and NATO, the US and China, and China and Taiwan and the crises in the Red Sea and those arising from the current US policies. Further risks include the rise in global health challenges and pandemics, trade policy and protectionism, climate catastrophe and environmental policy, secure energy supplies and the expansion of renewable energy as well as demographic change. The Country Risk Atlas 2026 [8] assesses the risks, opportunities, and economic development across 83 countries that may influence the risk of non-payment for businesses. This represents approximately 94% of the global GDP (Fig.1):

- Long-term risks: political and economic risks, business environment risks
- Short-term risks: financial and commercial risks

No company can be viewed in isolation. They operate within global networks with geographically distant suppliers, with reliability now more important than marginal price advantages.

To determine whether a risk is acceptable, four risk bands with specific decision-making rules are established (see Table 1) [9]. Table 2 shows corporate risks & opportunities of an economic, commercial, and regulatory nature as well as risks of a technological, environmental, and financial nature, together with a classification of their risk level.

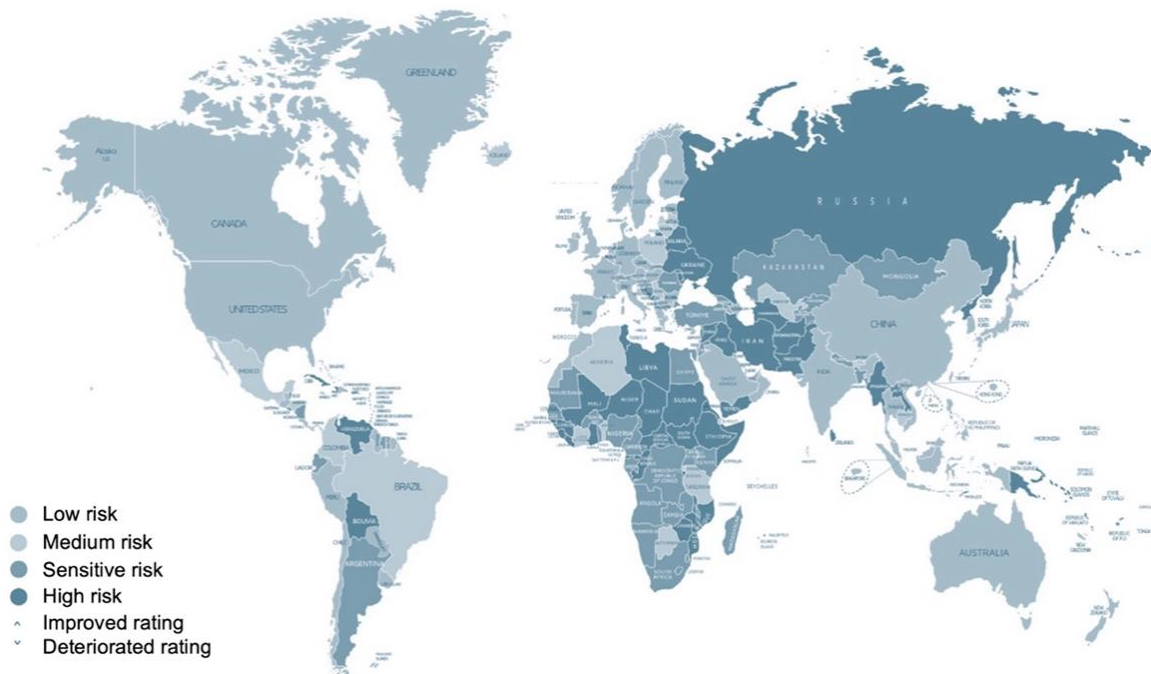


Fig. 1 Country Risk Atlas 2026 [8]

1.3 Legal regulations and ISO standard

Requirements for a risk management system come from:

- „Gesetz zur Kontrolle und Transparenz im Unternehmensbereich“ (abbr. KonTraG) [10] (Law on Control and Transparency in Business).
- Basel II and the Product Liability Act.

KonTraG targets the enhancement of corporate governance in German enterprises. KonTraG extended the liability of board of directors, supervisory board, and accountants within enterprises. KonTraG's key component constitutes a determination to bind corporate governance to establish and perform an enterprise wide early-warning mechanism for risks and release significant information of the enterprises risk and risk pattern in the annual report.

Table 1 – Risk bands with specific decision-making rules

Rating	Description
Very High	Unacceptable risk - requires urgent treatment.
High	Unacceptable risk - action to be taken as soon as possible.
Medium	Tolerable risk – action only taken, if the cost of reduction exceeds the improvement gained.
Low	Acceptable risk - with periodic review

Table 2 – Material risks & opportunities (max. XXXX-Right high; XXX-High; XX-Medium; X-Minimal) [9]

	Classification of risk level
Summarised Global & macroeconomic risks & opportunities	XXXX
Strategic and industry-specific risks and opportunities	XXXX
Changes in laws, ordinances, and regulations	XXX
Market development and dynamics	XXXX
Risks and opportunities arising from operational processes	XXX
Manufacturing processes and technological development	XXX
Procurement of parts and materials	XXX
Sales network	X
Security of information, data, and IT infrastructure	XXX
Risks & opportunities arising from financial developments	XX
Risks associated with currency volatility	XX
Volatility in supply security and raw material prices	XX
Cash flow and liquidity	X
Additional risks from the financial sector	XX
Pension obligations	XX
Risks of a national and international legal nature	XX

For the board of directors is necessary to “take appropriate measures, in particular to establish a monitoring system, so that developments threatening the continued existence of the company are identified at an early stage”. Such “developments threatening the continued existence of the company” usually arise from the interaction of single risks and compel enterprises are required to perform and aggregate periodically risk assessments. For auditors it is essential to strict check the new regulations for publicly listed enterprises, especially the existence and running of a early-warning mechanism for risks and the associated measures taken in the area of internal audit, and to include this as part of the audit report.

The audit mandate is issued by the supervisory board, which is also to be provided with the audit report. The auditor's attendance at the Supervisory Board's financial statements meeting is mandatory. As part of the rating process to which banks are subject under Basel II, set up and execution of a corporation -wide risk early warning system are also reviewed by the banks. Risk management is one of the responsibilities of the project management team. ISO 9001:2015 [11] is the world's most successful and widely recognised quality management system. In accordance with ISO 9001, every organisation is exposed to risks that may affect the quality of its services. The aim of risk-based thinking is to make processes more stable and robust and to prevent or minimise unforeseen events at an early stage. Section 6.1 of ISO 9001 requires organisations to implement a process for identifying, determining, and evaluating risks and opportunities related to quality. The process must also include how appropriate measures are taken to address these risks and opportunities. Principles and guidelines for risk management are provided by the international standard ISO 31000 [12]. It describes a comprehensive approach to the identification, analysis, evaluation, treatment, monitoring, and communication of risks within an organisation. ISO 31000 is not a certifiable risk management standard but provides an excellent framework for establishing a robust risk management programme.

2. RISK MANAGEMENT SYSTEM

2.1 Identification, evaluation, reduction of risks

The primary objective of risk management is to safeguard the company's continued existence and thereby reduce the likelihood of insolvency. The risk management procedure, which is presented in (Fig. 2), comprises several consecutive steps that are carried out systematically [9, 13]:

1. Risk identification: potential risks and events are identified and the possible sources of each risk and the consequences should it occur are recorded, with prioritization of the risk and implementation of risk filters where appropriate.
2. Risk analysis: risks are assessed in terms of their probability of occurrence and the potential consequences of damage using FMEA (Failure Mode and Effects Analysis) [14] and risk filters.

3. Risk assessment: the assessment of risks involves a detailed appraisal of all causes and consequences of the identified risks. Using this knowledge and the probability of occurrence, the risk can be specifically classified. Risks are prioritized and categorized within a risk scenario.
4. Risk management – planning measures for risk reduction:
 - risk avoidance through preventive measures, experience and knowledge
 - risk reduction through preventive measures, redundancies, stockholding
 - risk transfer through insurance and assumption of functions
 - risk monitoring, in which the entire process is regularly monitored and adjusted. Consciously living with risk and calculated risk provision defining the geometric assumptions of the nozzle and performing the modeling process in two variants.

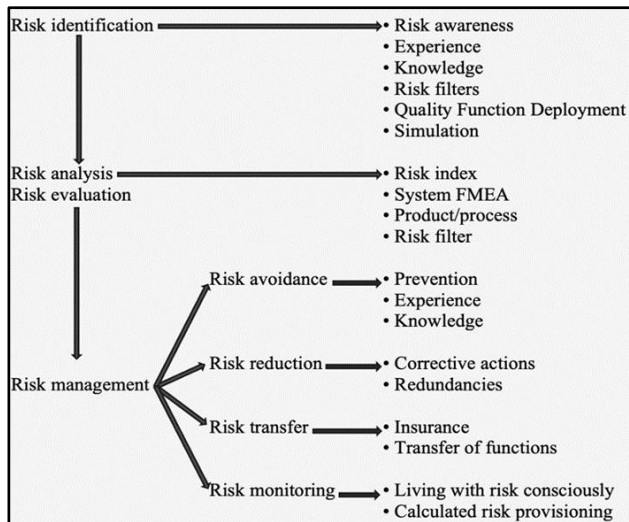


Fig. 2 Risk Management Graph [9]

2.2 Risks filter

In FMEA, the risk filter is used to distinguish between critical and minor failures using the risk priority number. High risks are identified, prioritised, and minimised through preventive and detection measures. Checklist-based risk filters are used to accurately capture customer requirements whilst identifying risks during implementation at an early stage.

Training and raising awareness among staff is crucial to their appreciation of the importance and bene-fits of early risk identification. A broad understanding of risk analysis and management can help to encourage staff to actively participate in the analysis process and strengthen risk awareness company-wide. Table 3 [9] shows a summary of a checklist-based risk filter and its wide range of implementa-tion in Enterprise Project Management, Concept/Design, Product use/Customer perspective , Product manufacturing, and Supply and Sales.

Table 3 – Checklist-based risk filter and its broad spectrum of applications across all business areas [9]

1	Enterprise Project Management
1.1	Resources, Budget
1.2	Timeline, Decision-Making
1.3	Responsibilities, Project Organization, Supplier
1.4	Selection Completed
1.5	Framework Conditions, Interfaces Management Process at the Supplier
2	Concept - Design
2.1	Significant New or Further Development, New
2.2	Technology
2.3	Complexity, Increased Functionality, Functional
2.4	Validation
2.5	Interface within the Overall System, Interactions Functional Safety, Safety Relevance, Regulatory Compliance Installation Space (Package), Weight, Tolerance Design
3	Product Use – Customer Perspective
3.1	Standard Functionality, Product Quality/Reliability
3.2	User-Friendliness (Ergonomics, Display and Control
3.3	Concept)
3.4	Sealing (Water, Dust)
3.5	Acoustics (noise), odours Appearance, haptics
4	Product manufacturing process (production and assembly process)
4.1	New or further development of
4.2	methods/processes/materials,
4.3	Handling of safety-critical technologies
4.4	Ease of assembly, assembly location environment,
4.5	accessibility
4.6	Resilience to user error in the assembly process, logistics process Capability and stability of manufacturing processes, emergency strategy Initialization or functional testing method Production strategy, start-up planning/customer process
5	Supplier Process
5.1	Supplier Experience in the Automotive
5.2	Sector/Company Experience
5.3	Production Site, Surroundings, Influences, “Know- how”
5.4	Supplier Agreements (Performance Interface
5.5	Agreement, Specifications, Quality Management Requirements for Parts) Ensuring Part Quality Supply Chain for Components and Systems (First, Second, ...)
6	Sales - Service
6.1	Repairability, workshop equipment and layout,
6.2	qualifications
6.3	Mastery of safety-critical technologies
6.4	Diagnostic capability of components and systems
6.5	Vehicle delivery, communication of innovations Recycling, spare parts

3. CASE STUDY: RISK & OPPORTUNITIES ARISING FROM OPERATIONAL AREAS

Effective and efficient risk and opportunity management forms the basis for a company's commercial success. This enables it to respond flexibly and swiftly to changes in society, the economy, geopolitics, technology, the environment, legislation, natural and environmental disasters, and pandemics. Individual and cumulative risks, as well as polycrises in extreme cases, must be identified, assessed and remedial measures determined. The focus of this article lies neither on the macro level nor on global risks-particularly those within the context of polycrises, but rather on a case study of an automobile manufacturer [9], and specifically on the risks of production interruptions, such as technology and supply risks [9]. Table 4 shows the ten most significant risks in German industry, ranked by frequency of occurrence: operational interruptions, cyber-attacks, legislative changes, natural disasters, new technologies, and fire/explosion [15].

Table 4 – The 10 most significant risks in German industry [15].

Rank	Risk cause or impact	%	Trend
1	Operational interruption (including supply chain disruption)	48%	↔
2	Cyber-attacks (IT failure, data breaches, fines and penalties, etc.)	44 %	↔
3	Legal changes (e.g. trade restrictions and trade wars, protectionism, collapse of the Eurozone)	35 %	↑
4	Natural disasters (e.g. storms, floods, earthquakes)	28 %	↓
5	New technologies (e.g. networking of machines, nanotechnology, AI, 3D printing, blockchain)	20 %	↑
6	Fire, explosion	19 %	↓
7	Product recalls, quality defects, serial faults	17 %	↔
8	Market developments (e.g. volatility, increased competition, M&A)	17 %	↓
9	Reputational damage or negative impact on brand value	13 %	↔
10	Macroeconomic developments (e.g. commodity prices, deflation, inflation)	9 %	↔

(Source: Allianz Global Corporate & Specialty (2019). The figures represent the frequency with which a risk was selected as a percentage of all responses. The figures do not add up to 100 per cent, as respondents could select up to three risks. A total of 172 participants were surveyed.)

3.1 Structuring risk management & evaluation

Risk management involves timely identification, analytical methods and assessment of risks, using appropriate control measures, and the review and evaluation of these activities. In a decentralised net-work, representatives from all divisions and manufacturing areas of the company are organised on a global basis and are managed centrally by the Risk Management Department. Their responsibilities and tasks are clearly defined and documented. The Risk Management Steering Committee reviews all significant identified risks, which are then forwarded to executive board and supervisory board. The risk-management system is independently assessed by the Group Internal Audit Department [9].

Risks are generally assessed with value-at-risk models and evaluated using standardised measures of loss distribution. This improves the comparison of risks in both internal and external reports. The risk assessment takes effective risk reduction actions into account (net assessment).

Value at Risk has become the industry standard in risk management and monitors the risks arising from the markets and the business environment. It represents the maximum loss that will not be exceeded within a specified period with a given confidence level [16].

Risks are categorised by their risk level (the average effect on financial performance, based on the probability of their occurrence). The impact on profits could be substantially greater should the risk be realised (worst-case scenario). In addition to the impact of risks, opportunities are presented separately and are not taken into account in this analysis; reputational risks are also not considered. Company-wide impacts and trends are identified by consolidating all significant financial impacts of the risks at a corporate level [9].

3.2 Manufacturing and technology risks

The main risk associated with manufacturing and technology at the plants is production downtime, which represents a significant level of risk [9].

Identifying risks:

- Disruptions and breakdowns: plant equipment, IT disruptions caused by cyberattacks, tool breakages, power supply, the supply of parts and materials.
- Damage to production facilities: fires, weather events such as storms or heavy rain, the effects of climate disasters and natural hazards.

Analysing and evaluating risks, implementing countermeasures:

The company's plants have taken consistent measures to analyse, assess, reduce, and prevent risks [9].

- Preventive maintenance; actions to prevent downtime caused by cyber-attacks, such as firewall rules, security software, etc.; redundancies; measures in logistics, procurement, and warehousing.
- Measures for preventive fire safety: including fire compartments, minimum distance requirements, fire-resistant walls and doors, smoke flaps, fire alarms, sprinklers, emergency exits and plans; establishment of an in-house fire brigade; preventive training; taking climate disasters and

natural hazards into account through site selection and appropriate construction measures.

- Risks arising from short-term legislative changes, delays in the start of production, costs associated with product recalls and the potential negative effect this may have on the company's reputation.

Transferring risks:

- The risks of property damage and losses resulting from production interruptions after the implementation of remedial measures are transferred to insurance companies.

3.3 Supply risks

Supply shortages caused by supplier failures represent a significant risk in procurement. Production disruptions resulting in a drop in sales for the company due to production problems at suppliers can lead to increased costs in both the short and long term. If customer demand cannot be met, this could damage the company's reputation. Delivery delays may be caused by shortages of materials, primary products and energy, IT issues, country-specific risks, fires and natural disasters, and by a violation of quality and sustainability standards.

Risk criteria such as site location or sustainability requirements are examined as standard during the supplier selection process. This also considers the impact of climate catastrophes and the rise in natural hazards [9].

- Over- or under-utilisation of capacity at suppliers may result from changes to the sales programme.
- Consequently, additional claims may arise due to capacity expansions or compensation claims.
- The supply of materials to the plants via indirect suppliers may be threatened by the increasing complexity of the supplier network.
- A prevention programme has been established to identify such developments at an early stage and to enable appropriate measures to be taken.
- Reduction of risks to supply security and the safeguarding of know-how by providing a defense against cyber-attacks and support for suppliers across the entire value chain.
- Risk of price increases by suppliers due to the high inflation of recent years.
- To ensure continued supplies, the company supports suppliers at risk of insolvency.
- The price risks for raw materials represent a medium risk.

Risk management is comprehensive with a very high number of risk representatives and extends to all departments and production areas. Macroeconomic, strategic, financial, and legal risks are not discussed here.

4. SUMMARY AND OUTLOOK

The company's risk management serves two purposes: firstly, to fulfil legal and regulatory requirements, and secondly, to make the company more resilient against

potential risks. Risk management is firmly embedded within the management and planning levels [17, 18]. The risks outlined herein represent potential challenges for the company [9] and must be further reinforced among the workforce: In accordance with company-wide policy, all managers and employees are required to report risks through designated reporting channels. Risks are reviewed and considered in decision-making and planning processes [17, 18]. The risk management network regularly conducts company-wide training and information sessions. Risk culture and risk management processes are embedded in the company's core values, risk strategy, and risk management guidelines and regulations. The risk management system is continuously developed on the basis of new insights and internal and external requirements [9].

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