Critical materials: identifying risks, securing supply

Critical materials are input products and raw materials whose failure or scarcity can significantly jeopardise a company's production, ability to deliver or competitive position. A material becomes critical not merely because of its price, but through the combination of supply risk, substitutability and business impact. For technical buyers, critical materials therefore form a distinct area of focus that demands systematic analysis, mitigation strategies and continuous monitoring. This article explains the definition, methods, key figures and current developments relating to critical materials in industrial procurement.

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Key facts at a glance

01 Critical materials are assessed on the basis of supply risk and business impact, not only purchasing volume.

02 Typical drivers are market concentration, long replenishment lead times, geopolitical dependencies and a lack of substitutes.

03 Established instruments are portfolio analyses, dual sourcing, strategic buffer stocks and long-term contracts.

04 Regulatory requirements such as supply chain acts and raw material due diligence significantly increase the review effort in individual cases.

05 Critical materials are often at the beginning of the value chain, so disruptions only become visible late and with a delay.

06 A structured process for criticality assessment should be updated annually or in the event of significant market changes.

Definition: Critical materials

Critical materials are goods, raw materials, components or intermediate products whose unavailability can cause material damage to production, revenue or reputation. Criticality arises from the interplay of probability of supply failure and magnitude of damage – not solely from the purchase value.

Distinction from C and A items

Not every A-material is critical, and not every critical material is significant in value terms. An inexpensive electronic component can cause a complete machine standstill, while high-priced components with many sources of supply are comparatively uncritical. The classic ABC analysis based on purchasing volume therefore needs to be supplemented by a risk dimension, for example in the form of a Kraljic portfolio analysis.

Dimensions of criticality

Four assessment dimensions have proven effective in practice: supply risk (market concentration, replenishment lead time), substitutability (technical alternatives, approval effort), business impact (production standstill, contractual penalties, image) and compliance risk (origin, trade restrictions, proof obligations). A material is typically considered critical if at least two dimensions show high levels.

Methods and approach for identifying critical materials

Systematic identification takes place in several stages: building a data basis, assessing materials, deriving measures and continuous monitoring. What matters is a reproducible procedure that delivers comparable results across staff changes.

Assessment using the risk matrix method

The starting point is usually an assessment matrix in which each material is classified by probability of supply failure and severity of impact. Assessment factors include the number of available suppliers, regional concentration, replenishment lead time, stock coverage and dependence on intermediate products. The result is a prioritised list from which measures are derived per material or material group.

Supplier and market analysis

In addition, the supplier structure is analysed: who supplies the material, from which region, with which upstream suppliers? A stock analysis and a stock issue indicator or stock issue analysis show how quickly a material is consumed and how long the autonomy lasts in the event of failure. A capacity risk at the supplier – for example due to fully utilised plants or long set-up times – is also taken into account.

Involvement of engineering and quality

Since substitutes can often only be used after approval or testing processes, technical documentation and development should be involved early. Methods from the quality field such as Gage R&R (measurement system analysis) or first sampling processes determine how quickly a second supplier can actually be qualified. Without quality-assured release, a nominal second supplier is worthless in the event of failure.

Mitigation strategies for critical materials

After identification comes mitigation. The choice of strategy depends on the criticality profile, cost structure and market situation; in practice, several instruments are combined.

Sourcing strategies

Dual sourcing or multi sourcing reduces supplier risk, but incurs qualification and administrative effort. Alternatively, a strategic main supplier can be safeguarded contractually, for example through long-term contracts with volume and capacity commitments. A category governance ensures that such decisions are made uniformly across the commodity group and are not undermined at decentralised level.

Stocks and contractual instruments

Safety stocks or strategic buffer stocks bridge short outage periods, but tie up capital and affect the cash-to-cash cycle. Call-off orders and framework agreements secure capacities without holding physical stock. When renewing critical supply contracts, the renewal should be tackled well before expiry to avoid negotiation pressure and supply gaps.

Early involvement and alternative development

Early supplier involvement helps to address critical characteristics during development – for example design-to-standard approaches that reduce the use of rare materials. In innovation management in procurement, substitutes, recyclates or process alternatives are systematically tracked. In addition, a consensus forecast gives the supplier planning certainty and reduces its own capacity risk.

Key KPIs for managing critical materials

Without measurable key figures, risk management remains theoretical. The following indicators have proven effective in practice for managing critical materials and should be evaluated regularly, often on a quarterly basis.

Supply and stock metrics

Key metrics are the delivery reliability of critical items, replenishment lead time and stock autonomy in days – i.e. how long production can run without replenishment. Inventory turns show whether buffer stocks are dimensioned economically. Ongoing stock analysis reveals whether buffers still match the current demand planning from demand planning.

Risk and qualification metrics

Also to be recorded are the share of critical materials with a qualified second supplier, the single-source share in critical commodity groups and the time-to-qualify for alternative sources. In addition, metrics on freight and procurement cost developments provide indications of emerging scarcities, such as rising spot prices or extended lead times.

Risks and controls in dealing with critical materials

Critical materials carry risks beyond pure supply failure: price volatility, compliance violations in the supply chain and operational weaknesses such as missing parts in assembly. Controls must cover these facets.

Compliance and supply chain risks

For materials from risk regions, due diligence requirements must be observed, for example evidence of origin and production conditions. Instruments such as a child labour risk assessment or general supply chain audits are part of the standard toolkit; the specific legal obligations depend on company size, industry and jurisdiction and must be reviewed legally on a case-by-case basis. International contracts determine via the governing law clause which law applies in the event of a dispute.

Operational controls and escalation

Effective shortage management prevents missing critical components from bringing production to an uncontrolled standstill: escalation levels, prioritisation appropriate to the situation and clear responsibilities are decisive. Regular inventory-like checks such as cycle counting ensure the data quality of stock levels – incorrect stock data leads to false confidence for critical materials. Quick price enquiry processes help to check terms at short notice during market fluctuations without going through formal tenders.

Current developments in critical materials

Several trends are increasing the importance of the topic: geopolitical upheaval, export restrictions, rising demand from electrification and digitalisation, and increasing regulatory requirements regarding proof of origin and the circular economy.

Regulation and transparency

Supply chain acts, conflict minerals regulations and raw material due diligence requirements expand buyers' duty of care. Practical implementation requires transparency down to the upstream stages – an effort that is often organised via a contract for services with audit providers or through industry-specific initiatives. Buyers should have their own obligations reviewed legally on a case-by-case basis.

Circular economy and partnership models

Recyclates, remanufacturing and material-saving design reduce dependencies in the long term. Strategic partnerships, for example in the form of a joint business plan with key suppliers, secure capacities and promote joint substitute development. Invoice automation is also gaining in importance, as reliable, fast settlement processes stabilise the relationship with closely bound specialist suppliers.

Typical metrics

Metric	Typical value
Stock autonomy of critical materials	typically 30–90 days *Guidance: duration for which production can continue without replenishment; the level is based on the replenishment lead time.*
Share of critical materials with a qualified second supplier	> 90 % *Target value in well-organised procurement organisations; starting values are often significantly lower.*
Delivery reliability of critical items	> 98 % *Refers to on-time delivery in the past quarter, measured at the level of the critical material list.*
Time-to-qualify alternative source	3–12 months *Highly industry-dependent depending on approval effort; important for sizing buffer stocks.*
Single-source share in critical commodity groups	< 10 % *Rule of thumb; the remainder should be compensated through contractual or stock-based safeguards.*

Practical example

A medium-sized machinery manufacturer identifies two power semiconductors and one rare-earth magnet material as critical in a portfolio analysis: both come from a handful of suppliers in a single region, the replenishment lead time is typically several months, and substitutes require a new approval of the machine assembly. After a brief supply failure requiring overtime on the production side, the company implements a bundle of measures.

- Qualification of a second supplier for each critical component, including first sampling and measurement system analysis, ahead of the next demand increase.
- Build-up of a strategic buffer stock of approx. 60 days of autonomy per material, managed via the stock issue analysis.
- Long-term contract with the main supplier including a capacity commitment and the provision of a consensus forecast.
- Four-level escalation concept in shortage management with defined decision-making authority and a quarterly risk report to the management.

Conclusion

Critical materials require their own, structured treatment process in industrial procurement – from systematic identification via secured sourcing and stock strategies to continuous monitoring. What

matters is the integration of the procurement, engineering, quality and logistics perspectives, since substitutes without qualification are worthless and stock without data quality is deceptive. Those who make criticality measurable and regulate responsibilities clearly reduce the risk of failure significantly and, as a side effect, improve their negotiating position. Given geopolitical uncertainties and increasing regulatory requirements, the topic is no longer a peripheral issue but an integral part of resilient procurement.

Frequently asked questions

? What are critical materials?

Critical materials are input products whose failure can significantly damage production, revenue or reputation. What matters is the combination of supply risk and business impact, not the purchase value. Even inexpensive components can therefore be critical if they cannot be substituted.

? How do you identify critical materials in procurement?

Typically a risk matrix is used in which materials are assessed by probability of failure and magnitude of damage. Factors include supplier concentration, replenishment lead time, substitutability and compliance risks. The result is a prioritised material list that serves as the basis for action.

? Which strategies secure the supply of critical materials?

Proven instruments include dual sourcing, long-term contracts with capacity commitments, safety or buffer stocks and early supplier development. Several measures are often combined, as each on its own only covers part of the risk. The choice depends on criticality, cost and market situation.

? How much safety stock makes sense for critical materials?

In practice, the level is based on the replenishment lead time plus the qualification time of an alternative supplier, often several weeks to months of autonomy. Higher stock levels tie up capital and strain cash flow. Regular stock analysis keeps the buffers aligned with changing demand planning.

? What legal obligations apply to critical materials?

Depending on the legal jurisdiction, industry and company size, supply chain acts, conflict minerals regulations or raw material due diligence obligations may apply. Typical requirements are proof of origin, risk assessments and grievance mechanisms. The specific obligations must be reviewed legally on a case-by-case basis.

? What is the difference between critical materials and critical raw materials?

Critical raw materials usually refers to economically defined raw material lists, such as those for strategic metals. The procurement term critical materials is broader and also encompasses components, intermediate products and chemical intermediates. A company therefore assesses its materials independently according to company-specific criteria.

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