

Bow-Tie Analysis: Systematically identifying and controlling risks in procurement

The bow-tie analysis is a visual risk management method that depicts the causes, event and consequences of a risk in the shape of a bow tie. It combines cause analysis and impact analysis with preventive and mitigating measures in a single diagram. In technical procurement and the supply industry, it helps to assess supplier and sourcing risks in a structured manner and document them in an auditable way.

Key facts

- The bow-tie analysis visualises a central risk event with causes on the left and consequences on the right, separated by barriers.
- It originally comes from process and plant safety and is increasingly used in supplier and procurement risk management.
- In a procurement context, it is particularly suitable for single sourcing, critical long-lead items and supplier failures.
- Preventive barriers act on the causes, mitigating barriers on the consequences of the top event.
- The method is closely related to FMEA, the Ishikawa diagram and Fault Tree Analysis, but delivers a more communicable overall picture.
- Typically, it is created per critical purchased item or supplier route and updated regularly.

Definition: bow-tie analysis

The bow-tie analysis is a semi-quantitative risk management method that places a central undesired event (top event) at its centre. To its left, causes with preventive barriers are mapped; to its right, consequences with mitigating barriers – the diagram resembles a bow tie.

Origin and classification of the method

The method has its roots in safety engineering, particularly in the plant safety of chemicals and energy, where it has been used for decades to control major hazards. Meanwhile, procurement and supply chain organisations also use the approach because it fits complex risk situations onto a single page and is comprehensible to non-specialists. In procurement, it is often used where classical risk matrices are too coarse: for critical components, quasi-monopolistic suppliers or long replenishment lead times.

Distinction from FMEA and Failure Mode Analysis

While FMEA systematically works through individual failure modes of a product or process, the bow-tie analysis focuses on a selected top event and its complete chain of effects. It answers less the question 'What could possibly go wrong?'

Procedure: creating a bow-tie analysis in procurement

In practice, creation usually follows six steps: define the top event, identify causes, describe consequences, identify barriers, examine escalation factors and derive measures. A workshop with procurement, quality, engineering and logistics typically delivers a robust first version in half a day to a full day.

Selecting the top event and critical purchased items

The top event should be formulated precisely, for example 'Failure of the sole supplier of a critical cast component'

Areas of application in technical procurement

The bow-tie analysis delivers value wherever failure consequences are costly and the cause structures are complex. It is suitable for product risks as well as process and supplier risks along the entire supply chain.

Single sourcing and critical suppliers

For single sources, supplier failure is the classic top event. Preventive barriers here include, among others, a maintained Approved Vendor List (AVL), dual-sourcing strategies, financial metrics monitoring and regular supplier evaluations. Mitigating measures include contingency plans, safety stocks and qualified alternative suppliers. Especially when onboarding new critical suppliers, it is worthwhile to create the bow-tie early so that barriers are contractually and operationally anchored from the outset.

Project procurement and first sample submission

In project procurement, the bow-tie analysis accompanies risky milestones such as first sample submission (EMPB) or pilot series sourcing. A typical top event is 'Sample run fails to meet quality requirements and delays the SOP'

Key KPIs for controlling bow-tie measures

The bow-tie itself is a qualitative tool, but its barriers can be monitored using metrics. This turns the static diagram into a live steering instrument for procurement.

Barrier availability and supplier metrics

Key metrics include barrier availability (for example, the proportion of verified and approved AVL suppliers), on-time delivery (OTD), the number of open complaints per supplier and the replenishment lead time for critical parts. Typically, organisations aim for on-time delivery above 95 per cent and an AVL completeness rate of nearly 100 per cent for critical parts. The specific target values should be defined according to industry, part criticality and contractual situation.

Inventory and early-warning indicators

In addition, inventory-versus-demand metrics, forecast error as an early indicator of planning uncertainty, and the proportion of single-sourced items in the total procurement volume are useful. The lead time from risk identification to measure implementation is also a practical KPI. Those who link bow-ties to a risk management system or a supplier portal can automatically monitor barrier status and trigger escalations in the event of deviations.

Risks, limitations and controls of the method

A bow-tie analysis is only as good as its creation and maintenance. Typical weaknesses are false precision, outdated diagrams and barriers that exist on paper but fail in practice.

Typical mistakes in application

Common mistakes are top events formulated too vaguely, overlooking escalation factors, and barriers without a clear owner or evidence. Confusing preventive and mitigating measures also leads to gaps in practice: a safety stock mitigates consequences but does not prevent a supplier failure. Moreover, when too many top events are processed in parallel, quality suffers; in practice, five to ten prioritised bow-ties per organisation have proven to be a realistic scope.

Verifying and evidencing barrier effectiveness

Every barrier needs an owner, a review interval and evidence – such as audit reports, contract texts with price adjustment and exit clauses, or documented emergency drills. As part of supplier audits and annual reviews, it should be checked whether preventive barriers are still effective. Integration with contract management is also important: control rights, pricing mechanisms such as the raw material escalation clause and clear escalation paths in the dunning process are among the operational barriers that make the difference in an emergency.

Current developments: digitalisation and supply chain topics

Bow-tie analyses are increasingly moving into digital risk management and SRM systems and are being combined with supply chain monitoring. In this way, they are evolving from a one-off workshop method into a continuous monitoring instrument.

Real-time data instead of one-off workshops

Modern set-ups automatically feed supplier metrics, financial early-warning indicators, trade data and logistics status into barrier monitoring. Static diagrams thus become dashboards that show which barrier is currently at risk. Procurement then prioritises measures along the sourcing wave plan and the Source-to-Contract (S2C) process instead of treating risks ad hoc.

Compliance, sustainability and supply chain laws

With tightened supply chain due diligence requirements, structured risk analyses are gaining importance. Bow-ties combine well with sustainability risks, for example when a top event is 'Violation of due diligence standards by a supplier'

Typical metrics

On-time delivery (OTD) of critical suppliers: > 95%

Typical benchmark value as a preventive barrier in single sourcing

AVL coverage of critical parts: 100%

Proportion of critical items with a qualified second source

Replenishment lead time for critical parts: Usually 4–16 weeks

Determines the required level of safety stocks

Barrier availability: > 95%

Proportion of verified and effective barriers per bow-tie

Practical example: safeguarding a single-sourcing supplier

A medium-sized mechanical engineering company sourced a critical precision cast part from a single European supplier. After a delivery delay leading to a production stoppage, the team from procurement, quality and logistics created a bow-tie analysis for the top event 'Failure of the main supplier before qualification of a second source'. On the causes side, it identified financial instability, capacity bottlenecks and a lack of group-wide integration; on the consequences side, production stoppages, contractual penalties and reputational damage with end customers.

- Qualification of a second supplier and addition to the Approved Vendor List (AVL) within nine months
- Building a strategic safety stock of typically eight weeks of demand for the critical part
- Quarterly monitoring of the main supplier's financial metrics and on-time delivery with defined escalation thresholds
- Contractual safeguarding through more flexible order quantities and documented contingency logistics with alternative transport routes

Conclusion

The bow-tie analysis translates complex procurement risks into a diagram that specialist departments and executives alike can understand. Its real value lies not in the graphic itself, but in the disciplined maintenance of the barriers with clear responsibilities and metrics. In technical procurement, it is particularly worthwhile for single sourcing, critical components and risky project procurement. Combined with digital supplier monitoring, it becomes an early-warning steering instrument. Those who consistently operate a few genuinely relevant bow-ties achieve more than with hundreds of unconnected risk lists.

Frequently asked questions

What is a bow-tie analysis in simple terms?

The bow-tie analysis is a method for visualising risks in the shape of a bow tie. At the centre is the undesired event (top event), on the left the possible causes with preventive measures, on the right the possible consequences with mitigating measures. This makes it visible at a glance which barriers a company has against a risk – and where gaps exist.

What is the difference between bow-tie and FMEA?

FMEA systematically examines all possible failure modes of a product or process and evaluates them by occurrence probability, detectability and severity. The bow-tie analysis, by contrast, focuses on a selected top event and maps its causes, consequences and barriers in full. In practice the two methods complement each other: FMEA for product and process details, bow-tie for the overall picture and communication.

How do you create a bow-tie analysis step by step?

First, define the top event precisely, for example the failure of a supplier of a critical component. Then identify causes and consequences, identify effective barriers for both sides and examine escalation factors. Finally, assign owners, review intervals and metrics for each barrier and update the analysis at regular intervals.

What is the bow-tie analysis used for in procurement?

In procurement, it is primarily used to analyse supplier and sourcing risks such as single sourcing, raw material shortages or failures in the logistics chain. It helps to distinguish preventive measures such as dual sourcing or contract control rights from mitigating measures such as safety stocks. Typical areas of application are critical suppliers, project procurement and the safeguarding of critical long-lead items.

What are barriers in the bow-tie method?

Barriers are measures that either prevent the top event from occurring (preventive barriers) or limit its consequences (mitigating barriers). Examples include supplier audits, dual-sourcing strategies, contract clauses, safety stocks and contingency plans. It is important that each barrier has an owner, evidence of effectiveness and a defined review interval.

Is the bow-tie analysis required by standards?

There is no general normative requirement for the bow-tie analysis. However, in safety-relevant industries such as chemicals or energy, it is frequently expected as part of management systems and regulatory requirements. Companies should examine on a case-by-case basis which industry-specific standards and regulations apply to them and how the method can be integrated into existing risk management systems.