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From data to decisions:

why using value at risk calculations can bolster supply chain management

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Introduction

Supplier risk management is in flux. While supply chain leaders have readjusted to business as usual following the Covid-19 pandemic, there is no doubt that it exposed global supply chains' fragility. In addition to seismic disruptions and production delays, demand for some products soared, leaving suppliers struggling to keep pace. The immediate steps taken to mitigate these risks were not only chaotic for supply chain leaders but also costly, as stockpiling inventory or scrambling for alternative suppliers became an all-too-familiar approach.

It is no wonder, now with the dust firmly settled, that many firms are rethinking and rebuilding their approach to supplier risk management so it not only advances resilience but is also more cost-conscious. And time is certainly of the essence. Evidence points to similar disruptions only becoming more common and severe, as recently seen following the rising geopolitical tensions and wars in the Middle East and Ukraine. It is paramount that supply chain teams are able to respond to disruption while protecting revenue and controlling costs.

THIS EBOOK WILL EXPLORE

→ The concept of VaR, how it is measured, and how it can be applied to supply chain management

→ The importance of enterprise data and predictive analytics to inform reliable VaR calculations

→ Real-world examples detailing how VaR can be applied in practice

SUPPLY CHAIN RISKS: AN OVERVIEW

In short, the pandemic produced a real-life lesson that proactive supply chain risk management can be less costly than reactive approaches. The question then becomes what can be done?

Against this complex backdrop, Moody's believes there are levers at the supply chain team's disposal that can help. Among them is the application of value at risk (VaR).

While more commonly used in financial modeling, VaR is not necessarily new to supplier risk management. It provides a more objective measurement of how risk mitigation strategies protect revenue — enabling supplier risk professionals to make more targeted, data- and outcome-led supply chain decisions according to the outcome or value a risk mitigation response can achieve.

But there's no doubt that VaR among supply chain professionals is resurfacing, and the reason why is clear: The greater quality and availability of enterprise data today means that VaR calculations are more reliable and can therefore become the cornerstone of a corporate's supplier risk strategy.

It has the potential to empower supply chain professionals to better communicate their actions, decisions, and outcomes to senior management. VaR can certainly play a fundamental role in this respect: Supply chain teams can apply it to more confidently communicate risk mitigation strategies to boards during times of crisis.

Central to VaR's efficacy is the availability of sophisticated enterprise-level data.

Thankfully, supply chain leaders today have access to an abundance of resources and analytics that ensure they shift from reactive and after-the-fact mitigation strategies to forward-looking and proactive approaches.

With the non-targeted approach to supply chain risk management now a thing of the past, this paper will explain the critical role VaR can play in helping supply chain leaders understand the efficacy of their risk mitigation strategies. It will also provide real-world examples of how VaR can be practically applied to help maintain supply chain performance and resilience.

Operational risk
Operational risks such as labor shortages undermine supply chain resilience, cause disruption to operations and processes, and can negatively impact product quality, production, and delivery.

Financial and supplier performance risk
A supplier's deteriorating financial health can lower employee morale and translate to declining product quality, delays, and cost increases.

Geopolitical risk
Geopolitical events (including conflicts, tariffs, sanctions, and blockades) can limit supply, increase supply chain costs, and raise prices.

Cyber risk
Cyberattacks on suppliers can lead to IT systems being compromised, as well as data breaches and losses.

Regulatory and compliance risk
Regulatory noncompliance can lead to fines or other disciplinary action for suppliers, potentially causing supply chain disruption or underperformance.

Reputational risk
This tangential risk can stem from poor supplier performance or practices.

Physical climate risk
Regulatory noncompliance can lead to fines or other disciplinary action for suppliers, potentially causing supply chain disruption or underperformance.

Environmental, social, and governance (ESG) and sustainability risk
Supply chains can directly or indirectly expose companies and their investors to ESG risks due to supplier malpractices, a lack of transparency around carbon emissions or environmental policies, or poor governance practices.

SECTION 2

THE VALUE AT RISK IN SUPPLY CHAIN

When it comes to communicating their strategy to senior management, supply chain leaders face a complex challenge. In its simplest terms, the task at hand is to ensure supply chain resilience and, in the event of disruption, introduce the appropriate mitigants to keep the supply chain moving. However, they navigate this without a standard measurement that gauges whether the costs of those mitigants represent value for money.

In our view, however, value at risk can provide an answer. Indeed, by using value at risk as the guiding principle within the supply chain risk management function, supply chain professionals now have a means to prioritize and make transparent — and even objective — supply chain decisions that align with the board's risk appetite.

It also elevates the notion of risk from an intangible concept that supply chain managers are attempting to mitigate at all costs to one that has a value assigned to it. It means supply chain professionals can begin determining between risks that can be considered palatable and others that must be prioritized for mitigation.

The key questions that value at risk answers:

- → What is the supply chain team protecting as its key objective — revenue, the guaranteed supply of goods, timely delivery?
- → In the event of disruption, what could be lost?
- → Based on how much it would cost the company to avoid these losses, is the cost of the mitigation a sound investment?

At its core, value at risk is an expression of the number of days a firm can continue to supply a product – and therefore generate revenue – before a disruption could lead to tangible losses due to the nonfulfilment of an order.

How is value at risk calculated?

Risk exposure index = daily revenue x (recovery time - inventory days)

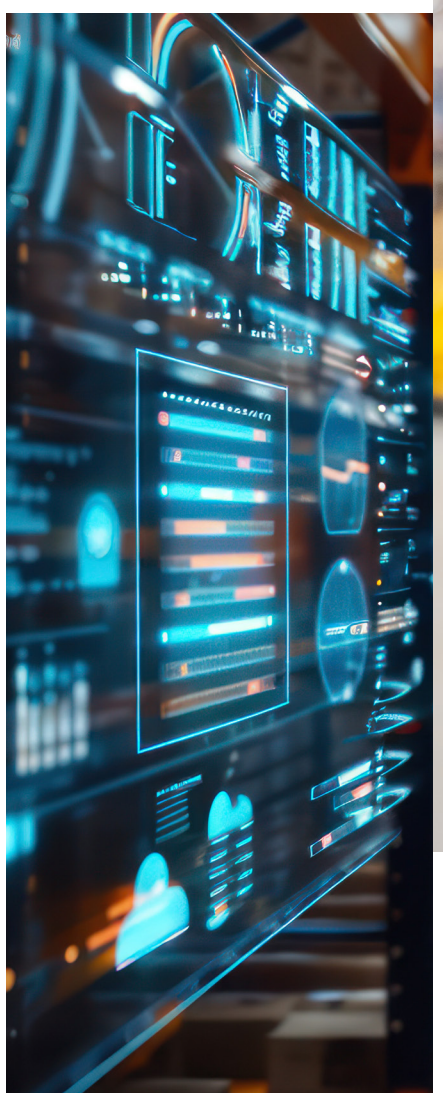
Risk exposure index x probability of disruption = value at risk

Value is not always revenue

The notion of value within the value at risk calculation is fluid and can be readily adaptable to any environment or setting. In the corporate space, supply chain professionals are tasked with protecting revenue to meet financial targets. However, there are other uses.

Take a military setting, for example. A government may use value at risk to determine the probability of disruption to the supply of military rations to frontline troops. In this example, rather than considering revenue, the supply chain leader may want to think in terms of quantity at risk for each core resource needed.

Nonetheless, a VaR calculation will enable military personnel to communicate to their leaders the potential risk to their stockpiles, as well as a cost-benefit analysis that mitigation strategies could yield to further protect or maintain these stockpiles.



To give an example, we can look at value at risk being applied to two scenarios at a fictitious company:

SCENARIO 1

Company A supplies an electronic component that generates daily revenue of $100,000. The company currently has 10 days of inventory based on existing orders and projected sales and a recovery time of 20 days.

The risk exposure index for this product can be calculated as follows:

$100,000 x (20 - 10) = $1 million

The probability of disruption can be based on historical data, expert judgment, or scenario analysis. For simplicity, let's assume that the supply chain leader uses historical data and predictive analytics to estimate the probability of disruption to be 10%. The value at risk for this product is:

$1 million x 10% = $100,000

This means if a disruption occurs, Company A has $100,000 in revenue at risk for this product. By comparing the value at risk across different products, the supply chain leader can prioritize the most critical products to protect by using mitigation strategies accordingly.

SCENARIO 2

Company A supplies a second component that also generates daily revenue of $100,000. It only has five days of inventory and a recovery time of 20 days.

In this scenario, the company identifies that there is a 70% chance that its supplier is at risk of not fulfilling its commitments. In the event of disruption, for each day that orders are not fulfilled, the company will miss out on $100,000 in revenue each day for 15 days (or $1.5 million total). Since the probability is 70%, the value at risk is $1.05 million, if calculated at that particular confidence level.

Faced with these two scenarios simultaneously, the supply chain leader can reasonably approach the board and request resources to intervene in order to protect a larger proportion of the revenue that could be lost. As such, the keys to effective supply chain management are understanding which risks must be mitigated as a priority, what the cost of inaction is, and, most importantly, a crystal-clear view on the true value of what risk mitigation strategies are attempting to protect.

Value at risk: the key benefits

REVENUE-BASED DECISION-MAKING

VaR calculations can help justify risk mitigation strategies by clearly outlining the costs as well as the anticipated revenue that can be protected, aiding supply chain leaders to make better decisions according to their risk profiles.

EASING BOARD ENGAGEMENT

VaR introduces a more transparent measure of anticipated return of investment, not only easing conversations around the cost-benefits of near-term risk mitigation strategies but also in demonstrating the longer-term value of investment in the supplier risk management function.

RISK PRIORITIZATION

Using a VaR calculation, the suppliers that expose a firm to heightened revenue risk can be identified and assessed more easily. By thinking about supply chain risks with a revenue-first mindset, supply chain leaders can make better decisions that avoid mitigating risks that do not pose the greatest threat to revenues.

IMPROVED RESILIENCE

Supply chain resilience is the capacity to absorb, mitigate, and avoid shocks to the supply chain. By calculating VaR, supply chain professionals can ensure that the largest and most severe anticipated shocks to the supply are prioritized, absorbed, and lessened.

COMMUNICATING IMPACT

In recent years, the supply chain function has transitioned from being a reactive cost center to one that is expected to proactively maximize revenue.

VaR enables supply chain professionals to clearly demonstrate the value the function brings to a company's bottom line.

The concept can also help alleviate a secondary issue in the supply chain field: professional attrition and high turnover rates. In recent years, we've noted higher levels of employee dissatisfaction among supply chain professionals. In a 2023 Gartner survey, 93% of respondents said burnout-related turnover had increased at their organization[1].

We see VaR as a possible antidote to help these professionals better demonstrate value to employers, which in turn can lead to greater employee engagement and satisfaction.

[1] https://www.gartner.com/peer-community/oneminuteinsights/managing-burnout-during-supply-chain-crisis-k4e

VaR in practice:

Leveraging advanced data and analytics to anticipate supplier risk

Among VaR's key strengths is its capacity to incorporate the probability of disruption into risk evaluation and decision-making processes. Ascertaining a reliable measure of probability of disruption is greatly facilitated by the availability of vast swaths of company and supplier data that can indicate supplier performance.

Of course, in years gone by, supply chain professionals would have only been able to react to an in-play disruption by employing mitigants with little data or analytics to inform the decisions made, by which time the disruption would already have caused revenue losses.

Fast-forward to today, and supply chain professionals can feed enterprise data into predictive analytics tools to calculate a more accurate reading of potential disruption. This in turn can make VaR a reliable concept around which to build a proactive risk management strategy geared toward greater anticipation of emerging risks and avoiding disruption.

Using a supplier performance score, a supply chain professional may detect the likelihood of declining performance within the next 90 days and decide to increase buffer stock in preparation.

Where the anticipated disruption is expected to be more severe or long term, a supply chain professional may decide to look to alternative mitigants. Geopolitical tension can be a good example: Where trade relations with an overseas supplier's country of origin are declining, the supply chain leader may look to friend- or near-shore production.

INCORPORATING DATA AND ANALYTICS INTO VAR CALCULATIONS

CAPABILITY	WHAT IT DOES	HOW IT HELPS
Supplier performance score	Company scores, which are based on financial analysis, predict a supplier's near-term operational performance risk.	This score serves as a "leading" indicator for potential declines in supplier performance (i.e., fill rates) and allows for proactive mitigation strategy deployment to minimize revenue loss.
Entity data	Verified information on suppliers, including financial data and sanctions information.	The vast range of company metrics on a supplier can help supply chain leaders develop a holistic view of company performance, which can be fed to VaR calculations or other proprietary modeling.
Cyber risk ratings	Ratings that represent the likelihood of a successful cyberattack on a supplier, which would, in turn, put both the organization and supplier's data at risk and negatively impact supply chain operations.	By identifying downward trends or rating fluctuations among key suppliers, supply chain leaders can extrapolate whether a cyber-attack is likely. This allows for proactive outreach to a supplier to discuss potential vulnerability to cyberattacks and the safeguards that can be deployed to minimize risk.

Mitigation strategies

Armed with a reliable measure of the value of risk in the supply chain, the question remains: What are the proactive and proven ways that supply chain professionals can protect a higher proportion of this value via mitigating techniques? Below, we explore these available measures.

WHAT MITIGATION STRATEGIES DOES A FIRM HAVE AT ITS DISPOSAL AMID SUPPLY CHAIN DISRUPTIONS?	
 **Increasing buffer stocks**	Increasing buffer stocks involves maintaining extra inventory to mitigate supply chain risks. The benefits include ensuring continuous production, preventing stockouts, and providing flexibility to handle sudden demand changes or supply delays. This strategy serves as a safety net against disruptions, helping businesses maintain service levels during unexpected challenges. A firm can use data and analytics to pre-position buffer stocks prior to taking reactive system-generated approaches so as to replenish stock at a faster rate based on real-time and predictive analysis of supplier performance. This would help prevent revenue losses.
 **Lead time increases**	By extending lead times, businesses create a time cushion to absorb unexpected delays or adjust to actual increases in lead times.
 **Supplier engagement**	Effectively engaging suppliers includes building strong, collaborative relationships that enhance communication, trust, and understanding of business requirements. Sharing risk data with suppliers and formulating mutually beneficial mitigation strategies are highly effective ways to do so as discussions focus on fact-based, data-driven discussions rather than emotional responses.
 **Supplier base diversification**	Supplier diversification involves establishing multiple suppliers for the same products as well as diversifying suppliers across multiple categories and geographical regions. The benefits of diversification include mitigating geographical, geopolitical, and industry-specific risks.
 **Contingency planning**	Contingency planning is an essential aspect of managing risks that could disrupt supply chains. A platform that proactively identifies risk, allows prioritization based on risk tolerance, and offers risk mitigation strategies is key.
 **Further technology adoption**	Blockchain and artificial intelligence (AI) are powerful tools in supply chain risk identification. Blockchain enhances transparency, traceability, and security of data assets and supports ecosystem development, while AI provides predictive analytics, real-time monitoring, and automation. Together, these technologies enable companies to identify risks more accurately and respond more effectively, ultimately enhancing supply chain resilience.
 **Multi-vendor strategies**	By reducing dependence on a single supplier — or several suppliers that use the same source for raw materials or components — companies can achieve significant risk reductions by being flexible as there are more alternative sources readily available to leverage when one supplier experiences disruptions. This can also create a competitive environment where a supplier will invest more heavily in risk mitigation strategies to keep or increase their share of your business by outperforming alternative suppliers.

Case study: supplier risk management at Alpha Manufacturing Inc

Now we can look at putting VaR into practice. The case study below illustrates VaR's application in a simulated scenario.

Background

Alpha Manufacturing Inc is a fictitious midsize company specializing in automotive component production. The company has established a reputation for delivering high-quality products on time. However, as competition intensifies, market conditions fluctuate, and supply chain disruptions become increasingly frequent and severe, the company faces pressure to manage costs and maintain its supply chain resilience.

Challenges

Among the critical challenges Alpha Manufacturing Inc faces is supplier diversification risk. The company relies heavily on a handful of key suppliers for raw materials and specialty components. This dependence has exposed the company to various risks, including supply disruptions, quality issues, and price volatility. Additionally, geopolitical tensions and regulatory changes in the regions where these suppliers operate have further heightened the risk profile.

Objective

To address these challenges, Alpha Manufacturing aims to develop a comprehensive risk mitigation strategy focusing on supplier risk. The objective is to quantify the supplier-related risks' impact on potential revenue and implement targeted mitigation strategies to protect the company's financial performance.

Methodology: value at risk (VaR) approach

To quantify the potential revenue impact, Alpha Manufacturing employs the VaR methodology. In this case, the company uses it to estimate the revenue at risk due to supplier-related disruptions.

STEP 1: DATA COLLECTION AND RISK ASSESSMENT

The first step involves collecting data on the company's suppliers, including historical performance, financial stability, geographic location, and dependence levels. The company also considers external factors such as political instability, natural disasters, and changes in trade policies.

STEP 2: SCENARIO ANALYSIS

Next, Alpha Manufacturing conducts a scenario analysis to simulate various risk events that could impact the supply chain. Scenarios include:

- → Supplier financial performance decline — the sudden insolvency of a critical supplier
- → Natural disasters — events such as earthquakes or floods that disrupt supplier operations
- → Regulatory changes — new tariffs or export restrictions affecting the availability or cost of materials

The company would assess each scenario for its probability and potential impact on the company's revenue.

STEP 3: CALCULATING REVENUE AT RISK (RaR)

Using the collected data and scenario analysis, the company calculates the potential RaR under each scenario. This involves estimating the loss in revenue that could occur if a supplier risk event were to materialize. The calculation considers the supplier's contribution to the company's revenue, current days of inventory on hand, alternative suppliers' availability, and the expected time needed to recover from the disruption.

STEP 4: AGGREGATING VaR

The individual RaR estimates are aggregated to determine the overall VaR for the company's supply chain. This aggregated VaR represents the maximum expected revenue loss at a given confidence level over a specific period.

Risk mitigation strategy selection

Based on the VaR analysis, Alpha Manufacturing develops targeted risk mitigation strategies:

- → Diversification of suppliers — reducing dependency on a single supplier by identifying and qualifying alternative suppliers
- → Supplier performance monitoring — implementing regular assessments of supplier financial stability and operational performance
- → Proactive buffer stock building — maintaining safety stock of critical materials to buffer against short-term supply disruptions
- → Contractual agreements — negotiating favorable terms with suppliers, such as guaranteed supply quantities and fixed pricing
- → Geographic diversification — sourcing from suppliers in different regions to mitigate risks related to geopolitical instability or natural disasters

Implementation and monitoring

The selected strategies are implemented as part of the company's broader risk management framework. Alpha Manufacturing continuously monitors supplier performance and market conditions, updating the VaR model as needed to reflect changes in the risk landscape.

By adopting a value-at-risk approach, Alpha Manufacturing can quantify the potential impact of supplier risks on revenue and effectively prioritize mitigation strategies. This proactive approach enhances the company's resilience, ensures the continuity of supply, and supports long-term business growth.

The case study illustrates the importance of data-driven risk management and highlights how companies can leverage financial models to safeguard against supply chain vulnerabilities.

Conclusion

VaR is enabling supply chain teams to reliably assess and prioritize risks, and to demonstrate financial value to their organization.

Value at risk has been a mainstay of financial analysis for decades and even permeated supply risk management for the best part of 20 years. However, what has changed is threefold.

First, supply chain teams are increasingly considered a commercial arm of a business. Intrinsically, they are being asked to show their financial value to their management teams to secure budgets and resources.

Second, as global risks become more interconnected, supply chain issues become harder to anticipate. The resulting web means supply chain leaders must be clear on what risk types they're protecting their supply chains from by employing mitigation strategies, which risk types to prioritize, and which to simply accept as unmitigated risks.

The third — and most crucial — value at risk has become more reliable thanks to the vast swaths of entity data at the supply chain team's disposal.

At Moody's, we believe the value at risk can empower supply chain leaders to communicate more effectively and transparently with board members around supply chain decision-making. By incorporating VaR and making reliable calculations, we believe the VaR concept represents an effective and proven method that can be the North Star of any supply chain function, helping organizations build resilience and make better supply chain decisions.

If you would like more information about incorporating value at risk into your functions or how Moody's can support your journey toward supply chain resilience, please contact us.

To learn more, visit:
moodys.com/supplier-risk

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