



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Improving Supply Chain Performance (ACEA 7011)

Module – Procurement and Supply Chain Management

Lecturer – Andrew Thorn

Jordan Randel – 1551653

Abstract

This report discusses the importance of effective supply chain management (SCM) for businesses to operate efficiently and meet the needs of their customers. There are many benefits of SCM, including cost savings, increased production efficiency, improved customer satisfaction and loyalty, and risk management. However, managing an international supply chain can be complex and has its challenges, a failure modes and effects analysis (FMEA) can be used to identify any potential failures and their impacts on the system. In the case of Siemens, a multinational company, several steps can be implemented to make its international supply chain more resilient, such as diversifying suppliers and supply chain routes, implementing a robust supplier evaluation and selection process, proactively monitoring supply chain risks, implementing quality control processes, developing flexible manufacturing processes, and investing in digital supply chain technologies. These steps can help Siemens optimise its supply chain and gain a competitive advantage in the marketplace.

Abbreviations

Supply Chain Management (SCM)

Failure Modes and Effects Analysis (FMEA)

Risk Priority Number (RPN)

Keywords

Supply Chain Management, Failure Modes and Effects Analysis, International Supply Chain

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Introduction

Supply chain management (SCM) is the management of the movement of goods and services from the origin to the final point of destination. It involves the coordination and integration of activities such as procurement, production, transportation, warehousing, and distribution, as well as the management of relationships with stakeholders, suppliers, and customers. Some of the main performance indicators of SCM are the quality of the product or service, the pace at which the product or service is supplied, dependability, the overall costs of the product or service, and the flexibility (Beske-Janssen, et al., 2015).

Effective SCM is essential for businesses to operate efficiently and meet the needs of their customers. Benefits of effective SCM include cost savings by optimising inventory levels through reducing stockouts as companies may need to expedite deliveries for missing items (Gonzalez-Benito, 2007). By optimising inventory levels, they can ensure the demand is met but without overstocking and tying up capital through excess storage fees, insurance, or depreciation. Transportation costs can be minimised, and production efficiency can be increased (Ahmadi Javid & Azad, 2010). Products will be delivered on time by a well-managed SCM, in the expected quality and quantity, which will improve customer satisfaction and loyalty which gives companies a competitive edge over their competitors.

SCM can assist companies in managing risks such as supplier disruptions, natural disasters, or geopolitical events that could impact their operations and supply chain. SCM can also contribute to a company's sustainability goals by reducing waste, minimising carbon emissions, and ensuring ethical and responsible sourcing (Waters, 2011).

In today's economy, SCM has become increasingly complex and challenging. However, with the correct strategies, tools, and technologies, companies can optimise their supply chains and gain a competitive advantage in the marketplace.

A Failure modes and effects analysis (FMEA) will be undertaken on a Siemens SITOP smart power supply. The FMEA is a method used to identify potential failures and their impact on a system, it will be used to critically analyse the international supply chain. Steps will be suggested and evaluated which can help the supply chain to become more resilient. In the case of Siemens, several steps will be recommended to be taken to make its international supply chain more resilient following the failure modes and effects analysis.

FMEA Analysis

Failure mode and effects analysis (FMEA) is a coordinated method which is used to expose and evaluate the potential failures and their effects on a system, procedure, product, or process (Petrillo, 2013). It is a proactive method of assessing risks, it is frequently used in manufacturing, engineering, and many other industries to better product or process design which will reduce the risk of failure or errors. The FMEA method is best suited during the implementation processes, planning processes, optimisation elements, or to improve unstable processes.

Generally, in an FMEA analysis, a team of multidisciplined experts will thoroughly examine each step of a process or aspect of a system to detect potential failure modes and the effects they could have on the process or product. The team of experts then assesses the likelihood of each failure mode occurring, the severity of its impact, and the ability to detect it before it causes damage to the organisation (Liu & Tang, 2022).

Following this analysis, the team will develop and put strategies into action which will aim to prevent or mitigate the identified failure modes. This may involve modifying the design or process to eliminate the failure mode, implementing additional quality control measures, or developing contingency plans for when a failure mode does occur.

FMEA analysis will aid organisations in identifying the potential failure modes and their potential impacts which can help the organisation to develop strategies to prevent or mitigate the risks. This can improve product reliability, safety, and quality which leads to increased customer satisfaction. Identifying potential issues early enough in the design or development stages can reduce the cost of making changes later in production. This will also reduce the risk of warranty claims or product recalls. FMEA is a requirement for compliance with standards or regulations such as ISO 9001, the quality management standard. It also leads to team collaboration and problem-solving skills (de Aguiar, et al., 2015).

The FMEA analysis presented on the following sheet will indicate ratings for severity, occurrence, and detection. All are rated between 1 and 10, these ratings are explained within table 1, table 2 and table 3. Where current controls are listed as “No known controls in place”, a detection ranking of 10 will be allocated.

FMEA Severity Rankings		
Rating	Effect	Description
1	None	No effect
2	Negligible	Not likely to cause any real affect.
3	Minor	Very small chance of any effects on process/product. Customer unlikely to notice.
4	Very Low	Only slight inconvenience caused for the customer.
5	Moderate	Can result in customer dissatisfaction. May result in damage to image.
6	High	Will result in some customer dissatisfaction. Likely to result in damage to image.
7	Very High	Many customers will be dissatisfied. Will result in damage to image.
8	Critical	Will result in a high sum of customer dissatisfaction. Safety of users is not at risk. Long term damage to image.
9	Hazardous	Non-conformance to government regulations. Could endanger users. Warning is given before failure.
10	Extremely Hazardous	Non-conformance to government regulations. Could endanger users. No warning given before failure.

Table 1 - FMEA Severity Rankings

FMEA Occurrence Rankings		
Rating	Likelihood	Criteria
1	None	Failure is eliminated.
2	Extremely Low	1 in 1,000,000.
3	Very Low	1 in 100,000.
4	Low	1 in 10,000.
5	Moderate	1 in 2,500.
6	Moderately High	1 in 500.
7	High	1 in 200.
8	Very High	1 in 50.
9	Extremely High	1 in 15.
10	Almost Certain	1 in 3.

Table 2 - FMEA Occurrence Rankings

FMEA Detection Rankings		
Rating	Effect	Criteria
1	Almost Certain	Control method(s) will almost certainly detect the problem.
2	Extremely High	Control method(s) has an extremely high chance to detect the problem.
3	Very High	Control method(s) has a very high chance to detect the problem.
4	High	Control method(s) has a high chance to detect the problem.
5	Moderately High	Control method(s) has a good chance to detect the problem.
6	Moderate	Control method(s) may detect the problem.
7	Low	Control method(s) will possibly detect the problem.
8	Very Low	Control method(s) has a very remote chance to detect the problem.
9	Extremely Low	Control method(s) likely will not detect the problem.
10	Absolute uncertainty	Control method(s) will never detect the problem.

Table 3 - FMEA Detection Rankings

FMEA Analysis										
Product: Siemens SITOP Power Supply			Produced by: Jordan Randel							
			FMEA date: 28/04/2023							
Process Step	Potential Failure Mode	Potential Failure Effects	Severity (1-10)	Potential Failure Causes	Occurrence (1-10)	Current Controls	Detection (1-10)	RPN (Sev*Occ*Det)	Action To Be Taken	Responsible Person
What is the process step under analysis?	In which ways could the step go wrong?	What is the impact on the customer if this failure is not avoided or rectified?		What causes the step to go wrong? How could it occur?		What controls currently exist that either prevent or detect the failure?			What are the recommended actions for reducing the occurrence of the cause or improving detection?	Who is responsible for ensuring the actions are completed?
The supply chain of a Siemens SITOP 24v power supply.	Delayed delivery of raw materials.	Delayed production, missed delivery deadlines.	8	Unexpected events such as natural disasters, strikes or geopolitical instability. Supplier capacity issues or transportation delays.	6	Working with reliable suppliers with proven track record of timely deliveries. Maintaining a buffer stock to minimise the impact of delays.	6	288	Regular supplier performance reviews, addressing any issues proactively. Collaborate with multiple suppliers to diversify the supply chain, reducing the risk of delays. Implement supply chain visibility tools that provide real-time tracking of shipments and alert the manufacturer of possible delays. Negotiate clear delivery timelines and penalties for late deliveries with suppliers.	Supply chain manager
	Poor quality of raw materials.	Defective products, production delays, missed delivery deadlines.	9	Substandard materials used by the supplier or supplier cutting corners to meet deadlines.	5	Implemented quality control measures.	4	180	Conduct regular quality checks on materials received from suppliers. Establish quality standards and communicate them to suppliers.	Quality assurance manager
	Forecasting of demand inaccurate.	Excess inventory, increased cost, and stock-outs.	7	Poor data analysis, missing historical data, or unforeseen events.	3	Collect and analyse data on historical demand patterns, market trends, and customer preference.	5	105	Utilise sophisticated forecasting models to predict future demand. Regular reviews and updates to the forecast.	Operations manager
	Poor inventory management.	Excess inventory leading to increased cost or stock-outs.	7	Inefficient inventory tracking, inaccurate demand forecasting or poor supplier forecasting.	3	Conduct regular inventory audits. Establish clear communication channels with suppliers to ensure timely replenishment.	5	105	Implement an inventory management system which uses real-time data to track inventory.	Operations manager
	Poor supplier performance.	Possible delays, poor quality, and increased cost.	7	Supplier capacity issues, poor communication, or poor supplier quality control measures.	6	Establish clear expectations for supplier performance.	5	210	Ensure a back-up supplier is in place in case the primary supplier fails to meet the standards. Regularly monitor supplier performance against metrics such as on-time delivery, quality, etc.	Procurement manager
	Shipping or handling damage.	Damaged goods, and increased costs.	6	Poor packaging or handling practices, poor shipping methods or mishandling during transit.	5	Using reliable couriers with a proven track record. Implement the correct standard for packaging.	4	120	Conduct regular quality checks upon receipt of goods to identify damage and address promptly. Implement handling procedures to minimise the risk of damage during transit.	Logistics manager

	Customs delays.	Delayed delivery, and increased costs.	7	Compliance issues - importer must comply with the customs and tariff laws of the country of import. Trade sanctions that prohibit or restrict importation of goods. Environmental regulations. Errors with documentation, or customs clearance delays.	4	Ensure compliance will all applicable regulations and documentation requirements.	3	84	Establish clear communication channels with customs officials to address issues promptly. Use a reliable customs broker to navigate complex customs requirements.	Export or compliance manager
	Production line breakdown.	Delayed production, missed delivery deadlines.	9	Equipment failure, human error, inadequate maintenance and repair practices.	7	No known controls in place.	10	630	Conduct regular maintenance and repair of equipment to minimise the risk of breakdowns. Having a backup production line in place. Implement a preventive maintenance program.	Maintenance manager
	Poor quality control.	Defective products, increased cost.	9	Poor quality control measures, lack of standardised production processes, or poor training of staff.	7	Provide adequate training to personnel, ensure they understand and follow quality control measures. Conduct regular audits.	3	189	Implement a robust quality control program, standardise processes, inspections and audits.	Quality assurance manager
	Poor testing and inspection.	Defective products, increased cost, and safety issues.	9	Lack of testing equipment or personnel, poor quality control measures, poor training of staff.	6	Conduct regular audits.	3	162	Implement a testing and inspection program. Provide adequate resources to conduct the testing and inspection effectively.	Quality assurance manager
	Poor transport network.	Delayed delivery, and increased costs.	5	Plant location, could be in an underdeveloped area. Access issues to roads, airport, rail networks, seaports, etc. Bad road conditions.	5	No known controls in place.	10	250	Planning of transport routes carefully. Source from suppliers in areas that are easily accessible.	Logistics manager
	Cyber security risks.	Delayed delivery, increased costs, loss of company image, legal action.	10	Human error through downloading an untrusted file, malware and viruses, phishing attacks, insider threats, outdated software.	9	Access controls including multi-factor authentication. Network security such as firewalls. Regular system updates and patches.	4	360	Conduct regular penetration testing and vulnerability assessments to identify weaknesses. Implement data loss prevention systems to prevent unauthorised transfer of sensitive data. Conduct 'red team' exercises to simulate real-world attacks.	Cybersecurity team
	Supplier bankruptcy.	Delayed production, missed delivery deadlines, increased costs, quality issues, loss of company image, legal action.	8	Supplier financial instability, market changes such as increased competition, or a shift in demand, natural disasters, labour disputes such as strikes, management issues.	7	Financial analysis of suppliers. Insurance coverage to protect against the financial impact of supplier bankruptcy.	4	224	Develop a supplier risk management program. Develop contingency plans and procedures that will be followed if this event occurs. Establish a supplier code of conduct which sets out expectations.	Supply chain manager
	Changes in tax rates or regulations.	Increased costs.	6	Tax regulations becoming unfavourable.	5	No known controls in place.	10	300	Re-location of business abroad to avoid tax changes.	Legal team

Suggestions to Improve the Supply Chain

Siemens is a multinational business that operates in various industries, including energy, healthcare, and transportation. As a global company, Siemens faces many challenges in managing its international supply chain. Several steps can be implemented by Siemens to make its international supply chain more resilient. As previously mentioned, the current controls for some potential failure modes are not known, therefore the detection ranking has been scored as 10. Therefore, some risk priority numbers (RPN) are larger because of this. In general, it is advised that potential failure modes that have higher RPN numbers should be considered first.

The first step is to diversify their suppliers and supply chain routes. Siemens could look to reduce its reliance on any single supplier or supply chain route by diversifying its supplier base and supply chain routes (Shan, et al., 2023). This could help to mitigate the risk of disruption due to factors such as geopolitical tensions, natural disasters, or even supplier bankruptcy. For example, Siemens could consider sourcing components from multiple suppliers which are located within different regions and utilise multiple modes of transportation to reduce its dependence on any one supplier or transportation route.

One step that Siemens could take to build the resilience of its international supply chain is to implement a robust supplier evaluation and selection process (Kant & Dalvi, 2017). This would involve assessing potential suppliers based on a range of criteria, such as quality, reliability, financial stability, and environmental and social responsibility. By selecting suppliers that meet high standards and are aligned with Siemens' values and objectives, the company can reduce the risk of supply chain disruptions caused by poor supplier performance or unethical practices. Additionally, Siemens would need to regularly review and evaluate its existing suppliers to ensure that they continue to meet these standards over time. The philosopher Immanuel Kant is relevant to SCM, particularly with regards to ethical practices. Kant's teachings emphasise the importance of acting with moral principles (Morgan, 2016). In SCM, this could mean adopting ethical and sustainable practices that consider the well-being of all stakeholders, including workers, customers, and the environment.

Another step Siemens could take is to proactively monitor supply chain risks to identify potential issues before they escalate into a critical or hazardous state. This could involve using tools such as risk assessments, early warning systems, and supply chain mapping to identify potential risks and take steps to mitigate them (Short, et al., 2016). For example, Siemens could use supply chain mapping to identify critical suppliers and assess their potential exposure to risks such as geopolitical instability, natural disasters, or labour disputes. Siemens could then decide whether the supplier is too high a risk to continue to trade with or whether they need to further diversify to protect their supply chain.

A large corporation such as Siemens withholds a reputation for high quality products. A major risk for Siemens would be the potential risk of poor-quality raw materials, or product defects. Siemens could implement robust quality control processes to ensure that its products meet high standards of quality and reliability. Their quality controls should be communicated to their suppliers and couriers to ensure the quality product and service is continued throughout (Bauer, et al., 2018). This could help to reduce the risk of product failures or

recalls that could disrupt the supply chain. Implementing rigorous testing and inspection processes for raw materials, components and finished products will ensure that they meet the required specifications and ensure customer satisfaction is maintained.

Another step that can be implemented to ensure the resilience of the international supply chain of Siemens is to develop flexible manufacturing processes that can be adapted to changes in demand or supply chain disruptions (Kumar & Deshmukh, 2006). This could involve using technologies such as 3D printing, robotics, or digital manufacturing to enable rapid production of products or replacement parts. For example, Siemens could use 3D printing technology to produce replacement parts for critical equipment that is no longer available from the original supplier or is going through a period of complications.

Siemens could invest in digital supply chain technologies which can be used to improve visibility, collaboration, and efficiency across its supply chain. This could involve using tools such as big data analytics, artificial intelligence, and blockchain to streamline processes, reduce costs, and improve transparency (Wang & Wang, 2022). A transparent system which tracks components and products across the supply chain can also reduce the risk of fraud or counterfeiting.

Conclusions and Recommendations for Future Research

To conclude, effective SPM is crucial for companies to operate efficiently and meet the needs of their customers. This report has highlighted the importance of supply chain resilience and how Siemens, a multinational company, can make its international supply chain more resilient. An FMEA analysis undertaken on Siemens has identified potential failure modes, effects, and causes. It is feasible to claim that it is impossible to completely mitigate all potential failures at a multinational company such as Siemens. Following an assessment of the risks and scoring their severity, occurrence and detection, a list of strategies has been suggested to reduce the occurrence and improve detection. By implementing several strategies such as diversifying suppliers and supply chain routes, implementing robust supplier evaluation processes, proactively monitoring supply chain risks, implementing rigorous quality control processes, developing flexible manufacturing processes, and investing in digital supply chain technologies, Siemens can reduce the risk of disruptions and maintain its reputation for high-quality products and services.

For future research, there is a demand to investigate the usefulness of the proposed strategies and their influence on the supply chain. In addition, research could concentrate on the development of new technologies and tools that can further improve supply chain efficiency and resilience. There is also a need to understand the impact of environmental and social factors on the supply chain, and how organisations can ensure ethical and responsible sourcing whilst maintaining the efficiency of their supply chain. As the importance of ethical concerns and sustainability continue to grow, there is a demand for research into the potential of SPM to contribute to sustainable and ethical business practices. Future research could focus on the potential of reducing waste within SPM, minimising carbon emissions, certifying ethical and responsible sourcing, and promote social responsibility.

References

- Ahmadi Javid, A. & Azad, N., 2010. Incorporating location, routing and inventory decisions in supply chain network design. *Transportation research*, 46(5), pp. 582-597.
- Bauer, A. M., Henderson, D. & Lynch, D. P., 2018. Supplier Internal Control Quality and the Duration of Customer-Supplier Relationships. *The Accounting review*, 93(3), pp. 59-82.
- Beske-Janssen, P., Johnson, M. P. & Schaltegger, S., 2015. 20 Years of Supply Chain Management: An International Journal. *Supply Chain Management*, 20(6), pp. 664-680.
- de Aguiar, D. C., Salomon, V. A. P. & Mello, C. H. P., 2015. An ISO 9001 based approach for the implementation of process FMEA in the Brazilian automotive industry. *The International Journal of Quality & Reliability Management*, 32(6), pp. 589-602.
- Gonzalez-Benito, J., 2007. Information technology investment and operational performance in purchasing: The mediating role of supply chain management practices and strategic integration of purchasing. *Industrial management + data systems*, 107(2), pp. 201-228.
- Kant, R. & Dalvi, M. V., 2017. Development of questionnaire to assess the supplier evaluation criteria and supplier selection benefits. *Benchmarking*, 24(2), pp. 359-383.
- Kumar, P. & Deshmukh, S. G., 2006. A Model for Flexible Supply Chain through Flexible Manufacturing. *Global journal of flexible systems management*, 7(3/4), pp. 17-24.
- Liu, Y. & Tang, Y., 2022. Managing uncertainty of expert's assessment in FMEA with the belief divergence measure. *Scientific reports*, 12(1), pp. 6812-6812.
- Morgan, J., 2016. Self-Knowledge and the Approximation of Divine Judgment: Conscience in the Practical Philosophy and Moral Theology of Immanuel Kant. *Journal of the Society of Christian Ethics*, 36(1), pp. 107-122.
- Petrillo, A. e. a., 2013. Risk Management in Magnetic Resonance: Failure Mode, Effects, and Criticality Analysis. *BioMed research international*, Volume 2013, pp. 1-5.
- Shan, X., Xiong, S. & Zhang, C., 2023. Mitigating supply disruption risks by diversifying competing suppliers and using sales effort. *International journal of production economics*, Volume 255, p. 108637.
- Short, J. L., Toffel, M. W. & Hugill, A. R., 2016. Monitoring global supply chains. *Strategic management journal*, 37(9), pp. 1878-1897.
- Wang, L. & Wang, Y., 2022. Supply chain financial service management system based on block chain IoT data sharing and edge computing. *Alexandria engineering journal*, 62(1), pp. 147-158.
- Waters, D., 2011. *Supply chain risk management: vulnerability and resilience in logistics*. 2nd ed. s.l.:Kogan Page.