



Addressing Inventory Management Concerns

Alex Greenslade | Sustainable Operations Management | April 2026

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Abstract

Brockswear and Sons Ltd is a long-established foundry and engineering company operating across three main business areas castings, fabrications and machined parts. Despite recent growth in certain areas of the business, an internal audit has revealed significant weaknesses in the company's inventory management practices, particularly within the sand foundry operations. Large quantities of sand binding resins were purchased in bulk without sufficient consideration of shelf-life limitations, resulting in approximately £20,000 worth of expired materials that now require disposal as special waste. Furthermore, changes in environmental regulations have increased the cost of disposing of used foundry sand, creating additional financial and environmental challenges for the company.

This report critically evaluates how Brockswear and Sons Ltd can improve the management of sand and resin inventory through the implementation of structured inventory control techniques. It also analyses the options available for dealing with obsolete stock and outlines measures to improve understanding of supply chain lead times in order to enhance operational efficiency and reduce future waste.

1. Introduction

Effective inventory management and supply chain coordination are critical components of operational efficiency in manufacturing organisations. Companies operating in highly competitive markets must carefully balance the availability of raw materials with the financial and environmental costs associated with holding excessive stock (Banyai, 2024). Poor inventory control can lead to unnecessary expenditure, production disruptions, and increased waste management costs. For organisations involved in foundry operations, these challenges can be particularly significant due to the specialised materials used in casting processes and the regulatory requirements associated with waste disposal (Afy-Shararah, Jagtap, Pagone, & Salonitis, 2023).

Brockswear and Sons Ltd, a long-established engineering and foundry company, produces castings, fabrications, and machined components for industrial customers. However, an internal audit has revealed weaknesses in sand and resin inventory management. Bulk purchasing without considering shelf-life has led to around £20,000 of expired resin requiring disposal as special waste. Rising regulatory costs for disposing of used foundry sand further emphasise the need for improved inventory control.

This assignment assesses ways Brockswear and Sons Ltd can enhance control of sand and resin inventory through methods such as Economic Order Quantity (EOQ), setting minimum and maximum stock levels, and strengthening supplier collaboration. It also reviews approaches for handling obsolete stock and improving visibility of supply chain lead times. Adopting these measures can reduce waste, increase efficiency, and support long-term business performance.

2. Phenolic & Furan Based Resins

Phenolic and furan-based resins are widely used as binders in foundry sand moulding processes, providing the strength and stability required to produce moulds and cores for metal casting. Phenolic resins, derived from phenol-formaldehyde reactions, offer high thermal stability, good mechanical strength, and relatively low gas evolution, which improves casting surface finish (Keane, 2026). Furan resins, derived from furfuryl alcohol, provide strong bonding and are particularly suitable for large or complex castings due to their effective curing properties (Major-Gabrys, Halejcio, Fijolek, Marosz, & Gorny, 2025).

Despite these advantages, both resin types present limitations, including relatively short shelf lives, typically a few months to one year, and sensitivity to storage conditions such as temperature and humidity. Poor storage can lead to degradation and reduced performance (Wozniak & Bobrowski, 2025).

Additionally, both resins pose health and safety concerns, as they may emit hazardous fumes, requiring appropriate ventilation, handling procedures, and personal protective equipment. And once expired or used, they are often classified as hazardous waste, resulting in high disposal costs under environmental regulations (HSE, 2026).

There is alternative binder systems are available. For example, sodium silicate binders offer a more environmentally friendly option with lower emissions, although they can present challenges in sand reclamation (Anwar, Jalava, & Orkas, 2023). Alkaline phenolic systems provide similar performance with reduced environmental impact, while cold box resins offer high productivity but involve toxic amine gases (Kmita, et al., 2024). Inorganic binder systems are also emerging as a low-emission alternative, although they may require higher costs and process modifications (Garitaonandia, Ibarra, Kmita, Danko, & Holtzer, 2025).

Overall, while phenolic and furan resins remain effective and widely used, alternative systems present viable options depending on cost, environmental considerations, and production requirements.



Figure 1 - Component Mould (Fenolit, 2022)

3. Managing Sand & Resin Inventory

The issues identified during the audit suggest that Brocksweir has historically relied on informal purchasing practices rather than structured inventory management systems. While bulk purchasing may have been intended to reduce unit costs, the absence of effective inventory control has resulted in excessive stock levels, increased waste, and higher operational costs. To address these issues, the company should implement several proven inventory management techniques.

3.1 ECONOMIC ORDER QUANTITY (EOQ)

One of the most widely used methods for determining optimal order quantities is the Economic Order Quantity (EOQ) model. EOQ identifies the order quantity that minimises the total cost associated with inventory management by balancing ordering costs against holding costs. Ordering costs include administrative expenses associated with placing purchase orders, while holding costs include storage costs, insurance, deterioration and the risk of obsolescence (Alnahhal, Aylak, Hazza, & Sakhrieh, 2024).

$$EOQ = \sqrt{\frac{2 \times D \times C_o}{C_h}}$$

Figure 2 - EOQ Equation (Vitello, 2024)

Where:

- Q = Order Quantity
- CH = Holding cost per unit
- D = Annual Demand
- Co = Cost per order

Applying EOQ to the procurement of sand and resins would enable Brocksweir to determine the optimal order quantity that minimises total inventory costs. This is particularly important for resin materials, which have relatively short shelf lives and can degrade over time. Ordering smaller

quantities more frequently may slightly increase ordering costs but would significantly reduce the risk of expiration and costly disposal.

However, the EOQ model has limitations. It assumes constant demand and lead time, which may not always reflect real operational conditions in a foundry environment where demand can fluctuate depending on customer orders. Therefore, EOQ should be used alongside other inventory control methods rather than as a standalone solution.

3.2 MINIMUM AND MAXIMUM INVENTORY LEVELS

Another important inventory control technique involves establishing minimum and maximum stock levels. Minimum stock levels ensure that sufficient materials are available to maintain production continuity, while maximum levels prevent excessive accumulation of materials (Pigon, 2026).

For example, resin materials should have relatively low maximum stock levels due to their limited shelf life. In contrast, sand, which does not deteriorate as quickly, may be held in larger quantities if storage space allows. By setting appropriate inventory thresholds, the company can maintain operational efficiency while reducing the risk of obsolete stock.

This system should also include reorder points, which trigger automatic purchasing when stock levels fall below a predetermined threshold. These reorder points should take into account both supplier lead time and average usage rates.

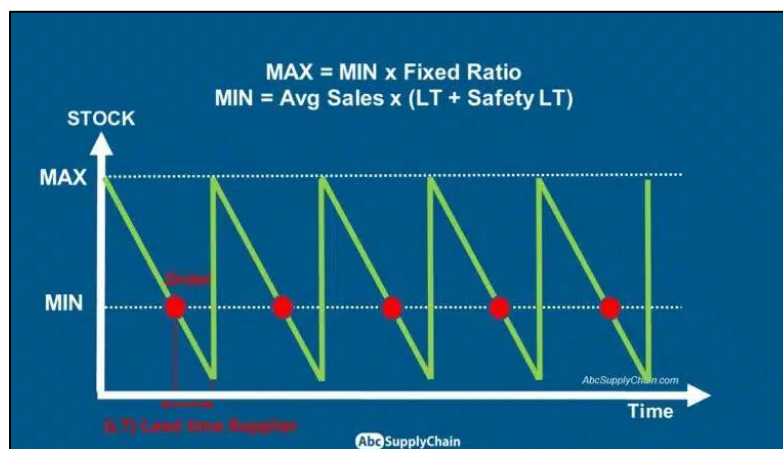


Figure 3 - Minimum & Maximum Stock Levels (Thieuleux, Inventory Optimization: Min/Max method or Safety Stock?. 2023)

3.3 VENDOR MANAGED INVENTORY (VMI)

Another option available to Brocksweir is Vendor Managed Inventory (VMI). Under this approach, suppliers are responsible for monitoring stock levels and replenishing inventory when required. The supplier typically has access to real-time inventory data and ensures that materials are delivered before stock levels fall below critical levels (Awati, 2023).

Implementing VMI could provide several advantages for Brocksweir. Firstly, it reduces administrative workload for the purchasing department. Secondly, suppliers often have greater expertise in forecasting demand for their own products and may therefore manage inventory more efficiently. Finally, VMI can reduce the need for large safety stocks, improving cash flow and reducing storage costs (Mateen & Chatterjee, 2015).

However, VMI also requires a high level of trust and collaboration between the company and its suppliers. It may also require investment in digital systems that allow suppliers to access inventory data in real time (Poehland, 2026).



Figure 4 - How Vendor Managed Inventory Works (Jenkins, 2024)

3.4 JUST-IN-TIME (JIT)

Just-In-Time (JIT) is an inventory management approach in which materials are ordered and delivered only as they are required for immediate use in production, rather than being stored in large quantities. The primary aim of JIT is to minimise inventory holding costs, reduce waste, and improve efficiency by aligning supply closely with demand (Joyce, 2021).

Within Brocksweir and Sons Ltd, JIT could be particularly effective for managing sand binding resins, which have limited shelf lives and present environmental risks when expired. By adopting a JIT approach, the company could order smaller quantities of resin in line with production schedules, thereby reducing the likelihood of stock obsolescence and disposal costs. However, the success of JIT would depend on reliable suppliers and accurate demand forecasting, as delays in delivery could disrupt production processes.

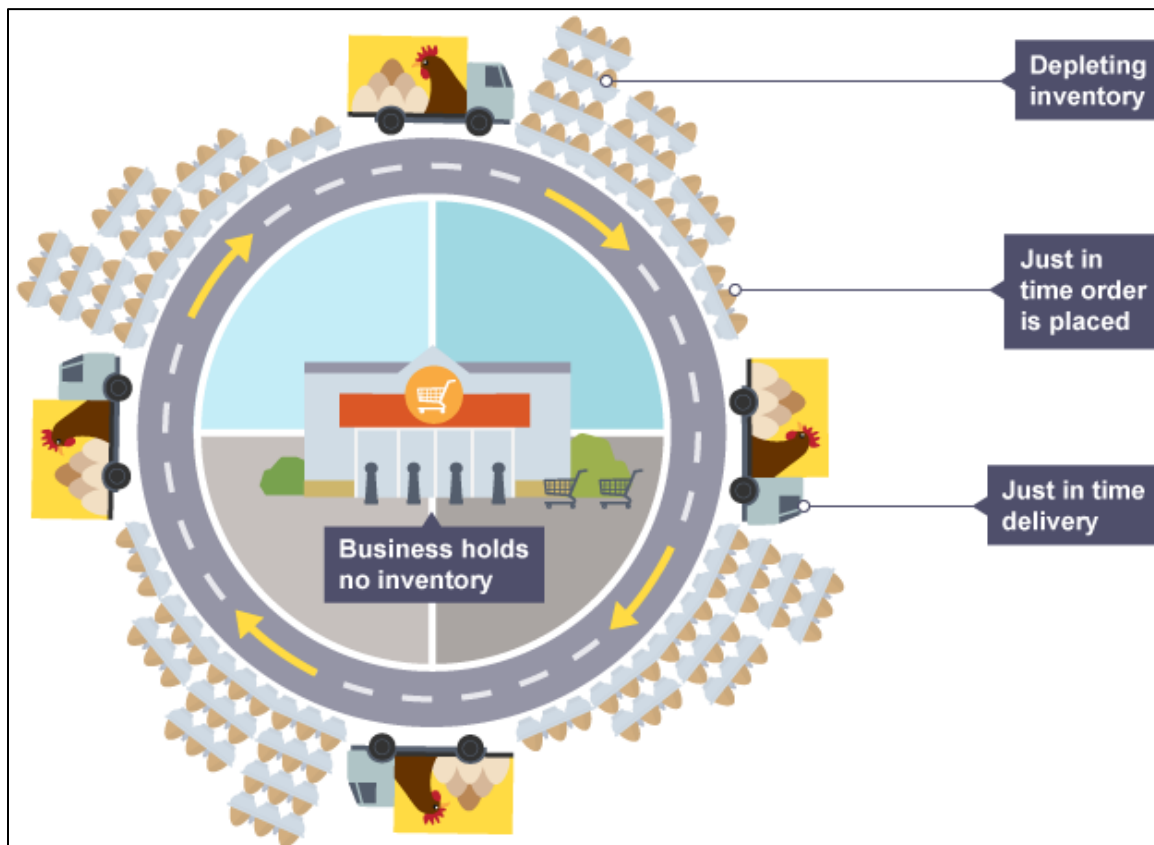


Figure 5 - Just-In-Time (Inventory management, 2026)

3.5 FIRST-IN-FIRST-OUT (FIFO)

First-In, First-Out (FIFO) is an inventory management method in which the oldest stock is used first, ensuring that materials are consumed in the order they are received. This approach is particularly important for materials with limited shelf lives (Parlar, Perry, & Stadjie, 2010).

At Brocksweir and Sons Ltd, FIFO can be applied to sand binding resins to reduce the risk of expiry and waste. By ensuring older resin batches are used before newer deliveries, the company can minimise obsolete stock and associated disposal costs. Implementing FIFO through clear labelling, organised storage systems, and digital inventory tracking would improve stock rotation and overall inventory control.



Figure 6 - First In, First Out (Johnson, 2026)

3.6 ABC ANALYSIS & THE PARETO PRINCIPLE

The company could also adopt ABC analysis, supported by the Pareto Principle (80/20 rule), to enable a more strategic and risk-based approach.

The Pareto Principle suggests that a small proportion of inventory items typically accounts for the majority of value or risk. In this context, ABC analysis classifies inventory into three categories: A items (high value, low volume), B items (moderate value and volume), and C items (low value, high volume) (Yu, 2011). Within Brocksweir, sand binding resins should be classified as Category A due to their high cost, limited shelf life, and hazardous nature when expired, whereas foundry sand would fall into Category C.

This classification enables differentiated control strategies. Category A items require strict management, including frequent monitoring, reduced order quantities, and effective stock rotation such as FIFO, to minimise expiry risk. In contrast, Category C items may be managed with less stringent controls, potentially allowing bulk purchasing where appropriate. The Pareto Principle highlights that the majority of inventory-related issues are likely concentrated within a small number of high-risk materials, particularly resins, suggesting that targeted improvements would yield significant benefits (Ramanathan, 2006).

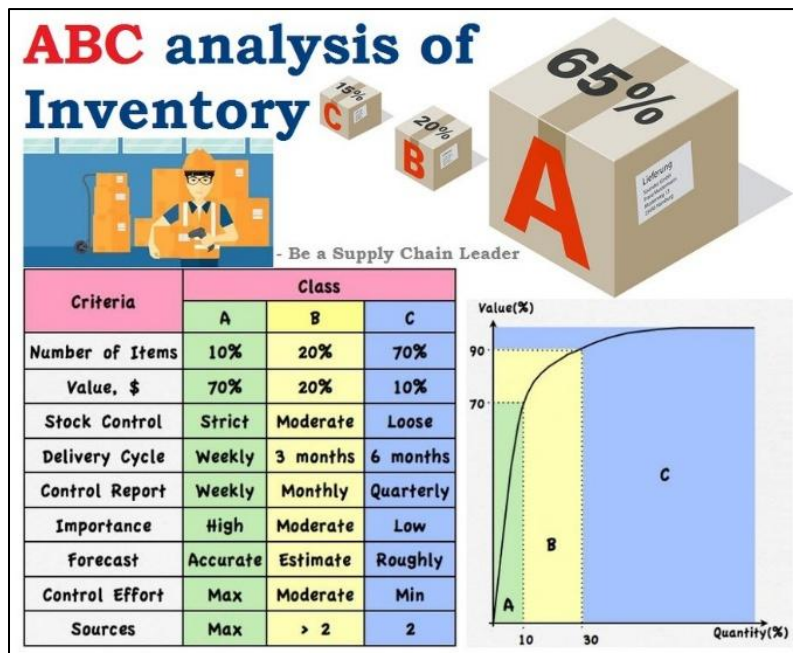


Figure 7 - ABC Analysis (Kabir, 2017)

However, ABC analysis has limitations, as it focuses primarily on financial value and may overlook factors such as supply risk or production criticality. Therefore, it should be complemented with additional criteria to ensure a more comprehensive classification system. The effectiveness of ABC analysis can be enhanced by integrating it with inventory control models such as Economic Order Quantity (EOQ), Just-In-Time (JIT), and Vendor Managed Inventory (VMI). Rather than applying a single approach, a segmented strategy should be adopted.

For Category A items such as resins, JIT and VMI are most appropriate. JIT enables smaller, more frequent deliveries aligned with production demand, reducing storage time and the risk of obsolescence. However, JIT increases reliance on supplier reliability. This risk can be mitigated through VMI, where suppliers manage inventory levels and ensure timely replenishment, improving coordination and reducing administrative burden.

In contrast, EOQ is less suitable for Category A items due to its assumption of stable demand and lack of consideration for perishability. However, it remains effective for Category B items, where demand is more predictable, and for Category C items such as sand, where bulk purchasing can still provide cost efficiencies. Despite this, increased disposal costs mean that even low-value materials must be carefully managed, with consideration given to waste reduction strategies such as sand reclamation.

Overall, the integration of ABC analysis with EOQ, JIT, and VMI supports a shift from a cost-focused purchasing approach to a total cost perspective, incorporating storage, waste, and environmental costs. While each technique offers distinct benefits, their effectiveness depends on appropriate application. A segmented and integrated approach allows Brocksweir and Sons Ltd to balance cost efficiency, risk management, and operational flexibility, ultimately improving inventory control and reducing waste.

3.7 DIGITAL INVENTORY MANAGEMENT SYSTEMS

The absence of a formal inventory management system appears to be one of the primary causes of the company's current problems. Introducing a digital inventory management system or enterprise resource planning (ERP) system would significantly improve stock control and transparency. Modern inventory systems allow companies to track stock levels in real time, monitor material shelf life, automatically generate reorder alerts and analyse historical patterns (Miller, 2026).



Figure 8 - Digital Inventory Systems (Dyer, 2022)

3.8 IMPROVED DEMAND FORECASTING

Demand forecasting is another key element of effective inventory management. The increased demand for sand castings suggests that Brockswear may not have fully anticipated the growth in this segment of its operations. By analysing historical production data and customer orders, the company can develop more accurate demand forecasts.



Figure 9 - Benefits of Demand Forecasting (Brandon, 2026)

3.9 ENVIRONMENTAL AND REGULATORY CONSIDERATIONS

Environmental legislation has significantly increased the cost of disposing of waste foundry sand and expired resins. As a result, inventory management decisions must now consider not only financial factors but also environmental compliance. Excessive stock levels increase the risk of hazardous waste accumulation, which can result in significant disposal costs, potential regulatory penalties and increased health & safety concerns.

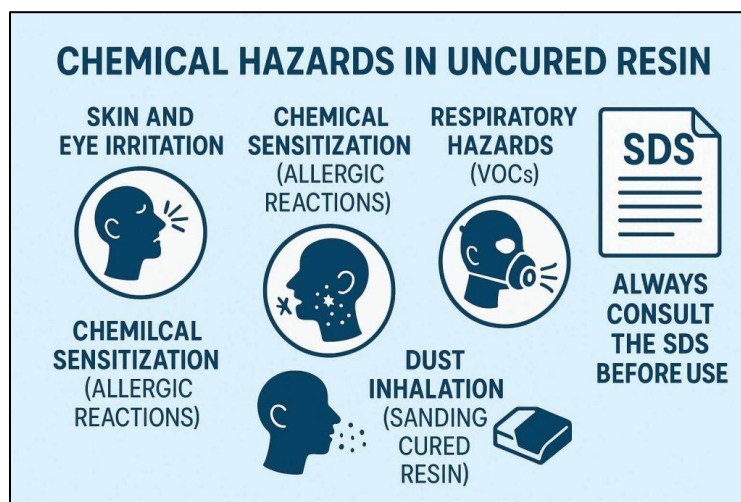


Figure 10 - Hazards associated with Resin (Clay, 2025)

4. Solutions for Obsolete Stock

Brocksweir and Sons Ltd must consider a range of strategic options when addressing obsolete resin stock, particularly given the financial loss and environmental implications associated with hazardous waste.

4.1 REGULATED WASTE DISPOSAL

The most immediate and commonly adopted solution is disposal through licensed waste contractors, ensuring compliance with environmental regulations. However, this approach represents a complete loss of material value and should therefore be viewed as a last resort. Alternative strategies that enable partial value recovery or cost mitigation should be explored where feasible (Cioli, Abba, Alias, & Sorlini, 2022).



Figure 11 - Hazardous Waste Disposal (Veolia, 2026)

4.2 SUPPLIER PRE-AGREEMENTS

One potential option is to engage with suppliers to determine whether any form of return, credit, or cost-sharing arrangement is possible. Although such agreements are often limited and may not apply to expired materials, this approach may still reduce financial losses, particularly if bulk purchasing decisions were influenced by supplier incentives (Lee, Song, & Cheong, 2018).

4.3 RESIN REPROCESSING CAPABILITIES

Similarly, the company could explore specialist reprocessing or reconditioning services, where certain resins may be chemically stabilised or treated to extend their usability. While this is dependent on technical feasibility and cost-effectiveness, it represents a more sustainable alternative to immediate disposal (Khan & Mahajani, 2024).

In some cases, obsolete resins may still retain partial functionality and could be utilised internally in non-critical applications. For example, they may be used for training purposes or process trials where product quality requirements are less stringent. Additionally, controlled blending of small quantities of expired resin with new material may be possible, provided that this is supported by testing and does not compromise product integrity. These approaches allow the company to extract value from materials that would otherwise be discarded, although they must be carefully managed to avoid quality or safety risks (Cioli, Abba, Alias, & Sorlini, 2022).

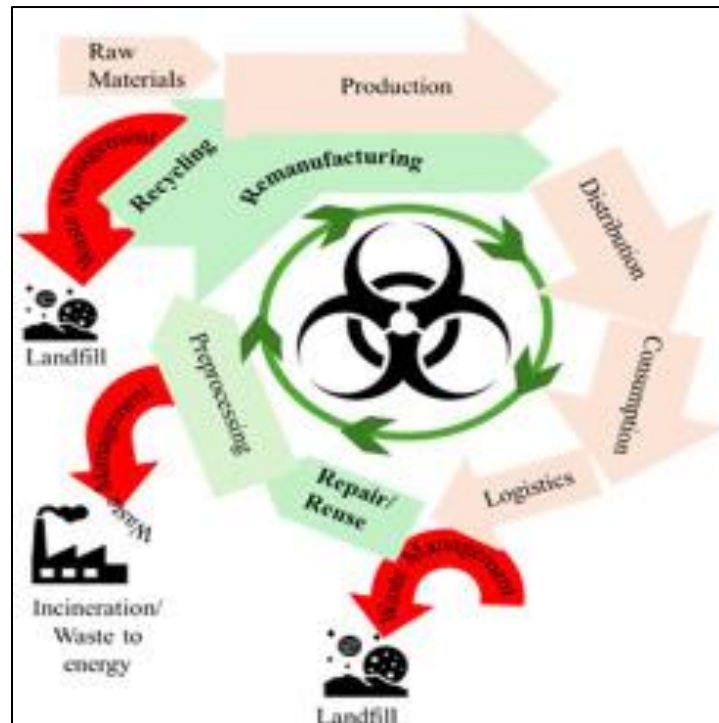


Figure 12 - Reuse & Recycling of Resin

4.4 WASTE-TO-ENERGY RECOVERY

From a sustainability perspective, waste-to-energy recovery offers a more environmentally responsible alternative to landfill disposal. Through controlled incineration processes, hazardous resin waste can be converted into usable energy, reducing environmental impact while ensuring regulatory compliance (Ata, Cankaya, Dede, & Pekey, 2026).

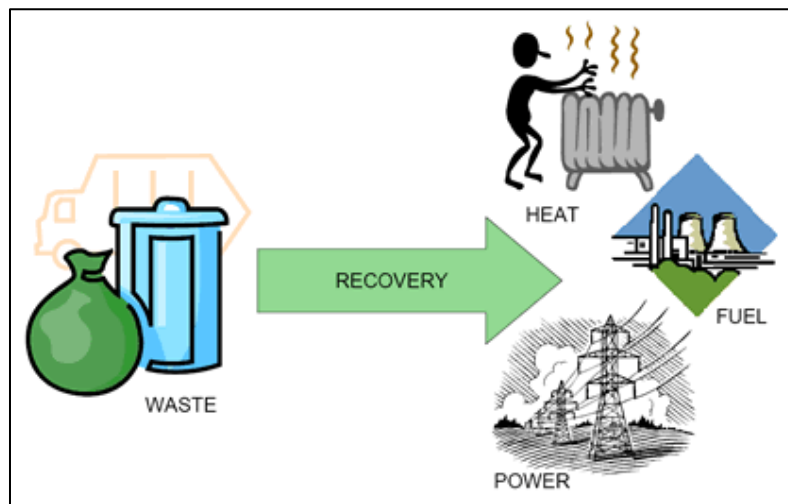


Figure 13 - Waste-To-Energy Recovery (Zafar, 2023)

Overall, while a range of reactive measures are available to manage obsolete stock, the most effective strategy lies in preventing obsolescence through improved inventory management practices. By implementing better forecasting, adopting appropriate ordering strategies, and integrating supplier collaboration, Brocksweir and Sons Ltd can significantly reduce the risk of future inventory waste while improving both financial performance and environmental compliance.

5. Understanding Supply Chain Lead Time

To develop a comprehensive understanding of supply chain lead time, Brocksweir and Sons Ltd should adopt a combination of analytical and operational approaches.

5.1 SUPPLY CHAIN MAPPING

Initially, supply chain mapping should be undertaken to identify each stage of the procurement process, including supplier production, transportation, and internal handling activities. This enables the identification of bottlenecks and inefficiencies across the supply chain (MacCarthy, Ahmed, & Demirel, 2022).

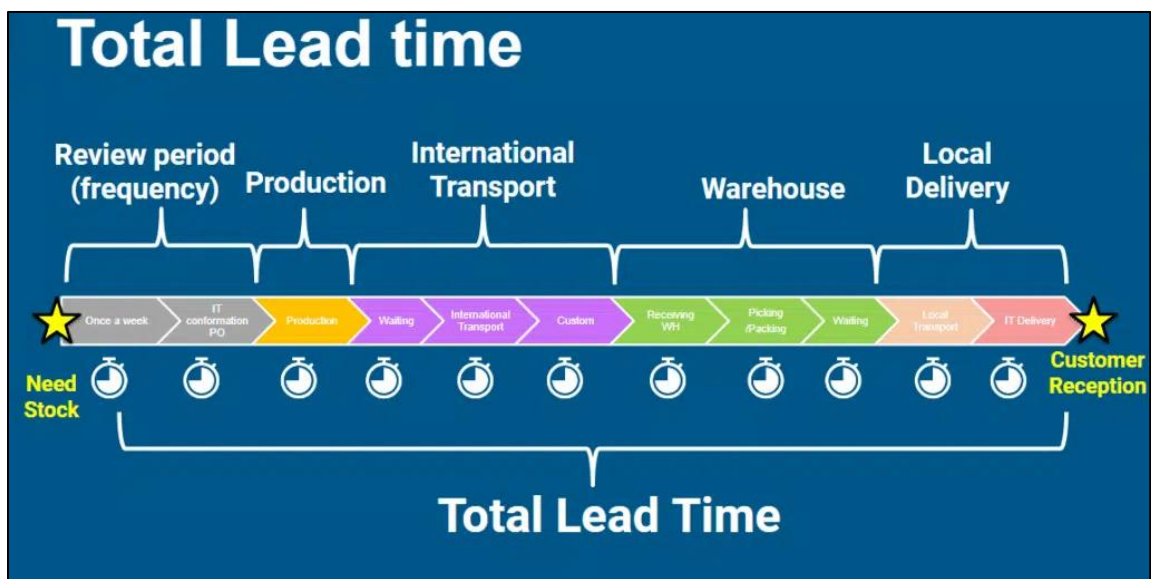


Figure 14 - Total Lead Time (Thieuleux, Supply Chain Lead Time: what is it and how to track it?, 2023)

5.2 KEY PERFORMANCE INDICATORS

In addition, historical lead time analysis should be used to calculate average delivery times and assess variability, providing a data-driven basis for planning. However, reliance on averages alone is insufficient. Therefore, supplier performance monitoring should be implemented using key performance indicators (KPIs) such as on-time delivery, lead time consistency, and order accuracy. This allows supplier reliability to be assessed and supports more informed sourcing decisions (Alanhhal, Ahrens, & Salah, 2021).



Figure 15 - Manufacturing KPI's (Lean Six Sigma Global, 2026)

5.3 REAL-TIME TRACKING

The use of real-time tracking systems or digital procurement platforms, would also improve visibility of material flow and enable early identification of delays. This reduces reliance on historical averages and supports more proactive decision-making (Bendhi, 2025).

5.4 COLLABORATIVE PLANNING, FORECASTING & REPLENISHMENT (CPFR)

The company should also consider supplier collaboration approaches, such as collaborative planning, forecasting, and replenishment (CPFR), to improve information sharing and alignment across the supply chain. This is particularly important for critical materials where delays have significant operational consequences (Panahifar, Heavey, Bryne, & Fazollahtabar, 2015).

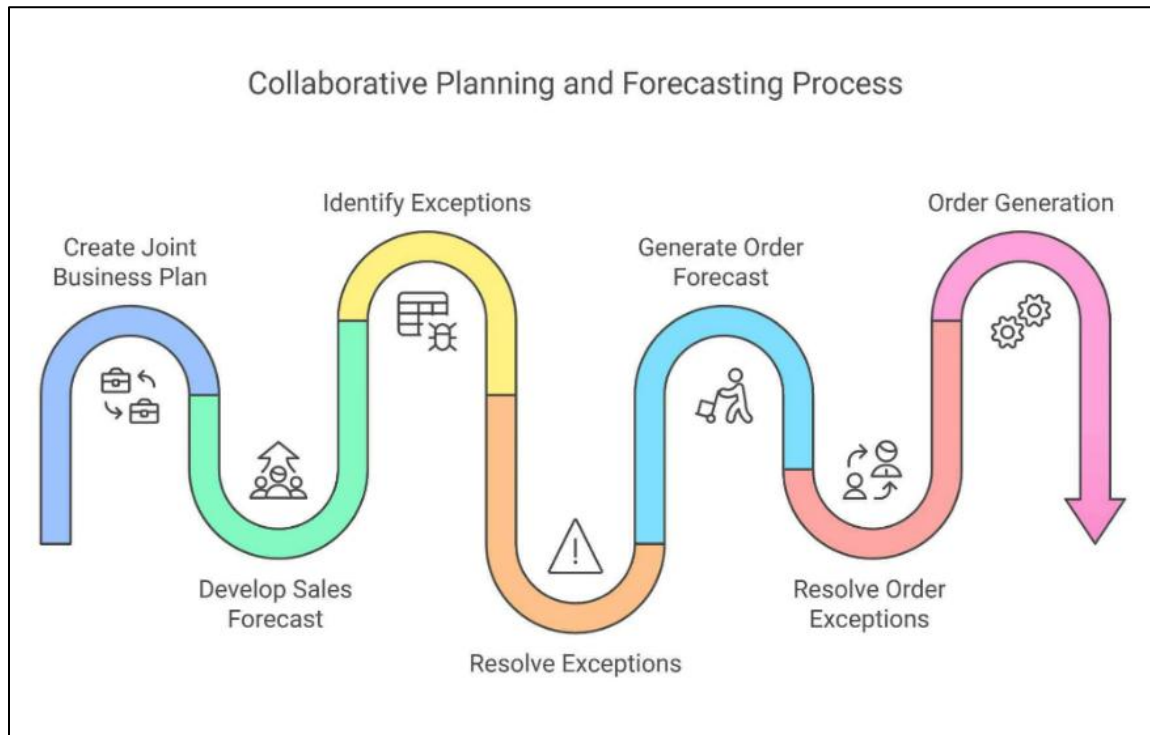


Figure 16 - Collaborative Planning, Forecasting and Replenishment (CPFR) (Nelson, 2026)

Overall, by combining supply chain mapping, historical analysis, supplier performance monitoring, safety stock optimisation, and advanced data-driven tools, Brocksweir and Sons Ltd can move towards a more proactive and reliable approach to lead time management, improving supply chain performance and reducing operational uncertainty.

6. Conclusion

The case of Brocksweir and Sons Ltd highlights the significant risks associated with inadequate inventory management and limited visibility across the supply chain. While the company has experienced growth in certain operational areas, particularly in machining, weaknesses in purchasing and stock control practices within the sand foundry have resulted in excessive inventory levels, expired resin stock, and increased disposal costs due to environmental regulations. These issues demonstrate the importance of implementing structured inventory management systems in order to improve operational efficiency and reduce financial losses.

To improve its management of sand and resin inventory, the company should adopt established inventory control techniques such as Economic Order Quantity (EOQ), minimum and maximum stock level policies, and improved demand forecasting. The introduction of a digital inventory management system would provide real-time visibility of stock levels and ensure better monitoring of material shelf life through stock rotation practices such as First-In-First-Out (FIFO). Additionally, closer collaboration with suppliers through approaches such as Vendor Managed Inventory could help optimise stock levels and reduce the risk of material obsolescence.

In addressing the existing obsolete stock, the company must consider a range of options including controlled disposal through licensed waste contractors, recycling or energy recovery processes, and potential use of materials in non-critical applications. Although disposal may ultimately be necessary, exploring alternative solutions could reduce financial losses and environmental impact.

Finally, gaining a better understanding of supply chain lead times will be essential for improving procurement planning and inventory control. By mapping the supply chain, analysing historical supplier performance and implementing digital monitoring systems, Brocksweir can reduce uncertainty and ensure that materials are delivered in line with production requirements.

Overall, by adopting more effective inventory management and supply chain practices, Brocksweir and Sons Ltd will be better positioned to reduce waste, improve operational efficiency, and maintain its competitiveness within an increasingly challenging manufacturing environment.

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