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Abstract

With a particular focus on the sand and resin inventory in the foundry operations, this project critically investigates the inventory and supply chain management problems at Brocksweir & Sons Ltd. Significant inefficiencies resulting from the lack of a formal inventory management system are shown by the investigation, including overstocking perishable commodities, poor demand forecasting, and poor operational function coordination. The study assesses how well-known supply chain theories like Vendor Managed Inventory (VMI), Just-in-Time (JIT), and Economic Order Quantity (EOQ) can be modified to enhance inventory control in a setting with shelf-life restrictions and environmental laws.

The assignment delves deeper into strategic options for handling outmoded inventory, emphasizing the financial and environmental consequences of value recovery, recycling, and disposal. It also evaluates the significance of lead time visibility and suggests collaborative, data-driven methods to improve supply chain performance.

The results imply that Brocksweir's operational inefficiencies are organizational as well as technical, necessitating supplier integration, digital transformation, and cultural change. The study concludes that increasing productivity, cutting expenses, and maintaining long-term competitiveness in the manufacturing industry require a comprehensive and strategically aligned approach to inventory and supply chain management (Christopher, 2016; Slack et al., 2022).

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1. Introduction

Effective supply chain and inventory management are crucial factors that determine an organization's effectiveness in today's fiercely competitive and globalized manufacturing industry. Businesses in conventional industrial sectors, such as metal fabrication and foundries, are under more and more pressure to optimize operations in response to growing environmental restrictions and financial restraints. These difficulties are best shown by Brockswear and Sons Ltd., a reputable engineering company with more than 250 years of foundry experience.

The company's sand foundry processes show notable inefficiencies, especially in inventory management, despite recent expansion in areas like machining. Overstocking of short-shelf-life materials, particularly phenolic and furan resins, has led to financial losses and higher disposal costs due to the absence of an organized inventory control system. The designation of foundry materials as special waste, which has greatly increased the cost of non-compliance and subpar inventory methods, exacerbates these problems.

Theoretically, correct data and connected systems are necessary to ensure that procurement strategies and operational demand are in line for effective inventory management (Heizer et al., 2020). But Brockswear's existing procedures point to a gap between these factors, with short-term cost considerations rather than long-term value optimization driving purchasing decisions. These methods frequently overlook the total cost of ownership, which results in inefficiencies and hidden expenses, as Christopher (2016) emphasizes.

The purpose of this assignment is to critically assess how Brockswear might enhance its inventory management procedures, specifically with regard to sand and resin components. It will evaluate strategies for managing obsolete stock, examine ways to improve lead time visibility throughout the supply chain, and analyze the implementation of sophisticated techniques like EOQ, JIT, ABC analysis, and VMI. By doing this, the study takes a comprehensive approach, acknowledging that organizational change, digital transformation, and improved supply chain collaboration are necessary to enable operational benefits.

2. Improving Sand and Resin Inventory Management

2.1 Diagnosis of Current Inventory Issues

The current situation at Brockswear reflects a reactive and fragmented approach to inventory management. The absence of a formal system has led to several interconnected problems:

- Overstocking of materials with limited shelf life
- Inefficient bulk purchasing decisions driven by unit cost savings
- Lack of demand forecasting and consumption tracking
- Poor coordination between purchasing, production, and storage functions

These issues indicate a classic misalignment between procurement strategy and operational requirements. As Christopher (2016) argues, focusing solely on purchase price ignores the broader concept of total cost of ownership, which includes storage, handling, obsolescence, and disposal costs.

Furthermore, the classification of sand and resins as special waste has significantly increased the cost of poor inventory decisions, turning what may have once been minor inefficiencies into major financial liabilities.

2.2 Application of Advanced Inventory Management Techniques

2.2.1 Economic Order Quantity (EOQ) with Shelf-Life Constraints

By balancing ordering and holding costs, the Economic Order Quantity (EOQ) model offers a basis for figuring out ideal order numbers (Heizer et al., 2020). However, in its most basic form, standard EOQ is inadequate for controlling resin inventory since it presupposes non-perishable items.

In order to modify EOQ for Brockswear's situation, the model needs to include:

- Limitations on shelf life
- Variability in demand
- Conditions of storage that impact deterioration

Within the material's useable lifespan, our improved EOQ technique guarantees that order quantities do not surpass consumption rates. This greatly lowers the danger of waste and obsolescence even while it increases ordering frequency.

The organization currently lacks precise demand data, which is crucial for implementing EOQ and underscores the need for better data collection tools.

2.2.2 Just-in-Time (JIT) and Lean Inventory Systems

By closely coordinating supplies with production schedules, the Just-in-Time (JIT) philosophy seeks to reduce inventory (Slack et al., 2022). Using JIT techniques would benefit Brocksweir by:

- Cut storage expenses
- Reduce the chance of expiration
- Reduce the need for working capital to increase cash flow.

JIT is not risk-free, though. It puts the business at risk of supply chain interruptions and increasing reliance on supplier dependability. A pure JIT method might be too dangerous given the current instability of the global supply chain.

A more balanced approach that preserves efficiency while guaranteeing resilience would be a hybrid model that combines JIT with strategic safety stock.

2.2.3 ABC Analysis and Inventory Segmentation

Inventory is categorized using ABC analysis according to criticality and value (Silver et al., 2017). Using Brocksweir as an example:

- A-items: Expensive, short-lived resins.
- B-items: Materials of moderate value.
- C-items: Bulk, inexpensive commodities like sand.

Differentiated management approaches are made possible by this segmentation. For instance:

Tight management, regular evaluation, and precise forecasting are necessary for A-items. Because there is less financial risk, C-items can be managed with easier restrictions.

The important realization here is that not every inventory should be handled in the same way. The company's present "one-size-fits-all" strategy has greatly increased inefficiency.

2.2.4 Vendor Managed Inventory (VMI)

Vendor Managed Inventory (VMI) transfers inventory management duties to suppliers, who keep an eye on usage and restock stock as necessary (Monczka et al., 2021). This strategy has a number of benefits:

- Lower costs associated with keeping inventory
- Reduced obsolescence risk
- Enhanced cooperation with suppliers

VMI might be especially useful for Brockswear's resin supply, as vendors are frequently more knowledgeable about product shelf life and handling specifications.

But VMI needs:

- High degrees of openness and trust
- Information systems that are integrated
- Contractual agreements with clear definitions

Without these, VMI may result in supplier opportunism and a loss of control.

2.2.5 Digital Transformation and ERP Systems

The lack of a "true inventory management system" implies that Brockswear uses disjointed or manual procedures. Putting in place an Enterprise Resource Planning (ERP) system would allow:

- Inventory visibility in real time
- Reorder points that are automated
- Integration of finance, production, and purchasing
- Sophisticated analytics for making decisions

Predictive analytics is another feature of digital systems that enables the business to foresee demand trends and modify procurement tactics appropriately (Waller & Fawcett, 2013).

ERP installation, however, necessitates organizational change management and is resource intensive. Its efficacy may be compromised by employee resistance and inadequate training.

2.3 Sustainability and Environmental Considerations

It is impossible to ignore the effects of resin waste on the environment. Hazardous emissions and disposal issues are linked to phenolic and furan resins. Sustainable inventory management should therefore include:

- Waste reduction through improved planning
- Investigation of environmentally friendly resin substitutes
- Reusing and recycling foundry sand

According to Govindan et al. (2020), incorporating sustainability into supply chain choices is now a strategic requirement rather than an option.

2.4 Critical Evaluation

Although implementing these strategies has many advantages, organizational preparedness is a must for their success. Brocksweir needs to deal with:

- Opposition to change in culture.
- Insufficient use of data to inform decisions.
- Insufficient integration of the supply chain.

Technical fixes by themselves won't result in long-lasting improvements if these fundamental problems aren't addressed.

3. Managing Obsolete Stock

3.1 Nature and Impact of Obsolete Inventory

Obsolete inventory represents a failure of planning and coordination. In Brocksweir's case, expired resins not only represent sunk costs but also incur additional disposal expenses due to regulatory requirements.

This highlights the dual financial impact of obsolescence:

- Loss of inventory value
- Additional disposal and compliance costs

3.2 Strategic Options for Managing Obsolete Stock

Table 1 Critical Analysis trade-offs:

Option	Advantage	Limitation
Disposal	Compliance	High cost
Recycling	Environmental benefit	Limited feasibility
Secondary markets	Cost recovery	Legal risks
Supplier returns	Risk sharing	Requires negotiation
Donation	CSR benefit	No financial return

A combined strategy is recommended, prioritising value recovery where possible and disposal only when necessary.

3.2.1 Disposal

Disposal through licensed waste management providers is the most straightforward option. However, it is:

- Costly
- Environmentally damaging
- Value-destructive

This option should be used only when no alternatives exist.

3.2.2 Recycling and Recovery

Advances in chemical engineering have made it possible to recover certain components from industrial waste. While not always economically viable, recycling offers:

- Reduced environmental impact.

- Partial cost recovery.

Guide and Van Wassenhove (2009) highlight the growing importance of reverse logistics in managing such processes.

3.2.3 Secondary Markets and Liquidation

Some value can be recovered by selling outdated or almost expired shares on secondary markets. However:

- Safety and legal issues need to be considered.
- Risks related to product quality and responsibility must be controlled.
- Only if the materials are still safe to use will this alternative be feasible.

3.2.4 Supplier Agreements

Future procurement contracts should include:

- Return policies for unused materials.
- Flexible order quantities.
- Shelf-life guarantees.

Such agreements distribute risk more evenly across the supply chain.

3.2.5 Repurposing and Donation

Materials may be repurposed for training, research, or lower-grade applications. While this does not generate revenue, it:

- Reduces disposal costs.
- Enhances corporate social responsibility.

3.3 Preventative Measures

The most effective strategy is prevention. This includes:

- Accurate demand forecasting.
- Real-time inventory monitoring.
- Smaller, more frequent orders.

As Christopher (2016) notes, prevention is always more cost-effective than corrective action.

3.4 Critical Analysis

Cost, risk, and environmental impact are all traded off in each choice. A coordinated approach is required, giving priority to:

- When feasible, value recovery.
- Risk reduction.
- Compliance with environmental regulations.

4. Improving Lead Time Understanding

4.1 Importance of Lead Time Visibility

One important factor influencing supply chain performance is lead time. Inadequate lead time visibility results in:

- Overstock.
- Delays in production.
- Decreased client satisfaction.

For Brocksweir, better knowledge of lead times is crucial to matching supply and demand.

4.2 Supply Chain Mapping

Supply chain end-to-end mapping offers insight into:

- Lead times for suppliers.
- Internal processing durations.
- Timelines for distribution.

This aids in locating inefficiencies and bottlenecks.

4.3 Data-Driven Decision Making

Robust data collection and analysis are necessary for accurate lead time management. Important metrics consist of:

- Rates of on-time delivery.
- Variability in lead time.
- Indicators of supplier performance.

For this procedure, digital solutions like ERP and Advanced Planning Systems (APS) are crucial.

4.4 Supplier Collaboration

Reducing lead time variability requires solid supplier connections. This comprises:

- Sharing of information.
- Collaborative forecasting.
- Evaluations of performance.

Strategic alliances can greatly increase responsiveness and dependability.

4.5 Technology Integration

Supply chain visibility is improved by emerging technologies like blockchain and the Internet of Things. These technologies make it possible for:

- Real-time material tracking.
- Increased openness.
- Quicker decision-making.

4.6 Lean and Agile Supply Chains

It is advised to use a hybrid strategy that combines lean and agile principles:

- In situations with steady demand, lean for efficiency.
- Flexible for adaptability in erratic markets.

This strategy improves flexibility and cost effectiveness.

4.7 Critical Assessment

Technical solutions alone are not enough to improve lead time comprehension. It requires:

- Alignment within the organization.
- Investing in systems.
- Shifts in culture.

Improvements won't be substantial or long-lasting without them.

Conclusion

Brockswear and Sons Ltd faces significant challenges in inventory and supply chain management, particularly within its sand foundry operations. The lack of structured inventory control has resulted in financial losses, inefficiencies, and environmental risks. The investigation has shown that the company's existing strategy is typified by inadequate alignment between procurement and operational requirements, reactive decision-making, and minimal data utilization.

The results show that ineffective inventory methods, like buying short-shelf-life products in bulk and failing to estimate demand, have led to large financial losses and increased environmental risks. There is a lot of room for improvement when sophisticated inventory management strategies like EOQ, JIT, ABC analysis, and VMI are used. However, these strategies need to be deployed within a more comprehensive framework of organizational transformation and tailored to the unique context of perishable materials.

The study highlights the significance of a multifaceted approach that strikes a balance between cost recovery, environmental responsibility, and regulatory compliance when dealing with outmoded stock. The best strategy is still prevention through better planning and inventory control, even while alternatives like recycling and secondary markets offer chances for value recovery.

The report also emphasizes how important lead time visibility is to improve supply chain performance. Reducing uncertainty and matching supply with demand requires better data gathering, supplier cooperation, and the use of digital technology. However, cultural change and cross-functional integration are just as important to these efforts' success as technology investment.

In conclusion, Brockswear needs to manage its supply chain and inventory in a comprehensive and strategically aligned manner. The business may cut expenses, minimize waste, and boost operational effectiveness by combining digital technologies, collaborative methods, and sophisticated analytical tools. In the end, this kind of change is necessary to stay competitive in a manufacturing environment that is becoming more complicated and environmentally controlled.

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