

SUPPLY CHAIN PRODUCTIVITY

THE MISSING LINK?

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Research programme

From Productivity to Prosperity: Inclusive Growth for The West Midlands

The 'Productivity to Prosperity' project brings together academics working across disciplines to focus on the cross-cutting themes of skills, management, investment, regional supply chains, innovation and enterprise, to address the main issues around productivity and the productivity gap.

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The WMG Supply Chain Research Group (SCRG) focuses on the theme of Supply Chain Productivity, which aims to provide guidance and support for practitioners to solve supply chain challenges and improve overall productivity. We hope you find this digest useful, and welcome any questions or feedback you may have. You can reach the team at SCIP@warwick.ac.uk.

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Introduction

Manufacturing matters, so does productivity

Historically, UK manufacturing has been a strong contributor to the country's productivity growth. However, firms have been in a productivity dilemma since the global economic crisis in 2008, which caused enormous challenges for manufacturers such as poor customer service, declining sales and excess inventories.

Over the past decade, industry has recognised that effective supply chains are a competitive advantage [1], but many firms have struggled to turn this vision into reality [2]. This is because firms tend to optimise their own productivity at the expense of others in the supply chain (SC) [3]. For instance, to keep an adequate level of customer service, manufacturers usually put buffers (such as inventory and production capacity) in the SC to prepare for uncertain demand. This creates greater demand volatilities to suppliers further down the chain and, in turn, undermines not only the productivity of individual firms, but the productivity of the entire SC.

To regain manufacturing productivity, firms need to understand the key factors that drive growth. This digest outlines three key strategies that manufacturing firms can adopt to create a step change in productivity through the adoption of effective SC management practices:

1. Shifting from 'functional' to 'process' thinking to build end-to-end SC integration.
2. Improving SC planning through the adoption of demand profiling.
3. Adopting digital technologies to support SC planning.

We encourage firms to take stock of their SC and consider the three strategies collectively as none of them should be treated as a single solution that, on its own, would improve the productivity of an entire SC.

Understanding the 'productivity puzzle'

To understand the productivity puzzle, it is important to recognise how productivity can be measured and interpreted in different contexts. The country-level productivity focuses on labour productivity, which is measured in terms of 'gross value added (GVA) per employee'. However, this concept is not familiar to industrial firms as they tend to view the term 'productivity' as the measure of efficiency linked to the time, cost and quality [4].

In the manufacturing sector, firms use a broad range of productivity measures that are predominantly related to financial performance and internal process efficiency. However, most standard measures such as profitability, market share, revenue and Overall Equipment Efficiency (OEE) have limited connection to the country-level productivity (GVA) [4]. This indicates a clear disconnect between the political dialogue and business practice and, more importantly, reveals the fact that the UK productivity growth slowdown is associated with growing variations between firms in the sector [5].

A recent study by Organisation for Economic Co-operation and Development (OECD) shows that there is an increasing gap between large global frontier firms (productive) and smaller non-frontier firms (less productive) in manufacturing [6]. This is because, too often, large firms have access to financial support, gain tax incentives for innovation and have the resources to provide training programmes to develop their talent pools. SMEs find it harder to access the same benefits and grasp opportunities to add value to the whole chain. This gives large firms advantages to improve productivity at the cost of its suppliers (mostly SMEs). To close the gap, it is urged that firms should focus on improving the productivity of the entire SC, in which everyone's productivity is considered and improved through joint commitments.

The productivity framework (Figure 1) demonstrates that SC productivity is an important missing dimension to understand and address the productivity puzzle, which emphasises the aggregated productivity of individual firms across the end-to-end SC. This bridges the gap between the country-level and firm-level productivity by aligning firms in the SC to a mutual business goal – delivering value at the lowest possible cost. This mitigates the exploitative buyer-supplier relationship in the conventional manufacturing SC and enables both parties to work on genuine cost reduction rather than only pushing down the price of supply.



Figure. 1 Productivity at three levels

SC productivity in manufacturing

Over past decades, manufacturing firms having increasingly recognised the strategic importance of SCs. Although there is not a single definition for SCs, most definitions tend to follow one of three perspectives:

- ▶ A **network** that connects the upstream suppliers and downstream customers.
- ▶ A series of **flows** within the business, including material, information and cash.
- ▶ A **process** that links the core functions – planning, procurement (source), manufacturing (make) and logistics (deliver).

In summary, SCs can be defined as:
‘A set of three or more entities (organisations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and and/or information from a source to a customer.’ [7]

Manufacturing SCs are complex and multi-faceted (see Figure 2). In modern business, manufacturers work with SC partners that cross multiple regions and countries to deliver the value to end customers worldwide. Firms often find it hard to manage such a complex network, as there is a lack of clear understanding of what the SC and its management means to the business.

SC management is all about planning and managing the SC, which is commonly referred to as ‘a management of

upstream and downstream relationships to deliver value at the lowest cost for all parties in the whole chain’ [1]. There are four types of functional roles that a SC manager can play within the manufacturing business (Figure 2) [8].

Role 1 – Supplier or supply base management
The supply base is a critical part of the supply chain, which is actively managed by the manufacturer. The focus of supply base management is to organise the relationship with suppliers, evaluate their performance over time and understand how the structure of the supplier network helps to accommodate potential changes in the business.

Role 2 – Resource flow management
The focus of flow management is to ensure that there are swift, even flows (of information, materials and cash) between suppliers and manufacturers, in which a proper SC design is necessary to eliminate bottlenecks.

Role 3 – Integrated resource flow management
This perspective focuses on taking an integrated approach to managing both the supply base and SC flows.

Role 4 – End-to-end (E2E) SC management
Delivering value to the end customer is the key focus of E2E SC management, which requires consideration of the other three perspectives. This enables manufacturers to gain a full picture of the entire SC and identify opportunities for value creation in collaboration with all partners.

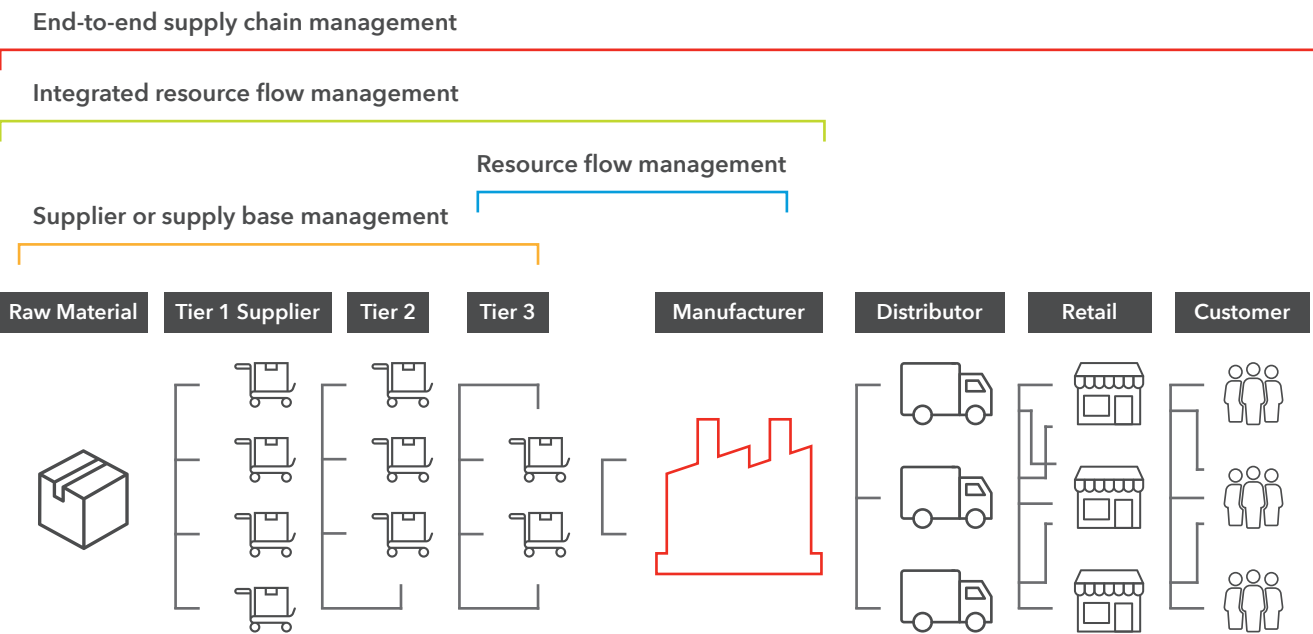


Figure. 2 Managing a typical manufacturing supply chain

To maximise productivity advantages from SC management, firms are urged to focus on the ‘product being made’; the material flow throughout the SC and not the factors of production [9]. This focus on ‘flow’ originated from the Toyota Production System and has been popularised through the Lean philosophy.

The five Lean principles have laid a solid foundation for the evolution of modern SC management principles (see Figure 3) and effective adoption can improve overall SC

productivity. First and foremost, manufacturers need to gain a solid understanding of market demand patterns, which they can then categorise based on product variability and volume. This enables them to develop and implement tailored practices to support each demand type, during which swift and even SC flows are created and buffers are rightsized to support the on-time delivery. Once the SC process has been established, continued monitoring and ongoing improvement maintain highly efficient management.

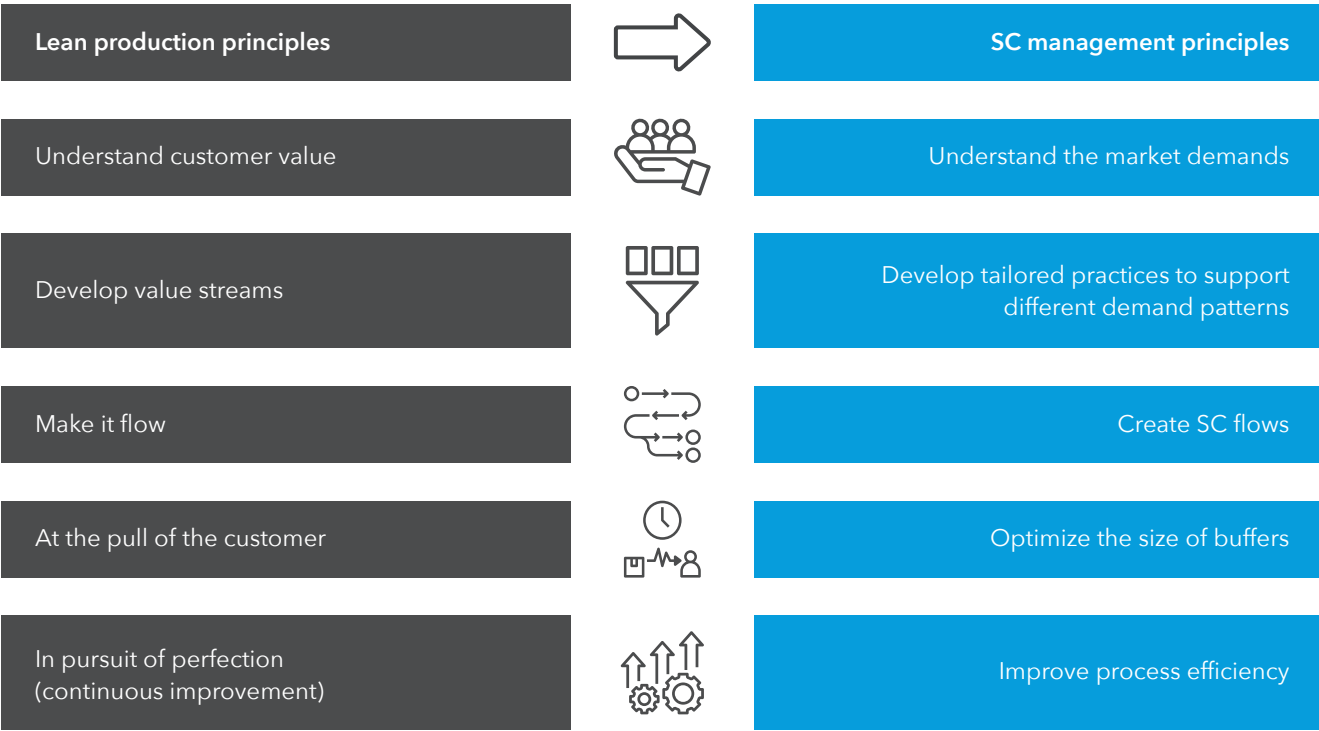


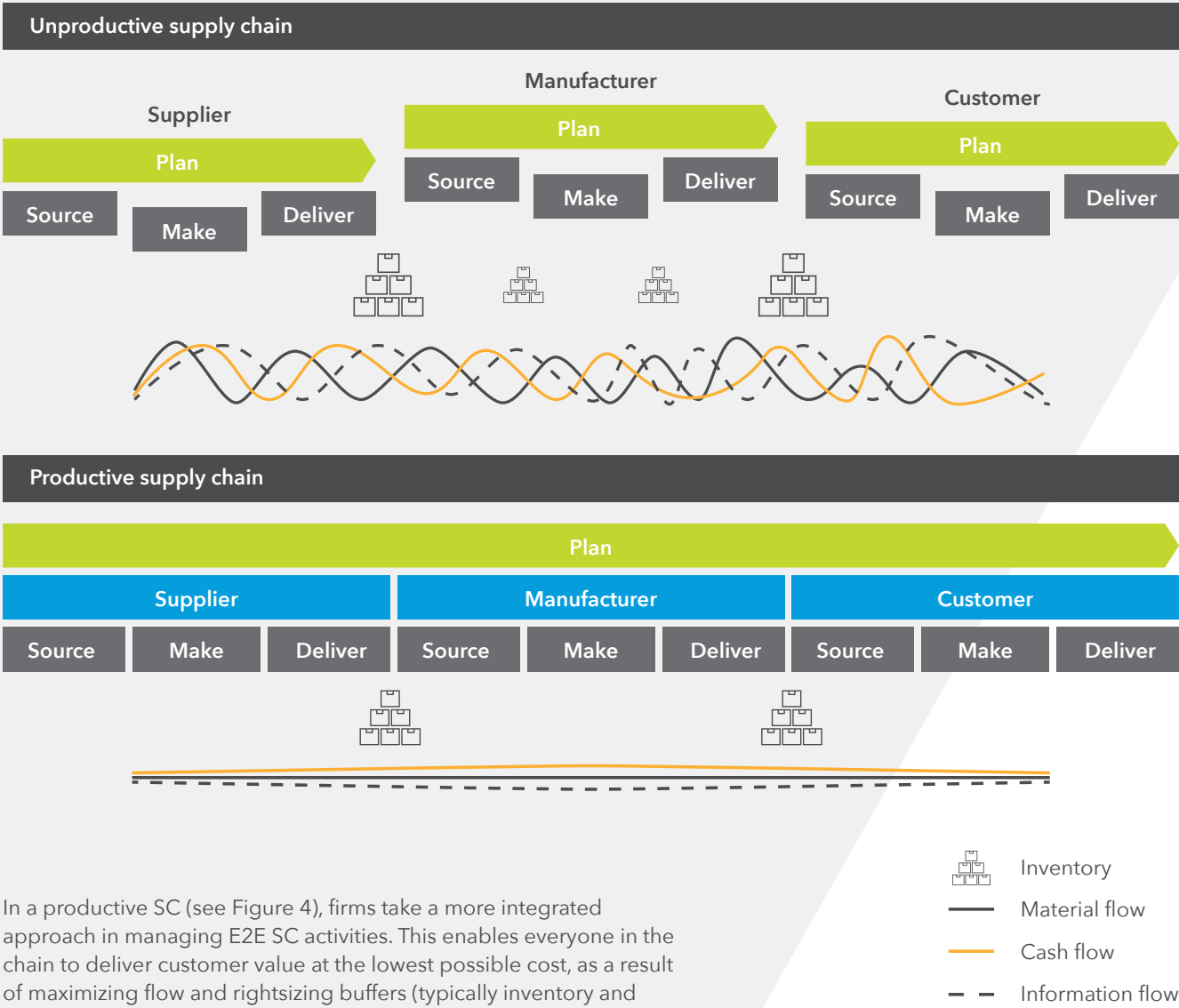
Figure. 3 Five principles of SC management

In reality, firms often find it challenging to implement the five SC management principles, particularly understanding demand patterns and managing SC flows and buffers. This leads to sub-optimal performance and productivity due to:

1. Poor integration within and outside the firm.
2. Material, information and cash flows that are ‘lumpy’.
3. Poorly managed buffers (inventory and production capacity in the SC).

This type of SC has high operating costs, long lead time and a high level of uncertainty.

Figure. 4 Unproductive vs. productive supply chain



In a productive SC (see Figure 4), firms take a more integrated approach in managing E2E SC activities. This enables everyone in the chain to deliver customer value at the lowest possible cost, as a result of maximizing flow and rightsizing buffers (typically inventory and production capacity).

Three enduring SC challenges

Visibility, integration and sustainability are three enduring SC challenges for manufacturing firms, hence the management should understand the interconnections among these challenges and the potential productivity implications (see Figure 5).

Visibility

SC visibility allows firms to visualise the status of the E2E SC and make decisions based on timely and accurate data. This reduces SC risk, operating costs and, more importantly, enables the integration of the SC network. A recent study by KPMG [10] highlighted that only 13% of the manufacturers surveyed had achieved full visibility along with their SCs. Most companies have achieved internal visibility through cross-functional engagement, but struggled to extend the scope to suppliers and customers to achieve E2E visibility. Common root causes are poor communication among the key players, limited access to real-time data and under-developed digital technologies and analytical capabilities. Without effective solutions to these issues, firms are unable to establish an integrated SC.

Integration

Firms with advanced SC practices know when they take a more integrated approach with suppliers in managing the SC, they are likely to unlock new sources of advantage that are beneficial to parties [2]. For example, manufacturers and suppliers can collectively work on new product introduction, take a more integrated approach to optimise SC processes, and collaborate on forecasting, planning and management to reduce waste, time and cost. This enables everyone in the chain to improve service levels, mitigate risks and, ultimately, enhance the productivity of the SC. However, firms often struggle to enable cross-functional engagement (internal integration) and strategic alignment with suppliers and customers (external integration). This results in slow and lumpy flows and poor utilisation of inventory and production capacity, which creates lots of variation in the SC in terms of cost, quality and lead time.

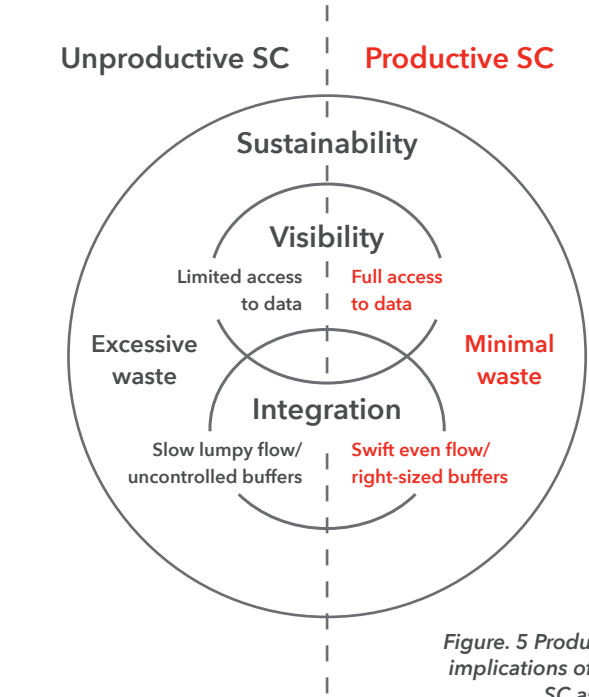


Figure. 5 Productivity implications of three SC aspects

Sustainability

As the world's population grows unsustainably, manufacturing firms have to rethink how they should manage the SC to combat issues such as natural disasters, changes in the business environment and shortages of non-renewable resources. The UK Government has set a target for net-zero carbon emission by 2050, meaning most local manufacturers are at a turning point: they need to pivot their SC to reduce carbon footprint and the use of primary resources. Firms with a more advanced SC have long recognised that they cannot achieve the goal without proper collaboration with suppliers and customers. A typical example would be the UK automotive SC. As the petrol, diesel and hybrid car sales ban has been brought forward to 2035 to support the 'net zero' target, automotive manufacturers have been forced to rethink their SC design, particularly, how they could collaborate with suppliers such as steelmakers to turn scrapped cars into new products through a sustainable route.

Addressing visibility, integration and sustainability issues can lead to a more productive SC, but what can be done to support this vision? The next section presents three strategies for firms to gain productivity advantages from SC management.

Three strategies to improve SC productivity in the manufacturing sector

To understand the factors that enable firms to improve SC productivity, WMG, at the University of Warwick, has been collaborating with local manufacturing firms to work on possible solutions to modern SC challenges. The findings identified three strategies that can be adopted by firms to boost SC productivity. The three strategies are:

1. Shifting from ‘functional’ to ‘process’ thinking to build E2E SC integration.
2. Improving SC planning through the adoption of demand profiling.
3. Adopting digital technologies to support SC planning.

Strategy 1: Shifting from ‘functional’ to ‘process’ thinking to build E2E SC integration

To improve the productivity of an E2E SC, there needs to be a ‘paradigm shift’ in the way that manufacturing firms organise their business and connect with others in the SC.

In 2016, Blue Yonder and The University of Warwick surveyed 100 manufacturing firms based in Europe to understand the role of SC in retaining business competitiveness [11]. Findings showed that 87% of firms have adopted ‘functional’ thinking in organising their business, which significantly inhibits E2E SC thinking. This is because firms are organised around commercial functions, creating ‘silos’ that break down the SC flows.

Therefore, shifting from ‘functional’ to ‘process’ thinking is the first critical step to building E2E SC integration. More importantly, the transformation brings four benefits to firms (see Figure 6).

- ▶ Redesigning firm-level organisational structure to achieve the seamless process.
- ▶ Delivering customer value through the adoption of integrated business planning.
- ▶ Visualising SC and making decisions based on timely and accurate data.
- ▶ Taking a co-ordinated approach to managing inventory and production capacity.

Benefits of 'process thinking'	Seamless process	Integrated planning	Better visibility	Effective buffer management
From	Business is organising around functions	Decentralised planning and functional segmentation	Unable to visualise real time situation	Managed by individual functions - buffers either too big or too small
To	Build business linkages following SC flows	Integrated business planning and segmentation across SC	Able to visualise the real time situation across E2E SC	Managed by coordinative approach across SC - rightsizing buffers
How to transform	Organise business around functional linkages and integrate all stakeholders	Collaborate with SC partners and integrated planning and segmentation	Integrate real-time situation visibility across E2E SC	Take coordinative approach across E2E SC to right-size buffers

Figure. 6 Shift from ‘functional’ to ‘process’ thinking brings benefits in several ways

With all of these benefits in place, firms are in a better position to address the visibility, integration and sustainability issues from the E2E SC perspective, making them more competitive and, ultimately, improving overall SC productivity.

Strategy 2: Improving SC planning through the adoption of demand profiling

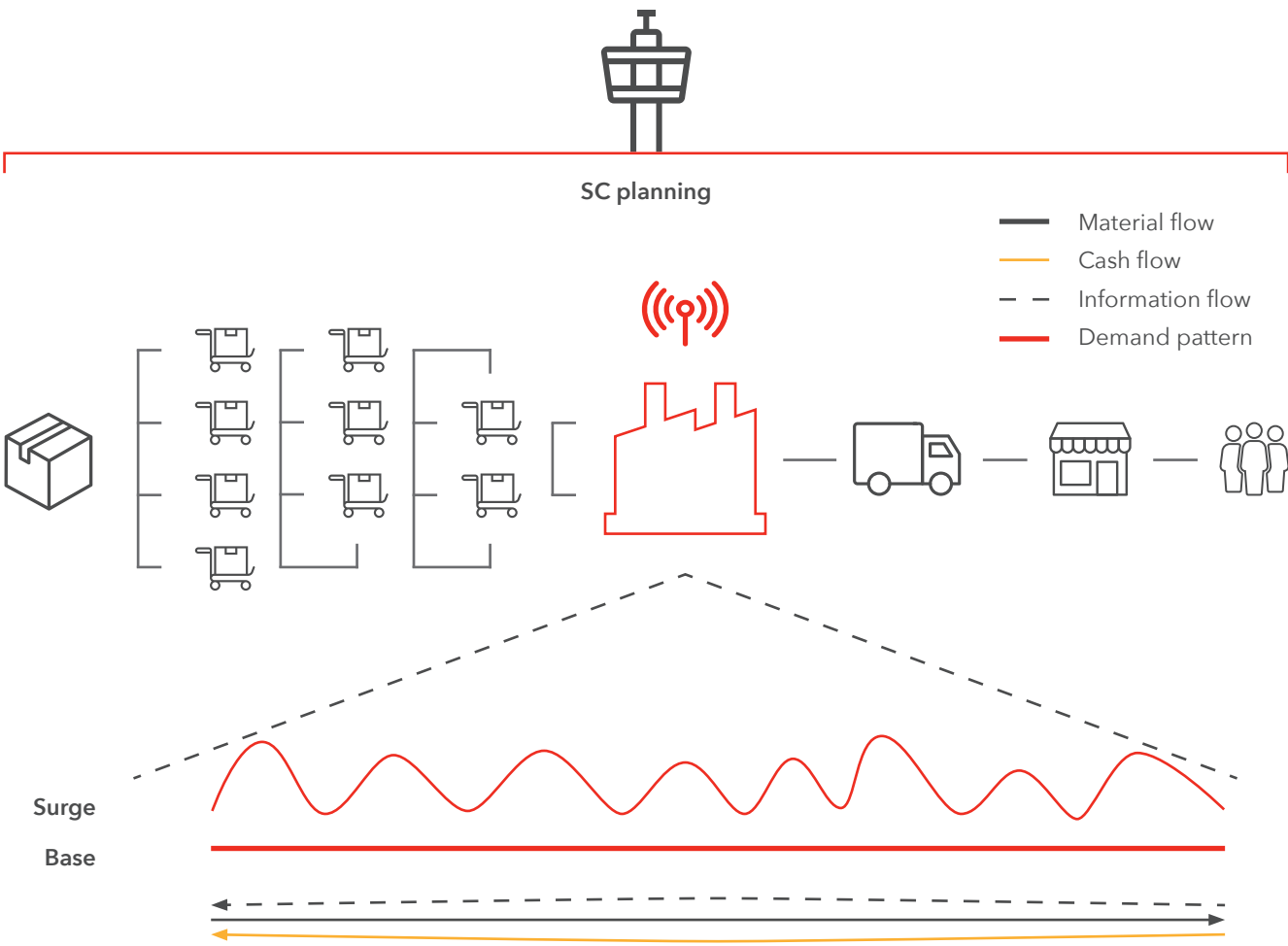


Figure. 7 SC planning acts as a ‘control tower’ that co-ordinates the activities and sets the demand for the chain

To reduce SC volatility, demand profiling is a critical approach that helps manufacturing firms to identify different demand patterns and co-ordinate the SC to respond to each demand type.

Adopting a demand profiling approach, firms can segment demand into four types based on two factors: product volume and variability (see Figure 8) [12].

- 1. **Erratic** – Frequent occurrences in time with high variations in quantity.
- 2. **Lumpy** – Irregular occurrences in time with high variations in quantity.
- 3. **Smooth** – Frequent occurrences in time with minimal variations in quantity.
- 4. **Intermittent** – Irregular occurrences in time with minimal variations in quantity and several periods of zero demand.

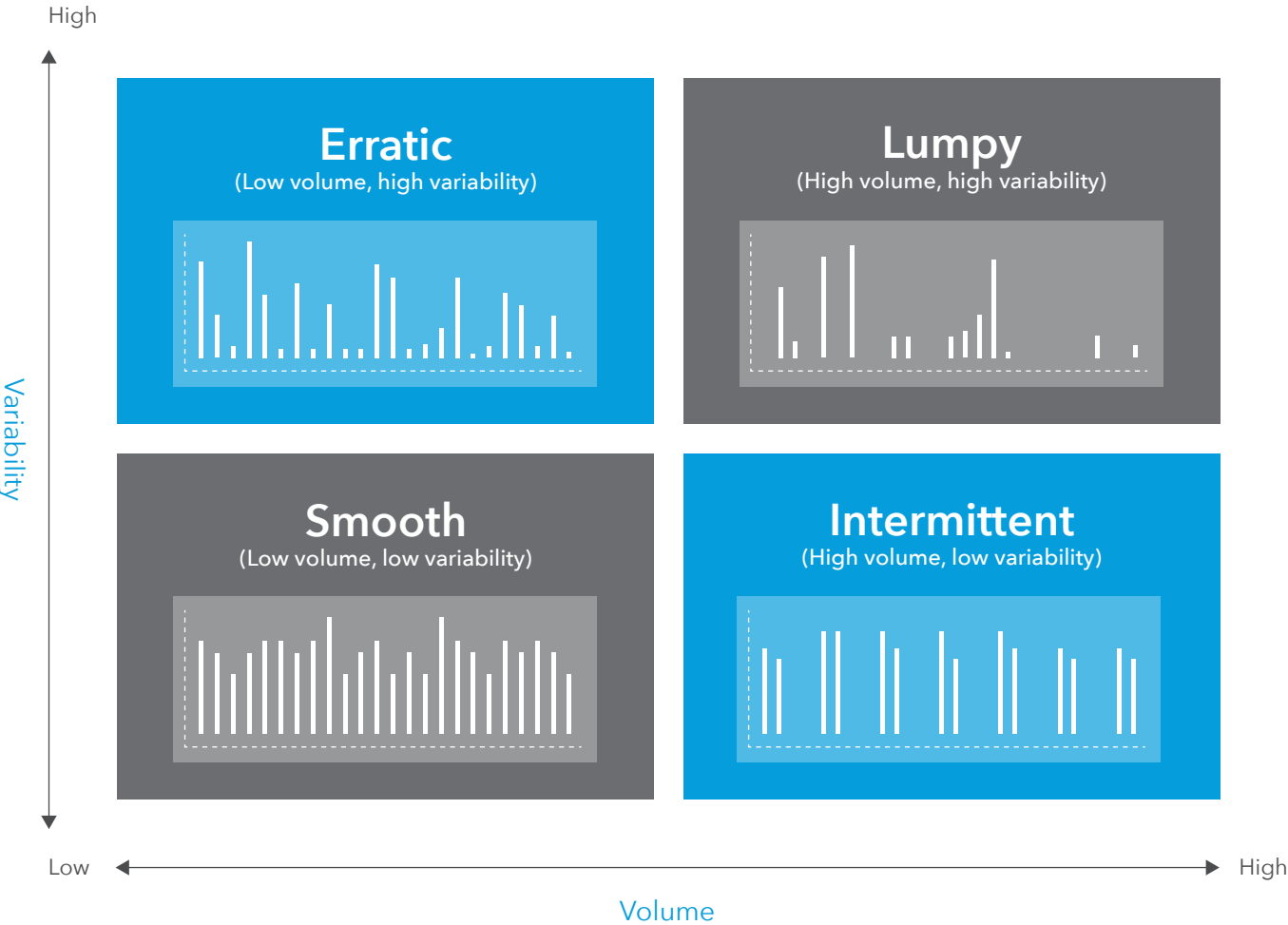


Figure 8. Types of demand profiles in manufacturing

Once manufacturing firms understand the demand signals from end customers, they can work with other SC partners to develop the tailored business practices to support each demand type. This improves the productivity of individual firms as well as the entire chain through the demand-driven segmentation approach.

Case study

Application of SC segmentation in a flooring manufacturing company

This case study demonstrates the application of demand profiling as an effective SC segmentation approach in a flooring manufacturing company (FMC). FMC manufactures and supplies flooring for construction and transport worldwide. Recently, the company took the initiative to improve its global SC, and they aimed to address the following challenges:

- ▶ The headquarter lacks visibility of regional sales data and inventory levels as all regions are using different planning systems.
- ▶ The headquarter can only plan its production based on historical shipment data to each region, instead of the direct sales at end markets.
- ▶ The company takes a unified approach to manage SCs for all their products.

To reconfigure and improve the global SC, FMC explored the benefits of using integrated business planning and SC segmentation across the regions. A demand profiling approach was implemented to categorise demand patterns into four types (smooth, erratic, intermittent and lumpy), in which high (top 80% (A) and then 15% (B) of the value) and low value (tail 5% of the value) products were identified based on sales value (Figure 9). For each demand type, the company developed tailored practice (Make to Stock (MTS), Stock to Order (STO) and Make to Order (MTO)) to differentiate the ways of holding inventory.

Sales value	Demand type			
	Smooth	Erratic	Intermittent	Lumpy
A (80%)	MTS	MTS	STO	MTO
B (15%)		STO	MTO	
C (5%)				

Figure 9. SC segmentation approach

Modelling the SC segmentation in FMC's global business demonstrates a few key benefits, which enables the company to:

- ▶ Gain visibility into the regional business through integrated business planning.
- ▶ Plan effectively for the future business.
- ▶ Develop tailored business practices to support each demand type.

Strategy 3: Adopting digital technologies to support SC planning

Industry 4.0 has brought disruptive changes to the manufacturing sector, urging firms to rethink what can be done to compete in the digital era.

SC planning relies upon big data and analytics to understand demand patterns. Therefore, digital technologies have become a key enabler to unleash the power of SC planning in four areas [13]:

- ▶ **Connectivity** – collecting real-time data throughout the E2E SC.
- ▶ **Automation** – automating processes and flows.
- ▶ **Prediction** – exploiting data to improve forecast and segmentation.
- ▶ **Security** – securing data and flows.

Considering that manufacturing SCs are complex and involve multiple players, adopting digital technologies in planning enables SCs to be [14]:

- ▶ **Faster** – enabling faster information, material and cash flows.
- ▶ **More transparent** – providing a complete view of the SC.
- ▶ **More integrated** – aligning better with suppliers and customers.
- ▶ **More flexible** – allowing flexible actions to respond to changing demand or operational situations.
- ▶ **More efficient** – providing better services to customers and reducing operating costs.

Developing digitally-enabled SC planning is not just about utilising different technologies and tools, but a complete shift in the way that the manufacturing SC operates. Being able to access real-time data, build connections with key players and create physical flows allows firms to gain greater visibility, form a more integrated E2E SC and utilise resources in a sustainable way. With all these benefits, SC productivity can be maintained in the long term.

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Conclusion

SCs are complex organisms and they can be turned into a competitive weapon to unlock the full potential of productivity. Now is a critical time for manufacturing firms to rethink the way they manage the SC to tackle the visibility, integration and sustainability challenges and, ultimately, gain productivity advantages. To help firms start, the three strategies are outlined in this digest are:

1. Shifting from 'functional' to 'process' thinking supports the business to build E2E SC integration through seamless processes, integrated planning, improved visibility and effective buffer management.

2. Adopting demand profiling in SC planning enables manufacturers to recognise different types of demand and co-ordinate with suppliers to develop tailored practices to support each demand type.
3. Developing digitally enabled planning practices helps the SC to be more effective, transparent, flexible and integrated.

With effective adoption of these strategies, manufacturing firms are capable of improving their performance and, more importantly, they will stand a better chance of co-ordinating with SC partners for a more productive future.

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