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By

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Abstract

The challenge for any distributor in a supply chain is to balance inbound and on-hand inventory to customer demand, thereby providing value by ensuring inventory is available in the needed location at the correct time. Global disruptions caused by the Covid-19 pandemic trigger numerous shortages of product causing costly stock out and market shortages. This paper reviews how improvements in supply chain communications and improvements in ordering forecasting can act as a buffer against unstable and unpredictable lead time disruptions. Ensuring efficient and smooth communication on future demand needs and partnering with vendors to manage long term blanket orders will ensure inventory levels are maintained at sufficient levels to meet customer needs while avoiding excessive carrying cost and inventory obsolescence.

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Introduction

Modern supply chains often operate like a wristwatch, with many actions taking place in synchronized motion with one another to ensure smooth timekeeping for the wearer of the watch. End customers, the watch wearers at the end of a supply chain, look for value by having goods and services produced to fulfill their needs in a manner that fits their schedule and desires. Ensuring that goods are available for sale in the proper place at the proper time often falls upon the distributors in the supply chain, one of the supply chain partners closest to end-user demand. A mix of demand forecasting and stocked inventory to be sold to retailers or direct to consumers ensure profitable and acceptable service levels to maintain competitive customer service.

Like many manufacturers, distributors look to minimize the amount of inventory needed on hand to lower overhead and inventory carrying costs, as inventory can cost distributors 20% to 40% of their value per year(Ganeshan, 1999). This is achieved by decreasing the order cycle time and relying on stable replenishment lead times from vendors to maintain enough stock to provide necessary value to the customer, while also carrying enough safety stock to hedge against unforeseen demand spikes. This delicate balance of synchronization was shattered with the Covid-19 pandemic that began in 2020, and the product, labor, and transportation shortages and bottlenecks that ensured for the next years. This was only compounded by growing stress from increased intermodal shipping traffic, the preferred method of transporting goods across the world, that was already expected to double to triple in volume by 2020. Distributors were whiplashed from fear of demand dramatically decreasing to supply disruptions that led to costly stock-outs and an inability to recover using normal supply chain means.

Statement of Purpose

The purpose of this paper is to research how distributors can overcome these new variable factors to maintain advantageous operations by improvements in communicating the demands of the end user to partners farther upstream in the supply chain and by optimizing and streamlining ordering forecasting. Bringing clarity and generating accurate forecasts throughout all levels of the supply can support each partner in preparing their own internal operations to account for bottlenecks, shortages, and disruptions. This in turn allows the distributor to provide accurate dates on when end customers can expect their demands to be fulfilled, maximizing the total value the customer can receive from their business.

This has led to a new problem of how distributors balance their inventory in support of customer demand as traditional stocking strategies can no longer be relied on in their current form, even as global supply chains resume operating in a stable pattern. Distributors cannot maintain profitable operations by overstocking inventory to shield against unpredictable and extreme lead times, while also facing a grave risk of not being able to meet customer demand due to stockouts from unreliable supply replenishment.

Rationale.

Finding this new balance is critical for distributors to maintain a competitive position in often-crowded distribution markets. Distributors now must consider the ability of upstream vendors to manage their inventories, inbound logistical disruptions, and labor pools to meet production schedules that support the distributors' needs and the market at large. Another factor needing to be examined is the overall length or number of other parties involved within the supply chain. The longer and more complex the supply chain becomes, forecasting in turn becomes more unreliable when demand farther down the supply chain is disorganized(Syntetos et al., 2015), which will only become more disorganized from delays and shortages of inventory flowing downstream. With unstable and uncertain supply chain threats remaining in the global market, reviewing improvements in supply chain communications and revised forecasting will ensure profitable and sustainable operations for distributors.

Literature Review

During periods of disruptions, supply chains can face extreme pressures to adjust operations to ensure the flow of goods are maintained at a profitable level in support of customer demand. Lean inventory and just-in-time inventory management practices were pushed past breaking points during the Covid-19 pandemic when lead times became unknown due to an almost impossible number of delays and bottlenecks. Clear and improved communication throughout the supply chain can help identify new risks and ensure distributors tasked with supplying customers maintain acceptable and sustainable levels of service and value.

Supply Chain Structure

In a supply chain, a distributor brings inventory in from a range of vendors which in turn are sold to regional markets with demand for the goods. Ram Ganeshan(1999) reviewed optimal inventory policies for a production and distribution network that relies on a central point receiving inventory from multiple vendors, and in turn shipping the product to a large number of retail locations. To form ideal ordering points the author analyzed three sub-systems of inventory; inventory at the retailer, inventory at the central warehouse, and the demand processed at the warehouse. Linking the interrelationships of each of the sub-systems, a total cost model led to 3.59% backorder levels at the retailer, and 1.12% backorders within the warehouse over a ten-year cycle. This was a notable improvement over traditional optimization model that viewed inventory at each location separately. The model helped found the idea that linking inventory stocking decision-making between the central distribution warehouse and retailers downstream lowered ordering costs while also filling more customer orders.

The inventory stagged within a central distribution point also acts an as a buffer against uncertain demand for both the retailers and the supply vendor partners. Baganha and Cohen(1996) studied how the cushion of inventory helps stabilize supply chain operations. Similar to the one used by Ganeshan(1999), a multi-echelon structure containing a production plant, distribution center, and multiple retailers selling to the general market was used. For optimal demand, each stage will only plan its forecasting method only when the partners downstream have established their stocking profiles, so the upstream partner has some certainty in demand. The authors used mathematical models to prove that production plants will have more success in projecting demand by using a distributor as a buffer between itself and retail demand. This is proven by demand variability to the production plant being mathematical modeled lower than models providing demand variability for retailers ordering direct to the plant. Baganha and Cohen provide direct results that distributors can provide a stable stocking profile for suppliers to plan demand around, and not be subject to the often-uncontrolled changes in demand at the retail level.

Building on shifting market demand, Symtetps et al.(2016) researched how information sharing and coordination within a supply chain affects demand forecasting. Basing their research on the length, or the number of partners within a supply chain, the depth of the hierarchical structure of products within the supply chain, and time constraints, the factors are linked together to generate demand signals to pull inventory through the chain. Improved information sharing flowing upstream in the supply chain can help reduce the downstream demand uncertainty to improve forecasting, leading to more stable stocking profiles sought in Baganha and Cohen’s(1996) study. A lack of data and software programs that are capable of overcoming the gaps in the length, depth, and time factors of a supply chain does pose a challenge in achieving accurate demand signals.

With many supply chain structures, risk management is a key point in handling demand forecasting and staging inventory in a distributor's warehouse. Improper reaction to risk can quickly eat away at the buffer of inventory and cause unstable stocking profiles as demand and supply flow become unsynced. After being heavily tested during the Covid-19 outbreak, El Baz and Ruel(2021) reviewed how supply chain risk management tactics mitigate disruptions toward supply chain resilience and robustness. Supply chain risk management relies on risk identification, assessment, mitigation control, and risk control to lessen the effects of disruptions from high-impact events. Supply chain robustness was negatively hampered in the short term by the Covid-19 outbreak due to the number of disturbances globally, whereas resilience was not directly impacted and allowed companies to recover operations in the long term. To improve robustness, only risk identification and mitigation control were directly linked to higher performance. Additionally, larger firms tend to have more resources to allocate toward risk identification and mitigation than smaller firms. Companies should improve upon internal organizational information processing to better identify risks and deal with uncertainty.

To build a more resilient and robust supply chain, distributors should view upstream and downstream risks when selecting vendor partners, a topic Yoon et al.(2017) explored. Companies need to both minimize cost and risk by achieving reliable supply flow from upstream partners while also facing uncertain customer demand. Through four risk mitigation strategies, with two focusing on upstream risk mitigation, and two hedging against downstream risk, overall risk performance varied depending on the company’s focus on maintaining costs or the reliability of product flow. While applying all four risk mitigation strategies can improve overall performance, single strategies can still perform better. Companies must consider outside factors, such as capacity at the upstream supplier, as tight supply capacity leads towards reliability being a greater factor, while surplus available capacity leads preference towards more cost benefit. Generally, combing upstream and downstream risks when selecting vendors is most effective when upstream production capacity is tight, and reliability becomes of greater importance over cost control.

Improve Performance from Communication

When looking to improve inventory stocking levels, reordering points, and risk mitigation, many supply chain strategies look to improve communication between partners. Information sharing within a supply chain is a critical aspect to maintain high overall performance, a topic covered by Baah et al.(2022). Supply chain collaboration, visibility, agility, and performance have long been viewed as key pillars of sustainable competitiveness in the era of global supply chains. The authors sought to link the four through how improved information sharing improved each pillar, which then also improved the performance of the remaining three pillars. Proven by mathematical modeling, information sharing had notable positive impacts on supply chain performance, collaboration, and agility.

These findings help solidify that information sharing within a supply chain enabled each partner to use their internal resources more efficiently, leading to higher profits and collaboration with other supply partners. Supply managers should ensure accurate information is timely shared with other supply chain stakeholders to produce superior outcomes and raise the competitiveness of the supply chain.

Over the years multiple ways to collaborate and communicate information between supply chain partners have been used to improve the performance of the entire supply chain. Al-

Doori(2019) selected three methods of collaboration, information sharing, joint decision-making, and electronic data interchange(EDI) to find how they have a positive impact on operational performance. The author found the use of all three did positively relate to improved operational supply chain performance, with information sharing and joint decision-making also improving management approaches to operational performance. These improvements include improved buying decisions throughout the supply chain by combing accurate and timely data from upstream and downstream sources. Lower operational costs, supply chain agility, lessen lead times, and reductions in waste through the chain build a sustainable competitive advantage only achievable through collaboration between supply chain partners.

In addition to how supply chain partners communicate, Li et al.(2023) looked into how communication activities and patterns influence the operations of both the buyer and supplier. The authors separated communication methods into four categories based on the richness of the media, the media's ability to provide feedback and attract attention, the communication channels used, and diversified languages. From a survey of companies, the authors found that lean media, media that rely on ERP or text messages, performed well in improving operational and planning communication for delivery and flexibility in operations. Rich media, relying on voice and video systems and face-to-face communications, tended to show improvements in task-oriented delivery and flexibility performance, and financial performance and flexibility. The report gives guidance in the selection of the optimal communication method and frequency to drive improvements in operations, delivery performance, and financial performance based on the task and information needing to be transmitted.

As covered earlier in the literature review, companies often must communicate risks faced in the open market and supply chain, which Duhadaway et al.(2018) expanded upon by studying the communication of this information and how it impacts individuals in a company. Organizational actions and decisions made by individuals have always been linked, but there was uncertainty on how the communication of risk impact supply decisions made on an individual level. When the risk is communicated throughout a company, the new perception of risk influences individuals to take more conservative supply approaches, such as increasing safety stocks or switching to purchasing from fewer but more reliable suppliers. Communicated risk has a far greater impact on supply chain decisions than recorded historical risk faced. Companies can shift individual internal behavior through risk communication as the new preserved risk will continue even after undertaking compensating actions.

Building a Communicative Supply Chain

Distributors should always look to build or improve on their vendor partner base by reviewing new possible vendors willing to collaborate and communicate to drive supply chain success and stability. Rezaei(2014) challenges the outlook of the process of selecting vendors as a one-way approach, rather it should be viewed as a two-way selection with both the buyer and supplier reviewing each other to form a partnership. Using a weighted mathematical equation, buyers and sellers can rank the attractiveness of a potential partner company. Instead of focusing on optimizing a single score, both buyers and sellers should seek to optimize the highest score for all buyers and sellers in a single system. While selecting the best partnership for a single linking may be beneficial for a company, the overall performance of the supply chain may not be able to operate at as high of a level if the overall scoring fit was considered. Embracing selecting buyer and seller relationships to achieve the highest system score improves long-term performance sustainability and reduces the rate that costly switches between buyers and sellers.

These high-scoring buyer and seller matches can ensure a high sense of trust and mutual commitment between the parties, a subject that Agarwal and Narayana(2020) explored to link the quality of communication to the underlying relationship. The authors focused on linking relational communication, or the exchange, frequency, and accuracy of data, with the level of trust, satisfaction, and commitment felt between the buyer and suppliers of a supply chain. Using data collected from online questionnaires from employees in procurement or vendor management roles, the authors were able to produce analytical results linking that relational communication, trust, and commitment positively impact each other within a supply chain. The results linked that buyers' positive view of a supplier's relational communication also preserved their level of trust and satisfaction with the supplier in a positive manner. Moreover, the study firmly encourages companies to build strong communications skills to utilize the confirmed positive direct link relational communication has on the preserved trust and satisfaction to increase the overall performance of the supply chain.

Opposite to what Duhadaway et al. study in 2018 noted where buyers tend to rely on fewer but more reliable vendors when risk is communicated, companies that rely on a single source to keep ordering costs low tend to expand to a handful of vendors when risk is identified. The balance of lot size ordering and vendor selection under a scenario of unstable lead time is researched by Thevenin et al.(2022). Using robust formulas to calculate the cost of lot orders, against worst-case inventory delivery delays, and back-ordering costs, the authors set out to find an optimize approached to vendor selection and lot-sizing purchases. For buyers deciding on single sourcing or using a multi-source strategy, risk aversion became a major factor. Paired with worse-case lead time scenarios, buyers can be pushed to diversify their vendor base to lower the risk of stocking out, even if the selected buyer has the highest buying costs if they provide low variation in lead time deliveries. This shows a buyer's level of risk aversion may push them to seek the most stable partner at the expense of higher overall ordering costs.

In addition to being supply chain partners, the social relationship between companies can have an impact on communication, a link Can Saglam et al.(2022) reviewed as there has been a gap in research on the topic. Focusing on relational commitment and reciprocity between partners, the authors set to link the factors to improve communication, which in turn leads to higher supply chain resilience and ultimately better supply chain risk management. Through numerous interviews with executives and managers, the research found that effective communication increased the supply chain’s ability to adapt to unexpected interruptions by increased facilitation of risk estimation. The quality of the transmission of this information was supported by both the relational commitment and the reciprocity level shared by the supply partners, which leads to a feeling of obligation to share knowledge and appropriately react to receiving it. Curiously though, no direct link between the relational and reciprocity commitment could be made to improve supply chain resilience, rather than the two factors indirectly improving it through increasing the quality of communication.

Overall improved communications can bring clarity to supply chain operations and help overcome unpredicted disruptions that threaten customer support and value. Most studies have shown communication and high levels of cooperation between supply partners improve the quality and timing of key information, which can be used to improve internal demand forecasting and shifts in operations when faced with rapidly shifting market conditions. Using the direct links from communicating and collaborating, selecting vendor partners that are looking for distributorships to form a mutually beneficial relationship has only grown in importance for long-term supply chain performance and resiliency. These improvements can ensure a distributor has a high-performing, resilient, and agile supply chain supporting customer demand. Distributors in different supply chains do face a large scope of challenges, and while studies such including Agarwal and Narayana(2020) and Li et al.(2023) conducted were based on surveys of current employees in the supply chain field, the data collected may not necessarily fit every supply chain. While Baah et al.(2020) and Rezaei(2014) used mathematical models which may decrease bias or challenges faced by unique circumstances, future research should focus on operations in real-time over a set timeframe to replicate and confirm the findings.

Methodology

Research from past and current academic studies conclude that communication and coordination throughout the supply chain can improve performance for each partner and the overall competitiveness within a market space. To fully exploit the possible improvement, managers and companies need to be aware of how communication improvements can overcome the new stocking challenges distributors face as global supply chains recover and look to learn from the disruptions the Covid-19 pandemic brought about.

Improving the Distribution Operation

Even in the current era of smart technology and online shopping, many distributors still operate within a multi-echelon structure that sees multiple retailers or customers draw inventory from the distributor at an unstable rate to fill market demand(Baganha & Cohen, 1998; Ganeshan, 1999; Syntetos, Babai, Boylan, Kolassa, & Nikolopoulos, 2016). Distributors in turn look to pull inventory from suppliers upstream within the supply chain at the lowest possible ordering cost while avoiding stocking out of inventory needed by the retail partners. While demand from retailers is unstable, there are historical trends distributors can base their forecasting around and calculate profitable safety stock levels which provides the needed stable stocking profile that allows their suppliers to have stable demand to base their operations around(Ganeshan, 1999).

This demand cycle fell apart when global supply chains were almost universally disrupted if not outright halted as countries grappled with Covid-19. Historical demand became useless as final consumer demand spiraled, causing instability in stocking profiles at distributors that made forecasting at the supplier level an impossible guess. To overcome the new variable of unpredictable demand and keep the supply chain as agile and resilient as possible, companies need to turn to the findings that DuHadway, Carnovale, and Kannan (2018) and Thevenin, Ben-Ammar, and Brahimi (2022) researched. During periods of high uncertainty, both groups of authors pointed towards either restricting supply partners(DuHadway et al., 2018) or expanding away from a single source(Thevenin et al., 2022) to a small pool of trusted and stable suppliers to pull inventory from.

Once a distributor can recover their stocking profile and product mix, they in turn can provide what products are available, supply chain restrictions faced in terms of allocation, additional ordering costs, and lead time delays to retailers and end consumers. This information can allow retailers to plan their demand around what product is available and guide purchasing habits of consumers to meet their demands while also coordinating more accurate demand signals to distributors and upstream partners as found in Syntetos et al. (2016)'s work. This expands the distributors' ability to act as a cushion for not only suppliers against unstable demand but also as a cushion to retailers and end consumers by providing accurate information on what products and quantities are available to reset the demand cycle within a supply chain to a more transparent and stable state.

Improvements from Distributor and Supplier Communication

For distributors to properly plan and act as a buffer against upstream and downstream uncertainty, clear communication about risks and bottlenecks must be achieved. Stable, accurate, and clear communication within a supply chain for distributors begins at the vendor selection stage. For long-term success, both the supplier and distributor will want to find a mutual best fit, with distributors seeking stable inventory flow that brings value to their customers, and the supplier often looking for a distributor that will help grow market share and represent their brand within the market. As Rezaei (2015) found, suppliers and distributors have become more dependent on each other, and review how the relationship between the companies impacts their entire supply chain. This view also builds into the risk mitigation factors presented by Yoon, Talluri, Yildiz, and Ho (2018) when reviewing how upstream and downstream risk impacts the vendor selection process. Having a clear view of the limitations that the supplier and distributors face will allow for greater transparency in demand forecasting and determining how new market disruptions will impact supply chain performance and needed mitigating actions. Knowing which vendors will perform the best and what the distributors calculate to be an acceptable cost level will reduce the possibility of either side feeling blindsided or betrayed by the other and build a strong relationship with high trust and confidence.

Such a relationship is important to build and maintain so distributors are enabled to fully harness the supply chain performance improvements found in the other reviewed literature. The improved supply chain robustness through risk management and the responding relocation of internal resources to combat the heightened risk factors El Baz and Ruel (2021) found relies on individuals within a distributor to fully recognize the communicated risk and shift their behaviors according (DuHadway et al., 2018). The improvements Baah et al. (2022) found in supply chain collaboration, visibility, agility, and performance by sharing information to be used to optimize internal operations would not be possible if both the suppliers and distributors did not view their successes as being co-dependent. Often the needed information relating to current sales, costs, and production are highly guarded and only shared with trusted partners and members. This is proven by Agarwal and Narayana (2020) linking the quality of shared information to the sense of trust and mutual commitment. With the relationship founded by the findings Rezaei (2015) presented, the self-feeding improvement from Agarwal and Narayana (2020) of the distributor maintaining a positive view of the supplier's commitment from the shared communication will lead to sustainable long-term supply chain performance and the distributor's own performance in maintaining high levels of customer value and satisfaction.

Maintaining a level of high trust and mutual commitment is also key in enabling the supply chain to be resilient to disruptions, such as those brought on during the Covid-19 pandemic. Can Saglam, Yildiz Çankaya, Golgeci, Sezen, and Zaim (2022) find that the improvements in communications helped the transmission of increased risk estimation, allowing the distributor to promptly communicate that risk to downstream retailers and customers. This in turn allocates more time for the customers to adjust their demand signals to the distributor while properly accounting for possible longer lead time and ordering costs. How suppliers can properly gauge the best method for transmitting the risk factors can be found in Li, Huo, and Wang (2023) work on communication patterns. For the new risk factors to overcome historical risk and drive meaningful change in an individual working within a distributor, such as those found in DuHadway et al. (2018) work, suppliers upstream and customers downstream of the distributor need to rely on the richer media transmission based on voice, video, and face-to-face communications that most improvements in operations and flexible performance(Li et al., 2023) to overcome new challenges the increased risk factors produced.

This cycle of communication between the distributor to its suppliers and to the customers downstream will ensure that relationships between the supplier and distributor can continue to be built on trust and mutual cooperation, and work towards building the same mutually beneficial relationship between the distributor and retail customers. Such improvements between the distributor and its customers include the need to carry more local safety stock at the retail level rather than rely on the distributor to do so, overriding the historical risk of carrying cost being the greater danger. Greater supply chain performance and market competitiveness through optimal ordering decision-making, lower overhead costs, and supply chain agility(Al-Doori, 2019) will lead to the distributor being able to attract more customers, increasing their own positive feelings towards suppliers sharing the information, with the suppliers also gaining benefits by the distributor successfully gaining market share. This will allow the relationship built to continue to be sustained and improve the distributors' ability to maintain inventory stock for customers without being overburdened with carrying costs or stockouts.

Discussion and Conclusions

The goal of this paper was to find improvements in supply chain performance when faced with unpredictable and unstable bottlenecks through supply chain communications and forecasting to ensure profitable and stable operations for distributors. In this regard, the paper successfully reviewed and linked multiple studies that built a foundation of competitive operations around integrating data and information exchange both up and downstream within a supply chain. This improvement in communication revealed how supply managers can forecast disruptions and bottlenecks before they affect actual operations and communicate these risk factors to change internal behaviors to take preemptive protection against stockouts. Effectively communicating supply conditions to retailers and consumers and transmitting market needs to suppliers upstream can increase the value a distributor can bring to the market, and overall increase their supply chain's competitiveness in the market.

While it will never be possible to control all aspects of a supply chain due to constant outside, uncontrollable factors, this paper outlines a clear path forward for supply chain managers and those involved with the logistics of a supply chain to build on the harsh lessons that occurred during the Covid-19 pandemic. Other disruptions, such as the blockage of the Suez Canal by the Ever Forward in 2022 will almost always be outside the control of any given supply chain. Finding supply partners that have or are willing to invest in the needed infrastructure and integration of transmitting and sharing market viewpoints and information will give a supply chain the highest possible agility and flexibility to overcome unpredictable global events and disruptions.

Limitations within this study include the emerging use of an omnichannel supply chain structure, which looks to seamlessly integrate a brand or message throughout a multitude of market touchpoints, including direct sales from a supplier to an end-consumer. Without the steady pathway provided by a multi-echelon structure for information to flow, it can become difficult to capture and transmit information in an impactful way. The continued use of eCommerce also removes valuable human-to-human contact points that may be needed to communicate data-rich information. Future work should be done to see how online data, or big data, can be more effectively processed and handled to provide the same results made possible by the research within this paper. Additionally, the development of intelligent AI has the potential to reinvent the operations of the supply chain. While currently there is insufficient data and studies available, AI may be able to unlock and predict trends and optimizations that are obscured in currently available data.

Recommendations and Implications

This paper recommends that all supply chain managers and stakeholders that are looking to improve their distribution operations by reviewing the relationship the distributor has with the supply base. Many of the findings and improvements in this paper would not be possible without the co-held belief that both the supplier and distributor are working towards their shared best interest and that both parties can successfully influence each other's actions when presented with relevant supply chain information. This review may involve decisions on if the current supply vendors are the best possible partner that brings the highest overall performance to the supply chain, and if investments in IT and other company infrastructure is needed to achieve the collection and dispersion of information within the supply chain and internal operational stakeholders.

While improvements in technology increased integration between supply chain partners, no distributor should be content with their status quo. Additional actions such as setting up weekly meetings with key supply partners, or key customers, can act as an opportunity to exchange rich data information and provide clear insight into either production challenges or abnormal shifts in consumer demand. Supply chain partners should continue to monitor best practices undertaken by other supply chains within shared marketspaces and external markets to help support an environment of continuous improvements to ensure the supply chain as a whole is best situated to overcome any future local or global disruptions and provide the best possible value to consumers while generating sustainable profit and margins for all supply chain partners.

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