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Improving Supply chain Performance

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Executive Summary

This report is an evaluation of the current mountain bike supply chain and what steps can be taken to improve it. Since the Covid-19 pandemic, the bike industry has seen demand increase substantially but are unable to meet the demand. This sudden increase in demand has shown how vulnerable the supply chain was, and how much resilience is needed. An assessment of the supply chain was carried out to identify what the biggest vulnerabilities are and the level of priority. It was found that the industry is heavily reliant on Asian manufacturing, and this is the largest shortcoming in the supply chain. With the increase in demand globally, transportation is the weakest link. With competition for shipping containers being at an all-time high coupled with increased turnaround times at docks, the supply chain is at a breaking point. Steps have been recommended of how to mitigate some of these issues and add resilience into the supply chain to stop the reoccurrence of these issues. However, until the reliance on Asia for manufacturing is reduced many of these factors will always be present.

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Introduction

This report will critically evaluate risks and vulnerabilities in the supply chain (SC) of Mountain bikes and components. It will give a strategy based on the findings of how to make the SC more robust and resilient. Giving a far more stable and cost-effective method of obtaining goods at a consistent price.

The mountain bike industry is comprised of many complex SCs. Most components and bike frames are manufactured in Taiwan. There is a reliance on the manufacturing of these components in Asia, due to cost and now the expertise that they possess. For most companies to stay competitive producing in Asia is seen to be the only viable method. Many large bike brands such as Giant, Specialized, Trek and Santa Cruz all own factories in Taiwan and the country have 50% of the total market share of bike manufacturing worldwide (Kang, 2020). But this reliance on supply from Asia makes the supply vulnerable. This was evident in the 2020 Covid-19 pandemic, where production stopped at these factories and the SC of bikes is still to recover.

The global bicycle market is now worth 59.33 billion USD with an expected growth of 8.2% in 2022 (GVR, 2021). This is due to several factors such as a push for sustainable transport, Covid-19 pandemic, promotion of cycling, large investment in mountain bike parks/trails and the want for fun outdoor exercise. Many large bike companies and suppliers have seen large increases in profit. However, there is a global shortage of all bike parts at the customer commerce level and some components have over a year lead time. The bike industry SC is very complex and is globalised with many factors contributing to the shortages of supply.

This report will give detail of the reasons for the shortages and explain what steps can be done to make the mitigate risk in the SC and make it more resilient.

Critical Evaluation of Supply Chain Vulnerability

To form a resilient SC there must be a form of supply chain management (SCM) to better understand the SC. Within SCM risk management is an important factor that identifies all potential risks. *“Risk in a supply chain is the probability of an adverse and unexpected event that can occur, and either directly or indirectly result in supply chain disruption”* (Garvey, et al., 2015). There is an important difference between risk and disruption, disruption is an indicator of risk, while risk can be present without disruption. There are numerous methodologies and literature to aid in the manage risk in SC (Sodhi & Tang, 2012), (Shang, et al., 2004), (Seuring & Muller, 2008), (Petrovic, et al., 1998). However, many of the models identify and categorise risk in different manners. This proves challenging to classify supply chain risk management (SCRM) and compare different methodologies. These models share many similarities with the importance to identify, evaluating, prioritising and mitigating risk to the SC through the collection of qualitative and qualitative data to give a better understanding of the capabilities and constraints of the SC. It is important to understand that not all SC have the same risks, but some risks are common across industries (Jemison, 1987).

Based on the similarities of the models the importance of identifying, evaluating, prioritising, and mitigating risk will be applied to improve the resilience in the SC of the bike industry

Identification of Risk & Vulnerabilities

There are many risks in the SC of the bike industry due to the complexity. In this report, the current risk of the SC which is causing the shortages of the supply will be the ones detailed in this report. These risks are not only present currently but will always have an ongoing effect on the SC.

Raw Material Supply

The two main raw materials which are used in the manufacturing of bike components are aluminium and carbon fibre reinforced plastic (CFRP). Both materials have multi-industry applications thus are heavily manufactured globally with large contracts in place to ensure consistent supply.

Aluminium Supply Chain

Aluminium is the most common material used in mountain bike components and frames.

While aluminium is the most abundant metallic element to be found in the earth's crust, Australia, Guinea, and China produce 67% of all bauxite ore, China is the biggest producer of alumina 54.1% and the largest producer of primary aluminium 56.7% (NRCAN, 2020). There is a heavy reliance on China for aluminium and currently, there is a global shortage.

China produces and consumes 58% of all aluminium globally and exports 6 million tons annually, however in 2021 China imported 1.27 million tons to ease shortages (SDC, 2021).

To reduce its energy consumptions China is limiting the production of aluminium to decrease carbon emissions (Alumeco, 2021) which is equals about 7% of its domestic annual capacity (Reuters, 2021). Also, an explosion in the Yunnan factory halted production and has reduced the country's output (Reuters, 2021). Furthermore, China has now capped annual

capacity to 45 million tons with the increased domestic consumption the exportable amount will only be decreased (Nasdaq, 2021).

Australia and China suspended all activities under the China-Australia Strategy Economic Dialogue in 2021. Australia is the largest producer of raw material and China is the largest refiner of the material (Nasdaq, 2021). Currently, this supply of bauxite to China is stable, however, the tension between the two countries is not improving (SCMP, 2021). Guinea another large supplier of bauxite is in a fragile state, the country has had a military coup and is in a state of uncertainty (Foregin Policy, 2021). This has raised the risk of disruption to the production capacity and the SC. This could be seen in the LME surging to 2,745USD, a ten year high (Financial Times, 2021). Experts say that China may turn to Australia for the supply of bauxite now due to the uncertainty in Guinea (SCMP, 2021). Signs of the increasing capacity to deal with this shortfall can be seen by looking at the investment in mines in Australia, Alcoa is reopening mines that have been idle since 2009 to deal with the global shortages and high demand for the material (Bloomberg, 2021).

Before all the issues, the price rise of aluminium has been increasing, in October 2019 aluminium was 1,761 USD per ton and now is 3,167 USD in October 2021 (LME, 2022). This is due to the increases in energy prices, transportation issues, recovering economy after Covid-19, the adoption of green technologies, and the reduction in energy heavy industries (Omrani, et al., 2015), (NRCAN, 2020), (Container-xChange, 2021), (Home, 2020). The price of aluminium is set to carry on rising with all the factors still being present and far more uncertainty in many countries.

Carbon Fibre

CFRP is now becoming heavily used as the material for high-end mountain bike frames.

Sports equipment is 7% of the demand of CFRB globally in 2020 which is heavily driven by the bike industry which equates to 15 kilotons of CFRB annually (Zhang, et al., 2020). The rest of the demand is for CFRP is 73% aerospace, 8% liquid storage, 6% automotive and 6% other (Statista, 2021). This demand will only grow due to increasing usage in industries where weight and strength are at a premium, such as automotive, wind turbines and aerospace.

CFRP is widely manufactured in many countries worldwide, however, predominately in the United States, Japan, Europe and China (CEMAC, 2017). While CFRP as a material has many advantageous properties the manufacturing process is far from desirable. The process of manufacturing is energy-intensive, CFRP composite uses 800 MJ/kg when compared to steel which only uses 50MJ/kg (Sunter, et al., 2015). While the production of CFRP is energy-intensive it is offset in many industries by reducing the weight of a component compared to an alloy equivalent, thus increasing efficiencies (Golkarnarenji, et al., 2018). However, in the bike industry, the offset of the efficiencies is not present.

In many of the countries where CFRP is produced, there is a push to reduce energy-intensive production. As seen in China there is a growing concern about the energy used in these industries and governments are now putting in place caps on production.

Transportation & Logistics

As with any product transportation between source and user is critical in the SC, the bike industry is no different. Many of the large manufacturers have production sites worldwide

but they are predominantly in Asia. With the raw materials being produced in the country or proximity it makes sense from a logistics view to have the production facilities close to the source of the raw materials. As previously discussed, the main two materials used are CFRP and aluminium, which are produced heavily in China due to energy and labour costs.

With the current increase in demand in the bike industry many large bike brands such as Sram and Shimano who are based in Asia have doubled production capacity but are unable to ship due to SC issues. Sram CEO, Ken Lousberg said: *"We have more finished goods on our shelves right now than we've ever had in the history of the company during the highest demand"* (Pinkbike, 2022). However, Lousberg goes on to say due to the shortages of shipping containers Sram are unable to ship parts out of Asia to the west. The increased demand for shipping containers has increased prices with companies competing to get their products shipped.

The container industry remains capacity-constrained even with the growth in the industry. This is due to continual disruption in the SC and bottlenecks at ports. The price of a 40ft container has doubled in price since March 2021 (5,000 USD) to September 2021 (10,100 USD) seen in Figure 1 (Drewry, 2022).

Furthermore, a review published by container exchange has shown the delay is in the importing countries, China reduced the turnaround of containers from 61 days in 2020 to 5 days in 2021 while the UK and US are 51 and 50 respectively in 2021 (Container-xChange, 2021) (Pinkbike, 2022). With more possible



Figure 1 World Container Index \$ per Container

disruption with new variants of Covid-19, many experts are expecting the worse. With increased bottlenecks at ports, reduced effective vessel capacity and a further global shortage of containers further price increases seem likely (Maersk, 2021).

Political Issues

As previously mentioned, the bike industry SC spans many countries, each with issues that affect the supply of materials, components, assembly, and point of sale. There are many factors to consider in this. Within Asia, Taiwan and China have a tense relationship of governing the country. The Peoples Republic of China (PRC) see Taiwan as a province of mainland China; however, Taiwan has its own democratically elected government which have different views on the status of Taiwan and see it as independent of the PRC (Council on Foreign Relations, 2021). This tension between the two parties while currently having no threat, this unease in the area, may potentially affect the production of the bike industry in Taiwan. Taiwan is critical in bike production when exports and global bike sales are considered, Taiwan exported 1.7 million bicycles in 2020, 670,000 went to Europe and 711,000 went to North America (Reuters, 2021), (Statista, 2021) when considering 3.3 million bikes got sold worldwide, Taiwan produced over 50% of bikes sold worldwide in 2020 (Mintel, 2021).

China and the United States are still in a trade war, with some Chinese imports carrying 25% duty (Reuters, 2022). Chinese imported bike components and frames carry the 25% duty which is being passed onto the customer. Many United States companies are asking for a better exclusion process, to exclude bikes from the tariffs as the likely hood of taking

production away from China is low (Bicycle Retailer, 2022). It is an increased cost for US firms without reducing the dependency of China which the tariffs were set out to do.

To add to the potential issues in Asia, Brexit regulation of importing has further complicated the SC. A clear indication of the direct effect of Brexit is the container availability index (CAx), which indicates the ins and outs of a port, 0.5 is seen to be a balanced market and below means, more containers leave a port than is being received. In 2021, Felixstowe was at 0.95 and Southampton was 0.86 which has been a direct effect of the post-Brexit customs and regulatory regime (Conatiner-xChange, 2021).

Further customs and duty regulations have also played their part in the bottleneck at ports in the UK. New import and export documentation is now expected from the 1st of January 2021, this additional documentation has added to the amount of administration needed to import and export goods to the UK which comes at a cost (Business Wales, 2021). Mike Wilson from Go Exporting expects this administration cost to comply with the new regulations to be about 8% of the cost of the good (Business Wales, 2021). Many companies do not see the value in addressing this regulation and now are importing into the UK at an increased price to cover the incurred duty.

Further documentation now required is the proof of origin, where companies want to import and export from the UK (European Union, 2022). The proof of origin gives a percentage of max non-originating material (MaxNOM) to a product in the UK and EU (European Commissie, 2022). This is used to gain preferential origin which may be allowed to be traded duty-free if a trade deal exists on the product. If the product does not have

enough percentage of UK/EU origin to be allowed preferential origin, then it becomes non-preferential and will be traded under world trade organisation tariffs (HMRC, 2022).

This proof of origin is now affecting many UK/EU based bike companies trying to export their bikes. UK/EU bike companies who have bikes manufactured outside the UK/EU are unable to trade duty-free with the UK/EU under the new agreement. If the MaxNOM value of the bike is greater than 45% then there is a 14% duty when exported to the UK/EU (HMRC, 2022), which is now being passed onto the customer (Bicycle Association, 2021).

Multi-Components

In the bike industry, there is not just a reliance on Asia, but within that, there are only two large companies that supply drive terrain. Sram and Shimano have an oligopoly of the market. While other brands exist not many are seen at an OEM level thus almost all-new bikes purchased will come with either Sram or Shimano. Both brands also offer a range of other components and offer almost a complete component solution. There is a huge reliance on both companies in the bike industry. This reliance is will only grow as both companies expand with the growth of the bike industry. However, Sram and Shimano have recognised the vulnerabilities in producing solely in one Asia and now have production facilities in multiple locations. Sram has its main production facilities in Taiwan and China but has added production in Portugal and North America (SRAM LLC, 2022). While Shimano has production in Japan, Taiwan, East Asia, and several in Europe (Shimano Inc, 2022).

Demand

Demand is one of the biggest contributing factors to the SC. It will be the driving factor in the design of the supply chain and determine the output of the company. The demand must

be understood, and elements put in place to ensure demand is met. The decision can be made on supply volume, supply rate, transportation, manufacturing capabilities and potential revenue. In the bike industry demand is challenging to forecast, for example, many companies at the start of the pandemic saw it as a recession and were preparing for the worst. When in fact it saw a growth in sales of 52% in some months of 2020 compared to 2019 (Bicycle Association, 2021). Having such volatile demand is difficult, many OEM companies were reluctant to increase capacity at the start of the pandemic due to them forecasting the growth was short-lived (Frothingham, 2021). Many of these reluctant companies have now started to increase capacity but are now behind the demand curve and sales have been fulfilled by other reactive companies. This demand proves difficult when outsourcing their production to Asia. Commitments to order volume must be done to ensure they have stock and suppliers have the capacity, however, too much stock without demand can be costly.

While bike components do not change as often as bike frames, there is always a strive for innovation and revisions of models year on year. Many companies have annual updates to bike frames, making it challenging when committing to orders volumes when outsourcing bike frame production. T

Evaluation of Supply Chain

From the research of the bike industry SC, many risks and vulnerabilities have been identified to potentially disrupt the supply of bikes at current costs. It is evident that there is a massive reliance on Asia to produce bike frames and components. Pre Covid-19 there was never an issue in the SC, where there was the same level of reliance on Asia. Since the disruption in transportation from Asia to the west, there was an issue with having over 50%

of all bikes made in Taiwan. The bike industry has a single point of failure in its SC, if there was an issue in Taiwan then many brands would have no revenue. Many large companies identify this as an issue and are adding production sites in Europe to safeguard themselves and have a more resilient SC (New York Times, 2021).

There are still many factors of the supply which are out of the industries hands, rising costs of energy and raw materials are will always be challenging. With caps of production in many countries of energy-intensive production, the price will continue to rise until sustainable energy sources are used. Canada has addressed this issue and is the 4th biggest producer of aluminium in the world and use predominantly hydroelectricity for their smelters and have the lowest carbon footprint amount among the biggest producers (NRCAN, 2020). The drive to use sustainable energy sources will aid in stabilising the cost of aluminium and will allow countries like Canada to compete against China even with higher labour costs.

Transportation of goods is a global issue, even at domestic levels, there is high demand. The bike industry cannot control the delay at ports, the global demand of shipping containers or the price. As discussed, the issue does not lay with Asia, but in the receiving countries. There is little resilience in the shipping ecosystem and the implementation of resilience in the SC is overdue. With the drive of lean manufacturing models such as just-in-time, many companies have left themselves vulnerable to any disruption in the SC. Long lead times of goods now are commonplace and many companies' business model is based upon having specific lead times which is no longer the case. When the SC is at normal operations the model works, however now many of these just-in-time companies have idle production cycles awaiting goods. This will have accrued costs that may not have been accounted for, also may not

have such resilience or alternative SCs to meet demand. The extra cost of shipping now is also putting many exporters off shipping low-profit goods, as the additional cost of shipping will further reduce the profit. Sram is an example of that, they currently have more finished goods than ever in their history. If Sram has finished goods waiting for shipping, is the increased price stopping them from shipping it. Goods are getting shipped from Asia to Europe and America, however, there is still a shortage of Sram components.

One of the largest factors in the SC is the uncertainty in demand. By outsourcing the production to Asia, companies are reducing the investment risk and liabilities that the company makes by producing it in house. Outsourcing production in Asia is advantageous when considering the skilled workforce Asia has, however, that comes at a cost. The recent surge in demand has shown that Asia cannot react as quickly to demand changes as expected. The increased demand for shipping containers has further shown the vulnerabilities in the SC. While many of these cannot be foreseen, it is important to note that while the bike industry may never see such a surge in demand again there are many underlying issues that the increase in demand has brought to light, which was previously hidden by large amounts of inventory in the SC.

An issue with such a large demand surge is that it is difficult to quantify the number of potential sales that could have been made if supply was present. Many potential customers could have been put off due to the large lead times and may have purchased a used bike. This data would be vital in forecasting future sales which will, in turn, be the driving factor in future orders. Pre-pandemic, 30 days was a lead time on many components. It was common practice for bike companies to place annual components orders and call on them 30 days

before meeting production output (Lousberg, 2022). In the current climate, a 300-day lead time is commonplace, which is proving challenging to forecast and commit to such orders when there is such large competition for the same stock from other bike companies.

Steps to Make the Supply Chain More Resilient

To make an SC more resilient the management of risks/vulnerabilities is critical. The resilience of an SC comes in the form of being prepared for unexpected risk events, responding in a timely manner and recovering to normal operations with the least amount of disruption (Ribeiro & Barbosa-Povoa, 2018). The risk/vulnerabilities that have been identified and evaluated, must be prioritised, and be mitigated. Many of the risk detailed have similarities due to the outsourcing of production offshore to Asia. While this is challenging due to the infrastructure that Asia possesses, the mitigation of risk/vulnerabilities and adaptability must be put in place if the SC is to recover from its current state.

Table 1 is an assessment of the risks in the SC (SCRA) from the identified risk previously discussed. Each risk gives details of how it can happen, what are the effects, details of the effects, impacts, probability factor, risk factor, priority result, and brief mitigation efforts. From the results of the probability factor and risk factor a priority result is given which shows the highest vulnerability in the current supply chain. This indicates which of the vulnerability needs the most resources and mitigation results. However, this will need to be investigated based on cost, company liability, available capital investment and viability.

Table 1 Risk Assessment of Supply Chain of Bike Industry

Risk Assessment of Supply Chain of Bike Industry

Risk/Vulnerability	How it can happen	What are the affects?	Details of affects	Impact	Probability	Risk	Priority	Mitigation efforts
Shortages in supply of components	Reduced capacity in Asia	Reduction in available parts	Decrease in capacity	Reduced output/loss of sales/increased prices	8	10	80	Alternative supplier
	Competition from larger competitors	Limited number of available parts	Smaller orders quantities/reduced discount/uncertainty in supply	Reduced output/loss of sales/increased prices	5	7	35	Increase/commit to larger orders
	Logistics	Long lead times	Uncertain lead time	Loss of sales, uneven production flow	10	4	40	Place orders with increased lead times/contingency buying
Transportation	Increased demand in transportation from supplying countries	Long lead times/competition	Uncertain lead time/uneven flow of goods/bottlenecks	Increased cost/idle production	7	6	42	Optimised order sizes to even out flow
Unstable costs	Increasing prices of raw materials/energy costs/transportation	Unaccounted price changes/increased production costs	Decreased profit/Increased sales price	Loss of sales/loss of competitiveness	7	6	42	Alternative supplier/fixed term price
Political Issues	Trade agreements breakdown	Duties®ulations/Admini stration increase/logistics lead times	Increase in price/restricted customer base/lead time increase	Loss of sales/increase price	3	5	15	Increase domestic production
	Conflict	Uncertainty in supply chain	Output reduction	Uncertain	4	7	28	Alternative supplier in stable country
Multi component construction	Reliance on small number of brands	Limited supplier choice	Potential of reduced supply/competition for available stocks	Reduced output/increased cost	4	3	12	Alternative suppliers/common cross platform parts
	Standards revision	Out-dated/legacy components/reduced supply of spares	Redundant component stock	Inventory costs/reduced sales	2	1	2	Communications with component brands/phase out legacy parts
Demand	Fluctuations in demand	Excessive/inadequate inventory levels	Unsold/over sold bikes	Loss of customer/bike sale at loss	7	5	35	Reactive to demand changes
	Model revisions	Consistent design changes	Cost of development	Cost/market acceptance	3	2	6	Up to date with customer requirements

Shortages of Supply (80)

As discussed, there is a large reliance on Asia in the bike industry. Any step towards reducing the reliance on Asia would be beneficial for any company. Based upon the SCRA the bike industry is highly vulnerable to any disruption in this supply. Nearshoring the supply chain to reduce the geographic dependence of the global SC is a way to reduce the risk of this.

Domestic or regional SC may cost more but will allow for far more control of inventory and quality which could result in shorter lead times. However, this may take a large investment which the company may not have. Strategic partnerships with other companies to gain capital investment to regionalise SC can be a far more viable option. It allows companies to reduce the liabilities of the investment and increase expertise and resources. Gaining partnerships with other companies or suppliers will allow for greater buying power and a more stable SC. Many North American companies are seeing the value in having low production facilities domestically, while this may come at an increased cost compared to Asia (Frothingham, 2021). Many customers are now choosing a domestically made bike due to the value of supporting domestic companies and knowing that the bike is been produced more sustainably and fairly. However, many UK and European based companies are not able to get the same domestic supply of materials. North America has many SCs on the same continent, such as aluminium from Canada and Brazil and carbon fibre made in the United States, also reducing the reliance on sea transportation.

Further mitigation can be done by multisourcing and manufacturing stream diversification. This is diversifying manufacturing sources by having more than one supplier, supply the same product. While this may be challenging in the bike industry due to having an oligopoly

of the drive terrain market, it still can be done on many other components that make a bike. This may happen organically due to the rising concern in Taiwan with Chinese tensions and increasing labour costs. Many component suppliers have started to move production from China and Taiwan to east Asian countries such as Vietnam and Cambodia, however, since the increased demand and the challenges of Covid-19 many of these plans have stalled when resources were allocated to meeting the increased demand (Reuters, 2021).

Transportation (42)

Transportation of goods from the source to the customer is deemed to be of high risk. This is heavily linked to the issue of the globalised SC of the bike industry. By nearshoring the production of components, the risk of transportation is reduced due to there being far more control and being far less complex. By having regional SC other transportation modes become more available, rail is an ideal mode when transporting regionally. It has a high yield, reliable, can offer extra capacity, and is energy efficient compared to other transport modes (CCC, 2020).

Having such a large distance from supplier and customer means that there are far more modes of transport all coming at an increased cost. Currently, the sea is the best option for shipping components from Asia to the west due to its high yield and low cost per part. However, recent events such as the Suez Canal obstruction shows how vulnerable that shipping method is. Other transport modes are available however, it comes at a premium. Many companies are now using air freight to transport goods from Asia to Europe to maintain production even at a low volume until sea-based transportation arrives. While air

freight is far more expensive than sea as a mode of transport, the cost of an idle assembly facility may outweigh the increased shipping cost. The choice of mode of transport is dependable on the product, for large products it may not be a cost-effective method due to the inefficiencies in packaging and volumetric weight. However, the pandemic did show the resilience of air freight as a mode of transporting goods (IATA, 2021). Many commercial airlines flew empty of passengers but with full belly cargo (Jackson, 2022). This did not only ease the pressure of the freight system but reduced the financial impact that airline companies had with the global lockdowns and travel bans. IATA expect air freight revenues to grow by 8% in 2022 with yields expected to grow by 15% also with airlines now committing to net-zero carbon by 2050 air freight is becoming a more favourable transportation mode (IATA, 2021).

If nearshoring is an unviable option, then alternative modes of transport should be considered. While air freight is at a higher cost, having goods available for sale due to them being transported by air will give a competitive edge in the marketplace against a company that is unable to get goods due to using sea transportation.

Unstable Costs (42)

Unstable costs are now commonplace in many industries and the bike industry is no different. The large fluctuations in the price of raw materials, shipping and energy costs are all adding to the unstableness of production cost. Even the packaging of bikes is now seeing cost increases, the shortage of cardboard packaging which is called the “Amazon effect” has driven up prices. The increased volume of online orders in the pandemic has led to a

shortage of cardboard which increased the price 10 times from pre-pandemic prices (Financial Times, 2021). Bike companies are now pressured to stabilise costs, however, there are only so many price increases that bike companies are willing to endure until the increase is passed onto the customer. Unstable prices are challenging to mitigate, however, there are options when it comes to buying goods. Bulk buying or committing a long-term supply of goods at a set price is common in many industries and can be applied to the bike industry. This will allow companies to plan resources and production around a given supply volume and a set price. As previously discussed, strategic partnerships can be ideal for negotiating these kinds of deals. However, buying excessive stock comes with extra costs and liabilities. In the bike industry, there is a need for consistent new models and has forced innovation to stay current. This consistent updating of components and models means companies can only commit to stock for one year in case their stock becomes obsolete. Also, there is the added cost of holding the inventory and the risk associated with the damaging stock. The best option in the current climate would have optimised inventory based upon previous sales data, market data with the option to add more promptly from alternative suppliers if the lead time from Asia is unattainable.

Demand (35)

Demand is a challenging risk to mitigate, bike sales have been on the rise pre-pandemic but has seen the biggest growth between 2020 and 2022 (Bicycle Association, 2021). The current issue is committing to orders with 300-day lead times without having proper forecasting data and the competition from other companies for the same parts. A possible option is to over-commit for components and frames in the hope that there will be enough

demand for the bike. Inventory buffers are common in many industries and are used to ease the pressure when long/inconsistent lead times. But too much buffer inventory can hinder profit and come with increased risk and cost. There will be extra costs due to the increased volume, which will not be revenue until the sale is completed. This coupled with extra lead time and excess storage costs could be too much for smaller companies, which, may not have the cash flow to make it a viable option. Another option is to find extra supply from a local distributor to meet demand. This will reduce the order commitment needed to go to OEM, and possibly be able to have a steady supply. This will come at an increased cost; however, it may free up cash flow. The use of cross-platform parts to reduce the variety of components will help in the change of demand. Using standardised cross-platform components across the bike range will help by increasing order volumes and components can be used for in-demand bikes from non-demanded bikes.

Recommendations

A supplier appraisal process (SAP) is an important part of SCM and ensures suppliers are meeting the expectations of the buyer. SAP indicate the competency, performance of a supplier and their ability to meet the buyer's demands. Selecting a supplier is critical in the success of any company which shows the importance of this process (Choi, et al., 2020). An SAP can consume a lot of resources if not carried out correctly. To initiate potential new suppliers a questionnaire is an inexpensive method of obtaining new supplier data. It can give concise answers and can be used to shortlist suppliers. A supplier visit should be the next stage, where information obtained from the questionnaire can be verified and can be an opportunity to identify issues and improvements. The supplier assessment should be

carried out before the contract or relationship starts. The supplier assessment can be used to understand suppliers' performance and put in clauses in contracts to compensate for under-performance.

Some key factors that should be considered when choosing a supplier are:

- Quality control and assurance – the ability to make a product to specification reliably (Luthra, et al., 2020).
- Process control – The capability to change processes to maintain quality and improve performance (Oakland, 2008)
- Resources – Available investment, cash flow, financial stability and intellect
- Capacity – Open capacity for growth and demand changes
- Location – Transportation and logistics
- Total acquisition cost – Cost of goods supplied
- Communication – Communication stream of information
- Environmental – Sustainability objectives

(Choi, et al., 2020), (Glas, et al., 2021)

All these factors are important to consider when choosing a supplier, however, it should not stop. Suppliers need monitoring to ensure that the needs of the company are being met throughout the relationship and should be seen as measurable feedback (Bai & Sarkis, 2014). Metrics of supplier's performance are critical and commonly called key performance indicators (KPI), as expectations can be subjective and may not give a true representation of the supplier (Srinivasan & Swink, 2015). Some important metrics are quality, on-time delivery, and total acquisition costs. These KPI's will give the buyer and supplier

transparency of what is expected, and sub-expectations can be identified and addressed (Terpend, et al., 2008).

As discussed, many components in the bike industry are an oligopoly. While all these KPI's are relevant it is hard to find an alternative supplier who can compete with the market leaders. Nevertheless, it is important to use an SAP to identify their current performance and how it is affecting the company's operations.

A factor that should have been considered more in the current industry is location. As discussed throughout this report, the reliance on Asia is a risk to the SC. The result of this reliance is risks that can be mitigated if nearshoring is possible. When choosing new suppliers, the weighting of this should be far greater than other factors based on these findings. However, due to the infrastructure in Asia an alternative supplier with equal or greater capabilities to supply with the same quality, price and quantity are unlikely to happen soon.

Based on this in the current climate in the short-term, there should be an emphasis on on-time delivery and the cost from suppliers. With the extended lead times now it should still be expected on time at the agreed price. Resources and inventory will need to be planned to ensure that production can operate smoothly. Where supplier appraisal process would be best implemented is in the transportation of goods. This process can be used to find the best logistic service so goods can be transported from Asia to the west. As previously discussed, several suppliers now have increased capacity and excess finished goods awaiting shipping but are unable to due to the competitiveness of the shipping industry. An SAP will

be best used to identify logistics companies to ship these finished goods and gain a competitive advantage over competitors.

It will be important to get evidence of a logistics company's ability to deliver what is promised. This will ensure that there are no hidden costs, and the goods will be delivered when expected. This will put the resilience needed in the SC and give stability to commit to customer delivery dates with more confidence.

The medium to long-term objectives should be to nearshore as much of the production as possible. As a bike company, the frame is the part of the bike that would be the most favourable to make in house. Raw materials can be sourced globally; transferable skills from other industries; effective innovation development; greater quality and process control; increased reactivity to demand and can be sold just like a frame. It makes far more sense to bring the frame manufacturing in-house than components as all the large companies are reliable suppliers in normal times with acceptable quality and lead times. The pandemic affected the bike industry more than most. With increased lead times and prices, the whole industry has been affected and no other brand can offer better lead times, prices, or supply from a closer location.

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