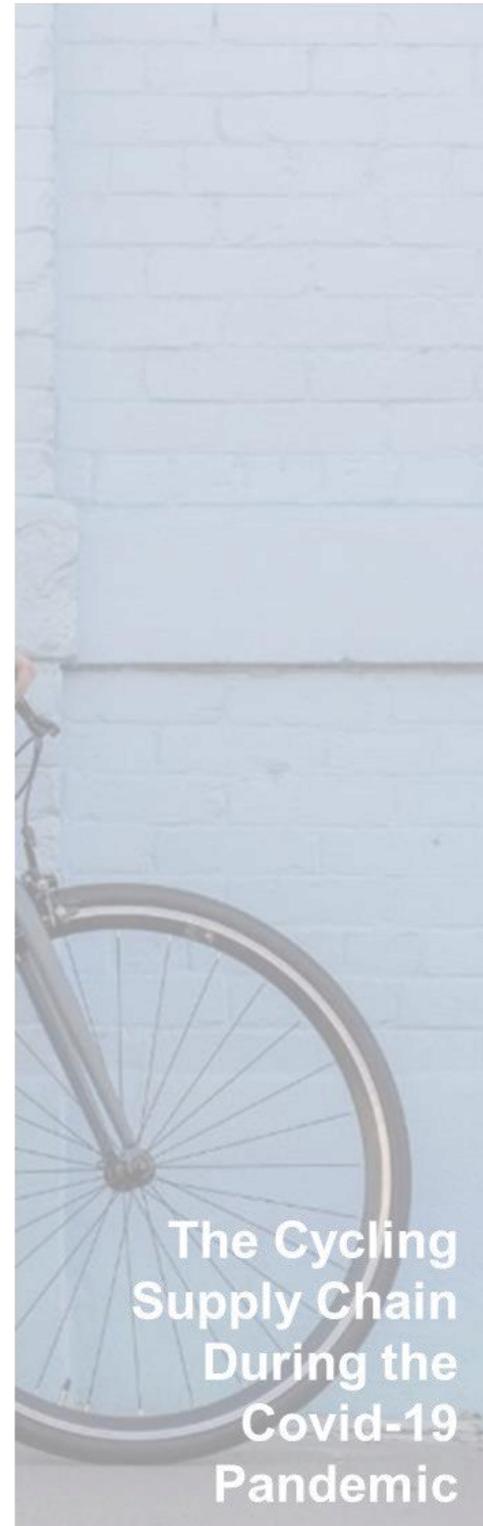


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**The Cycling
Supply Chain
During the
Covid-19
Pandemic**

Sports Marketing Surveys



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Introduction and Scope

Across industry sectors and at a worldwide scale, the Covid-19 pandemic is having severe impacts on supply chains. Manifesting itself in symptoms such as raw material shortages, exploding lead times, and sky-rocketing prices both for components and end products, it has disrupted once well-functioning supply chains across low- and high-tech sectors to an unprecedented extent.

Also the cycling industry supply chain has suffered from severe pandemic-induced distortions. During lockdown, consumer demand dramatically dropped, before the market then saw a strong growth in demand when coming out of the lockdown phases. In coincidence with a supply chain that is complex (e.g., due to its global scope and various value-creation stages) on the one and little integrated on the other hand, the cycling industry has been hit by a “perfect storm”.

“Bridging the Gap” is an initiative to evaluate the state of supply chains in the European cycling market after the effects of the COVID-19 pandemic and to recommend strategic actions that companies, governments, investors and associations can take to underwrite a sustainable supply of bicycles and allied products to European markets within a complex global supply system. The ultimate aim of Bridging the Gap is to create a set of strategic recommendations to support expected growth in bicycle sales in Europe and by that contribute to reaching shared goals within industry, policy makers, and society at large on sustainable growth of mobility, road safety and public health.

To achieve this aim, “Bridging the Gap” was set up as an initiative with input from three perspectives: Supply chain management, market research / consumer behaviour, and the cycling industry, and involved a team of contributors from four institutions: (1) Anna Buchmann and Christoph Neye from MotionLab.Berlin, (2) Marc Anderman from Sports Marketing Surveys, (3) Eoin Plant O’Toole, Miles Weaver, Geraint Florida-James and Christof Backhaus from Edinburgh Napier University’s School of Applied Sciences and Business School, and (4) Kevin Mayne from CIE – acting as a the initiator and main sponsor of the project.

This set up allowed drawing on a combination of three methodological approaches (see Figure 1):

- A large-scale **consumer survey** conducted amongst more than 6,200 respondents from six European countries (France, Germany, The Netherlands, Italy, UK and Sweden). The survey was run as an online survey, with nationally-representative samples for each of the six countries.
- Analysis of **supply chain order- and sales data** obtained from 13 supply chain partners. This analysis examined demand and supply over time by looking at indexed order and production volumes to map supply chain dynamics as they happened across the pandemic.
- A set of 15 **expert interviews** conducted with key respondents from 9 OEMs and 6 component suppliers, all different sizes. These interviews helped the team to gain an in-depth understanding of the SC partners’ perceptions regarding the phenomena at hand.

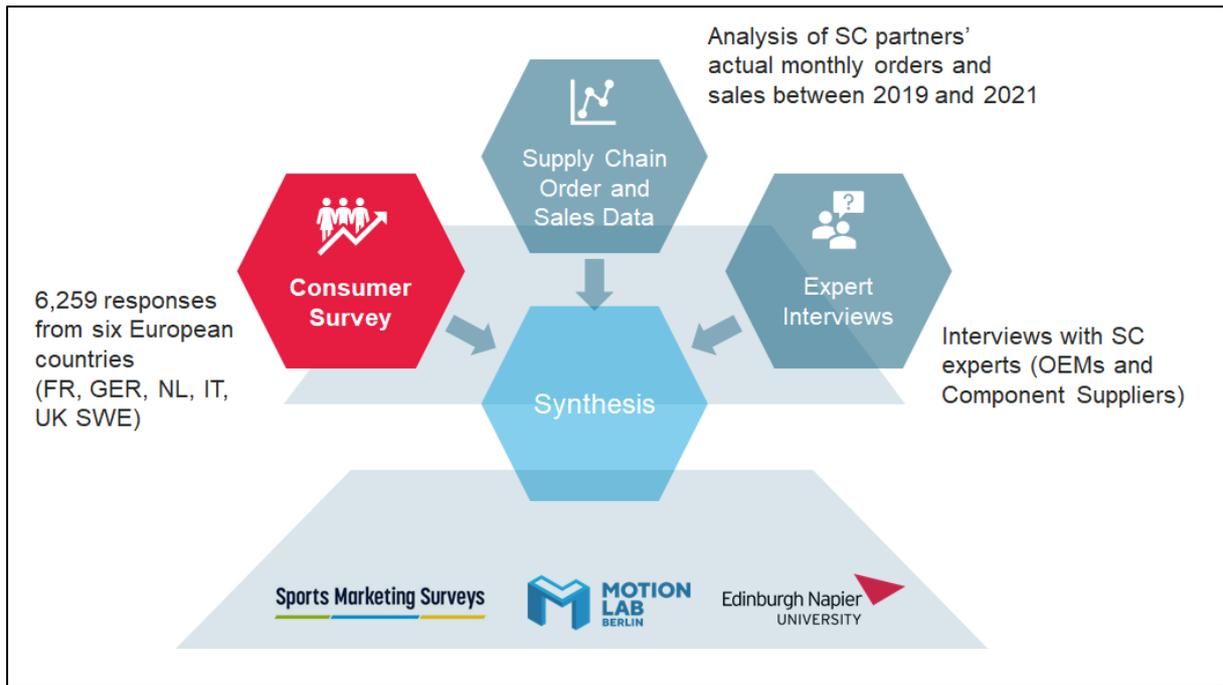


Figure 1: Project Design and Consortium

1. The Cycling Supply Chain in the Context of the Pandemic

1.1. The Cycling Industry Supply Chain

Historically, the European bicycle supply chain experienced a shift in the 1960s when most of the manufacturing work was outsourced to Southeast Asia, mainly Taiwan and China. These countries have established themselves as the leading manufacturers of cycling-related products, and remain highly competitive on price, expertise, and quality. Following their example, other countries have attracted factories and warehouses from European brands to produce one or more of the almost 200 parts that make up a bicycle. Nonetheless, assembly activities and distribution are still mainly clustered on the European continent. Therefore, it is a global chain, that is long and complex. Long chains are perceived to be more **vulnerable to disruptions**.

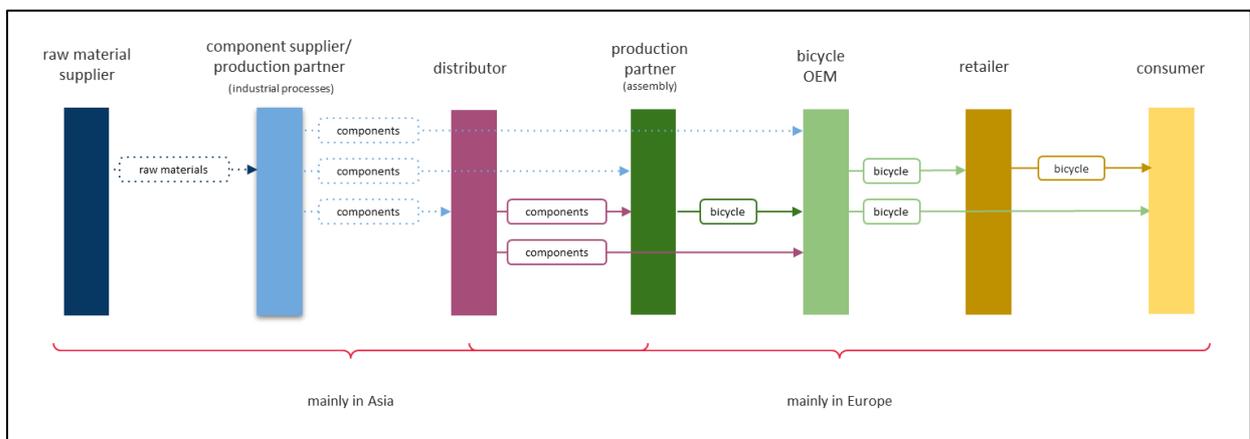


Figure 2: Visualisation of European Bicycle Supply Chain

Figure 2 depicts a simplified representation of the bicycle supply chain. While the image assumes a linear flow of materials and information, the supply chain should be imagined as a network, where multiple suppliers and assemblers are collaborating with an OEM to produce the finished product.

There are two key flows in any supply chain, the physical flow of goods, and information flow. The physical **material flow** within the chain, raw materials are manufactured into components (purchase part vs. made parts), sold directly or via distributors/wholesalers to OEMs. The bicycles are assembled by OEMs themselves or assembly service providers into bicycles, and then sold to the end user either directly or via retailers. Although not the focus of this study, there is furthermore the distribution stage, consisting of retailers and potentially wholesalers through which the finished product to the end customers through physical or online channels.

Regarding **information flow**, the cycling supply chain is still mostly characterised by traditional forms of production and order management, rather than showing high levels of data sharing across different stages or more innovative approaches to supply chain management as used for example in the automotive industry.

In terms of the size of partnership portfolios to be managed, participating OEMs indicated to work with more than 100 suppliers, 10-20% of them being strategic. Similarly, also suppliers work with a relatively large number of OEMs (up to 150+), of which about 10% are strategic customers. Most of the interview partners reported to **have and value long-term relationships** with their supply chain partners, typically working together for 10 years or more.

The design power of the frame and customised made parts lies primarily with the OEM. However, component suppliers drive and direct innovation and technological development of their parts. Given this critical role of suppliers in value generation and innovation, the cycling industry appears as being a **supplier-dominant industry**. Resulting from this, the distribution of power seems in favour of suppliers, e.g., in regard to batteries, drive train or gearing. This also becomes evident when comparing order management practices in the cycling supply chain to other industries, where suppliers compete for OEM tenders, rather than OEMs trying to secure their share of supplier capacity.

In pre-pandemic times, the industry has broadly focused on a lean supply chain strategy, taking advantage of low-cost sourcing at the compromise of transportation lead time and flexibility. Such lean approaches are normally aligned to conditions of stable market demand, rather than environments of high variability, short product life cycles, and uncertainty.

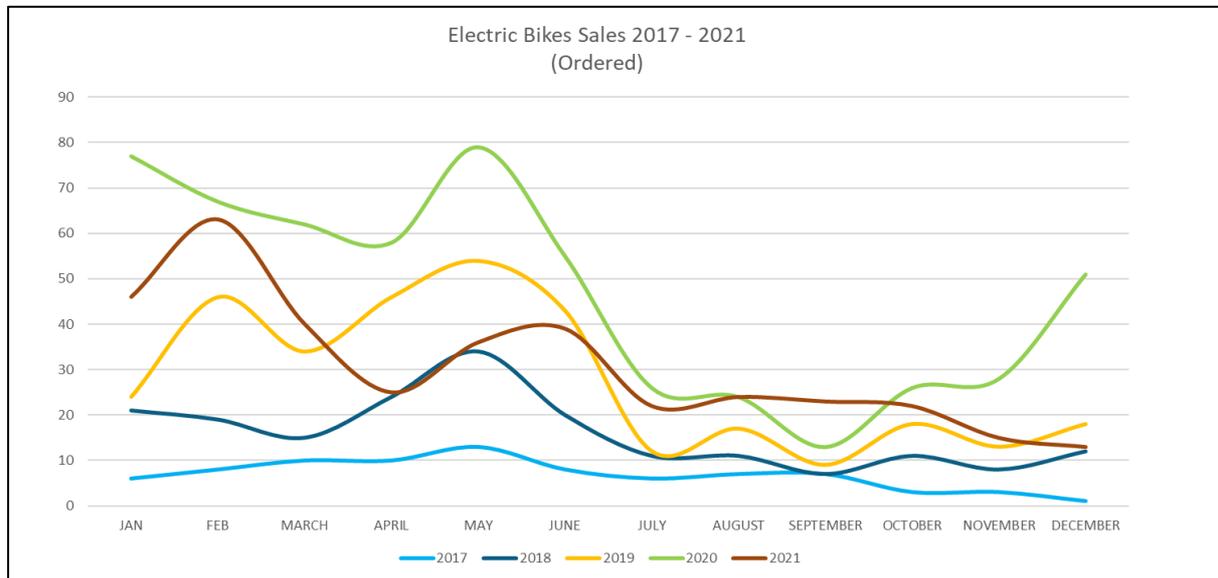
1.2. The demand for Bicycles during the pandemic

In 2019, 3.7 million e-bikes were sold in the European Union, and in the beginning of the pandemic, the cycling market was on a growth path, with a 23% increase in sales between 2019 and 2020 despite many shops being closed during spring. This development is despite a decline in the mechanical bike market in recent years, with e-bike sales supplementing sales of mechanical bikes.

To identify the levels of consumer behaviour before and during the Covid-19 pandemic and potential future trends, we conducted a large-scale consumer study based on over 6,000 nationally representative interviews across six selected countries identified by CIE members. In addition to areas such as attitudes towards cycling, riding behaviour, and positive as well as negative factors towards infrastructure, the study also looked into purchasing behaviour in the context of bicycles, electric bikes, parts and accessories.

The results from the data depicted in Figure 3 show what an extraordinary year 2020 was for e-bikes sales, with high figures in the first three months of the year, a partial dip associated with lockdowns and then a double peak in summer and winter.

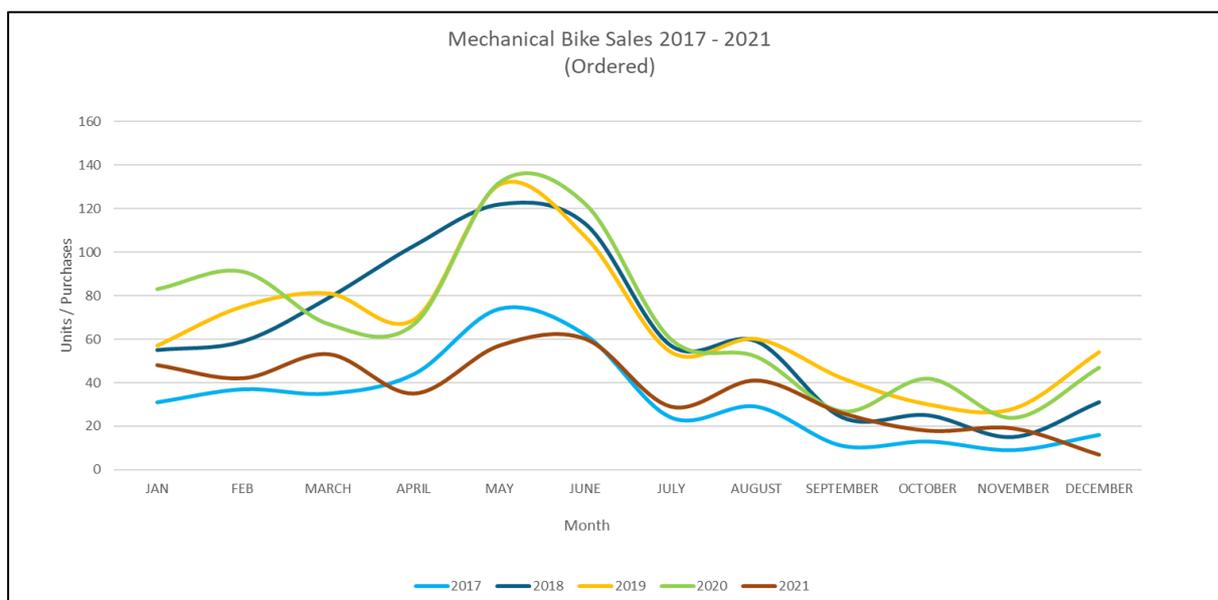
Purchasing – Q: When did you order / purchase this bike / electric bike?



*Figure 3: Electric Bikes Sales 2017 – 2021 / Base: 7,798 purchases (5,825 mechanical 1,973 electric)
Source: Bridging the Gap Consumer Survey / Sports Marketing Surveys*

By comparison, 2021 seems modest, with sales running alongside previous years and even falling below some prior years. Indications are that the second half of the year is under-representing demand because some key countries were struggling with supply throughout this period. However, researchers also suggest that the 2020 peak was so high that some of the 2021 sales were probably brought forward into 2020.

Purchasing – Q: When did you order / purchase this bike / electric bike?



*Figure 4: Mechanical Bike Sales 2017 – 2021 (Base: 7,798 purchases; 5,825 mechanical; 1,973 electric)
Source: Bridging the Gap Consumer Survey / Sports Marketing Surveys*

In 2020, fully mechanical bikes maintained sales, offsetting long term declines due to replacement by e-bikes in leading markets. However, this research suggest that 2021 sales will return to the overall downward trend, potentially reflecting the acceleration of the e-bike take up.

1.3. How the cycling industry experienced the Covid-19 Pandemic

Like many other industries, the bicycle industry was not well prepared for the effects of the Covid-19 pandemic. From the expert interviews, three major phases emerged throughout the Covid-19 pandemic which can be described as follows:

Phase 1: Lockdowns and store closures

Supply chain disruptions began with the first lockdowns being imposed in China in early 2020 and subsequently in Europe. Following Chinese New Year 2020, factory closures in China led to first delivery delays also for European (OEM) customers, whereby at the very early stage the extent of the disruptions to follow was unforeseeable. With business in Europe initially continuing as usual, some OEMs reacted to the growing uncertainties by increasing order volumes and building up stock to ensure production capacity and ability to supply.

When lockdowns then also affected the European country markets and retail stores were forced to close, this led to two types of reactions: Some OEMs deciding to keep their production going, while others stopped production. Overall, thereby, OEMs either postponed or cancelled their orders with component suppliers, whereby postponing orders was much more common than cancellations. Across interviews the cancellation rate was estimated somewhere between 5-15%. Given that major OEMs in Europe adjusted their order volumes, component suppliers either decided to continue to produce to their specified targets to avoid costs of stopping production and produce to stock, or reduce targets based on the order cancellations and postponements. As a result, these immediate industry reactions marked the first instance where demand slowed down less in comparison to supply, highlighting first signs of the gap that was emerging between demand and supply.

Phase 2: A sudden rise in demand

Once bicycle retail stores were declared essential in Europe and consumer demand for cycling as a mode of individual transport became clear, bicycle OEMs asked component suppliers “to ship everything they have”. Here, the consumer study outlines the main motives for starting cycling during the Covid-19 pandemic. Most importantly, respondents started cycling to enjoy being outside, with 71% of respondents selecting this as one of three possible reasons they could provide. 66% of respondents indicated to start cycling because of health or exercise benefits. The ranking of the reasons is shown in figure 5 below.

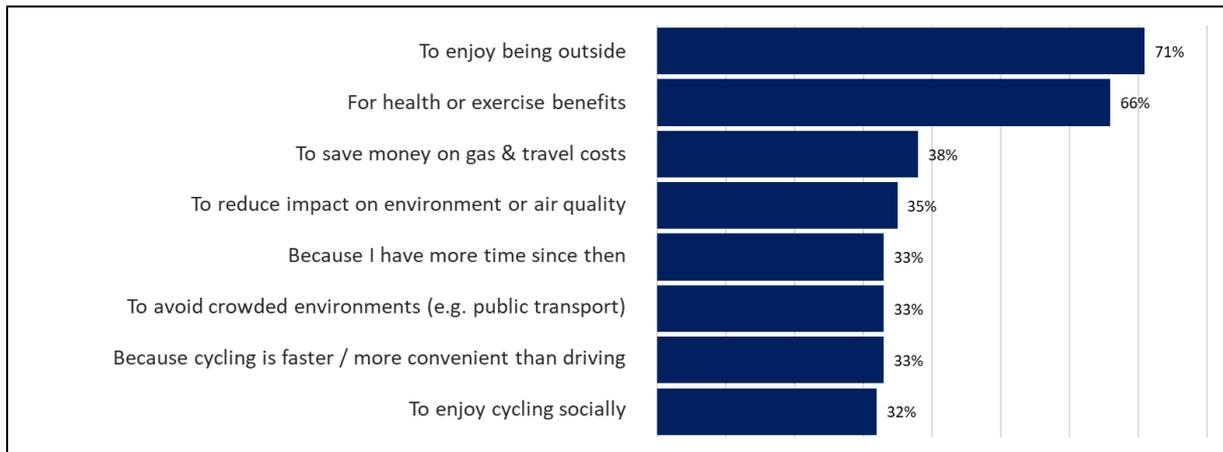


Figure 5: The main reasons why people started cycling during the Covid-19 pandemic.
 Source: Bridging the Gap Consumer survey / Sports Marketing Surveys; n=6,259.

In terms of the sudden rise in demand and its implications for the supply chain, interviews highlighted how smaller OEMs were able to react to these changes much faster than their larger competitors. As OEM orders flooded in, suppliers implemented short-term measures to bring production to original levels and above, but the lag in time saw order books fill up faster than capacity could be increased.

Phase 3: Supply chain squeeze

As consumers (re)discovered the advantages of cycling, the never before experienced increase in demand, coupled with the factory and labour closures of key production sites in Asia, led to a breakdown of the supply chain. Ordered components could only be produced with long lead times, or could not be shipped/delivered to assembly points. As lead times increased from an average of 3 months to more than 12 months for key components, bicycle OEMs started placing more frequent and larger orders further ahead to secure (future) supply. As a result, many suppliers are now documenting full order books until 2024/2025.

In the later stages of the pandemic, demand for consumer goods rapidly recovered, which brought particularly the logistics sector under pressure. The resulting shortage of logistics capacity and containers led to skyrocketing freight prices. Also in the cycling industry, this has impacted business models particularly of OEMs quite severely. As one of the experts noted, in the first year of the pandemic the challenge was mostly related to securing raw materials, production capacities, and components, whereas the main issue in the second year was about logistics or how to get components and bikes to Europe in a reasonable time and at acceptable costs. Lead times and logistics prices were thereby not only affected by the Covid-19 pandemic: The average of the *Ever Given* in the Suez Canal in March 2021 and the knock-on effects the Canal's blockage had on several hundred ship's schedules further exacerbated the situation on the supply side.

A timeline of main events alongside the supply chain during the first year of the pandemic is outlined in Figure 6.



Figure 6: Timeline of main events alongside the supply chain during the first year of the Covid-19 Pandemic.

To summarise, it was not one but several factors upon which the later described dynamics evolved, with the following three aspects being of particular relevance:

- The fragmented, geographically dispersed and non-integrated nature of the cycling supply chain,
- the variations in consumer demand due to the impact of the Covid-19 pandemic, and
- upstream supply chain disruptions due to factory shutdowns, logistics issues, and raw material shortages.

In combination, these factors set up the breeding ground for a “perfect storm” gathering in the cycling supply chain worldwide.

2. Responses of supply chain partners and evolving dynamics: The Perfect Storm

2.1. Responses of supply chain partners

Both on the side of OEMs and component suppliers, the Covid-19 pandemic and its consequences have induced a range of short-, medium- and also long-term responses. Attempting to at least mitigate the shortages in terms of raw materials, component supplies, and also transportation capacity, suppliers and OEMs increased communication for crisis management and in order to get an overview of needs and capacities.

In the mid-term, some OEMs reported to consciously over-order to ensure future supply and build up buffer and to allocate resources to finding alternatives for sourcing, increased stock levels, and generally bridged bottlenecks with alternative approaches, such as shifting transport mode from sea to air or rail. This also led to an increased willingness to accept higher prices, especially when it comes to transportation to avoid production stop, order cancellation, and missing the season: *“It’s no longer about costs but whether you can get it transported - the price is almost irrelevant.”* In fact, the majority of respondents mentioned that the most significant change in challenges between 2020 and 2021 was the emergence of transport as an additional bottleneck. Product development was also stalled and while OEM product managers have become more flexible on using specific component brands,

technical specifications are now set earlier on and set for longer periods of time. As a result, suppliers are preparing for longer adoption periods of new components.

In the long-term, most respondents are looking to shorten supply chains to a certain extent, improve relationship management but at the same time diversify their supplier base overall. Plans and trends on building more resilient supply chains are discussed later in more detail.

	Short-term (6 months)	Mid-term (3 years)	Long-term (5-10 years)
OEMs	<ul style="list-style-type: none"> ▪ Intensification of communications with suppliers ▪ Finding short-term sourcing alternatives to secure continuation of production ▪ Produce bikes without key components ▪ Sea to air freight ▪ Increase stock/inventory ▪ Extend planning system + simulation ▪ Provide purchase commitments 	<ul style="list-style-type: none"> ▪ Over-ordering ▪ Accepting alternative brands ▪ Less complexity ▪ Buffer ▪ Collaboration for component exchange ▪ Reshoring ▪ Dual sourcing ▪ Freeze product specifications longer 	<ul style="list-style-type: none"> ▪ Move to alternative suppliers ▪ Invest in co-production (vertical integration) ▪ Reshoring ▪ Work with SUPs to Increase SC transparency ▪ Agreements ▪ Relationship-building
Suppliers	<ul style="list-style-type: none"> ▪ Intensification of communications with OEMs ▪ Extend planning system ▪ Sea to air/rail freight ▪ Reduce complexity ▪ Quick-wins to increase capacity (e.g., adjusting shift timing) ▪ Secondary sourcing 	<ul style="list-style-type: none"> ▪ Initiation of projects to increase long-term capacity ▪ Accelerate reshoring ▪ Buffer ▪ Rolling forecasting system ▪ Accelerate growth plans 	<ul style="list-style-type: none"> ▪ Dual sourcing ▪ Work with SUPs to Increase SC transparency ▪ Reshoring ▪ Collaboration for more vertical integration

Table 1: Short-, medium- and long-term responses of the supply chain partners

2.2. Evolving dynamics

The combination of the cycling industry’s experience of/reaction to the Covid-19 pandemic and its unique supply chain facilitated the emergence of three distinct trends:

(1) The Conundrum of order placement and management

	Before Covid-19 pandemic	During the Covid-19 pandemic
Lead times	3-6 months	12-24-36 months during peak times
Cancellations	Very rarely	5-15% at the start --> less than expected, but more expected to come
Over-ordering	As little as possible	20-30% where liquidity allowed

Table 2: Comparison of lead times, cancellations, and over-ordering before and during the Covid-19 pandemic

The initial lockdowns and restrictions connected to the Covid-19 pandemic in early 2020 led to **fewer cancellations than expected**. The best practice of not cancelling orders, but rather pushing them further into the future continued during these uncertain months. Interview respondents estimate order rates between 5-15% because of the lockdowns.

As lead times increased in summer 2020, orders were placed further and further into the future to ensure supply ahead of time. This **“order placement race”** was mainly driven by OEM behaviour as a response to the long lead times of key component suppliers. Other suppliers reported that initially, orders came in slowly as OEMs could not get key components, and as order books opened and filled up until as far ahead as 2025, OEMs started placing orders with all their suppliers to ensure all components would you available as soon as key parts were set to arrive.

While placing orders further and further ahead, most OEMs started to add **quantity as well as time buffer to their orders**. OEMs – if they confirmed to have used the practice of over-ordering – stated that they increased their order volume by 20-30% on average, as they expected to be allocated around 80% of their orders. Suppliers – when they assumed to witness over-ordering – estimated up to 50% additional order volume per year and above realistic levels. As a response, suppliers started to open conversations around order levels, as well as capping order volumes if historical data suggested unrealistic increases in order quantities.

Next to long lead times and limited availability, the increasing **divergence of lead times** of different components from the same and different suppliers poses a significant challenge for procurement teams in the cycling industry. On the one hand, OEMs can easily lose oversight which component is set to arrive when from which supplier, and what component is missing as they move stock and batches around to continue production. On the other hand, as bicycles usually cannot be built and sold even if just one component is missing, everything can become a bottleneck. This leads to production standstill and capital lock-up, which negatively affects liquidity even further.

(2) Introduction of longer planning cycles

	Before Covid-19 pandemic	During Covid-19 pandemic
Planning cycle	Yearly production plan	3-5 year production and business plan
Planning tools	Own growth model + gut feeling	Own growth model + “get what you can”
Digitalisation	Very limited	Introduction of planning tools

Table 3. Planning and Digitalisation before and during the Covid-19 pandemic

Before the supply chain crunch caused by the Covid-19 pandemic, bicycle OEMs’ business-as-usual planning process included a yearly production plan based on:

last year’s sales numbers + own growth model + gut feeling

One interview partner termed this process a self-referencing cycle, where a successful year triggers an increase in component orders in the following year, leading to over-stock. As a result of the overstock, the following orders are considerably lower, leading to shortages and the impression that more growth is possible. Then, the cycle starts again with an over-optimistic increase in orders. *“Then the whole story starts again because everybody believes they can grow. (...) But the difference with Covid was: everyone did the same at the same time.”*

The planning process before the supply chain crunch was mainly influenced by a focus on gaining market share from competing OEMs and short-term sales figures. Arguably, OEMs took a passive

approach to planning. With the increase in lead times and spike in demand, OEMs had to switch to an active way of planning within months. While some OEMs were able to make that change very quickly and increased orders in the first half of 2020 as they anticipated bottlenecks, others were left paralysed by the enormous planning task at hand: *“We did not have any system to manage to kind of lead time that our main supplier was suggesting we should do.”* No matter how long it took to switch into crisis mode, most OEMs reported similar response actions regarding the planning processes:

- The planning horizon increased from one to three to five years
- Production dates were pre-defined until 2024/25
- Rather than a pure focus on production planning, OEMs started to clearly define their position in the market, their strategic growth scenarios and business models
- Introduction and/or increased use of digital planning tools

Paradoxically, the increase in lead time and thereby full order books for years to come, has created a greater sense of uncertainty. On the one hand, order books being filled 60-100% a year in advance, which for some suppliers means three times as much than previous years, helps suppliers plan production and make investment decisions. However, suppliers are aware of the possible bullwhip effect and the connected inflated order amounts: *“We don't see that's the long-term solution because it means that everybody is guessing from the dealer to the OEM. And the more people are guessing the more inaccuracy we would have in the end in the chain.”* To reduce the risk of cancellations and over-stock, suppliers introduced the following changes in their sales and customer relation processes:

- Limited price guarantees or no price information when placing orders years ahead
- Increased communication around cancellations and stricter guidelines
- More frequent follow-up and payment collection
- Greater discussion with customers around realistic quantities when orders are being placed
- Greater visibility (forecasts) and commitments when placing orders

Similarly, component suppliers increased visibility with their raw material partners to in turn ensure they could keep the commitments they guaranteed their customers.

While supply chain management and procurement during the supply chain crunch was complex and often chaotic, it seems to have forced bicycle OEMs and component suppliers to lay the groundwork for professionalising their processes in response. These changes in planning and order management nonetheless significantly affected the relationship between the two.

(3) Strained relationships between OEMs and suppliers

	Before Covid-19 pandemic	During Covid-19 pandemic
Dynamic	Low - change in supplier base only due to technical developments or growth	Still low - but increased risk management and dual sourcing
Focus	Sales (newer, better, cheaper products)	Customer Service (deliver parts reliably)
Market power	With component suppliers	With component suppliers

Table 4: Relationships between OEMs and suppliers before and during the Covid-19 pandemic

A defining factor of the cycling industry is the close-knit, relationship-driven network of component suppliers and OEMs. Relationships are built with a long-term perspective und the supplier base of

OEMs rarely change. In fact, rather than replacing suppliers, suppliers are added to respond to technical developments and growth needs. In these relationships, suppliers used to focus on sales and presenting newer, better and cheaper products. With the delays in lead times and increasing difficulties to deliver products, this relationship took a hit during the Covid-19 pandemic, as one interviewee put it: *“It feels like the tension is growing on both sides. While the relationship was always based on trust, it’s gotten increasingly complex in the past two years.”*

The complexity starts with the missing personal touch that the industry used to thrive on. Communication moved from the personal to the digital. As the industry had to learn to leverage this new communication channel, the switch was accompanied by an increase in misunderstandings and delays in development projects. As a result, interviewees reflected that even though they experienced intensified contact with their partners along the supply chain, the focus of communication was on crisis management and putting out fires, rather than on strategic and partnership development.

Another trend identified by interview partners was the **entering of supply chain managers from other industries**, where relationships hold less power than agreed contracts and terms. As a result, *“what has changed is that still relations are important, but you also see new people in new positions trying to find new ways of managing the supply chain in a more structured way.”* Especially larger scale OEMs reported the use of *“what we call capacity agreements, commitments and a promise of minimum quantity of orders we would place and corresponding commitment from our key suppliers’ point of view to deliver a minimum quantity of this.”* In comparison, smaller OEMs recognise that *“the size of our company puts us in a position where we’re not really able to enforce, you know, rigid, you know, contracts, paragraphs whatsoever. So we need to survive through collaboration.”*

Multiple interview partners from bicycle OEMs pointed out the **difference in customer management practices amongst component suppliers**. Especially the crisis management by component suppliers with an automotive background were perceived as positive. Here it seems that a strategic approach to customer management was preferred to a first-in-first-out (fifo) tactic, which dominated the cycling industry’s order process. In fact, fifo was heavily connected to (and blamed for) suppliers not being able to serve their long-term customer base. Some suppliers reacted by restructuring orders, focusing on core products and limiting customisation/variation to ensure a base supply of the existing customer structure. Others either were not able or refused to adjust their fifo systems.

Nonetheless, the market power of component manufacturers in the supply chain seemed to be highlighted even further during the Covid-19 pandemic. In the interview, OEM representatives mentioned that *“now we really have to beg for our products”* and that *“it’s a permanent fight for more than one year.”* However, the frustration was visible on both sides, as component suppliers reported to work closely with OEMs to place realistic orders and avoid over-ordering.

In this development of supplier-OEM relations, **data plays a significant role**. Transparency along the supply chain is one method of avoiding a bullwhip effect, i.e., over-ordering along the supply chain. While traditionally some high-level data seems to be exchanged between suppliers and OEMs, the response of interview participants were highly varied. While some OEMs reported that *“We share a very detailed and relatively long-term view on our sales expectations, production needs and purchasing orders,”* others stated that *“it’s high level. We don’t exchange data.”* Overall, it seems that there are two trends when it comes to data sharing:

- Data sharing is met with a high level of suspicion in the cycling industry as everyone wants to protect their market share and possibly unique insights.
- Data sharing is connected to driving market power and own interests to have a higher standing with suppliers. For example, OEMs might highlight their strategic importance to gain advantages through a large sales outlook, which could then lead to inflated figures amongst their projections.

3. The Gap

3.1. Manifestations of the Gap and Bullwhip Analysis

The “gap” manifests through lead-time increases and out-of-stock situations occurring in four ways:

- Gap 1: Customer demand vs availability of bikes and components from retailers
- Gap 2: Retailer demand vs availability of bikes and components from OEMs
- Gap 3: OEM demand for components vs availability of components from suppliers
- Gap 4: Suppliers’ demand for raw materials vs availability of raw materials

Before exploring the underlying issues for these gaps in more detail, a related aim of this study was to evaluate the extent to which orders are amplified when travelling upstream in the supply chain. If so, there would be evidence for a Bullwhip Effect. The Bullwhip Effect is a demand distortion that travels upstream in the supply chain, i.e., from retailers back to wholesalers, manufactures, component- and finally raw material suppliers. This distortion can, among other factors, be caused by a variance in end customer demand that amplifies as it moves upstream.

This study analysed quantities and timings of orders that OEMs and component suppliers *received* from partners on the downstream side (i.e., incoming orders), and orders OEMs and component suppliers *placed* with their upstream supply chain partners (i.e., placed orders). The data for the analysis was collected from OEMs and component suppliers who contributed to the study by providing variation-based monthly figures of their orders and other relevant aspects through an excel spreadsheet designed to support data collection.

Having received responses from 13 firms, the analysis to explore the existence of a Bullwhip effect included monthly time series data for both incoming and placed orders with regards to one particular product and component from eight firms (the other five firms could not be included in the analysis due to missing values for example in relation to the reference year 2019 or other reasons). To assess if there was evidence for a Bullwhip Effect, the time series data was indexed to the average levels of orders in the year 2019, which served as the baseline year for the comparison with the following two years of the Covid-19 pandemic.

Calculation of standard deviations of the monthly order data revealed that the level of **variation of placed orders was on average 22.2% higher** than the level of **variation of incoming orders**. While this result needs to be interpreted with due prudence given the very small sample size, it suggests that upstream-facing order quantities vary slightly more than downstream-facing ones – which would point into the direction of a Bullwhip Effect occurring. To statistically substantiate and generalise this,

a larger sample of firms that is representative for the particular stages of the cycling supply chain would be needed.

In addition, the data was also used to provide an illustration of the “gap” occurring between consumer demand and orders between 2019 and 2021. As Figure 7 demonstrates, there is a divergence between the indexed consumer demand data (represented as grey columns in Figure 7) and the OEMs’ and component suppliers’ orders received and placed. As above, the data series were indexed to 100 for the year 2019.

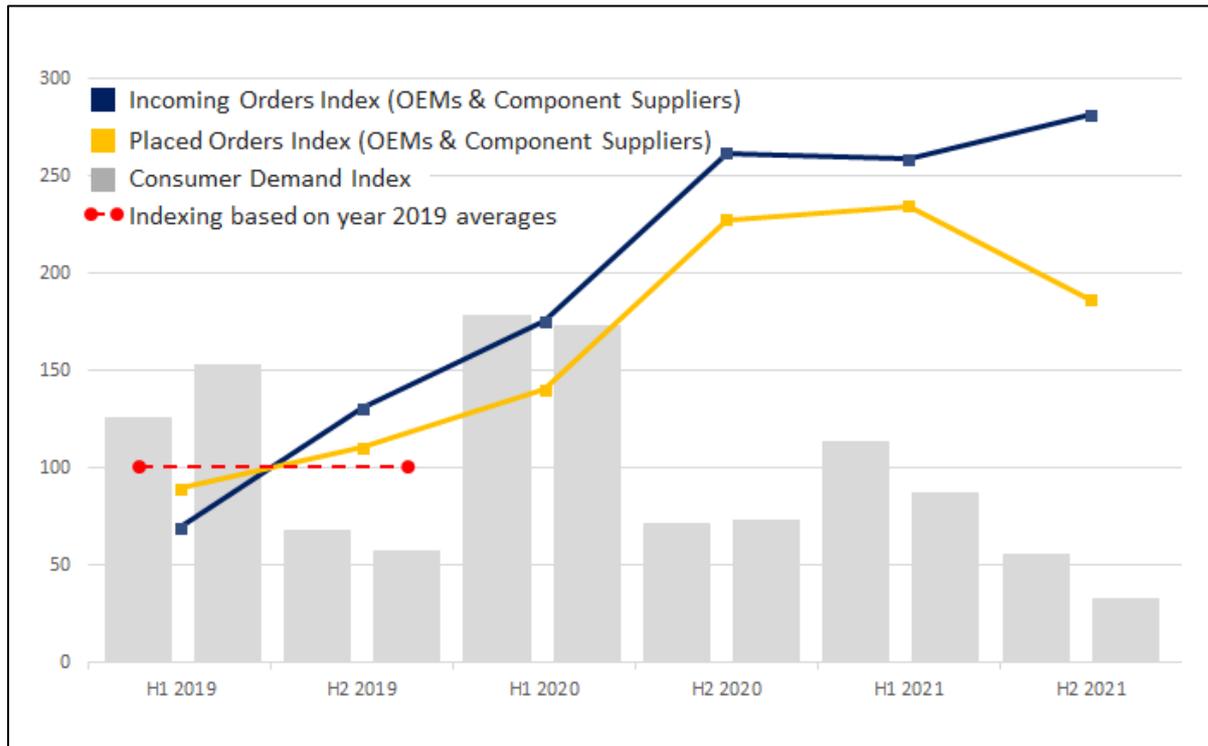


Figure 7: Comparison of Consumer and OEM/Supplier Data: 2019 to 2021

As described before, the consumer data shows a strong increase in demand in the first and also the second quarter of 2020. Demand then cooled down in second half of the year, before growing again in the first quarter of 2021 and declining thereafter.

The development of the incoming and placed orders is mostly parallel, with a steep increase particularly between the first and the second half of the year 2020. This increase seems to, with a certain lag, mirror the growing consumer demand in the first half of 2020. Orders levels then are maintained at a very high level, apart from a downward trajectory of placed orders in the second half of 2021. This might relate to growth expectations being adjusted; from the interviews there was evidence that OEMs have started to cap growth or to adjust orders downward to some extent at the end of 2021.

The interviews supported these findings, highlighting that:

- Companies added buffers or engaged in over-ordering at levels of 20-30%.
- Revenues of both OEMs and suppliers could have grown 10-20% more in 2020, with extremes going up to 40-50%.
- 10-25% of placed component orders were not delivered, or arrived considerably delayed.

3.2. The Consumer Perspective

From the consumer study, 16% of those respondents that had purchased a bike, e-bike or componentry had experienced an out of stock / delay in the last two years. The highest levels buying a bike or e-bike were felt amongst consumers in the Netherlands (average 4.4 times), whilst consumers in the UK (average 2.8 times) had the most issues when purchasing componentry.

With Out-of-stock situations occurring, a “natural” response from consumers might be to search for their bike of choice elsewhere – and in case of an opportunity to get it quicker from a different store, one might just put in another order. What seems straightforward from a consumers’ viewpoint, does affect the Supply Chain in case there are two orders placed by different retailers which originate from the same consumer who is in need of just one bike. This issue of artificial demand was also mentioned during some of our expert interviews.

To see whether and to what extent this might be an issue, we included two questions in relation to this phenomenon into the consumer questionnaire.

Of all respondents who had purchased a **mechanical bike** within the last two years,

- 59% did not visit another retailer.
- 29% indicated to have visited another store for information purposes.
- 12% indicated to have visited another store for information purposes, and placed the order there as well.

Of the 12% placing a second order, 59% said they did not cancel which suggests about 7% of overorders in the system.

For **e-bikes**, the picture looks slightly different in terms of consumers’ approach to information gathering, with 57% of respondents who had purchased indicating they had visited another retailer(s) for information purposes, and 18% visiting and placed the order there as well (25% said they did not visit another retailer). Of the 18% that had placed a second order, 38% indicated not to have cancelled, which results in 6.8% overorders. In so far, overorders for both mechanical and electric bikes seem to be at roundabout the same level.

Overall, there is some indicative evidence suggesting that consumers visit more than one retailer, and a bit more so when they look for an e- as compared to a mechanical bike. The suggested reason for this being slightly more pronounced for e-bike purchases might be the higher value of the purchase, with an average price of €1,728 as compared to €712. In terms of placing an order, the consumer survey data suggests that this is a less of an issue as one might have thought.

4. Underlying Issues

With the gap and its manifestations representing symptoms, the three perspectives taken in this study provide the opportunity to explore the issues underlying these symptoms. Also here, various aspects at different levels play a role and interact with each other, contributing to the gaps described before.

At a broader level, issues related to the **supply chain structure, operational practices**, and to the **behaviour of supply chain partners** can be identified.

Structurally, the geographically dispersed approach to production implies long supply routes and -times. In combination with the high level of fragmentation, i.e., a multitude of players at each stage and the operational characteristics of a high variety of products as well as little coordinated attempts for information exchange and collaborative planning and forecasting, this suggests the cycling supply chain to have reached a very high degree of complexity.

Little integration and coordination then lead to behavioural issues, with each firm primarily optimising tactics with a view to their own advantage. Specifically, two major **behavioural bottlenecks** relate to order management, and information and data sharing.

- In terms of **order management**, due to increasing lead times and the challenges of forecasting with uncertainty, orders are placed further ahead. An additional aspect here is also that, as capacities at each stage of the supply chain are limited, every party is trying to ensure to get their fair share – especially under an expectation of an overall growing market. Furthermore, the supply chain data collected not only suggests **high levels of variability regarding order volumes**, but in some cases also seemed to some extent **sporadic** in terms of the timely pattern. Relatedly, in our study we found evidence for at least a certain level of **overordering** at various stages of the supply chain, with consumers placing orders for the same bike with one or more retailer(s), retailers overordering with OEMs, and OEMs with component suppliers. Certainly, these behaviours are rationale from an individual actor's perspective and their effects in isolation might not seem severe, however they add up alongside the stages of the supply chain which can then cause major disruptions. Accordingly, overordering or shortage gaming has been identified as a major underlying cause of the bullwhip effect (Lee, Padmanabhan & Whang 1997).
- While there was a general view amongst our interview partners that information and data sharing are generally improving, it also became clear that motivation to share data and initiatives to increase transparency of what is happening at each stage of the supply chain are still tentative. This again relates back to the lack of a reliable and easy-to-navigate information base which seems to exist only in few firms.

A summary of the issues identified as relevant at the structural, operational, and behavioural level is outlined in Figure 8.



Figure 8: Underlying issues of the Gap

5. Building the Resilient Cycling Supply Chain

The effects of the Covid-19 Pandemic shook the cycling industry to its core and dramatically highlighted vulnerabilities in the supply chain - that were there before but could be managed to a satisfactory level. One of the major learnings that interview respondents and industry experts reflected on during the study was the need to build a resilient supply chain both at company and industry level. Looking at the commonly mentioned aspects, the following trends and measures could be identified:

- **The supply chain as a strategy.** Before the Corona-19 pandemic hit the cycling industry, it was a common understanding that the supply chain - relationships with suppliers, efficient ordering systems, etc. - is a competitive advantage. During the course of the supply crunch, even market leaders changed their perspective on this, and the industry started to view the supply chain as a strategic factor where cross-company collaboration is required to build more resilience and increase competitiveness vis-à-vis other industries.
- **The need to professionalise supply chain management.** The bicycle industry thrives on network and personal relationships - and will continue to do so. However, in the process of building more resilience, actors across the board plan to manage their supply chains more professionally, including the dedication of resources to digitalisation for more traceability and transparency, increased sharing of data with partners, the introduction of clearer and more streamlined processes as well as agreements. However, while the academic literature on bullwhip effects has acknowledged information sharing an effective countermeasure, there is also evidence that it cannot fully eliminate amplifying demand fluctuations (Wang & Disney 2016).
- **Standardisation over customisation.** Especially in the high-end cycling market, customisation was seen as a major revenue driver for suppliers and OEMs pre-Corona-19 pandemic. Throughout the course of the supply chain crunch, both parties reduced variation to a minimum and focused on core products to manage risk and complexity. Interview

respondents drew a positive balance from this development, as standardisation significantly reduces costs in the procurement, production, and planning process.

- **Re-shoring efforts to shorten supply chains.** One of the most commonly mentioned measures/strategies to build the resilient supply chain of the future was local production/reshoring. While industry experts acknowledge that production in Europe is not the panacea to supply chain vulnerability, they assign it significant weight in reducing risks. Especially investments in local assembly facilities and warehouse facilities by OEMs and suppliers were addressed in interviews. In addition, dual sourcing with globally distributed alternatives was a commonly mentioned strategy for increasing supply chain resilience.

To what extent the mentioned trends will continue, and measures put into practice will need to be revisited in the future. Other studies might provide insights into the direction that resilience-building is going. For example, survey results from [McKinsey](#) show that “in practice, companies were much more likely than expected to increase inventories, and much less likely either to diversify supply bases (with raw-material supply being a notable exception) or to implement nearshoring or regionalization strategies” (Alicke, Barriball, & Trautwein 2021).

6. Looking Ahead: A Post-Pandemic Perspective

The post-pandemic economy offers enormous opportunities for the cycling industry, but there are also threats, with the current political, economic, and societal environments being characterised by an extent of uncertainty that has not been seen for decades. Climate change, the war in Ukraine, inflation, and impending or already manifest scarcities in areas including energy, water, raw materials and skilled labour are some of the global challenges driving this uncertainty.

Due to the ecological edge that (in particular mechanical) bikes have compared to other modes of transport, the cycling industry is not only associated with positive connotations, but also in a unique position to act as a catalyst for change. In terms of change to more environmentally-friendly modes of transport, the consumer research part of this study highlighted a new segment of cyclists, as there has been a significant number of new cyclists within the last two years. They have the following characteristics relative to established cyclists:

- A higher percentage of females (56% female / 44% male)
- Younger (78% 40 years or less)
- 56% live in an urban location
- Two-thirds have a season ticket for public transport
- They cycle primarily for leisure reasons and to be outside.

It is worth noting though the ‘new cyclists’ did give greater weight to ‘Save money on gas and travel costs’ and ‘to reduce impact on the environment or air quality’ as secondary motivators for cycling during the last two years so it could be suggested that they have a great environmental consciousness relative to the non-cyclist and established cyclist.

The ‘new cyclists’ have a significant higher purchase rate for e-bikes than ‘established cyclists’, this can be partly attributed to the segment outlining that they felt they had more disposable income available and were also taking greater advantage of discounts (both manufacturer and retailer) and subsidies (both government and employee) offered to them.

From the consumer data, however, also a current trend of demand cooling down can be diagnosed, as becomes evident from the longer-term perspective shown in Figure 9.

Purchasing – Q: When did you order / purchase this bike / electric bike?

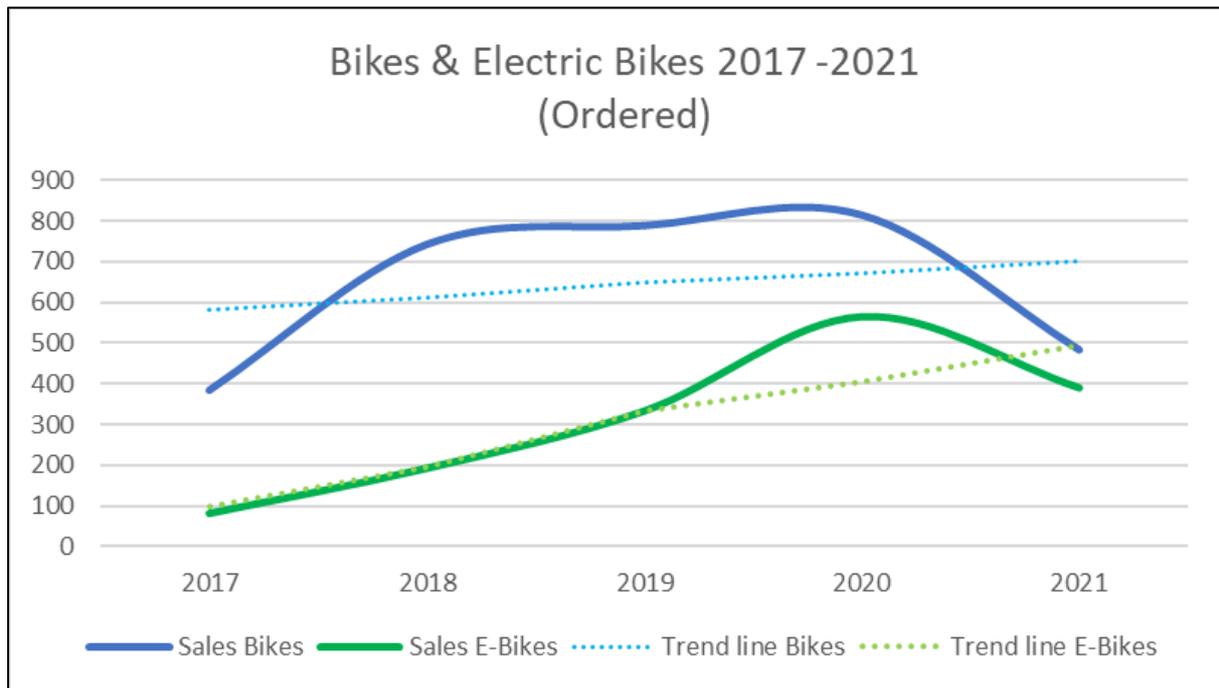


Figure 9: Bikes and E-Bikes ordered 2017 – 2021 (Base: 7,798 purchases - 5,825 mechanical; 1,973 electric)
 Source: Bridging the Gap Consumer survey / Sports Marketing Surveys; n=6,259.

The net effect of the two trends that the consumer research identified is that for 2021 the forecast is to be a significant decline in units against 2020, mainly driven by the mechanical bike decline. However, it is worth noting that both bikes and e-bikes have positive trend lines over this time period.

Whether and in how far this decline in demand can be attributed to consumers having shifting purchases to the early phases of the pandemic, is beyond the focus of the study. In terms of future development, inflation might on the one hand have a negative impact to increasing cost-consciousness of consumers; on the other hand it might trigger more people to substitute car-based mobility with cycling, at least for shorter or medium distances. Whatever scenario the future brings, it will be key for the industry to be able to quickly respond to changing market conditions. In this context, anecdotal evidence at the time of writing suggests that warehouses are almost full to capacity, and that postponements of orders might become more frequent, posing new and continued challenges to the supply chain actors.

Looking ahead, there is a need for increased digitalisation, agile production methods, less customisation and more standardisation alongside the supply chain. The following section outlines an action plan for the industry, with implications for firms, the industry as a whole and policy making.

7. An Action Plan for the Cycling Industry

With the following implications, firms are encouraged to work towards an agile and resilient SC:

- **Align supply chain strategy with market characteristics.** Lean supply chains are utilised to keep costs down and are normally aligned with relatively stable market conditions. However, when there is volatility in the marketplace, **agility** and **resilience** are usually a more appropriate strategy. Through building resilience in the supply chain, disruptive events can be prevented, and acceptable levels of performance can be achieved and maintained. There are different tools, models, and technologies that can be adopted by supply chain managers to mitigate disruptions and build resilient supply chains. However, changing supply chain strategy is not straight forward. It requires collaboration, flexibility, information technology, knowledge management, redundancy, risk mitigation culture, risk sharing, robustness, social capital, top management support, trust, and visibility.
- **Map the supply chain.** Supply chain mapping is a tool that can be used to gain visibility of all supply chain activities, from raw material sourcing to the end customer. It can identify not only their location, but also show inventory levels in the system, at which points, how this is affecting lead times and ultimately can result in a much better understanding of the costs (inventory, warehousing, transportation and distribution). The map can also identify other elements such as risks, environmental and CSR issues in the chain and inform supply chain (re)design to mitigate against these or risk of supply disruption.

Once visibility of the processes within the supply chain has been achieved, benchmarking against accepted performance indicators and metrics of risk impact on revenues can identify important areas for improvement.

- Create a **reliable and structured in-house information base.** Often, data is managed in different departments within the firm, with little oversight regarding what kind of data is already being generated and would be available for analysis. Also here, a mapping exercise can be useful to understand what data is captured across the firm, and what additional insights could be gained through an integrated perspective, drawing on the collective and coordinated analysis of data from different departments.
- Increase **information flow and visibility** in supply chains. This is an important aspect to counteracting the bullwhip effect and effectively having as much visibility as possible. In particular, a shared perspective on expectations with regard to consumer demand is useful for long-term planning.
- **Diversification of sourcing / onshoring.** There is a reliance on a small number of key strategic sources/components. This has the potential to cause bottlenecks in the supply chain. Onshoring and near shoring can reduce the length of the transportation chain.
- Further enhance **collaborative planning.** There was some evidence from the study of limited collaborative planning. Establish common processes and metrics to help supply chain trading partners achieve their common goals. Improved communication, collaboration and information sharing are vital to ensuring the successful implementation of this strategy.
- **Benchmark supply chain innovation** with world best practice including more detailed risk analysis of existing approaches. With increasing dynamic

externalities such as the Covid-19 disruption alongside geopolitical, and transportation factors, re-examination of sourcing strategies to mitigate further future disruptions is prudent. Potentially, this could include reshoring (nearshoring, backshoring) wholly or partly upstream supply chain activities, depending on their level of strategic importance. Lessons can be learnt from other industries (e.g., the retail industry, Zara), where a dual supply chain can establish efficiency and cost effectiveness. Basic components could be sourced from Asia to maintain low costs, and components that are strategic or need a quick response would be sourced using a dual strategy with reshoring. However, this has implications for the broader industry including a need to increase production activities and -capabilities in the EU.

- **Cultural shift and supply chain maturity.** Having an integrated supply chain requires the sharing of often tightly controlled information. Hence the further enhancement of trust and relationships in the chain will be key to achieve supply chain developments. The cultural alignment within and between organisations is a key factor. While the focus can be on common goals and agreements both (multiple) parties' benefit when areas of incompatibility are identified so that accommodations can be made, or steps can be taken to not only improve their alignment but also cultural maturity.

Several of the challenges outlined in this report cannot (or hardly) be tackled by individual players within the cycling supply chain. Here, a coordinated approach at the broader **industry level** is needed.

- As a precondition for effective information flow between supply chain partners, **standards for information exchange and digitalisation** / open data need to be agreed and implemented.
- Another area where resource pooling and an industry-wide approach seems useful is the **collection of market information**.
- Develop and agree on **industry standards for sustainability** including fair trade.
- Develop a **mapping of critical raw materials incl. demand forecast** to inform policy makers.
- Further **advance the cycling industry as a work environment**, incl. career development, internal marketing and advocacy for the industry.
- Identify, collate, and communicate **best practice approaches**, and moderate opinion- and consensus-building processes to align interests of individual supply chain partners.

At the level of **policy making**, the following recommendations can be derived:

- From a strategic perspective, **frameworks and good practice** are needed to continue develop competency and harmonise approaches in areas including, e.g., safety standards in terms of production and cycling usage, investments and procedures to improve cycling infrastructure, promotion of active travel, and accessibility and inclusivity.
- Support **development of cycling manufacturing and innovation clusters** to increase production in Europe. Strengthening emerging and creating new cycling manufacturing and innovation hubs will create local clusters of expertise in R&D, manufacturing and related activities. Such industry clusters

are a place-based approach that can consist of OEMs, suppliers, service providers and research and educational institutions. These are useful to support regional growth and collaborative practice. Policymakers can also concentrate investment in skill development specific for the cycling industry. As cycling is a growing sector that is increasingly dependent on advanced and diverse skills, there is an opportunity for people to transition into the industry and support cluster building through a skilled workforce.

- A complementing element is to provide **support for local areas** striving to develop a core competency and reputation around Cycling beyond manufacturing and innovation, for example in cycling-based eco-tourism or by hosting professional cycling events. Once established across Europe, connections could be developed across different clusters and cycling-oriented regions, unleashing the potential of pan-European collaboration across the wider cycling industry – from raw materials supply to event hosting. Taken together, innovation clusters and local cycling hubs also allow small- and medium sized enterprises to thrive.
- To help overcome strategic dependencies and vulnerabilities in relation to raw material supplies, a joint and coordinated **strategy for sourcing and provision of raw materials** that are currently not directly accessible in Europe needs to be prepared. In addition, measures need to be developed, implemented and enforced to ensure efficient recycling of any kind of scarce raw materials. Here, a particular need is also increased R&D around recycling of batteries and battery production overall.
- To support the transition to a green and sustainable economy, **R&D investment in sustainable production and a circular cycling economy** is needed. The concept of the circular supply chain has grown in prominence over recent years. Although the industry can be seen as supportive of the sustainability agenda, it also has a responsibility to consider a ‘cradle to grave’ approach in terms of the consumption of finite resources. There is an immediate need for the industry to embrace the circular concept and work towards net zero. Developing a reputation for sustainable production and circular approaches would also provide huge opportunities to establish the European Union as thought-leading.
- Finally, further growth of the industry is dependent on consumer demand. Therefore, further efforts need to be made regarding **investments in better infrastructure and the promotion of cycling**. With cycling proving to be attracting new customer segments, the consumer research part of this study supports the transformational potential of cycling and thus its strategic relevance as an industry.

8. Limitations and Outlook

This report has a number of limitations. Further work to reach further suppliers would help to identify how collaboration can grow in the industry, particularly in the area of sustainability and moving towards net-zero. The sustainability agenda will provide ample opportunity to collaborate and build capacity in the industry. Future research could help understand the drivers for collaboration, as well as related challenges and opportunities.

Society is at the crossroads currently in terms of either continue doing “business as usual”, or fundamentally change in terms of how we live, work, and organise our mobility. While the direction of travel seems clear, the strategy to get there is less obvious – however cycling and the cycling industry are in a unique position not only to facilitate the change that is needed, but also to act as a role model for other sectors in terms of undergoing the transition to a green and truly sustainable industry. As one expert noted there is a chance for a “sustainability revolution” in the cycling industry – **#letsgetonwithit!**

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