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Automotive apocalypse

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It is hard to exaggerate the transformation in the automotive sector. GM CEO Mary Barra's statement that it will change more in the next five-to-ten years than in the past 50, may feel like a cliché but such predictions are starting to become reality and the implications for logistics service providers in business with the automotive sector are enormous

Inside

The automotive supply chain is undergoing a near complete restructuring, and that includes its geography. Until now, the supply chains in the automotive sector have been remarkably local. In the recent past, even a highly globalised vehicle manufacturer such as Toyota would expect to source 90% of its components from within a radius of 100km.

Over the past five or 10 years there has been some gradual change.

Hi-tech features, such as flat panel TFT screens and anti-collision sensors, are now central to the driver experience and this has quietly increased the demand for globally sourced electronics products.

There has also been a continuing rise in standardised major components, leading to an emphasis on global components. For example, a Nissan-Renault engine is likely to be trucked a lot farther from a centralised engine plant to assembly plant than it used to.

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This still has its limits. Audi's new SUV plant in Chiapa, Mexico, will source an increasing level of its components locally. The conventional internal combustion manufacturers really do not like the uncertainty of shipping major parts of the vehicle between continents. It is too uncertain and requires additional inventory.

So far, such change has been evolutionary. Yet what the sector faces next is a revolution.

The scandal over Volkswagen faking its diesel engine emissions has had a huge impact. The demand from both regulators and customers is for new technology now. This means 'electric drive' in some form, whether hybrid or pure electric vehicles. This is amplified by China's attempts to drive through 'electrification' almost overnight.

As Toni Fondevilla, senior vice president of automotive at logistics service provider CEVA points out: "There are already at least 60 start-ups in China, companies previously not in the automotive sector... the speed of China alone is quicker and greater than anyone imagined."

China is now one of the largest automotive markets in the world, so ignoring such developments is not an option. The result is something close to panic in the big incumbent vehicle manufacturers (VMs). They not only need new designs, they also need to re-configure much of their assembly operations. And, above all, they require a source of batteries. They are all uncertain how any of this will happen.

Nissan is one of the better-placed VMs in the world of electric vehicles, making the world's best-seller – the Leaf – and with its own battery-pack facilities in Sunderland in the UK, Smyrna in the US and Zama in Japan.

However, when Martin Corner, vice president of supply chain at Nissan Europe & Renault Nissan, spoke at the Automotive Logistics conference in Silverstone in October, he admitted that it was "an area we are very much working on.....although we have our own production facilities, overall demand is growing so quickly that it is likely we may have to buy batteries from China".

Such has been the speed of change that Nissan is struggling to adapt to the new supply chain reality. Indeed, it is unclear exactly what this reality will be.

Martin Corner reflects such uncertainty, commenting that Nissan's plans were "still fluid on sourcing location ... presumably there will be a lot of transporting so it will require specialist providers. There will be a more global situation".

Toni Fondevilla, senior vice president of automotive at logistics service provider CEVA

This "more global situation" is of vital significance. If just a modest proportion of batteries are moved between continents, the implications for container shipping alone would be substantial.

To take Tesla as an example, even the cheaper Model S has a battery pack that weighs over 450kg. Tesla sold over 20,000 cars in September, suggesting annual sales of around 250,000. The more modest Nissan Leaf has a pack weighing 218kg. It sold 15,000 cars in Europe alone in 2017 and roughly similar numbers in the US.

Presently, both these vehicles source their batteries from plants next to their respective assembly facilities, but if even a small proportion of their batteries were sourced from more remote facilities there would be consequences for container shipping lines.

So far, such change has been evolutionary. Yet what the sector faces next is a revolution

Combined with greater production, to reflect electric vehicles becoming even a modest proportion of global car sales, the volumes handled would represent a significant container vertical.

And moving these batteries around is not straightforward. Lithium ion batteries are classified as a hazardous cargo and there are strict limits on the density of storage within a container. Sustained movement of Li-Ion batteries in large numbers will require dedicated facilities and specialist logistics service providers – essentially new hazardous cargo handlers moving Class 9 material. This may not sound overly difficult to provide, but the combination with the volume of the trade will make it significant.

Propulsion platforms

It is not just about batteries. There are more fundamental logistics issues. The tempo of the electric vehicle supply chains will also be different. The business of assembling internal combustion engine vehicles has been one of the most intensely precise operations in logistics. Following the introduction of the Toyota Production System, the sector leapt forward, characterised by concepts such as just-in-time and rigorous inventory management. Yet this conceptual environment will undergo a significant change with electric vehicles.

Nissan's Martin Corner explains the nature of the engineering: "The next generation of cars will have less complexity and fewer mechanical parts".

The commonality of parts between vehicles, especially on the 'propulsion platform' that contains the battery pack and the electric motors, will increase. If this is the case the assembly operations around the vehicle will be less demanding in terms of scheduling within individual plants. However, the geography of component manufacture is likely to become more demanding, although it remains unclear who will manufacture which components. The result will be a distinctly new profile of automotive logistics.

This is likely to go far beyond the standardised engineering platforms of today's internal combustion engine cars. It also reflects the fact that the core engineering competences of vehicle manufacturers are changing. As JaguarLandRover's (JLR) head of design, Wolfgang Ziebart, pointed out recently at the launch of the iPace electric model: "Battery management systems are the core of an electric car... and it is between electricity, chemistry".

This is a complete change from the mechanical engineering of internal combustion engines. This would also imply a much more dedicated and integrated supply chain around specific models, or rather specific propulsion

Photo: © Wellesenterprises

In the 1920s, General Motors pioneered the concept of combining the different parts of the production process into one large corporation

platforms. Such engineering shifts are transforming how vehicle manufacturers think about their assembly operations.

There are also major implications for supply chain management from the change in technology. For example, it might have been expected that JLR would have externally purchased the electric motors for its iPace, yet Ziebart has explained that JLR viewed such motors as being of such importance to the performance of the vehicle that these were designed and manufactured in-house. This is also the case for much of the engineering around the battery-pack.

Such core questions of 'make or buy' are vital in estimating logistics requirements. The greater the outsourcing the greater the likelihood of global logistics requirements, yet at this stage no-one – including the vehicle manufacturers – knows what the approach will be. If JLR is to be taken as an example, the result may be very large integrated locations – although, again, this remains uncertain.

These questions about supply chain management are further complicated by the role digital engineering plays in new vehicles beyond that of managing propulsion systems. Guidance systems are also undergoing a revolution.

On the radar

Fully autonomous vehicles may still be some time away, however radar and laser-based guidance systems are rapidly becoming standard and semi-automatic digitally based steering systems are likely to enter production within a few years. The modules for this are pieces of IT hardware and have to be handled as such during transport and assembly. All of this demands a completely different approach to assembly in-plant as well as handling and sourcing.

Yet the new production architecture of such assembly operations will have to go beyond conventional contract logistics solutions, for there is a growing realisation in the automotive sector that its traditional ways of doing

What goes around, comes around

Tyres have always been at the edge of the automotive sector. Large companies with strong brands, tyre manufacturers are among the few component producers with a direct relationship with consumers: some 75% of the product is sold directly to end-users. That is unusual.

For the past decade or more, the business of tyres has been changing, but it has been a change more conventional than the 'electric vehicle' transformation overtaking the rest of the automotive sector. Mainly it has been fashion, and the increasing size of vehicles has led to an expansion both in the type of tyres, but also in the range of different sizes.

Markets vary, with those economies with a big appetite for sport utility vehicles being very lucrative for tyre manufacturers, but generally the range of different types of tyres has increased five-fold.

The response has been a strong example of efficient logistics management, at least for the branded premium tyre-makers such as Michelin, Bridgestone and Goodyear. Tyre production facilities used to be very local, but are now increasingly organised at a continental level, with individual factories specialising in certain sizes and designs.

Plants are increasingly automated, and the higher capital investment demands long product runs. Inventory has also been centralised to a national and continental level. This means tyres are transported longer distances to customers from larger manufacturing facilities. At the cheap end of the market, tyres are imported from Asia, especially China, the US being the largest consumer. This trade is a heavy user of container shipping, although it emphasises low-cost solutions.

The model of importing huge numbers of cheap tyres into the US from China is not a particularly sustainable one. Cheap tyres do not show good profit and transport costs eat into margins, but there are other reasons as well, as Madhubhaskar Thirikode, director, global tyres, for CEVA, points out.

"Chinese and Korean producers are opening plants in the US, both from fear of anti-dumping measures, but also for macro-economic reasons."

This maturing of the global production base, alongside the growth in car ownership has led the number of tyre production facilities to almost double worldwide, to just under 500.

This supply chain geography demands good logistics solutions. With such increasingly complex production bases and product flows, the old way of doing things is not really viable. To compound this, manufacturers need to sell higher-priced, higher-margin premium tyres – but the customer for such tyres also demands the highest availability.

Photo: © Mrsegui

Again, the need is for more powerful logistics solutions.

This is an opportunity. Global logistics providers are hoping to offer manufacturers the sort of higher-level management systems they have learnt from the rest of the automotive sector.

One key area is that of inventory control. Until recently, levels of product tracking were basic. Now there has been a move to integrate barcodes into each tyre, giving the ability to deliver individual products. CEVA's Thirikode says: "The need to offer the ability to track individual product complements the desire of many companies to sell a more expensive product".

These visibility questions are fundamental to contemporary inventory management, but in the tyre sector, with its exposure to retailing, it becomes even more important. This varies between different economies, but in many markets the logistics service provider delivers product direct to the retail location and not to a distribution centre, and this demands precision.

The management of transport assets is also vital, bearing in mind the increasing distances that tyres are being shipped. The reality of shipping tyres, especially lower-priced ones, on a global basis, has involved stuffing as many of them into a shipping container as possible, and looking for the lowest freight rate. This is hardly sustainable in the long-run, not least as such methods impose major inefficiencies in terms of handling and tracking.

CEVA and the IBC manufacturer Goodpack have attempted to manage this by designing what is essentially a stillage that can achieve high product density in shipping, but offers effective handling and tracking in loading, un-loading and storage.

This underlines that one of the drivers of cost in tyre logistics is the difficulty of handling the product, both in the warehouses and in road freight operations. And the more complex production base, combined with the higher level of globalisation, is also making demands on other areas of the supply chain. For example, not only are raw materials sourced globally, but there are now significant interplant movements of semi-finished products. All of this adds complexity that some tyre manufacturers struggle with.

It might be expected that tyres would be one of the few areas largely untouched by the electric revolution in automotive. CEVA's Thirikode says EVs "will be a new thing for everyone... ..the eco tyres needed will be different wheel sizes, different moulds, compounds, but for the moment the volumes will be small produced, by small teams".

Nonetheless, the logistics of tyres for electric vehicles will not change in terms of the structure of the supply chain.

The underlying market for tyres generally grows at the rate of the increase in sales of passenger cars and trucks, which is generally in the low-to-mid single-digit percentages at a global level – although wheezes such a new regulations for winter tyres have boosted demand in low-growth markets such as continental Europe.

The result is quite an attractive market for certain incumbent logistics service providers. They have invested in the types of material-handling equipment that efficient tyre logistics requires. This is not an insurmountable entry barrier, but the modest pace of growth does not really justify enormous investment in the short term. Consequently, the likes of CEVA, DHL Supply Chain and Kerry Logistics have the opportunity for increasingly good business in a steady market.

things have become horribly out of date. Nissan's Martin Corner is forthright in admitting that much of the customer interface of the automotive sector is very old fashioned with dire quality of service.

"We did a survey of customer satisfaction with dealerships. Volkswagen was highest, with 25% of its customers happy with the service".

He acknowledges that the data-rich relationship that so many new technology companies have with their customers is something the automotive sector must learn from. This will have big impact on logistics. It is already the case that internet retailers run their inventory management through artificial intelligence (AI). Such an approach is hard to comprehend for many vehicle manufacturers, but the implication is that the crown jewel of the automotive supply chain – the master production schedule of the assembly plant – could change profoundly.

For the AI-driven world of Ocado or Amazon, this is nothing new. They have real-time management of schedules, capturing the data from customers' smartphones and using it to drive their entire business.

John Buchanan, manager of powertrain programming & constraints at Ford, also spoke at Silverstone. He says the engineering and economic realities of many existing internal combustion engine assembly operations simply cannot be run like this, as they "have to be managed on fixed schedules".

The conventional vehicle manufacturers have struggled for a couple of decades to reconcile the economies of scale from high-volume manufacturing operations with the volatile nature of customer demand. Ford in particular has a strong supply chain information system that can flex production schedules to accommodate changing demand.

Yet the difference is the centrality of information to the tech companies' business models that enables them to adapt their operations so much more effectively to consumer demand trends. It is the focus on generating data on the customer that distinguishes such business models from that of the traditional car industry.

Buchanan adds that to even begin to adapt to a new information environment demands much higher levels of visibility, "not just in Tier 1 and Tier 2 suppliers but further down the supply chain". The problem is that many of the solutions required to do this are not really in place – he observes that "blockchain is not ready to be industrialised today", for example. If so, the logistics information infrastructures that so many in the automotive sector have spent so much on will have to be adapted very quickly – for the business of building electric cars, the destination will be a quick, agile supply chain with extended geographical structure and new types of sub-assembly facilities.

Nissan is one of the better-placed VMs in the world of electric vehicles, making the world's best-seller – the Leaf *photo: © Slava296*

New ideas

The VMs are openly requesting new ideas from logistics service providers, such as overland services out of China for batteries. But if, as appears the case, the greatest change may be in the area of information, then an operator such as Ocado that can offer state-of-the-art off-the-shelf logistics and supply chain information architecture focused on managing customer demand may be very powerfully positioned to deliver the sort of strategic solution that VMs could find far more attractive in the long-run.

Such competitors may prove lethal for conventional contract logistics providers.

As for the transport providers, container shipping is already used to move 'Complete Knock Down' kits and, to a lesser extent, automotive components. However, in an automotive sector used to detailed planning and efficient utilisation of fixed assets, relying on the less than exact schedules of container shipping lines will not be enough. Martin Corner says rail solutions through Central Asia are interesting, as a result.

For components other than batteries, air freight is an option, but the automotive sector has always had a difficult relationship with that mode – VMs have long regarded it as a wasteful extravagance, except for emergency shipments. Fast and precise it may be, but it is regarded as very expensive.

VMs are also highly intolerant of being rolled-off any aircraft or ship. They demand guaranteed service but expect to pay the lowest price for it, citing their large volumes.

This attitude may not work in the new reality, which is already painful for them. VMs are shocked to discover their declining influence on supply chains.

"We are really surprised to be sitting around a table talking to suppliers and in a situation where we are competing with the really large consumer electronics companies. Our voice is not as loud. We are not used to that."

Ceva's Fondevilla confirms VMs being increasingly crowded-out from transport markets, notably in air freight. This is uncomfortable to companies used to dominating their

Made in Mexico: strong output, weak logistics

The growth of Mexico as a location for automotive production has been an emblem of how emerging markets have become critical for the sector.

Over the past 10 years, production has doubled in Mexico, from two million cars and trucks in 2007 to four million in 2017. But this number disguises the real growth, which took place in the 1990s and transformed a small rudimentary manufacturing base, designed to produce for the national market, into a production hub of global importance.

Cheap labour is often cited as the reason behind the growth of Mexican production, but this is overly simple. Certainly, Mexican wages are lower than those in the US. Average wages in the US are around $60,000, in Mexico they are just over $8,000. However, talk to assembly plant managers on either side of the border and they will tell you that labour flexibility in Mexico is not as great and the gap in unit wage costs is not as large as might be expected. Rather, the key to its success is the Mexican automotive sector's ability to integrate into the wider North American supply chain.

The headline news concerning Mexican car production has been the implications of the renegotiations of NAFTA. The new US Mexico Canada Agreement, signed in October, was remarkably explicit in addressing the automotive supply chain. The agreement states that within the North American free trade area, any vehicle has to have at least 75% of its value produced in the US, Mexico or Canada. This is hardly revolutionary, as the previous agreement already guaranteed 62% of content.

Agustin Croche, president of DHL Supply Chain in Mexico, says: "A lot of tier 1 and tier 2 [component suppliers] will look to expand production in thr US and Canada, but especially Mexico, and especially for the expansion of tier 3 suppliers. One of the challenges for the region is to develop the Mexican suppliers".

Croche adds that the "great impact" of the agreement in the development of the automotive supply chain in Mexico "has been removing the uncertainty". Therefore, demand for logistics from the automotive sector in Mexico is likely to be stable. The problems are focused on the execution of logistics operations.

There are three options for movement of components of finished vehicles in and out of Mexico: rail, road and sea.

The automotive sector is a heavy user of rail freight in North America. Both as intermodal and direct rail service, it offers a highly cost-effective means of moving high volumes of components between the supplier base and assembly plants. It is also a very good means of moving finished vehicles.

Mexico's rail system has been improving in recent years, but things are far from perfect. There is choice of private sector providers operating a mix of owned and rented from the state infrastructure organisation, with Kansas City Southern de Mexico and Ferromex dominating.

Volume has consistently grown, with total freight carried now being over 120 million tonnes per year – a problem, as the network is struggling to expand capacity. In June, the Mexican government announced its intention to build three new freight-orientated lines: from Guadalajara to Monterrey, Pacific; to the Gulf Coast at the Tehuantepec isthmus; and Tampico and Veracruz, the latter seeking to improve links to the port of Veracruz.

Increasingly, criticism of rail from the automotive sector focuses on theft and vandalism, but a structural weakness is the border bottleneck. In addition to customs, US and Mexican trains do not have access to each other's network. Managing this is time-consuming, although new investments for border

interchange are improving this. This problem of the border also applies in road freight. Trucks from either side are limited to a zone of a couple of hundred kilometres. After that they must transfer their cargo using cross-docks. DP-DHL is a leading player in this cross-border traffic, partly because of the scale of its cross-dock infrastructure.

The distances to be travelled are substantial in Mexico, links to the south of the country can be difficult and congestion around Mexico City is often a problem. DHL's Croche emphasises that routes of hundreds of kilometres is a real issue in Mexican road freight, but "despite the problems it is always possible to plan around them, you have always several alternative routes".

He is quite clear that "although it can be complex, the quality and precision required for JIT in-sequence operations can be delivered if you have the right infrastructure of cross-docks and consolidation centres".

An alternative ought to be shortsea shipping. However, Mexico's ports are in need of sustained investment. The largest port at Veracruz in particular suffers from shortage of storage areas and unpredictable rail links. There is a programme of investment, but at present Mexico is not fully exploiting its potential for linking, not just to the east of west coasts of the US, but also to markets in South America and beyond. If the expansion in vehicle production is to continue, the country will have to tackle this.

Mexico also faces particular problems with its road and rail freight, notably crime. Hijacking of cargo has become so severe that occasionally trucks are obliged to travel in convoys to deter thieves, but only with moderate success. The Honda plant at Celaya, north of Mexico City, was badly hit by repeated assaults on both road and rail transport into the facility, delaying the introduction of the Fit model.

GM, Ford, Volkswagen and others continue to mutter about the damage and theft of cargo on the rail network. It is hard to assess the cost of such problems but it must be substantial.

However, the issues of trade barriers have proved to be largely illusory, and Mexico would appear to have strong potential as a major producer of vehicles, not just within North America but also as a global hub. However, its transport infrastructure can sometimes struggle to keep up.

logistics supply base. The concept of having to plan around a 'peak-season' is not one they have encountered much before.

Domenico Ceci, executive VP of sales and marketing at Cargolux, which has a longstanding presence providing air freight for the automotive sector, emphasises the need for better planning.

"We would love to have pre-planning rather than demands for emergency and last-minute services ... what is needed to cope with these sort of issues is buying capacity year-round, buying forward capacity with guaranteed access to capacity through block-booking."

This can and does exist. Cargolux has created dedicated services for automotive clients – notably Daimler but also Volkswagen – yet making it a fixed aspect of logistics inbound to the assembly plant will not be popular.

Question of change

It is not just that operations will change. Over the longer term, the nature of the vehicle manufacturer is likely to transform. Although rarely understood, supply chain management is not just an operational concern, it is part of what defines VMs.

In the 1920s, General Motors pioneered the concept of combining the different parts of the production process into one large corporation. That model is now being questioned; again, driven by tech, where software drives product design and hardware is of secondary importance.

This is how the Chinese start-ups operate – buying in all components, batteries, battery-pack, brakes, guidance systems. Only software is core, and established VMs are unnerved by it.

As Martin Corner of Nissan says: "Software is the really important part of the new technology coming in now...yet so many of our guys are mechanical engineers, it's a really big change for Nissan".

Sceptics in conventional VMs argue that the Chinese start-ups are too dependent on suppliers and too under-resourced to have a plan B. However, even technology-rich new entrants such as Dyson appear to be following this trend to some extent.

Dyson is one of the world's largest purchasers of Li-Ion batteries and has an R&D capability comparable with the largest conventional VM, and its electric vehicle project has adopted a tech supply chain model, with its new assembly plant in Singapore.

It indicates a very different type of automotive sector. Driven by a powerful R&D capability, the assembly plants may be in very new types of location accessing a major freight transport node, while major suppliers may be scattered across the world.

Such assembly plants will also be quite different in what they do. Even more radical is the suggestion by JLR's Wolfgang Ziebart that final assembly may be outsourced completely, citing as his previous experience as CEO of chip manufacturer Infineon, which frequently outsources its production.

Presently, most conventional VMs are a country mile from considering such a move. They tenaciously cling to assembly and engine plants and defining their ability to manage them as a core-competency. Yet the example of Apple, a company many times the size of any VM which shut down its one assembly plant 20 years ago to outsource assembly to China, cannot be ignored.

photo: © Jonathan Weiss

Potentially, cars could be created in large design centres – Dyson has already built a large complex dedicated to EV research in the UK – while assembly plants are more distant, giving the flexibility to change models and production quickly, and thereby changing the nature of the VMs themselves.

The economies of scale with internal combustion vehicle manufacturing at present mean that just 16 companies account for 90% of all production, while six account for more than half of all cars produced. The 'Chinese' supply chain model would imply this could change.

There are also implications for economic geography. If Dyson's Singapore move is of any relevance there will be whole economies that will be losers and winners. For Germany, and also much of Central Europe, the business of car assembly is economically fundamental, yet it is not clear that such regions have any particular advantage in accessing the electronics supply chain.

In contrast, Thailand may have an advantage with its well-established electronics and automotive sectors. This represents an enormous disruption to the global economy, and there will be a ripple-out effect for ports, airports, roads and rail systems. Such is the scale of the change, it is likely to affect wider global trading patterns.

Volt Age

What is the timescale? Toyota chief executive Akio Toyoda suggests that electric vehicles will not become the most important part of the automotive market for almost a decade, with hybrid engines more viable in the short term.

Others disagree. Certainly, the pace of EV model introduction has accelerated in just the last few months. Ten years is a short time in a sector as enormous as automotive, but many VMs are already changing their operations, which is why batteries are so important.

Toyota, Dyson and others are pouring money into a battery technology such as 'solid state' . If this offers the range, performance and price it promises, electric vehicles will take a substantial market share, possibly within five years, while technology around autonomous guidance systems will likely continue growing.

Fully autonomously guided vehicles may be years away, but AI will increasingly dominate automotive technology. The merging of the electronics and the automotive supply chain looks to be inevitable within just two or three years.

Meanwhile, conventional VMs are in a difficult position – stuck producing three different types of drive-train; internal-combustion; hybrid; and electric. All require substantial investment in both R&D and production facilities.

The financial strain could be too great for many existing manufacturers. Already there has been a rationalisation of the sector in Japan as the likes of Toyota, Suzuki, Mitsubishi and Mazda collaborate on propulsion technology, which is likely to spread, ultimately ending with fewer vehicle manufacturers with greater purchasing power, which they hope will give them enough firepower to see off the new kids on the block.