Take control of supply chain costs

Prepare for the age of autonomy with ESI Automotive

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TAKE CONTROL OF YOUR COSTS

Foreword

The automotive industry is standing at the edge of a precipice. The future age of mobility has brought a watershed moment for traditional supply chains. An entire sector is shifting gears. Global disruption, technological breakthroughs and rapidly changing consumer demands are forcing vehicle manufacturers to completely reimagine the way they build and sell vehicles.

The future demands revolution, not evolution – but where does this leave the traditional automotive OEM?

Introduction

For years, OEMs have set the direction of travel for the automotive supply chain; they have dictated the vehicle ecosystem, imposed new designs on consumers, specified parts design downstream, set the precedent for consumer financing and led the way. In the age of future mobility, demand travels upstream.

Consumers are demanding cleaner vehicles; legislation dictates electrification; shifting economies force new ownership models and OEMs are caught in the middle.

The OEM's pride and joy; their point of differentiation; their decades-worth of IP, the heart of the vehicle; the engine, is out. Instead, safety is in. The brain is in control. ADAS and safety lead the way. But this is unchartered territory for the OEM. In this brave new world, the supply chain is wrestling away control; new market entrants are moving ahead and consumers are continually changing their demands.

It's time to open the black box. It's time to dive into the unknown. It's time to face the future. It's time for the OEM to take control of automotive supply costs.

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Upstairs – downstairs: How supply chains are transforming

To truly understand the transformative mindset required to adjust to change in today's automotive supply chain, it is useful to make an analogy to a child's brain.

According to neuropsychiatrist Daniel J. Siegel and parenting expert Tina Payne Bryson, a child's brain is departmentalized into upstairs and downstairs. In their book The Whole Brainchild, the two explain how children's brains have a downstairs area where all the important functions live; breathing, blinking, innate responses and emotions such as anger and fear. The upstairs brain is more complicated and is where higher order thinking and planning takes place; imagining, analyzing, problem solving and decision making.

You can make a similar analogy about the automotive supply chain. For a long time, the engine has sat downstairs. It's an important function of the vehicle but one that comes almost unconsciously. Most OEMs design and manufacture their own engines and have done for a long time. As a result, there is a comprehensive understanding of the costs associated with engine builds.

Vehicle electronics however, most notably Advanced Driver Assistance Systems (ADAS), live upstairs. Using the context above, less is known about these safety-critical systems, which are responsible for a vehicle's thinking and planning: scanning, analyzing, problem solving and decision making. There's little doubt that as carmakers move towards Level 3 vehicle autonomy and beyond, the ADAS system will become as integral to a vehicle's overall performance, safety and operation as the engine always used to be.

In future vehicles, the engine is out, and the Advanced Driver Assistance System (ADAS) is in. As such, OEMs face a new supply chain with different costs and perspectives. It's time to move ADAS from upstairs to downstairs. The first step is making sense of the new supply chain. Only then can you effectively understand, manage, and take control of your costs.

By viewing the entire supply chain at a systems-level, it is possible to understand both the intricate relationships between different materials and the cost implications of making material changes.

Once this is clarified, significant savings can be made, which can contribute to minimizing the overall risk of material failures, thereby enhancing vehicle reliability, form factor, and performance. This is where ESI Automotive is an industry specialist, working with OEMs and Tier 1 businesses to gain a systems-level view of their supply chains, to make informed design changes which result in significant vehicle improvements.

ESI Automotive collaborates directly with

40 OEMs & Tier 1s
globally

Operations in over
50 countries

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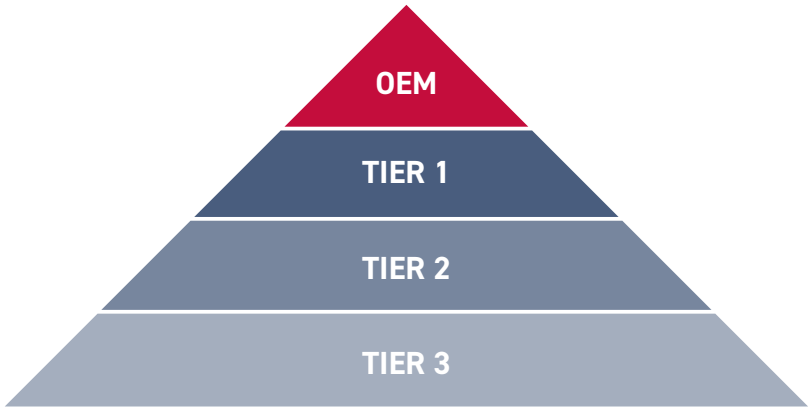
Taking control

Traditionally, automotive supply chains have been highly vertical and hierarchical. However, over time, as vehicles became more sophisticated with different features, this rigid structure unravelled into a tangled web of suppliers and costs.

As an example, large Tier 1 systems integrators may supply directly to carmakers, but underneath the Tier 1s sits a complex network of smaller suppliers, who each perform vital roles in a vehicle build, with highly specialist knowledge and experience. As we begin to move ADAS downstairs in the supply chain, these smaller suppliers will become ever more essential to ensuring vehicle safety and helping those businesses above them to more effectively manage their costs, but to what degree?

Typical vertical supply chain structure:



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Traditional supply chains place the OEM in control. Typically, the OEM decided what critical vehicle components were needed and placed its demands down the supply chain, where tiered suppliers worked together to fulfil the request. Specifics such as which materials were used and how components interacted were the concern of the supply chain, and not necessarily the vehicle maker. Generally speaking, as long as the material does what is expected of it and is within a specified budget, it is procured. However, in the age of autonomy, all this is flipped on its head.

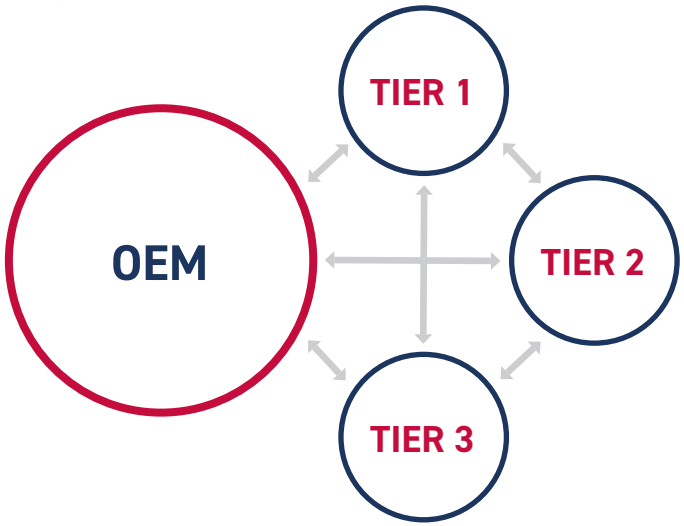
Instead, consumers drive demand. In the age of vehicle autonomy, differentiation is key. When all vehicles look and operate in a similar way, studies have shown that a consumer's brand perception determines purchasing choice. A consumer wants assurance of vehicle reliability, safety, and efficiency. Therefore, these three requirements must become the concern of the OEM, creating a further shift in supply chain dynamics.

What does this mean for supply chain costs?

Whereas traditional supply chains were built upon a philosophy that minimized inventory costs and prioritized efficiency – hence the heralding of just-in-time supply chains - future supply chain costs are not so easy to slash. Carmakers know that the most resilient supply chains are driven by quality and reliability, as much as they are by cost. Establishing the right sourcing criteria from the start will ensure standards are met while building a supply chain that is fit for the future.

As a result, we are increasingly witnessing the creation of a complex ecosystem of suppliers throughout the supply chain. In the race towards Level 3 vehicle autonomy, OEMs are increasingly having to collaborate more closely with tiered suppliers in an effort to share knowledge, experience and responsibility for new vehicle designs, particularly in the critical field of vehicle electronics.

New Ecosystem:



Creation of this intricate ecosystem was accelerated by the covid pandemic. Lockdowns and restrictions on the movement of goods exposed vulnerabilities in vertical supply chains in areas of over reliance, for example semiconductors. As a result, many OEMs were encouraged to find alternative solutions but for this, they needed the knowledge and expertize of the supply chain. After all, semiconductors are commonly used by the electronics industry, rather than major automotive manufacturers. In this instance, the supply chain had the answers.

Some OEMs fared better than others and indeed, there was a small minority that had already pivoted away from a hierarchical, vertical electronics supply chain ahead of 2020, instead building more directly managed partnerships with chip suppliers. Those which had protected themselves early on were able to ride out the storm more effectively than those that had not.

Some OEMs that did well were typically Japanese carmakers, which already had strong supplier relationships thanks to 'Keiretsu' corporate alliances. Keiretsu is the Japanese term for a set of businesses that have similar relationships and shareholdings; or an informal business group that has loosely shared alliances within the social world of Japan's business community. Indeed, the Japanese cultural model Keiretsu demonstrates where the future automotive supply chain may be heading.

Fragility in automotive supply chains comes with the prevalence of multiple tiers, international sourcing flows and hierarchical, vertical supplier structures. A move instead towards an integrated ecosystem helps to remove risk and enables carmakers to receive a more transparent view, and thorough understanding of, their supply chain costs. But who do you partner with and how do you scale costs effectively?

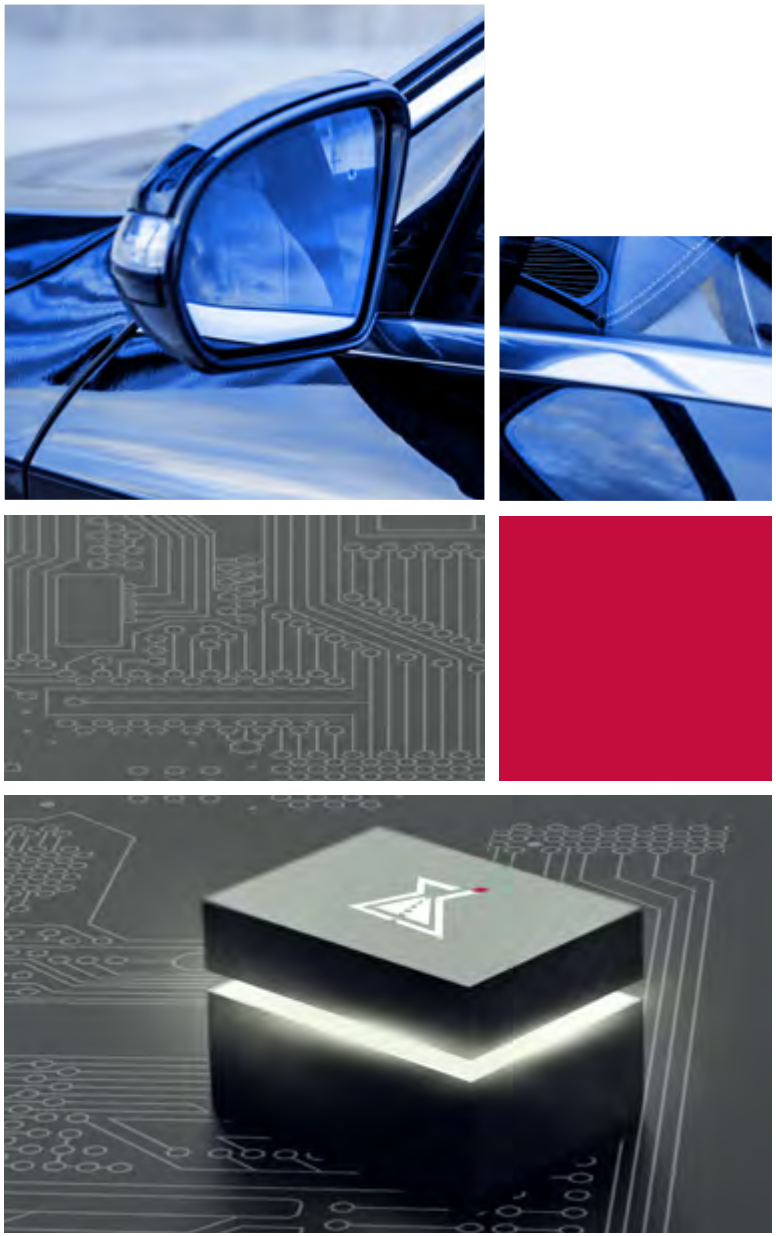
What costs need to be considered for a sustainable and effective supply chain?

"It is possible to aid the reliability of advanced safety systems by using unique substrates, which offer greater durability, while saving weight and space."

There's a famous John Ruskin quote which says: "It's unwise to pay too much, but it's worse to pay too little. When you pay too much, you lose a little money – that's all. When you pay too little, you sometimes lose everything, because the thing you bought was incapable of doing the thing it was bought to do."

As carmakers move towards Level 3 autonomy and beyond, the operational rigors that vehicle electronics must withstand will only increase, with ADAS bearing the brunt. Ensuring these systems have highly durable hardware materials with outstanding thermal conductivity properties and long lifecycles will be critical to the safe and reliable operation of vehicles.

However, from an OEM perspective at least, while assuming the traditional vertical, hierarchical supply chain model, little is known about these materials. ADAS has long been the black box to carmakers – while they recognize the importance of the system, rarely have they become too involved in how it is designed or manufactured. With advanced safety systems becoming a critical factor for vehicle differentiation and quite literally the part of a vehicle upon which brand reputations are built, it is time to open the black box and understand the associated costs.



To facilitate the creation of ever-more reliable and effective ADAS, collaboration across the value chain is required, with OEMs and Tier 1s working more closely with the supply chain when it comes to specifying hardware materials and electronics. For example, it is possible to aid the reliability of advanced safety systems by using unique substrates, which offer greater durability, while saving weight and space. Miniaturization can accelerate innovation and provide further efficiency savings, while more effective use of chemical compounds can overcome typical performance limitations and improve resilience.

However, as indicated by Ruskin's quote, carmakers cannot afford to misjudge the critical cost or value of materials when it comes to vehicle electronics.

The way that most businesses view supply chain costs is explained by the relationship between perceived costs and operational costs. Operational costs sit downstairs in the supply chain. They are widely understood by OEMs, who are clear on the balance between material cost and the potential value of that material. However, perceived costs sit upstairs. They are more complicated and often belong to new or emerging areas of a vehicle design, for example electronics. In this instance, OEMs are likely aware of the cost of materials, but less is known about the value the materials can provide to the vehicle over time. This has previously been the concern of the supply chain, but as we move towards full vehicle autonomy, entire supply chain ecosystems must move away from a cost model towards a value model.

Moving from cost to value

Managing the costs associated with producing the 'ADAS black box' goes way beyond looking at small changes to Bills of Materials, as suppliers collaborate with OEMs and Tier 1s to improve safety, reliability and efficiency of electronic materials. For example, a move from a standard tin-silver-copper solder (SnAgCu) 'SAC' and tin-silver (SnAg) alloy within ADAS hardware, to a high reliability alloy such as Innolot, is likely to be a perceived increase to automakers, since the material cost is slightly higher. However, if thermal cycling tests have proven Innolot to improve solder joint reliability by some 40% compared to a traditional SAC alloy, this perceived cost becomes an operational cost. In other words, the value the new alloy provides to the vehicle in terms of safety, reliability and extended operational lifecycles, far outweighs the cost increase on the Bill of Materials.

Why? Simply because that small cost could result in a major improvement to overall vehicle safety and therefore further minimize the risk of a warranty-related recall as a consequence of electronic failure. When you calculate the potential cost of such a recall, that small material increase quickly becomes insignificant.

Materials Matter

Reliability demands on electronic assemblies are becoming increasingly more challenging with the rapid evolution of automotive electronics. A combination of extreme environmental stresses, challenging customer warranty demands driven by longer service life, and increased component performance requirements is reaching the limits of the current standard tin-silver-copper (SAC) alloys.

The answer to this problem is the patented Innolot solder alloy. Innolot has been used in real-world applications since 2008 and has become the default standard alloy for high-reliability applications in automotive electronics. Although the motivation behind the alloy's development was to achieve higher operating temperatures in assemblies close to the vehicle powertrain, increasingly Innolot is also being used in lower temperature applications to extend service life, such as advanced safety systems, automotive lighting and high-power LEDs. **See how it works:**

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The value of redundancy

Another important point of value for carmakers is that provided by built-in redundancy. Ever since the likes of Tesla and Waymo showed the world it is possible for vehicles to operate and make decisions for themselves without human interference, the entire sector has reshuffled its design priorities towards advanced safety.

Consider this; The first ever recorded audio-visual fatality in a vehicle was recorded in 2016. A camera on the vehicle had its vision interrupted by the sun and failed to identify an obstacle in the vehicle's path, causing collision. To prevent such an occurrence, it is not uncommon today for automakers to add a secondary redundant system such as lidar or radar to take over from the camera in similar situations. It was reported that the car in this example had radar installed, but the vehicle architecture was not integrated sufficiently for functional redundancy.

There are several challenges when it comes to justifying the cost for redundancy systems. Firstly, this is a cost that may never be returned. Just because redundancy systems are integrated into a vehicle design, they're like life insurance – they provide a guarantee, but you hope you will never need to use them. Secondly, redundancy systems in the form of electronics, add further vehicle weight, further complicated wiring looms, and assume valuable space within the vehicle. Why invest in materials that go against most of your design goals?

Creating vehicle differentiation

The path to a safe autonomous vehicle starts with creating systems that work both individually and together to create a safer, more efficient driving experience. One way to improve the reliability of ADAS is to take a systems-level approach to the design of such technologies. It is here where materials will play an integral role: specifying optimal materials will support the function and reliability of these systems.

It is possible to aid reliability of ADAS by using unique substrates, which offer greater performance, while saving weight and space. Miniaturization will accelerate innovation and provide further efficiency savings. The use of specific chemical compounds will overcome typical performance limitations and improve durability.

Find out more here

Simply because the potential cost of failure is too high for an OEM to risk.

Many modern vehicle designs already incorporate redundant PCB circuits and IC Substrate packages because safety systems cannot fail. If the system senses something wrong with the circuit, it switches to another path which is an exact replica of the circuit.

Think ahead once more to the age of full vehicle autonomy. If the future population of personal transportation is electrified and autonomous, vehicle differentiation becomes more of a challenge for OEMs, particularly in the world of mobility-as-a-service where the rules surrounding traditional vehicle ownership will have been completely rewritten. Brand trust, loyalty and customer experience will come to the fore in fleet purchasing decisions. In this environment, no carmaker envisions a reputation for not having reliable ADAS.

What is the potential cost of electronic failure?

Advanced safety ultimately delivers vehicle autonomy. The role of ADAS on the road to autonomy cannot be understated and nor can the precedence of electronic hardware materials. By placing a focus on form factor, performance, and reliability, it is possible to deliver systems-level advanced safety solutions which provide improved safety, reliability, and peace of mind for automakers.

However, to do this – and for OEMs to truly strike a balance between material cost and value – it is essential that the entire supply chain undergoes a transformation from a vertical, hierarchical structure into an advanced ecosystem where collaboration and partnership takes precedence, opening up the traditional roles and responsibilities of tiered suppliers.

When it comes to ADAS hardware, it is important to look beyond bills of materials and costs alone, focusing instead on value, safety and security. The automotive market is driven by safety and reliability requirements and the concept of zero defects is gaining pace.

Today, there are already several standards that OEMs must adhere to when it comes to selecting and procuring materials for advanced safety systems. The formation of the Automotive Electronics Council's Q100 and Q101 specifications set out some of these regulations. The Society of Automotive Engineers (SAE) also published its own list of requirements, as has the International Automotive Task Force (IATF). In addition, several OEMs and Tier 1 suppliers have additionally created their own standards, but at date of publication, there remains no universal, global standard to which all OEM ecosystems must adhere.

For total peace of mind, advanced safety must be 'designed-in' to vehicle builds, which is why a collaborative supply chain approach is the most effective. New material approaches to printed circuit boards, joining materials and semiconductors can improve safety and reliability at a fraction of the overall vehicle cost.

The warranty effect

The proportion of warranty failures connected to electronics already stands at between 30-40%[2], with ADAS accounting for an ever-growing portion of this. Advanced safety is a rapidly growing segment of automotive electronics. Taking this into account, carmakers may well be forced to increase their warranty provisions unless they can develop a more robust methodology for identifying the best materials to use for these systems. Materials are the bedrock of ADAS, and when these are compromised, this places vehicle hardware at risk.

Managing costs will always be important but should be balanced against a more holistic evaluation of the reliability and performance benefits of opting for a superior, yet on paper at least more costly, alternative choice of material.

To give a practical example of this, assume a hypothesis whereby the cost of a radar sensor is around $50. A conventional solder paste would cost perhaps $0.07 compared with an enhanced reliability solder paste with a unit cost of $0.14. It could be tempting to opt for the cheaper alternative to halve your cost outlay, discarding the fact that the $0.14 option has a life expectancy that is 40% superior. By selecting the cheaper material, you are increasing your exposure to system failure and additional warranty costs. When viewed in relation to a mounting $40 billion warranty cost for the entire industry, suddenly a $0.07 unit saving is much less appealing!

Let's extrapolate this $0.07 cost addition for a high reliability solder paste, against the cost an overall vehicle build. If the average cost to design a Level 2 autonomous vehicle is $47,000, of which 30% is electronic content, comprising $14,100 of the overall cost, then ADAS represents about 20%, or $2,820. That $0.07 cost increase represents less than half a percent of the overall vehicle cost; so small as to be insignificant. However, this insignificant cost increase could not be any more significant when it comes to ensuring vehicle safety, reliability and peace of mind. This brings with it a consumer perception of safety, reliability and high performance, which creates a major differentiating factor in future vehicles, aiding and swaying purchasing or leasing decisions.

Would you sacrifice hardware quality for a few cents?

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[2] *Stout 2021*

Optimized material choices

The continued automation of driver functions is leading towards full vehicle autonomy. Enabling this is an array of electronics which require long-term reliability due to the critical functions which they provide, such as braking and steering. Material selection is critical to optimizing hardware to meet and exceed reliability requirements. Often critical materials will be a very small percentage of the bill of materials but can have a massive impact on the financial performance of OEM's and affect their reputation with the consumer.

If you missed our presentation at Car Symposium, you can take a look below.

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How do you take control of your costs in the future automotive supply chain?

As vehicle designs evolve, so too must supply chain approaches, with collaboration and partnership at their core. In future vehicles, traditional supply chain costs are no longer representative of value and new approaches must be developed.

A thorough evaluation of cost, value and performance in line with existing safety standards can help to ensure vehicle designs place advanced safety at the fore.

In the age of autonomy, the price of failure is one that is too high for any OEM to pay.

Can you afford not to take control of your costs?

About ESI Automotive

A leading provider of integrated advanced circuitry, joining materials and surface finishing technology, ESI Automotive's specialist knowledge across the global automotive supply chain enhances system-level solutions to industry challenges of reliability, form factor and performance. As design enablers in next generation connected automotive technology, we are powered by innovation, collaboration, expertise and material science.

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Take control of the future vehicle

It's not just supply chains that are evolving - control is changing within vehicles themselves. As carmakers move towards Level 3 autonomy, there will be more of a reliance on advanced safety systems to take over critical vehicle responsibilities from the driver. This puts safety and reliability front of mind, placing new demands on vehicle materials and systems. What happens to vehicle occupants in this new age? How do you ensure constant vehicle reliability and safety?

Find out in our next eBook, coming soon...

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