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How Japanese corporate IP departments are reinventing themselves

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We reveal the individuals who are driving the world's rapidly changing IP market

The future of mobility – can patents keep up?

The automotive sector is experiencing significant disruption. In order to succeed, the incumbent car manufacturers, their suppliers and new entrants need to consider how this transformation will change their view of patents

By Nigel Swycher and Steve Harris

There are many sectors that have been and will be disrupted by technology, but perhaps none more so than automotive. For over 50 years, there has been relative stability in the roster of vehicle manufacturers (ie, the original equipment manufacturers (OEMs)) and major suppliers to the manufacturers (collectively the Tier 1s). From a patent perspective, there has been little to disturb this – all the OEMs and Tier 1s have built and maintained large portfolios and there has been little in the way of IP disputes. However, the next 30 years look set to be radically different.

These differences can be analysed from a number of perspectives. First, understanding where we are today. Patent portfolios are not created, they evolve. For the automotive sector, it has taken well over 150 years to get to where we are today. Even over the last 15 years, the number of automotive patents has doubled. That is hundreds of thousands of patents and billions in IP-related costs.

Second, from this starting point, we can consider how things are beginning to change. This is not only a question of appreciating the current surge in batteries and autonomous technologies, but also understanding who is doing what. Analysed through a patent lens, you can observe the different OEM strategies (eg, who is backing batteries and who is still pursuing hydrogen fuel cells). Just as interesting is the dramatic shift in what constitutes the automotive ecosystem. The collaborations that are now being entertained are quite different to the familiar bond between OEMs and Tier 1s. The Microsoft IP licence to Toyota and the collaboration with Nvidia all illustrate the increased dependence on the broad range of technologies necessary to make the connected car a reality.

Third, as the trend to full autonomy accelerates, it is not unreasonable to regard cars as smartphones on wheels. The IP wars which have raged in that arena for decades can be seen as an omen for what the future holds in store for the automotive sector. However, a more detailed analysis suggests that this negativity may be unwarranted. Two specific areas merit closer examination: non-practising entities (NPEs) and disputes between operating companies (OpCos). There is no doubt that NPEs see a technology-enabled automotive sector as a hot target. However, they are gearing up in an adverse legislative and judicial climate, in particular one in which well-organised defences, such as the Licence on Transfer Network (LOT Network), Unified Patents and RPX are already in place.

The OpCo dimension is more interesting. An analysis of litigation data establishes that there is little in the way of disputes between OEMs and Tier 1s. The question is whether this will change as both the car and associated business models (eg, car ownership to ride-sharing) undergo radical transformation. In reality, there may be different answers for each of electrification and connectivity. For electrification, the battle will be between batteries and fuel cells, with the data suggesting an overwhelming bias in favour of the former. Assuming that this is the future, it seems unlikely that the next battleground will be a 100 year-old technology, where the OEMs have been patenting for decades.

Autonomous is much more complicated, as achieving conditions for full automation levels (eg, Society of Automotive Engineers Levels 3 to 5) requires the integration and interoperability of a large number of technologies. If the current trend of collaboration continues, this mitigates the risk of disputes with one possible exception: telecommunications, and specifically third generation (3G), fourth generation (4G) and soon fifth generation (5G) standard-essential patents (SEPs). This is not something that OEMs and Tier 1s have ever had to face and SEP owners are highly experienced, battle hardened and already standing in line. While this creates the potential for disputes, it is to be hoped that as the last of the epic SEP battles reach a resolution (ie, Nokia versus Samsung and Qualcomm versus Apple), the experience of how to determine a fair royalty can be more efficiently applied to cars, than has previously been the case for phones. In this context, licensing platforms such as Avanci hold real potential.

We conclude our analysis with our reasons why automotive patenting will play an important part in the future of mobility. However, the importance is built on a different framework from the strategies which have served the industry so well for the last 50 years. Our action plan is directed at those who either work in or for the sector, with encouragement to ensure that patents and the information which is captured within them are used to deliver maximum value and minimum of risk in the years to come.

Brief history of automobiles

The history of the automobile dates back to the early 19th century. This includes the invention of the DC motor (1834), the discovery of hydrogen fuel cells

(1838), the first electric car (the Flocken Elektrowagen, 1888) and the first petrol-powered car (Karl Benz, 1885). In 1900 it was the electric vehicle that held the land speed record – it was only after the launch of Ford's Model T (1908) that the electric car was consigned to the back seat.

Year	Invention
1834	Thomas Davenport inventor of the DC motor, makes a model electric car
1838	Christian Schönbein credited with the discovery of the hydrogen fuel cell
1859	Jean J Lenoir develops the first internal combustion engine (patented 1860)
1885	Karl Benz develops a petrol-powered automobile
1888	Flocken Elektrowagen regarded to be the first real electric car (inventor, Andreas Flocken)
1889	Gottlieb Daimler designs the first automobile (rather than a converted horse-drawn carriage)
1895	George Seldon granted a patent for an engine in a four-wheeled car (priority date 1879) and licenses to most major manufacturers
1898	Louis Renault introduces fixed drive shaft and differential
1900	Launch of the Lohner-Porsche Semper Vivus, the first hybrid petrol-electric car
1903	Electric ignition system credited to Robert Bosch
1908	Ford Motor Company commences mass production of the Model T
1917	Launch of Mitsubishi Model A

Car production has grown steadily from 1950 (approximately 10 million) to the 1990s (50 million+) to approximately 95 million a year today. While there has been no shortage of drama (notably the economic crisis of 2008) the automotive landscape has enjoyed stability for many decades. A notable exception to this has been the rapid growth of Chinese car manufacturers – China became the world's largest car producing country in 2009. It is estimated that there are over a billion cars on the road today, which could grow to 2 billion by 2035. Where there is less agreement is on who will make them, who will drive them and who will own them.

Automotive sector through a patent lens

After 100 years of innovation, what is the current state of the OEMs and Tier 1 portfolios? We start by analysing the global OEMs and Tier 1s. In all the charts that follow, we analyse active families, which includes patent families where there is a subsisting granted patent or application. This analysis has been conducted using a taxonomy developed in collaboration with a number of OEMs and Tier 1s. The taxonomy has been converted into artificial intelligence classifiers using our proprietary analytics platform, Cipher Automotive. It is essential for technology trend analysis of this sort that the data is applied consistently across owners, geography and time.

Figures 1a and 1b are the technologies patented by the global OEMs and their Tier 1 suppliers. At one level, there is a clear demarcation. OEMs patent the internal combustion engine (45%), whereas the Tier 1s protect driveline (also referred to as drivetrain) technologies (30%). In other areas, activity is split across OEMs and Tier 1s, such as interiors and safety and electrification.

Figures 2a and 2b apply the same taxonomy to each of the top 10 OEMs and Tier 1s. What is immediately striking is sheer size; the combined group owns over 400,000 active families. Figure 2a also highlights the significant variance between Asian OEMs (notably Toyota and Hyundai) and their US and European counterparts.

As you might expect, there is more variety in the patenting strategies of the Tier 1s (Figure 2b). This manifests itself in two ways. First, there is a more balanced distribution (IC is 45% of the aggregate for OEMs, while driveline is only 30% of the Tier 1 aggregate). Second, Tier 1s tend to focus on their core business such that over 70% of ZF's portfolio relates to driveline. A similar percentage of Johnson Controls' portfolio relates to interior and safety technologies.

It is also interesting to analyse growth over time. Figure 3 analyses patenting activity (by priority date) for the top 10 OEMs and separately for the top 10 Tier 1s. Since 2000, this has doubled in size with a marked increase in patenting by suppliers.

All this activity comes at a cost. Billions of dollars have been invested in developing and maintaining these portfolios. Figure 4 provides a snapshot for the top 10 OEMs in 2015. Again using analytics from Cipher

FIGURE 1A. Global OEMs, patented technologies

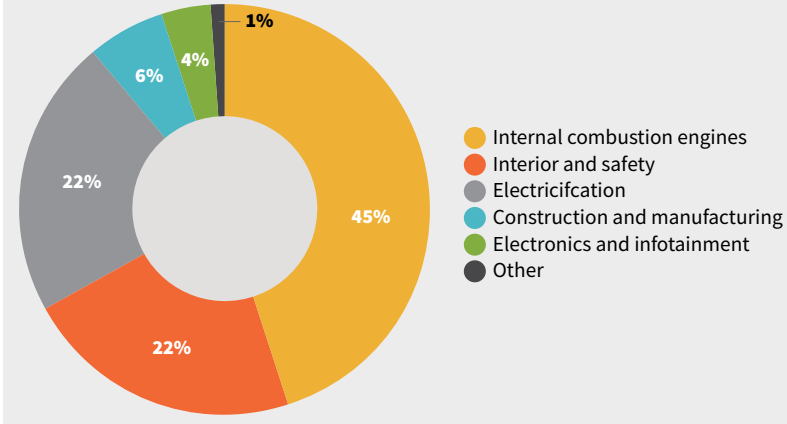


FIGURE 1B. Global Tier 1s, patented technologies

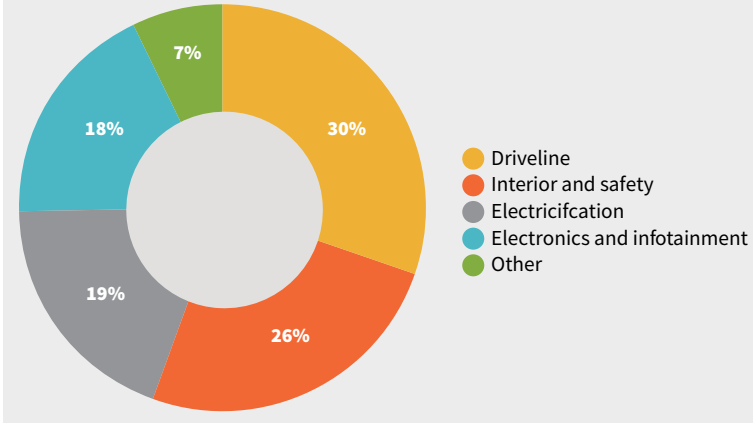


TABLE 2A. Top 10 OEMs and what they protect

	Toyota	Hyundai	Honda	Nissan	GM	VW	Ford	Suzuki	FCA	Renault	Total
Internal combustion engines	35,764	22,505	14,954	8,823	8,648	7,327	7,975	2,717	2,168	2,542	113,424
Interior and safety	14,430	13,134	7,776	2,841	4,237	5,483	3,464	1,495	1,321	1,296	55,478
Electricifcation	23,801	5,782	7,078	5,583	3,988	3,165	1,770	648	1,146	822	53,784
Construction and manufacturing	3,888	3,689	1,894	1,097	1,346	1,645	573	399	474	199	15,203
Electronics and infotainment	4,461	1,146	1,196	947	947	723	349	75	50	50	9,944
Other	374	598	199	50	100	224	50	25	0	25	1,645
Total	82,719	46,855	33,098	19,340	19,265	18,568	14,181	5,358	5,159	4,935	249,478

TABLE 2B. Top 10 Tier 1s and what they protect

	Denso	Bosch	Aisin Seiki	Conti	ZF	H Mobis	Magna	Johnson C	Faurecia	Lear	Total
Driveline	4,639	11,192	10,742	6,485	10,539	3,490	2,027	135	270	45	49,564
Interior and safety	11,462	4,076	3,581	3,108	2,927	5,495	1,959	3,896	4,256	1,103	41,863
Electricifcation	12,543	10,449	3,333	1,779	495	1,036	293	1,013	23	495	31,459
Electronics and infotainment	12,160	6,103	4,661	3,873	203	1,666	721	90	0	23	29,500
Other	2,342	3,130	3,018	405	383	203	1,284	65	180	68	11,079
Construction	0	23	45	68	90	113	135	180	158	203	1,013
Total	43,146	34,972	25,379	15,718	14,637	12,003	6,418	5,379	4,887	1,937	164,479

FIGURE 3. OEM and supplier portfolio size (2000-2015)

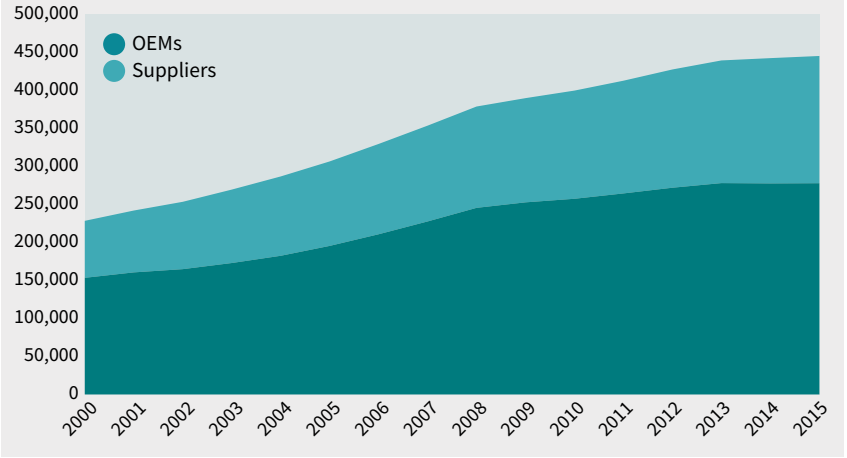
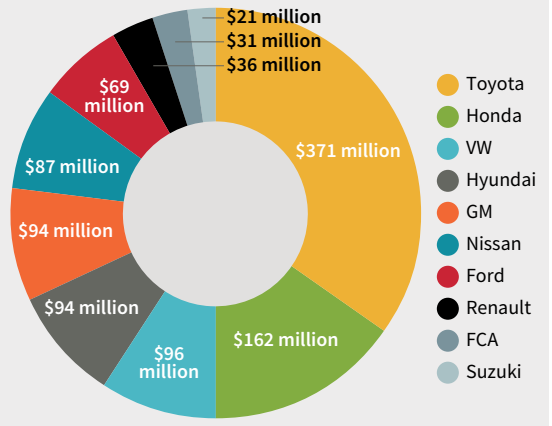


FIGURE 4. Top 10 OEMs and average annual cost over last 10 years



Automotive, it is possible to calculate the estimated costs for any portfolio or cluster within it. This data is the bedrock not only for budgeting but also benchmarking. VW, for example, has the sixth-largest portfolio (Figure 2a), but third-largest cost (Figure 4).

There are a number of factors that drive cost. Size is one, so it is unsurprising that Toyota spends the most on patenting (its portfolio is four times larger than any US or European OEM). Also important is geographic coverage.

There is a marked difference between the territorial footprint of the OEMs, which seems to suggest a home, rather than a sales, market bias. Figure 5 selects a major OEM from each of the United States, Europe, Japan and China. Each of the companies selected has well over 75% of its portfolio protected in its home market (eg, GM in the United States and VW in Europe). Except for BYD, this is at odds with vehicle sales. In 2016, only one-quarter of Toyota vehicles were sold in Japan, VW sold less than half in Europe and GM sold well under half of its vehicles in the United States. BYD (a Chinese car manufacturer founded in 2003) has a more acute problem as it considers international expansion with no patent-base from which to build.

This study of automotive patenting helps with understanding the what, but does not explain the why. The World Intellectual Property Office's conventional reasons for patenting are to protect market position, secure exclusive rights, achieve higher returns on investment, support licensing and sales, improve negotiating position and to create a positive image. It is not easy to find support for automotive patenting within this list, with two possible exceptions.

Vorsprung durch technik

The Audi slogan coined in 1971, roughly translates as "advancement through technology". Patenting is a count of inventions and may go some way to explain why automotive companies file so heavily in their home markets (see Figure 5). There is no evidence that patents form part of financial or other public relations, so it is hard to believe that reputation sits at the heart of patenting strategy.

Peace in our time

Automotive companies have historically not asserted their patents against each other. Figure 6 compares the most litigious OEMs with a similar sample from the technology and telecommunications sector (Nokia, Apple, Qualcomm, Ericsson and Google). This data highlights the fact that, notwithstanding the size of OEM portfolios, minuscule levels of litigation are initiated by the OEMs.

This supports the contention that the automotive sector today does not believe that IP issues are best resolved through litigation. On this basis, these large portfolios can be compared to the nuclear arms' race, where stockpiling is essential, if only to maintain the status quo. Whether the level of harmony will continue in the new era is a topic we will return to later.

All change – electrification, connectivity and autonomous

In June 2017, Tesla's market capitalisation passed that of BMW. Tesla had already overtaken GM and Ford in April. These are today's financial realities, even though BMW sold over 2.4 million vehicles in 2016, whereas Tesla delivered fewer than 80,000. In the same period, Tesla lost $675 million, while BMW made $7.7 billion. Morgan Stanley has recently predicted that Waymo could be worth $70 billion by 2030. The driver of these valuations is the arrival (or should we say return) of the electric vehicle and the dawn of the era of the connected and autonomous vehicle.

In order to understand how this disruption to the existing world order is affecting automobile patenting, we analysed the patenting strategies of US OEMs between 2012 and 2015 (using this cohort as a proxy for global trends). Figure 7a analyses the areas where there is growth, which includes battery electric vehicles and radar sensors. It also includes regenerative braking and cylinder blocks, making the point that the new does not trump the now, which is responsible for the vast majority of automotive revenues.

Figure 7b analyses areas of decline, with reduction across a number of traditional technologies, such as steering columns, automatic gearboxes and suspension. The fall in start-stop may tell a different story: perhaps a feature that is ubiquitous and stable?

The decrease in patenting of hydrogen fuel cells does merit further examination. Figure 8 analyses the patenting trends for fuel cells and batteries across global OEMs. For the many who believe that the pendulum is swinging dramatically in favour of batteries, this analysis provides evidence in support. The year 2010 was the tipping point and there are now over twice as many filings for batteries as fuel cells.

What also merits comment as part of this analysis is how patents are being integrated into corporate technology strategies. Elon Musk made an open source pledge in 2014 in respect of Tesla's battery patents. Toyota made a very public announcement at CES 2015 that it would make 5,680 of its fuel-cell patents available on a royalty-free basis. Strategies such as this illustrate the current automotive mindset: intellectual property as a collaborative carrot, as opposed to being used as a stick.

FIGURE 5. Study of selected OEMs geographic cover

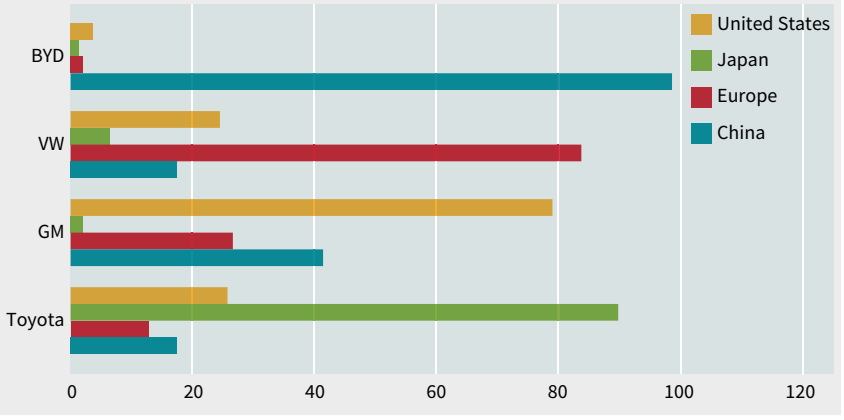
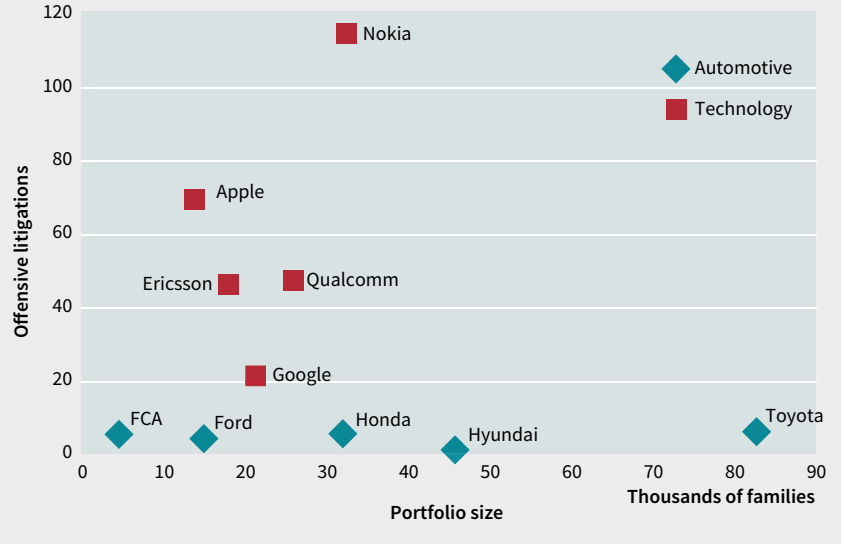


FIGURE 6. Offensive litigation, auto OEMs compared to tech



Illustrative automotive/tech collaborations

Toyota, Microsoft and NVIDIA: Announced as a patent licensing deal, Microsoft referenced telematics, entertainment, safety and other systems used in connected cars (March 2017). More recently, Toyota announced its collaboration with NVIDIA to access its artificial intelligence technology to process massive amounts of sensor data (May 2017).

Volvo Cars and Autoliv: Volvo Cars and Autoliv established a joint venture, Zenuity, to develop software for autonomous driving and driver-assistance systems (January 2017).

Delphi, BMW, Intel (and Mobileye): Delphi joined BMW, Intel and Mobileye, which previously announced an initiative to develop an autonomous driving platform (May 2017).

FIGURE 7A. US OEMs, growth areas 2012-2015

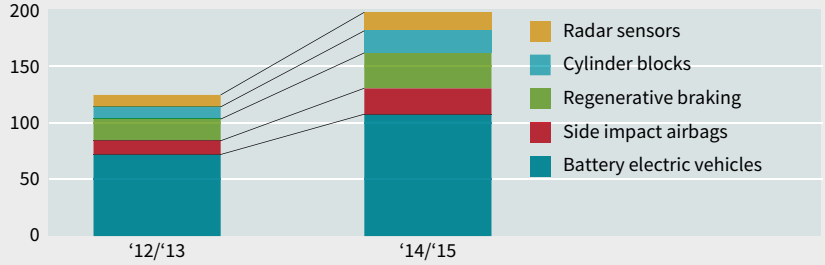


FIGURE 7B. US OEMs, areas in decline 2012-2015

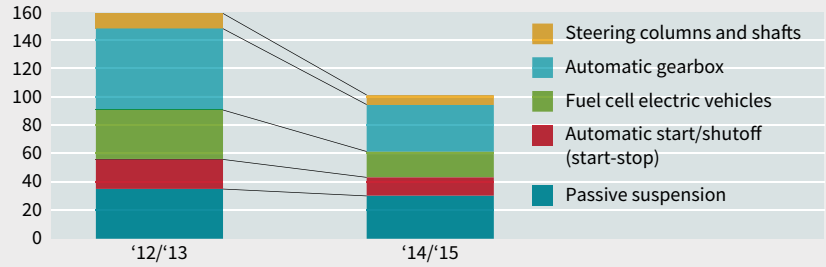


FIGURE 8. Global OEMs, activity analysis of fuel cells and batteries

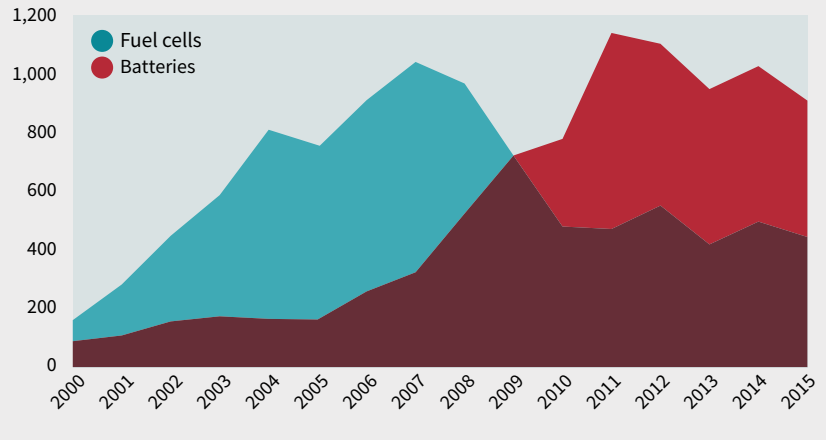
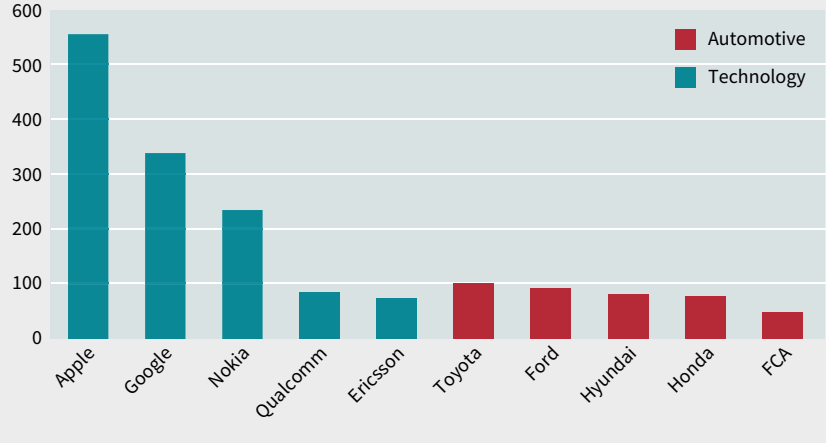


FIGURE 9. NPE actions since 2000 (tech versus auto)



Avoiding the next smartphone war

Much of the commentary around IP risk speculates on whether the connected car will be the site of the next smartphone war. The more immediate concern is whether the connected car will breathe fresh life into NPEs. Figure 9 compares NPE actions against selected OEMs and major technology companies (the same cohort as Figure 6). While the number of NPE actions is declining, it is evident that the problem has not disappeared.

While there have been many allusions to cars being smartphones on wheels, there is every reason to believe that the automotive companies will not face the same onslaught as the tech sector. NPEs planning a revival do so in an unfavourable legislative and judicial climate, and at a time where defensive measures in the form of RPX, AST, Unified Patent and LOT Network are well established.

This raises the question of whether there will be automotive wars between operating companies. This is best considered separately for electrification, autonomous and connectivity. Electrification is largely answered by the earlier discussion of batteries versus fuel cells. The technology is well established with significant patent holdings within the existing ecosystem.

The ability to deliver autonomy requires access to many foundational components owned by technology companies, which now show great interest in the automotive sector. The current torrent of deals suggest that there is a recognition that no one can go it alone. The box-out illustrates the type of collaborations which will enable technology to cross sector boundaries.

There is also a marked increase in M&A as technology companies become increasingly relevant to automotive companies (eg, Intel's acquisition of Mobileye for ADAS technologies) and automotive companies strive for independence (eg, BMW, VW, Daimler's acquisition of HERE; GM's acquisition of Cruise). A similar network of relationships can be observed in areas such as ride-sharing (eg, Waymo partnering with Lyft (a ride-sharing service), itself a company backed by General Motors).

This leaves connectivity, which was the epicentre of the smartphone wars. Dozens of actions were brought involving Nokia, Apple, Qualcomm, Samsung, Microsoft, LG Electronics, ZTE and others – in fact, nearly every major software and hardware company in the mobile phone supply chain. The principal battleground was royalties relating to 2G, 3G and 4G SEPs. Add to that 5G, and the stage is set.

It is outside the scope of this article to predict how SEP licensing to the automotive sector will be resolved. Our expectation is amicable licensing and rational pricing. Our reasons for this are threefold. First, more is known. After over a decade of litigation, there is a vast amount of experience about SEP licensing. The major owners control many thousands of SEPs and now understand the futility of litigating them one at a time. The Nokia/Samsung arbitration and the UK judgment in *Unwired Planet v Huawei* are case studies of how to resolve global SEP issues.

Second, no one wants to stand in the way. While users were willing to tolerate incompatible US and European networks and excessive roaming charges, this will not be acceptable for the connected car, so standardisation and interoperability will be a requirement from the start. This again points to collaboration – licensing platforms such as Avanci could be the way forward.

Action plan

From a patenting perspective, the automotive sector has enjoyed a period of relative calm for over 50 years. With the rapid evolution of electric vehicles and autonomous vehicles, this looks set to change which provides an opportunity for IP teams to make a difference:

- Increase your network – there will be many influences from outside the sector that will help with the transition. Take the opportunity to broaden your network.
- Cross new boundaries – there are many teams across organisations which will need to know more about the patent landscape. Find out who they are and be sure to communicate in their terms.
- Prepare for change – faced with new technologies, consider how best to close the gap. There are many new sources of IP business information which can fast-track this process.
- Focus on value – patents are not well understood by senior management but are often seen as a performance metric or a cost. Identify opportunities to change this perception by using patents as a way of influencing strategic decisions (eg, identification of partners, influencing build/buy decisions or key financials in acquisitions and divestments).
- Mitigate IP risk – gone are the days when managing risk equated to reporting on the settlement of a piece of litigation. Help to integrate risk management into mainstream corporate strategy. This transcends patenting to management of supply chain risk and membership of industry groups such as LOT Network.

Third, common sense will prevail. Connectivity is not one thing, but many. There are significant differences in the functionality delivered by in-car services such as OnStar (GM's security, navigation and remote diagnostic service) and an always-on connected car constantly communicating with other cars and the infrastructure. Equally, autonomous is a new set of technologies, which will have to find a place amongst the plethora of electric, interior, safety and driveline technologies, not to forget other IP rights such as brands and designs. SEP owners know all of this and will do the right thing.

Increased importance of patents

Intellectual property is a strategic asset. While this is repeated as doctrinal truth, the task of making this a reality falls to those who work in the sector. Patenting strategies need to support and enhance an organisation's market position. This may require a number of subtle but crucial changes:

- All change – there will be a massive investment in new technologies required by the transition to EV and autonomous. This will mean developing strategies to protect the new, while maintaining sufficient rights to protect traditional technologies, which will remain core to revenue for at least the next 10 years.
- Who is doing what – OEMs and their suppliers know each other well – competitive intelligence is inherent in the ecosystem. However, the new automotive ecosystems are larger and different. Patent analysis will be increasingly important as a way to monitor technology trends and new entrants.
- More deals, less time – there will be acquisitions, divestments, partnerships and collaborations of all shapes and sizes. The majority will have key technology drivers. Patents will be a crucial part of due diligence and it will be more important than ever to assess their relevance and importance against the wider and complex technology landscape.
- Mitigating IP risk – the technology sector (eg, Intel, Microsoft, Google and Apple) have a very different perspective on IP risk and specifically patents, than the automotive sector. It is critical that, as these two worlds meet, there is no assumption of right and wrong, and that each side can benefit from the experiences of the other to mould a sector that encapsulates the best of both.
- Standardisation – there are plenty of examples of sectors which have found it hard to standardise (eg, trains, TV and mobile phones, not to mention plugs). Patents (and fair, reasonable and non-discriminatory terms) inevitably have a role to play in determining who deserves what. While this is a new area for the automotive sector, we should be optimistic that the decades of experience of SEP licensing in telecoms (not all good) can be leveraged to full advantage.
- Intellectual property as a team sport – there has been a tendency for automotive patenting to be isolated from mainstream business strategy. This is likely to change as technology becomes the key driver of many strategic, R&D and collaboration decisions.
- Responsibility, not power – the quasi-monopoly conferred by a patent has been abused in recent times and the adverse reaction (by business, the media and the legislature) has not benefited the patent system. There will be an opportunity to redress the balance as the automotive sector becomes a vibrant testbed in which to apply the accumulated experiences across time, industries and geography.

The automotive sector is the home of many of the greatest inventions of all time. The fact that there will never be one patent which will control the development of EVs or autonomous vehicles does not make patents less important. Quite the opposite. It is the fact that there are so many inventions by so many people that will give fresh meaning to the role of patents. In an era where data science and artificial intelligence can enhance the ability of patents to communicate information to the world (and not just patent professionals), there is every reason to believe that patents will play an essential role in shaping the sector for many years to come. iam

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All data is accurate as of August 1 2017. The charts are generated by Cipher Automotive using a taxonomy developed in collaboration with a number of OEMs and Tier 1s