Editorial

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The last international colloquium of Gerpisa in Paris focused on the tension between, on the one hand, the current evolution of the automotive sector, which is one of the most capital insensitive industries and, for this very same reason, one of the most conservative ones; and, on the other hand, the several radical transformations that are now 'expected' to disrupt this industry in a very near future: the EV revolution, the digital and autonomous car revolution, the new mobility revolution and the Industry 4.0 revolution.

Almost everyday (Pardi and Calabrese, 2017), new forecasts from authoritative agencies announce that the car as we have come to know it until the beginning of the 21st century – privately acquired and owned, personally driven, propelled by an internal combustion engine and manufactured by human beings is about to cease to exist, replaced by electric, autonomous, connected mobility services whose supports – the cars – will be

produced in highly automated, flexible and interconnected factories. Carmakers and automotive traditional suppliers do not contest these views: they rather portray themselves as the future providers of these new services and technologies. Several reports suggest that if they do not (or even if they do), other actors, ranging from GAFA (Google, Apple, Facebook, Amazon) to others information and communication technology (ICT) and 'social network' firms and start-ups, will take the control of this new digital value chain (Donada and Attias, 2015).

Yet, if one looks at the 97 millions of new cars and light vehicles sold worldwide in 2017, an all time record, it is hard to see many traces of these ongoing and/or upcoming revolutions. Indeed, never before in the history of humankind the traditional players of the automotive industry had produced so many conventional, ICE propelled and privately owned and driven cars. Of course, all the carmakers have been announcing the launch of an increasing number of EV and PHEV models, and full autonomous cars are expected to be on the roads for as soon as the early 2020s, but again, when one looks at their prices (very high for both) and performances (clearly inferiors to ICEs for EVs, and still in their infancy for AVs) is difficult to see how they could replace in the tastes of consumers the best selling models in each major market (Proff and Fojcik, 2016).

The first difficulty with disruptive innovations is that they are supposed to start small, before becoming dominant very quickly. The smartphone for instance moved from 6% to more than 50% of the US market in less than four years. But how to know in advance if we are dealing with true radical changes or passing fashions? How to properly characterise their dynamics in order to assess what is actually happening? More precisely, what are the economic, technological, institutional, political and social conditions that would allow these radical changes to take place and diffuse? Companies like Tesla and Uber do appear as successful disruptive players, pushing forward fully electric cars, new mobility services and autonomous vehicles, but their impact is still very small and one may question how long they can survive if their losses grow faster than their revenues. More generally, what are the 'business models' that sustain these radical transformations? It is indeed important to remind that so far nobody is really making any money in any of these new businesses.

The second difficulty with disruptive innovations is that they are supposed to grow by 'disrupting' existing markets for goods and services, and this is why they are systematically associated with new companies emerging in a given market or 'invaders' coming from other sectors (Christensen, 1997). But in the automotive industry there are no clear candidates to play this role. While there are no doubts that the GAFA and other ICT companies would like to take a share of the future market for connected services and autonomous driving, they have not shown so far any intention to really build their own cars. What they are rather doing is making alliances with traditional carmakers to develop their businesses in this field. Tesla, on the other hand, is a good example of how difficult it is to make money in the automotive industry. Producing a car requires huge investments in fixed capital and it is only with significant volumes and a very high degree of efficiency that the returns on investments can be, in the best-case scenario, slightly positive. By contrast, if these conditions are not met, losses can pile up very quickly. For instance in 2016, eight years after the start of production, Tesla has produced 76,230 cars for a loss of $0.7 million; the cumulated losses amount to $2.3 million and represent one third of total sales while the total running debt of the company is of $23 million, which is more or less half of its total value in the stock market. In other words, without constant

cash inflows from investors Tesla would be already bankrupted. And yet, we are talking about the most successful start-up involved in the production of cars.

But if start-ups and GAFA will not disrupt the automotive industry, who will do it? As already argued by MacDuffie and Fujimoto (2010) some years ago, 'dinosaurs', the traditional incumbent long-standing players of the industry, are probably the only companies around that can really master the growing complexity implied by all these transformations in the design and production of cars without losing money every step of the way. But if these revolutions will be eventually done by the incumbents, what kind of revolutions will they be? Aren't these companies those that have the least interest in 'disrupting' their own businesses?

In this special number, Alex Covarrubias V tries to make sense of this paradox by combining the theory of disruptive innovations developed by Christensen (1997) and Wessel and, Christensen (2015) with the dialectic issue life cycle (DILC) model proposed by Geels and Penna (2015). He argues that disruptive innovations and technologies are brought to the automotive sector by digital companies, such as Tesla, Uber, Google and Apple, but that the final outcome of these transformations will ultimately depend on how the carmakers and other traditional players of the industry will adapt and transform in reaction to these external pressures. This entails notably the search of a 'new balancing act': by moving from a defensive to a proactive approach towards these new technologies incumbents will have to rethink their business models in order to lead the innovation race.

Yet, this 'new balancing act' is clearly fraught with difficulties. David Morris, Garikayi Madzudzo and Alexeis Garcia-Perez provide in this special number a stimulating overview of one of the most underrated challenges raised by these upcoming 'revolutions': the issue of cyber-security. Connected cars, and even more autonomous and electric cars will be prone to cyber-attacks, unauthorised access and manipulations from outside as it is already the case for computers and all other kinds of connected devices. The consequences could be devastating ranging from cyber-terrorism, massive ransoms and large-scale sabotage. The paper highlights the fundamental role of cooperation and in particular of information and knowledge sharing between carmakers and suppliers in order to mitigate cyber-security threats which are also, ironically, the main obstacle in the current development of cyber-security. Carmakers have indeed many reasons to under-report cyber-security incidents that might frighten consumers and impact sales and reputation. They are also very reluctant to share confidential commercial information protected by legal rights. Under these conditions, Morris et al. argue that the advantage is clearly on the side of the attackers and that only a highly coordinated and organised answer from the incumbent players of the industry could create the conditions to deal with the cyber-security challenge.

From a different perspective, Samuel Klebaner, the winner of the 2017 Young Author Prize of Gerpisa, explores a second key reason that pushes carmakers to embrace at least some of these revolutions: the regulatory pressure. By focusing on the outcomes of the dieselgate at the European Parliament level, he tries to answer the following important question: why industry stakeholders, and in particular the European Automobile Manufacturers Association (ACEA), are actively participating in the co-construction of a regulation that goes against their own interests? It is indeed quite clear that the agreed introduction of the real driving emission (RDE) regulation in September 2017 is going to make extremely difficult for European carmakers to homologate diesel vehicles without

significant cost penalties. Yet, despite their terrible image, diesel vehicles still represent over 50% of the European sales of new cars, and, even more important, without these sales it will be almost impossible for European carmakers to meet the 2021 new target for CO_2 average emission of 90 g per kilometre, since gasoline cars emit 20% more CO_2 that an equivalent diesel model. Of course, the alternative is to sell EVs and HEVs, but these sales are completely dependent on public subsidies, and due to their high prices (in particular for HEVs), small autonomy, long recharging time, and low resale value (in particular for EVs), the willingness to pay of consumers for these green vehicles is still very small.

The paper offers two interesting insights into what has been really happening behind the scenes of the RDE regulation. First, it shows that the interests of the automotive industry are very heterogeneous concerning this issue: on the one hand, suppliers push for more greening technology, and in particular the catalyst manufacturers that hold the strongest position in favour of tighter air pollutant emissions limits; on the other hand, OEMs are much more reluctant to push for more stringent regulations because these can affect their costs and margins even though for premium brands these costs are much more easily absorbed than for generalists. Second, it highlights how the new regulation represents a compromise whose objective is not to phase out the diesel cars but to save them from the scandal of the dieselgate. Indeed, by making the selective catalyst reduction compulsory (the only technology that can possibly clean up diesel engines for the new homologation cycles) the regulation reduces uncertainty for carmakers and suppliers allowing for bigger economies of scale and lower costs.

A third insight that we can take from this analysis, is that EVs and HEVs are not considered so far by the European automotive industry as a new paradigm that will completely replace ICE cars in the next future, but rather as a complementary technological solutions to reduce the average emissions of the fleet sold in the market and to comply with the new CO_2 regulations.

The last two contributions to this special number are more focused on the current evolution of the automotive sector rather than on the upcoming 'expected' disruptions, but they still provide interesting insights into why 'dinosaurs' should keep ruling the automotive world for a long time.

Zejian Li's paper on the introduction of mega-platforms by local Chinese carmakers shows that in order to survive in a growing competing Chinese market local companies need to constantly expand their range and also increase the renewal rate of their models. With dedicated platforms for different kinds of vehicles this implies diminishing volumes per platform and very low-profitability models. Mega-platforms, as the *Modularer Querbaukasten* (MQB) pioneered by Volkswagen, provide a solution to this problem, because they allow for a higher variety of models produced on a same platform with a high degree of standardisation through smaller modules that can be combined together. Contrary to some Industry 4.0 narratives that suggest that economies of scale will be less important in the future, thanks for instance to 3D metal printing, mega-platforms actually raise significantly the barriers to entry in the automotive sector. On the one hand, only big players with a significant range of models and strong design architecture capabilities can afford to make this kind of investment. On the other hand, because of the huge fixed costs implied by such a mega platforms, these companies develop aggressive commercial strategies to increase sales, eventually squeezing-out smaller players from the market.

Darina Lepadatu and Thomas Janoski's paper focuses on the US auto industry, and in particular on the evolution of the employment relationship in Japanese transplants and

their lean factories. In the *Machine that Changed the World*, Womack et al. (1990) stated that:

> "…Once lean production principles are fully instituted, companies will be able to move rapidly in the 1990s to automate most of the remaining repetitive tasks in auto assembly – and more. Thus by the end of the century we expect that lean-assembly plants will be populated almost entirely by highly skilled problem solvers whose task will be to think continually of ways to make the system run more smoothly and productively." (p.102)

Their prophecy turn out to be wrong on both accounts: on the one hand, the degree of automation in assembly plants have rather declined in the 1990s and 2000s, as the need for further flexibility scaled down previous investments and experimentations in automation; on the other hand, lean factories are now populated by an increasing number of unskilled or semi-skilled workers performing hard and repetitive tasks while the middle shop-floor management has been significantly reduced. Furthermore, as Lepadatu and Janoski show in the paper, temporary workers have become a structural feature of lean factories, representing on average more than 20% of the total employment. These workers do not have employment security, are paid significantly less than permanent workers and are under higher physical and psychological pressure to perform in teams. Their precarious status clearly contradicts the whole ideology of long-term employment and equality in teamwork that was conveyed by lean production promoters and employers. It also reminds of the crucial importance of human work and agency in car factories in particular when products and technologies are becoming more complex and heterogeneous. At a time when new narratives of smart and highly automated factories dominate the debates about the future of manufacturing, this an important message to retain: robots will not solve the tensions, conflicts and contradictions of the lean production workplaces.

All in all this special number presents a contrasted but generally 'conservative' view about the present and the future of the automotive industry where current trends and evolutions are expected to take the lead over more radical transformations. Our next international colloquium in Sao Paulo, Brazil, 'Who drives the change? New and traditional players in the global automotive sector' (11–13 June 2018), will be the occasion to challenge these positions and to debate about more disruptive scenarios. What is indeed particularly exciting and stimulating about the present state of the automotive industry is that while it is very much probable that most of what we know about this sector will be still true tomorrow, the exact opposite is also possible.

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