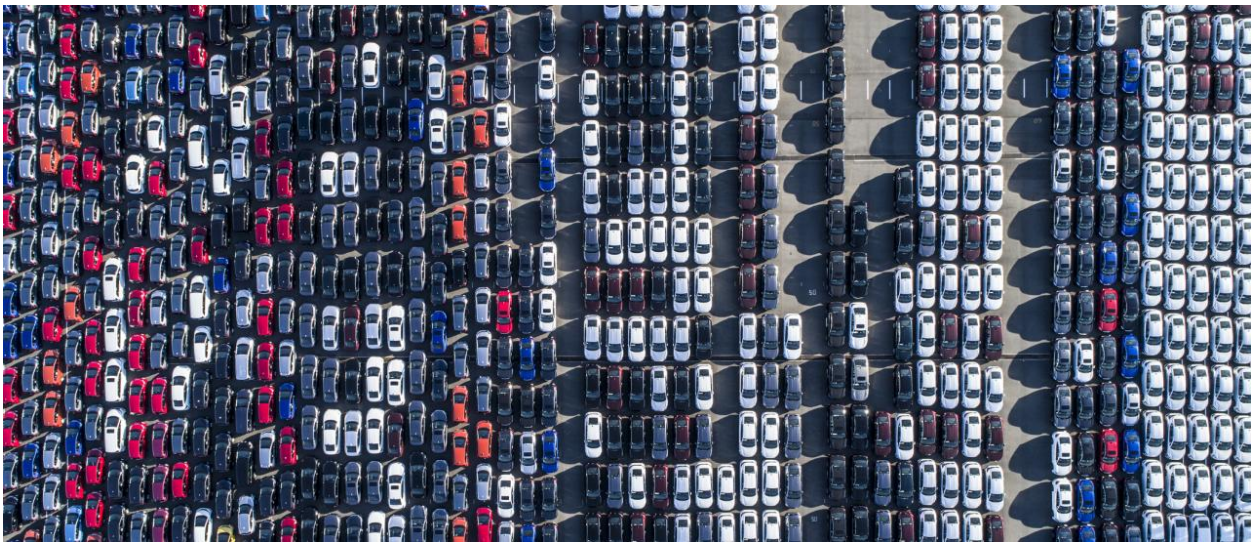
A Potential Playbook for the Future of the Car Industry



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Here's how automakers should optimise their processes in Manufacturing 4.0.

One fine morning in 1909, Henry Ford made a surprise announcement during a company meeting. In the future, Ford Motor would stick to a single car model, the Model T, in black only. No other choices or, as he said, "Any customer can have a car painted any colour that he wants so long as it is black." The lesser-known part of the story is the reaction of the sales executives present – they were livid. As Ford put it in his **biography**: "I cannot say that any one agreed with me." In fact, equally unimpressed with his decision that the car would be affordable, observers started wondering: "How soon will Ford blow up?"

Of course, we now know that Ford was onto something. The Model T sold for another 18 years, and additional colours only returned in the last year of production. Ford pioneered standardised mass production with its single-minded goal of minimising operating costs. The Model T came in black because it was the hue that dried the fastest.

However, over the years, increasing competition forced automakers to cater to the market's varying tastes. Consumers desired more options and manufacturers started obliging, in the hopes of extracting a premium in exchange. This differentiation strategy worked for some time, but once too many players got in on the game, customisation lost much of its power to command higher prices.

Executives went back to the drawing board to figure out how to offer variety without sending their fixed costs through the roof – after all, automotive plants do not come cheap. Then as now, executives faced a lot of uncertainty. Take Chrysler, for example. In 2000, its PT Cruiser model sold like hot cakes, whereas its Town & Country minivans struggled. As both products were manufactured on dedicated lines, Chrysler could not shift capacity from one line to the next quickly enough and lost approximately US$2 billion.

Flexibility as an early solution

To avoid being stuck with inventory or underutilised capacity, the industry turned to the concept of flexibility. Simply put, it meant having assembly plants flexible enough to produce more than one model. With any luck, the lack of correlation between the demand for different products would make it possible to optimise capacity. Obviously, flexibility involved modularising car designs to some extent – for instance, using a common chassis or shared specifications. It was also not free: Retooling a line to allow it to produce multiple models requires investment.

Just when the industry was grappling with these issues, out came a paper by **Jordan and Graves**. It introduced the concept of chaining, which is essentially: *Firms need to invest money in creating flexibility, but a little will go a long way if it's done cleverly.* That paper went on to be cited nearly a thousand times – a blockbuster by academic standards. However, as researchers, we were surprised to find vehicle model production data showing that, despite the stated benefits of flexibility and the ever-increasing amount of car models, the industry moved in the opposite

direction. From 1998 to 2006, carmakers *reduced* the flexibility of their plants. For example, Ford was manufacturing nine models in flexible plants in 1998; by 2006, that number had dropped to just three.

We thus set out to examine the rationale of carmakers. Were the benefits of flexibility overstated? Its costs understated?

The inverted U-shape benefits of flexibility

Perusing the literature, we found that empirical studies examined flexibility from the narrow perspective of individual plants instead of a whole company's network. Meanwhile, the theoretical models didn't consider changeovers and their associated costs. Every time a plant switches models, the production line needs to be shut down in order to get it ready to start producing another model. Aside from the retooling costs, changeovers involve both ramp-down and ramp-up periods that lower overall labour productivity. In sum, while both empirical and theoretical studies were correct within their parameters, the empirical ones understated the benefits of flexibility, while theoretical models overstated them.

In our recent working paper, "**Do Flexibility and Chaining Really Help? An Empirical Analysis of Automotive Plant Networks**", we put all the pieces of the puzzle together and show that flexibility does benefit firms, *when applied in great moderation*. Some flexibility allows firms to better utilise their capacity. However, as flexibility increases, the downsides of changeovers start to spiral and impact productivity.

These results beg the question: Just how much flexibility is ideal? Circling back to Jordan and Graves – who argued for chaining, or a little flexibility done in a clever way – we find that even chaining is still too much, due to the high costs of changeover in terms of labour hours lost. This is consistent with the observations we made during our examination of real-life automotive assembly plant networks.

Implications for the future of the car industry

Our message to automotive manufacturing managers is this: Your firm probably needs much less flexibility than chaining to optimise its productivity. In making decisions regarding flexibility, firms should consider their whole network, as well as adopt new measures of flexibility that takes it into account. Our paper introduces one such flexibility metric that captures

both demand-supply matching and changeover losses.

Our findings on flexibility have considerable implications in terms of automobile design. Cars are already built in a somewhat Lego-like way, but our paper – based on real-life changeover data – shows that this is not good enough. Could cars be further modularised? Ford Motor seems to think so. About a year ago, it announced that it would move away from vehicle platforms and retain only **five flexible vehicle architectures**, which would come with either an electric or internal combustion engine.

Looking even further ahead, could some auto parts be 3D-printed, either at the plant or literally in the back of the car showroom? It's not that far-fetched. A US company, **Local Motors**, launched the world's first 3D-printed car in 2014 and now has several micro-factories in the US as well as one in Germany.

In some ways, the industry might be looking at a return to the highly standardised Model T, with only a splash of variety. Fifteen or twenty years from now, it is possible that product differentiation will be found less in the hardware (the car body and engine) and more in the software – the technology that goes into the car. Tesla is already adding new features and functionality to its vehicles as they sit in their owners' garages via wireless **software updates**.

For those planning the strategic future of the auto industry, higher and higher physical standardisation may just be the playbook. Wherever he is now, Henry Ford is smiling.

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