MQB modular platforms, and design evolution
We have grown used to platforms being the core guide to the vehicle design, generally giving some indication of how the vehicle will be constructed. Knowing a Chevrolet Cruze is on the Delta2 platform, gave a strong indication that it will share many construction traits (such as material and joining techniques) with the Vauxhall Astra. Typically the platform is chosen for its wheelbase and dimensions.
However, there is an important shift in production techniques being driven by a need for greater cost efficiency and production flexibility. Commercially, vehicle manufacturers need to be able to produce a greater range of vehicles on each production line. This was illustrated during the Asian tsunami crisis when Japanese manufacturers were relatively quickly able to shift production away from the devastated facilities in Japan.

Economic factors also include being better able to respond to market changes. With the somewhat depressed European economy, it is relatively cost effective to produce cars in Europe, but should labour costs dramatically increase, production can be shifted elsewhere. For vehicles that achieve sales volumes that enable full capacity at a plant, such as Toyota Hilux or VW Golf, economies of scale are easy to achieve. If a vehicle does not achieve such a high sales volume which does not keep the production plant at 100% capacity, the overheads of the facility, not operating at peak, can soon affect the profit margin of each car sold. So by adding more models into each plant, greater capacity utilisation can be achieved and consequential lower production costs attained.
There are important quality benefits to be gained from a greater integration of more models on each production line and a greater consistency globally. Honda is one manufacturer that collates data and compares quality reports from all of their global plants, to ensure best practice and consistent standards are maintained. But there is more to come on quality.

Greater integration and flexibility can also benefit the supply chain. If two cars are sharing components on the production line, it reduces the number of components needing to be supplied and available at production. By sharing floor and chassis components, one Japanese car manufacturer claimed to be able to build 8 models on one production line. This includes estate, saloon, hatch variants, but does also include different model ranges, so is impressive nonetheless.
Skoda Rapid has been designed and engineered on what were effectively 2 or 3 platforms, one of which was the PQ26 that is the basis for the Audi A1. An effective side impact structure has been constructed using Press Hardened Steel and High Strength Steels for the A-post, B-post, Sill, and for the roof side rails and header rail.

This floor platform and occupant cell unit (including doors) is used as a basis for other VW/Audi Group vehicles globally, such as Seat Toledo, and vehicles supplied to Asian markets such as VW Vento.

But there is more to the inclusion of HSS and PHS in the structure than meets the eye; it is not solely used for the impact resistance. Use of materials such as PHS has been used to substitute single panels, where previously several reinforcements would have been required.

This reduces the parts/panel count, which simplifies supply and production. This may very well have a positive effect on aftermarket supply of panels for accident repairs. The other obvious benefit of greater HSS and UHSS content and lower parts count is reduced body weight. The Rapid is nearly the same size as the Skoda Octavia, yet is within 5kg of the much smaller Fabia.

As the Rapid is constructed using a single piece body-side panel, changes to different models for different markets can be restricted to joining on a slightly different body-side and the significant changes are therefore restricted to other hang-on panels; the only real difference that need concern the manufacturer body shop.

Two new vehicles are illustrating the changes to the established and understood practices:
There is also significant improvement to the time taken to integrate a model into the production facilities as the logistical chain, the weld-stations, cycle times and even production line size/complexity is already known and tooling can be arranged quicker. And this consistency leads to greater production quality as “bugs” and issues have already been resolved at the prototype master production line.

VW/Audi MQB is a different philosophy. First seen on the Audi A3 (2012MY), it will shortly be used for the VW Golf VII. MQB is perhaps better thought of as a platform “kit” of compatible and standardised panel sets. This has been achieved by standardising some selected key dimensions for the platform, such as pedals to front axle and making modules with options to allow combinations that give flexibility in construction.

The front and under-body chassis rails comprise one module, with 3 different sets to select from for different engine & transmissions.

The front floor, transmission tunnel, and inner sills and reinforcements comprise the 2nd module. The rearward length of the floor and of the sill reinforcements defines the different module options suitability for 3 door, 5-door, estate, cabriolet, or coupe.
The 3rd module is the rear floor, which can define different wheelbases (of which there are 4 with MQB) as the front axle dimension is fixed. The length and shape of the rear floor will also define the body-shape derivative or whether the vehicle is to accommodate a high voltage battery as a hybrid of full EV. The decision to define the rear of the front floor module, ahead of the rear bench was taken to allow future VW/Audi Group energy package options, such as HV developments and even Hydrogen fuel. This platform kit concept was developed from the outset to be able to accommodate these options.

The production line for the Body in White is now more radial than linear. The different modules required at each plant, being produced at various weld/bonding stations prior to the required 3 modules being selected and joined to produce the vehicle floor platform assembly.
But the modular nature of this concept means that the clamping locations for the different derivatives are consistent and minimal changes to the weld station robot patterns are required. Audi believes this leads to as much as a 23% decrease in production time; a quite significant cost saving.

It also means that some plants, such as Foshan in China, will see Audi A3 and VW Golf coming down the same production line. Inclusion of a greater percentage of HSS and Press Hardened Steels, as with the Skoda Rapid, also leads to reduced number of panels/components. This further reduces production complexity for VW/Audi Group.

This is not the first and only modular platform for VW/Audi Group. The MLB platform has been used for several Audi models. MLB (for longitudinal engines) has already aided Audi reduce product development time and, just as importantly, reduce costs. The next generation A6, A8, Q7, and Q2 will all be on the MLB platform.

Both of these platform “kits” are core to VW plans to be the number one car manufacturer by 2018 and if this rate of development and production efficiency continues, that target may be achieved by 2016.

With both of these vehicles and with others, we see a further increase in laser welding & brazing, bonding and riveting. This decreases the number of spot welds in the vehicle body, which has also enabled this decrease in unit production time. Engineering decisions have to include production efficiency, so it is not unknown for a different joining technique to be used for some panels, solely to reduce time spent at one weld-station. This results in greater consistency, with time spent at other stations and a greater overall throughput of production. The cost benefits of this for a model that is planned for production volumes of 200,000 per year should not be under estimated.
The accuracy and robust flexibility of this package means that the Audi A3 Fastback is being developed without a physical prototype; confidence is that high.

There are quality benefits from this further development of vehicle construction too. Each join is a potential quality issue, so each part saved is a quality issue avoided. And the improvements in torsional rigidity give greater noise reduction and enables sharper, better handling and more agile cars.

BMW have used very similar ideas with the new F30 3-series. Again, this is a truly global car with annual sales of 340,000 units in 130 different counties; therefore production efficiency is critical. BMW achieved greater integration of production by taking the 1 series PL2 platform as a base. By establishing 1-series and 3-series as sub lines of the same architecture, they were able to define the number of body derivatives, wheelbases, and body overhangs (i.e. 3-series saloon has a rear overhang that is greater than the 1-series hatch) that are required in total. By planning both off the same platform from the outset, the number of unique components required for the platform to be used for 3-series was greatly reduced. And of these many were considered “synergy” parts that use the same tooling in production.

Sub-line A BMW 1-series models (with 2 models to come)

Sub-line B BMW 3-series models
This BMW platform production is split into modules;

The front bulkhead and engine bay is one module, with 1 series and 3 series being slightly different, and submodules for cabriolet versions (4 series) if/when they launch.

The main floor is the 2nd module, with 3 versions: 1-series, 3-series, and 3-series for China, as this has a different wheelbase. These can be varied with differing sub-assemblies of these modules for hybrids, 4WD or for estate versions.

The 3rd module is the rear floor/wheelhouse section, with 2 main modules but sub-modules for hybrids, cabriolet, or Tourer’s.

Whilst less modular than the VW/Audi MQB package, this modularity allows pre-assembly in other press shops before the appropriate modules are joined to become the platform for each vehicle in the production line.

This modular process enables better handling of the 6 main body types for the 3-series; x-drive (4WD), S-drive (RWD), and Hybrid drive, all with or without sunroof.

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There is the added benefit of the same mounting clamping for the production line being used for 1-series and 3-series. By using automated turntables at many stations, with derivative specific body grippers, the same robots are easily able to handle either model.

Again, as with the Audi A3, this has also helped BMW develop the 3-series Tourer without a prototype model.
You’d not expect Mercedes to be left behind and they certainly haven’t. The new B class (W246) was launched earlier this year on the MFA (Modular Front Antrieb) platform, which shall be seen again, already on the new A-class (W176) from December.

The Rastatt plant should have greater production capacity using the new platform, and production roll out to Kecskemet in Hungary and Beijing in China will follow swiftly. 100,000 units have been contracted out to Valmet in Finland whilst production ramps up.

Mercedes Benz has spent 1.4 billion euros building and developing Rastatt and Kecskemet for the new cars, and the X156 small SUV from Mercedes is planned for production at Rastatt, and Kecskemet is preparing already for the CLC.
Mercedes are recouping some costs by licencing their platform to other vehicle manufacturers, initially Renault, with Nissan investigating the benefits of using the MFA platform idea for an entry level Infiniti model.

Fewer parts, made from thinner gauge HSS, UHSS, Press Hardened Steels, or aluminium, also leads to reduced weight of the body and the overall vehicle. This enables inclusion of more sophisticated systems and interiors, but more importantly, engine downsizing and reduced emissions as less energy is required to move the vehicle mass. In recent years we have seen HSS inclusion increase to nearly 50% of the vehicle body. We have now reached the point where HSS and UHSS material content has surpassed this to as much as 60 – 65% of the content. In recent years we have seen HSS inclusion increase to nearly 50% of the vehicle body. We have now reached the point where HSS and UHSS material content has surpassed this to as much as 60 – 65% of the content.

Many manufacturers are increasingly buying in pre-formed panels. The B-pillar for the 3-series is one example of this.

It is clear that engineering is becoming far more globally focussed and the accountants are keeping a firm control to ensure construction is efficient and cost-effective. Engineering decisions are taken with regard to production cost, with one manufacturer openly admitting that cost was the dominant factor in most decisions. And this is not merely restricted to steel. Land Rover will produce at least two more models on the aluminium platform for the new Range Rover.
The L405 is an impressive 400kg lighter than its predecessor, which has a great impact on efficiency and emissions. And the production techniques that are predominantly focussed around riveting will be further enhanced for these future models and possibly even for other light weight material such as Carbon Fibre (CFRP).

As seen above, some components will be “bought-in” as required, rather than adding a complex and costly additional production process to the manufacturer bodyshop.

VW Group has invested $50 billion over 4 years to develop and implement the modular MQB platform. But the pay-off is that as more and more new models are developed in this way, the time taken to realise the concept car into actual production, will be greatly reduced.

The increased productivity may benefit the western European car industry in other ways. One recent report suggested that car production typically costs €36 per hour in France and Germany, but just €10 in the Czech Republic, €6 in Poland, and just €3 in Romania. The manufacturers do not want to close production plants in their home countries (which is bad public relations) so it’s imperative that these plants are ultra-efficient so they remain viable.

And whilst the even greater inclusion of High Strength Steels and Ultra High Strength Steels will present engineering challenges, the reduction in parts count and the greater sharing of structures will maybe lead to greater availability and cheaper replacement panel unit costs. It is entirely conceivable that panels could be sourced from other suppliers servicing the relevant platform set; i.e ordering a VW sill panel from Audi or Seat dealer.
There may be other benefits to be gained in accident repair. Whilst many of the model defining cosmetic and exterior panels may be unique, it is quite possible that there will be far greater commonality in replacement of structural panels, with panel technicians finding removal and replacement of a panel familiar from other cars they have repaired with similar platforms.

However, this needs to be balanced with the fact that the majority of accident repairs are light structural or cosmetic. In the case of the Skoda Rapid A0 platform set that includes the door panels this may have a positive impact on cosmetic repairs, but this model is an exception.

What may have a greater impact on repair is that by using this modular strategy vehicle development and production roll-out is much quicker. So many more new models will be coming to market. Nissan has been reported to have a plan for 51 new models by 2018, and the VW Strategy 2018 targets an increase in sales from 8million cars in 2011 to 10million by 2018 with MQB underpinning many of these new models. This could pose a huge challenge in repair and the need for good methods availability is even more important.

One other question is whether the benefits of greater panel sharing between models will be negated by the greater stock holding required more so many new models and the legacy models. Franchised dealer stock is smaller than it used to be with quicker supply from centralised manufacturer warehouses being quicker than before, but this supply logistical chain may be put under strain.

Further developments of high voltage battery packs and with hydrogen fuel packaging, may lead to other modules within the platform sets, but it is in the manufacturers interests to keep additions to a minimum. As we have already seen, some manufacturers have developed their platform sets with future technological developments in mind.
What is clear is that for vehicle manufacturers that wish to survive and grow in a competitive and changing global market, car design and car manufacture are not separate operations. Car design now incorporates manufacturing efficiency into the design decision process and manufacturing is learning to be far more flexible to adapt and adopt more and more options.