# *Henry Ford and the Model T: lessons for product platforming and mass customization*

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*Henry Ford is recognized as the father of mass production, but his contributions extend well beyond that, offering valuable lessons for product platforming and mass customization. In this paper, we study Ford's Model T and its many variants in depth and describe insights into Ford's vision and his car. In particular, we examine how the platform was built, leveraged and dynamically maintained with continuous improvements to maximize learning and economies of scale. Finally, we compare Ford's approach to more current approaches for platforming and mass customization. October 2008 marked the 100-year anniversary of the introduction of the Model T. In some aspects this old car still outperforms us, and we can learn valuable lessons from its past to avoid future mistakes and improve current practices.*


*Keywords: design practice, automotive design, design history, customization, product development*

Many of today's industries target platform-based products tailored to customers' needs through derivative products. This approach enables companies to increase their market share and reduce their development and manufacturing costs (Meyer and Lehnerd, 1997; Robertson and Ulrich, 1998). Even if platform-based product development is better understood and managed today, it is still far from being mastered by industry and academia (Alizon et al., 2007). Thus, the goal in this study is to examine one of the most successful products in automotive history, namely, the Ford Model T. We assert that the Model T was one of the first platform-based products ever produced in quantity and one of the most efficiently designed. Despite the famous maxim attributed to Henry Ford: 'You can have any color car so long as it's black', Ford's contributions extend far beyond being the pioneer of mass production processes. Ford adapted techniques from the U.S. weapon and meat packing industries to the automotive industry and improved

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it to its limits by rigorous principles (Hounshell, 1984). Each Model T model was built on the same platform, with a deep level of customization: the body was specific to each model. Nowadays, only the 'Skateboard' concept and the Sequel prototype by GM (Eberle, 2006) target the same level of customization. Furthermore, this platform was improved over time along with the models. For all these reasons we suggest that the Model T platform was and is still a reference in terms of platform-based design, permitting Henry Ford to tailor derivative products for multiple market segments, and to even mass customize this product based on an original approach.

Managing variety is not a new phenomenon and goes back to the beginning of the industrial revolution and even predates it (Arndt and Kierzkowski, 2001); therefore, there has always been room for fragmented markets to emerge. Hence, at the beginning of the automotive industry, mass production was the right choice (with an average of 5 models per year over 19 years) (Hounshell, 1984). Ford also engendered principles for mass customization by developing a core platform with a high level of production while outsourcing tailored products to specialized companies.

The first aim in this study is historical, highlighting Henry Ford's work in terms of product platforming and mass customization; usually only mass production is considered (Hounshell, 1984). The second aim is to discuss how Ford and his team developed the Model T as a platform and why and how it was possible to easily customize this car. Finally, the last aim is to extend this success to today's platform-based approach, garnering insights from the past and lessons learned from this success story.

In the next section, we revisit the Model T's history, discussing its lifecycle, design, and manufacturing processes. This description explains why and how Ford did more that just implementing mass production; hence, Sections 2 and 3 discuss how Ford specified a relevant product platform, which enabled mass customization strategy. This study is based primarily on a historical viewpoint (Clymer, 1955), two technical sources (Fahnestock, 1921; Ford Motor Company, 1921), and an existing Model T (a Touring 1923).

## 1 *Related literature*

Before producing the Model T, Ford first gauged the market with several designs, through the Model N, a Roadster built in 1905 and one of the first four-cylinder cars at the time, the model R and S built in 1906 and 1907, respectively, and the Model K, a six-cylinder car, which was a failure and his last venture in the high-priced car market. In October 1908, Ford launched the Model T. At the very beginning, the Model T was a success for its general utility, fine performance and price. This car rapidly became the first car owned by many in the country. Early versions of this car were refined and offered very

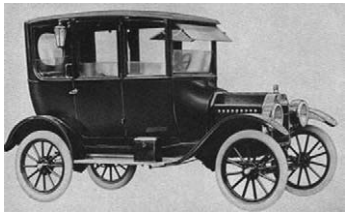
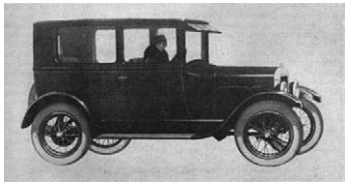
basic features: no speedometer, no starter, no temperature gauge, and no bumpers. The Model T's owners were seduced by the fact that it was easy to drive, repair, and modify while also being affordable. The vanadium alloys used by Ford to build this car was a significant advantage in terms of quality. The Model T was produced from October 1908 to May 1927 for an overall production of 15 million cars. During this time, the Ford Motor Company produced more Model Ts than all other American carmakers combined. Anecdotal, but significant since it impacted the entire automotive industry, the left-hand drive is credited to Henry Ford who thought it would facilitate ladies' access to the car.

Contrary to the legend, the first model proposed by Ford was the Touring, offered in red, followed by the Roadster in pearl grey. Model Ts were not available in black at all. Nobody knows the exact reason for the black color, which appears in the peak of production, but many speculate that Ford chose black because it dried faster, allowing cars to be produced faster as the paint did not have to dry as long. The Model T was followed by the Runabout and Town Model T offered in brewster green, grey, and red. At the end of its lifecycle, the Model T was also available in several different colors. The Model T was often referred to as the 'universal car', because it was extended to every type of customer and could be used for every situation. Interestingly enough, the product lifecycle in today's automotive industry is still roughly the same as Ford's model (except for the outsourcing) with a proposed model, followed by an improvement stage reducing cost and better fitting customers' needs, and finally offering more features (color, interior, etc.).

As illustrated in Table 1, there was a significant number of Model T derivatives especially given that Ford and his engineers improved the design and styles each year. These changes were due to four main aims: (1) improve speed of production, (2) cut costs, (3) increase customer appeal (in a limited way), and (4) order through different suppliers with different manufacturing processes. Thus, a given Model T can be recognized through the years by special features. However, again contrary to the legend, there were actually so many modifications during the Model T lifetime that it is impossible to generalize and specify a features/year rule. Even during a given year of production, there were many modifications. In total, eleven main models were offered (due to the number of modifications, the pictures in the table are only indicative): Touring, Touring Fore-door, Runabout, Commercial Runabout, Coupé, Town, Tourster, Torpedo, Coupélet, Sedan 4-door, Tudor. The Model Ts were based on the already used 'en bloc' cylinder casing; Ford added the upper crankcase with a main bearing and a removable cylinder head.

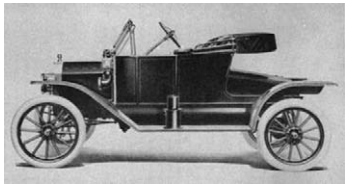
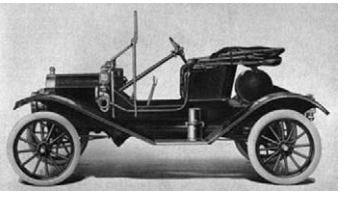
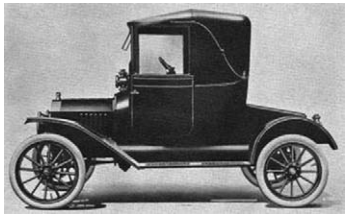
Regarding production, the strength of Ford's project was to adopt mass production used in arms manufacture (for half a century) and assembly lines of the meat packing industry to the automotive industry. He improved both

**Table 1 Types of Model Ts in Ford's catalogue built and produced from 1908 to 1927 (Clymer, 1955)**

| *Model T − Type* | *Picture* | *Year of Production* | *Model T − Type* | *Picture* | *Year of Production* |
|---|---|---|---|---|---|
| Touring |  | 1909–1927 | Sedan |  | 1915–1923 |
| Touring Fore-door |  | 1912–1916 | Sedan Fordor |  | 1924–1927 |
| Coupé |  | 1909–1911, 1914, 1919–1927 | Tudor |  | 1925–1927 |

(*continued on next page*)

**Table 1** (*continued*)

| *Model T – Type* | *Picture* | *Year of Production* | *Model T – Type* | *Picture* | *Year of Production* |
|---|---|---|---|---|---|
| Runabout |  | 1909–1927 | Torpedo |  | 1910–1912 |
| Town |  | 1909–1917 | Coupélet |  | 1915–1918 |
| Tourster | – | 1909 | | | |

and pushed them to the limit of production speed, maintaining targeted quality. It was not until 1920 that Ford reached his goal to control the overall production, producing 100% of his cars in his own factory (the River Rogue plant). Before then, several components were provided by suppliers. In parallel, Ford built the Model TT (1-ton), a tractor, and designed a 3-ton truck. The Model TT targeted a market between the truck and the car. This model had great success. The *Fordson* tractor was launched in 1919 in honor of Edsel, Ford's son. This model was the starting point for today's tractor product line at Ford. Before this model, contractors were customizing the Model T to offer a tractor. The 3-ton truck was based on the same platform as the tractor and reused many components from the tractor, but it was never produced. We can imagine that if Ford had launched the 3-ton truck, there might be a Ford truck product line today.

The Model T was replaced in 1928 with the Model A. All the Model Ts were built on a common platform and specified based on several derivative products (average of four derivative products for a given year). More detail about the Model T and its derivatives can be found in (Clymer, 1955).

## 2 *The Model T as a platform*

All of the Model Ts were based on a common platform promoting sharing of modules, components, manufacturing processes, and/or services to reduce the cost of each product. As a matter of fact, the Model T platform (see Figure 1) was a module and sold, as a product itself, to manufacturers, who customized to respond to specific customers' needs. The core of the product underbody was common while the body of each model was specific; so, this platform was shared by the entire Model T family. We believe that Ford was the first to adopt this strategy: common functions should generate common components, and specific functions should generate specific components (Ericsson and Erixon, 1999; Alizon et al., 2006).

It could also be argued that Ford implemented a form of lean manufacturing as the statement appears in the Ford Model T owner manual that highlights this philosophy 'it is foolish in commercial work to use a heavier or larger chassis than is actually needed for the work to be done' (Clymer, 1955). Figure 1a shows the elements in the Model T platform. The Model T's overall underbody was common, including the engine, pedals, switches, suspensions, wheels, transmission, gas tank, steering wheel, lights (not pictured), etc. The Model T platform allows late differentiation since the body of each derivative product can be assemble late in the assemble sequence. The resemblance to today's automotive platforms is striking as seen in Figure 1b, which shows Dana's Rolling Chassis Platform for the Dodge Dakota that is comprised of brake, fuel, steering, and exhaust systems, suspension, and driveline assembled to the frame. However, regarding the manufacturing aspect, Dana's Rolling Chassis Platform does not allow

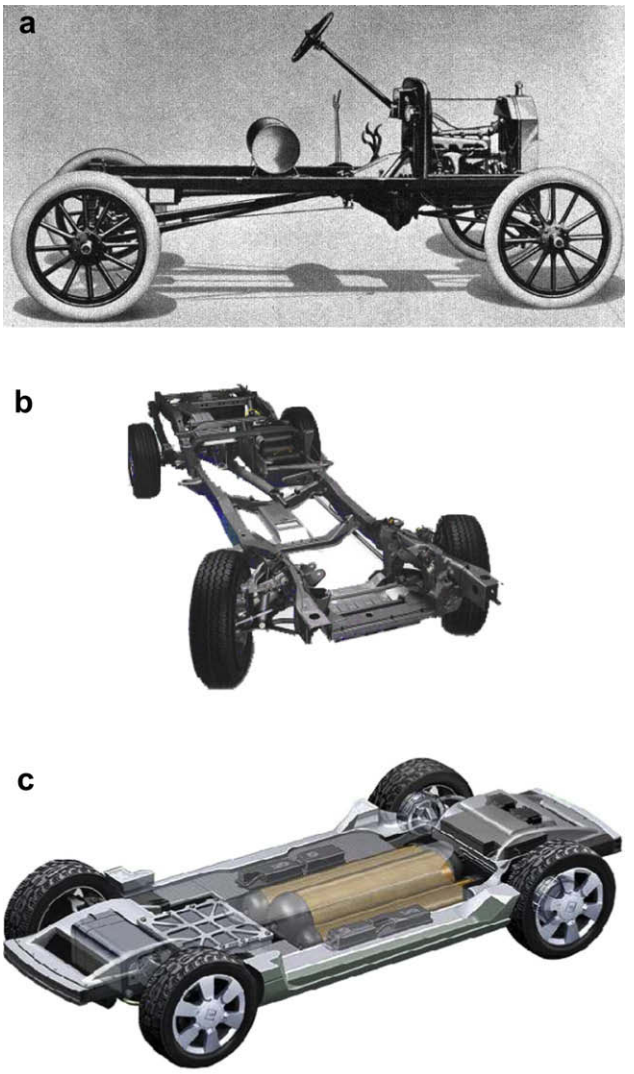



*Figure 1 Automotive platforms. (a) Model T Platform (Clymer, 1955), (b) Dana's Rolling Chassis Platform (Kimberly, 1999), (c) Skateboard concept (Eberle, 2006)*

late differentiation since it is linked to the car right at the beginning. Thus, the Model T platform is closer to what General Motors tries to accomplish nowadays with their Skateboard platform (see Figure 1c), where it will be possible to 'plug and play' different bodies having the same common platform.

One of the strengths of Ford and his engineers was to evolve this initial Model T platform. The interfaces were purposefully and systematically reused over time. As a result, the common platform was improved, and all the products in the Model T family benefited from these improvements along their product lifecycle. An example is the wheel brake and reverse band that were actuated via different hand levers, which were replaced in

1909 by the famous three-pedal system. The first 2500 models were proposed with a centrifuge water pump, slightly shorter engine block, crankshaft, and very small commutators. Early engine versions were the more powerful 22 horsepower, which decreased through the years to 20 horsepower by 1917. A notable realization was the doors designed in the body of the 1913 style of the touring two-door. A year earlier, the touring four-door was produced, supporting both models. Another example of pushing commonality to the limits can be found on the Ford Touring two-door where the right and left doors were designed with dummy copy until 1911. The tires evolved from solid rubber to inflatable tires. So, the basic platform was dynamically improved and enhanced.

External design was also improved and updated as seen in Figure 2. To illustrate the modifications over the years, Figure 2a shows an early Touring (1908), the first Model T by Ford. Figure 2b shows the *same* Touring in 1926 with lights, bumper, windshield, doors, new shapes, wire wheels, etc. Bodies as well as the platform evolved, and numerous improvements were performed. With few exceptions, all bodies were in wood until 1911, when sheet steel was applied over the wooden frame.

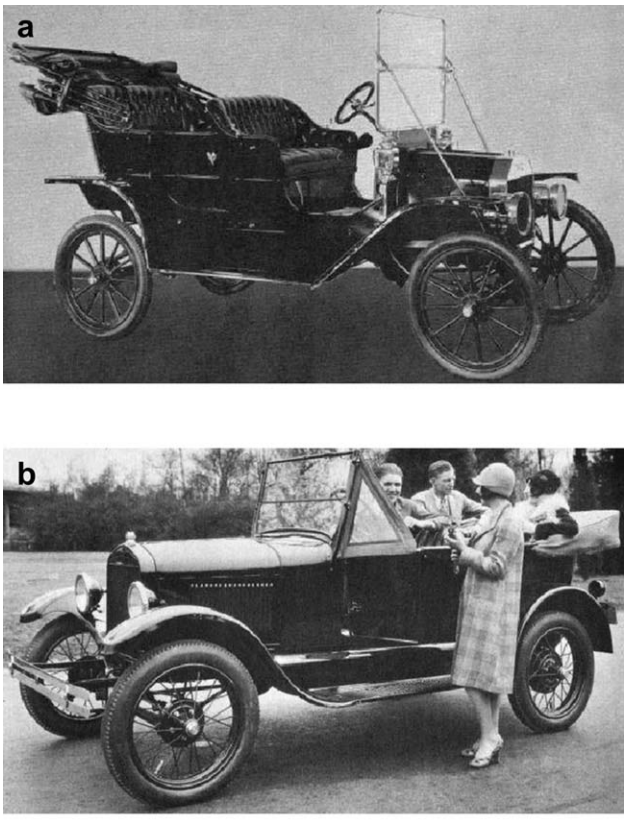



*Figure 2 Two versions of the Touring Model T highlighting different features and styling differences (Clymer, 1955). (a) Touring, 1908, (b) Touring, 1926*

Two methods enable designers to handle variety within a product platform (Simpson, 2004): (1) modular-based design and (2) scaled-based design. In modular-based design, modules are added, substituted, and/or removed to fit specific needs. In scale-based design scaling variable(s) are used to 'stretch' or 'shrink' parameters in one or more dimensions to satisfy specific market segments. The variety of the Model T platform was managed through a module-based design. Ulrich (1995) defines a module-based architecture as a one-to-one or many-to-one mapping of functional elements to physical structures. The Model T family was tailored via specific bodies and features; however, interfaces with the platform were common, and each body can be adapted to this common underbody. An interesting example of module-based design (besides the engine) was the modularity of the Touring model, which enabled users to have a four-seat car or a 'platform' truck, the equivalent of today's pick-up truck (see Figure 3a). In this figure we can appreciate how the back of the car can be removed, transforming it into a pick-up truck. Fast forward


*Figure 3 Examples of automotive modularity: then and now. (a) Ford's Touring model (1914): four-seat car to truck (Clymer, 1955), (b) Mercedes' Vario Research Car (2004): wagon to sedan to convertible*

almost a century, and we can see that today's automakers are trying to replicate this level of modularity: Figure 3b shows Mercedes' Vario Research Car at the 2004 Detroit Auto Show transforming from a wagon to a sedan to a convertible using a modular back section (and four people to lift them off and on).

Another interesting fact is how Ford adapted the Model T to create the Model TT by stretching (scaled-based) the Model T chassis to obtain a 1-ton light truck. This operation was done by reusing many components from the Model T and specific new components to adapt to this new weight constraint. Similarly, this model was based on a platform/module and also sold as a separate product itself (see Figure 4). The next section details this variety aspect and develops how Ford addressed mass customization.

## 3 *Model T mass customization*

When the automotive industry first started, the mission was to replace horses, which were used for nearly every task: delivering, transporting, working, fighting, etc. So, while the gap between demand and supply was filled through mass production, the gap between what a standard car could do compared to what a horse could do needed to be fulfilled also. Trying to quantify this need, Ford estimated that the standard T models should satisfy 95% of the demand, while 5% of the demand should be satisfied through customization. This trend and numbers were validated by sales (Fahnestock, 1921). As a first answer to satisfy the need for variety, Ford proposed more than 5000 gadgets to customize the Model T; although, many components were decorative in nature. This variety was managed by the Ford Motor Company, but assembly was done by customers. Furthermore, dimensions, interfaces and methods to customize bodies were published in the Ford Service Bulletin.

The second way to offer variety was to sell the common platform directly. The customization was realized by Ford but mainly by specialized companies tailoring it to exact customers' needs. This action ensured that mass production and mass customization generated thousands of unique vehicles during the

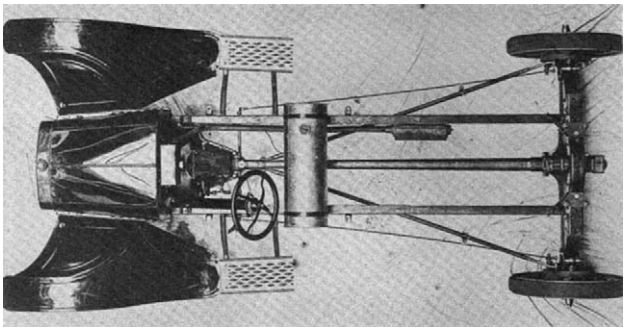


*Figure 4 Model TT platform (Clymer, 1955)*

lifecycle of the Model T. A sampling is provided in Table 2, where it is possible to see specific models such as a snowmobile, chemical/hose car, woody wagon, racer, truck with chain hoist, business body, tractor, tractor/semi-trailer, circus model, chain drive, business truck, and milk wagon. Other models not pictured include a carved hearse, police wagon, depot hack, ambulance, tank-truck, military vehicle, etc. It is interesting to note that Volkswagen successfully employed a similar strategy in the late 1990's with its A-platform: 19 different models of Volkswagen, Audi, Skoda and Seat cars were built or planned on the common A-platform underbody with different 'hats' for each brand (Wilhelm, 1997; Bremmer, 1999). Unfortunately, while this strategy saved them billions of dollars in development costs, it hurt their sales as brands lost their distinctiveness allowing lower-end models to cannibalize sales of higher-end models (Miller, 1999; Anonymous, 2002).

Regarding customization, did Ford really apply mass customization? Jiao and Tseng (2004) define mass customization as a strategy for offering individual customer's needs yet maintaining near mass production efficiency. We consider what Henry Ford did, by manufacturing a core product and tailoring each product through specialized manufacturers, fit the definition of Jiao and Tseng. This approach also matches Duray et al.'s (2000) assertion that mass customization must involve the customer in the design process. Finally, Ford's approach also matches Pine's (1993) definition who declares that a platform can facilitate addressing different market niches through derivative products such as those in the table.

By outsourcing customization, Ford was able to maintain mass production efficiency and its economic advantages while satisfying specific customers' needs. Integrating customization into his manufacturing process would have reduced the production rate because products would not have been standard anymore. The advantages of outsourcing customization are many. First, as we mentioned, it handles variety in parallel and avoids disturbing the mass production processes. Second, each specialized 'customizer' has its own specialty to tailor to customers' needs. Skills to build a tank truck are very different from a military vehicle or an ambulance. Third, the customer is directly integrated in the customization process.

This approach, to sell the platform as a product, was possible because of the separation between the common underbody (platform) and the derivative bodies (hats). Mass customization was also possible because this platform was significant and sufficient by itself being the entire underbody. As a result, the platform was already almost a car, which needed to be body-customized.

## 4 *Discussion*

Despite all of the attention that Ford's mass production processes and his famous maxim have received, he successfully designed and sold a product line

**Table 2 Sample of customized Model Ts**

White snowmobile (Burdick, 2006)

Chemical/Hose Car (CLAFMA, 2006)

Woody wagon (Filiss, 2006)

Racer (Michael, 2001)

Truck w/chain hoist (Ritter, 2006)


'Business Body' (Oldwoodies magazine, 1959)

Tractor with a Model T platform (Anonymous, 2006a)

Tractor coupled to semitrailer (Cavette, 2006)

Circus model (Anonymous, 2006b)

Chain drive (Anonymous, 2006c)


Business tops (Quinn, 2006)

Milk wagon (Oldwoodies magazine, 2006)

integrating significant variety with eleven basic models, offering customization with a line of 5000 gadgets, and customized models offered through specialized manufacturers. The lifecycle of current cars is roughly composed of three main phases (Alizon, 2007), which we believe were inspired from Ford and his Model T. As a matter of fact, modern vehicles are designed and launched (Phase 1) and then improved during a second phase ($\sim$2–3 years after the introduction) to better fit customers' needs, costs, etc. Finally, Phase 3 offers upgraded features to fight against obsolescence of the current vehicle and newer, more competitive products. Also noticeable, vehicles are improved and repackaged each year, with the famous 'year of production' used to appraise vehicles. The Model T was designed and launched, and during the maturation stage (production ramp up), the platform and product line were improved. A new product line was proposed each year, with old models retiring and news models appearing. Finally, during the last stage (when the production decreased, at the end of the lifecycle) the Model T was upgraded through improved features, better styling, and different colors.

It is interesting to compare Ford's approach and modern strategies, while hundreds of carmakers were offering cars at that time in the United States. In fact, Ford continuously improved his models, and each year a complete new line was launched; most of today's 'new' models just offer small modifications, typically a repackage of the previous year. This can be one of the keys to success of the significantly long lifecycle of the Model T. The platform and the product line were entirely redesigned when the Model T platform was obsolete and no longer supported the customers' needs in terms of power and behavior, like the three-speed gear. Even if the complexity of today's automobiles makes updating them more complicated (there are more requirements, higher in terms of safety, comfort, gas mileage, environment, etc.), it will be fascinating to see if such an in-depth use of platforms (where each body can be assembled by late differentiation) with significant modifications to the product line each year can be technically feasible and commercially interesting.

Another significant difference is the 'all production in', better known as vertical integration (Monteverde and Teece, 1982), instantiated by early automakers (both Americans and Europeans), versus the current trend toward horizontal integration where components, modules, or expertise are outsourced to specialized companies. Ford started to outsource components at the beginning but transitioned to full production within his factories, which he reached in 1920. The horizontal strategy shows its undeniable advantage in terms of cost saving, but it also points to the question of lost expertise by the company, which is ensured by a vertical strategy. This question becomes more important with the product platform approach, which involves a tight coupling between the common platform and its derivative products. From a product platform point of view, a horizontal strategy is theoretically more complicated to manage with

potential geographical distances and divergent objectives: a local optimum (e.g., a module) is often not the optimum (e.g., a car).

Regarding the platform, Ford realized what most industries want to achieve: design a strong common platform sustaining variety through common interfaces; thus, only bodies were specific. This platform was dynamic and constantly improved, benefiting the entire family of derivative products. Until recently vehicles were not designed the same way; in fact, unlike few exceptions (Eberle, 2006), the underbody and upperbody are linked to each other, forming a unique model right at the beginning of the assembly process; hence, the underbody does not provide a platform. Now, most automakers target a product line based on a common platform where the basic underbody is the same with adaptations enabling commonality within the product line. It is interesting to study this evolution as Ford cars have become more specific (unique models) and more recently were designed on an adaptative platform. By extension, Ford proved that it was possible to build a common platform and design and assemble a specific body. So, under conditions of profitability, automakers should be able to build a common platform and ensure variety through specific bodies, thereby taking full advantage of the late differentiation. Regarding the management of variety, constraints of fragmented markets (Arndt and Kierzkowski, 2001) force industries to include variety into the manufacturing process (mainly through assemble-to-order) and not only through 'gadgets' as Ford used to manage it. The different configurations (variety) of the product are defined in advance, and the final configuration is created during assembly.

Regarding mass customization, most of today's automobiles (except the *Smart* model by Daimler (Smart, 2007) and the Nissan Pulsar) are not manufactured as late differentiated products. So, at the beginning of the manufacturing process, the body of the vehicle is already specific in the assembly line. So, automakers cannot use Ford's approach because the platform and vehicle are not independent. As a result, when carmakers want to customize their vehicle, they also use specialized manufacturers, but they work on the entire vehicle (not the platform). Hence they almost never build the body, but improve the engine, tires, aesthetics, etc. This is minor customization compared to the Model T customization. One family of products is similar to Ford's approach: European pick-up trucks that are transformed into recreation vehicles, but this approach is still an assemble-to-order approach and not a customized approach, because configurations are already pre-defined.

More generally for a manufactured product line, most of Ford's techniques are still relevant today and should be better considered by industry. His vision helped define the product lifecycle, platform, and customization management. For the lifecycle, industry should recognize that wider variation of the product line over time can generate a longer lifecycle. This aspect is also important for

the brand image. Regarding platform management, Ford showed that it is important to separate the platform from the body to fully benefit from the platform approach by enabling late differentiation in the manufacturing process and potential mass customization (Robertson and Ulrich, 1998). His ideas enabled designers to improve the common platform and carry these improvements to the entire family of products. The interoperability of Model T bodies highlights the important problem of common interfaces, which should be better studied.

For mass customization, Ford used an outsourced mass customization approach focusing on his expertise – the core of the product and the standard version – while specialized manufacturers used their expertise to tailor final products to specific markets or customers. Two insights are interesting from this approach: (1) the separation between platform and customization in the design via common interfaces, and (2) the fact that Ford used a parallel process to customize products. We say parallel because he could have produced these cars in another factory or via specialized manufacturers; he chose the second one but could have applied the first one.

The end of the Model T is rather difficult. Many other cars were being manufactured and offered with more features, speed, etc. Ford was not prepared for the drop of demand, and it took time to develop a new model. Eventually, it was GM that was more adept at aligning an array of different models at different segments of the market. Alfred Sloan's focus on producing a greater variety of better quality cars, not necessarily cheaper cars, allowed GM to overtake Ford in sales in 1927, after which the Model T was discontinued (Gartman, 2004).

## 5 *Conclusions*

Most of today's industries want to offer a variety of products based on a well-designed product platform. Ideally, families of products should have high commonality while tailoring products from sets of customers to each customer (fragmented market to mass customization). Many questions remain unanswered, but we believe that past experience can help improve current thoughts and approaches. In this study, we focused on the origin of the automotive industry to learn about product platform and mass customization. We discussed Ford's work and the Model T. This very successful car (the longest and perhaps most successful car ever realized), was not only available in a black model, but represented a product line of vehicles characterized by significant variety. Variety within the product line (average of five different products each year), variety also through 5000 gadgets offered by the Ford Company; and variety finally with thousands of specific Model Ts tailored to final customers' needs.

The Model T platform was significant, including the entire underbody, the engine, etc., and improved over time along with the car bodies. The platform was

independent from the bodies used to customize it. Interfaces were common for the entire product family, permitting easy manufacturing mixing and late differentiation. A version of mass customization was also implemented by Ford. In fact, Ford's company built the common platform and used specialized manufacturers to tailor the Model Ts to the exact customers' needs.

Industries with manufactured products can learn from Henry Ford's success. Ford's experience was forgotten in the past industry designing non-platform product even when some product lines had sufficient homogeneity to be build on a product platform. Current practices will benefit from the Model T on numerous aspects from lifecycle management to mass customization via platform design and management. Future work will target the study of points highlighted in the discussion section, especially the detail of the platform specification and the resulting family of products.

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