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Abstract

This paper identifies the ways in which the ideas of Fordism and Taylorism have been responsible for the success of the U.S. motor vehicle companies until 1955, and for their subsequent decline. On three occasions, the motor vehicle industry has changed the fundamental ideas on the process of manufacturing, and, perhaps more significantly, on how humans work together to create value. Under Fordism and Taylorism, the conditions of employment at the assembly lines became less and less bearable for the workers, and this resulted in an ongoing confrontation between management and the workforce, led by United Auto Workers (UAW). This confrontation resulted in escalating labor costs for the U.S. motor vehicle companies, and undermined their capacity to compete with the Japanese motor vehicle companies, who had developed a lean production system and a more humanistic management style.

Keywords: Fordism, Taylorism, decline of the U.S. motor vehicle companies, mass production system, lean production system, reflective production system, confrontational management-labor-relations

Introduction

My aim in this paper is to identify how Fordism and Taylorism are responsible for the early success, and the recent decline, of the U.S. motor vehicle industry. Historically, there have been three occasions in which the U.S. motor vehicle industry changed the most fundamental ideas on manufacturing processes and, more importantly, changed its understanding of how humans work together to create value. These are discussed below.

The U.S. motor vehicle industry emerged at the end of the 19th century as a craft production system, with a workforce that was mainly comprised of skilled craftspeople who understood mechanical design principles and the materials they worked with. Many of the more experienced craftspeople became independent contractors working inside the factory. After World War I, however, Henry Ford invented the mass production system (now known as *Fordism*). In his system, the product, the production process, and the tasks that each particular worker performed were all standardized.

At roughly the same time, Frederick Winslow Taylor developed an approach to scientific management (now known as *Taylorism*), that divided management tasks that required intelligence (such as planning and control) from standardized repetitive production tasks that required minimal qualifications. As a consequence of this division, management came to consider the workforce as comprising variable costs, and as a result was always trying to reduce these costs to improve the company's bottom line. The mass production system inspired by Ford and Taylor was responsible for the extraordinary success of the U.S. motor vehicle companies up to 1955.

The Japanese and the Europeans followed Ford and Taylor´s ideas but where faced with the realization that due to its dead-end monotony the mass production system was unbearable for the workers, and so they developed different approaches to the mass production system. In Japan after World War II, Eiji Toyoda and Taiichi Ohno developed the Toyota Production System (TPS) that later became known as the *lean production system.* Toyota considered workers as fixed costs and continuously enhanced their workers' skill to derive ongoing benefits from their seniority in the form of knowledge, experience, and commitment. The Europeans,

faced with the same dissatisfaction from their assembly line workers, also adopted job enrichment and a technology-oriented productivity strategies. In Germany, for example, workers had representation on the board of the companies. One of the most emblematic attempts to humanize work and promote teamwork was the *reflective production system* that was pioneered by Volvo in the 1980s. The system was called *reflective* because the workers had to reflect over their work during the work process to be able to execute the complex tasks.

The craft production system

The first motor vehicles were created in 1885, when both Benz and Gottlieb Daimler separately introduced the first petrol-engine driven four-wheel carriage, the *Velozipede* (Clarke, 2005, p. 71). Motor vehicle production flourished in the late 1880s and early 1890s, when the Parisian machine-tool company Panhard et Levassor (P&L) became the world's leading motor vehicle company, building several hundred vehicles each year. Panhard et Levassor was able to gain a head start over other competitors in 1887 when Emille Levassor negotiated a license to manufacture Daimler's new high-speed gasoline engine (Womack, Jones, & Roos, 2007). Their vehicles were designed according to the *Système Panhard*, very modern approach for its time, whereby the engine was located in the front with passengers seated in rows behind. In this system, the engine drove the rear wheels using a crude sliding-gear transmission.

Panhard et Levassor was a classic craft production system that had originally manufactured metal-cutting saws, prior to its partial conversion to enable it to manufacture motor vehicles (Womack et al., 2007). The workforce mainly comprised skilled craftspeople who carefully hand-built the motor vehicles in small numbers. These workers thoroughly understood mechanical design principles and the materials they worked with. Many of the more experienced workers were independent contractors working inside the P&L plant, or independent machine-shop owners contracted to produce specific parts or components.

The founders of the company (Panhard and Levassor) and their associates took orders directly from customers, who would define their requirements and determine the vehicle's exact specifications. Based on

these specifications, P&L then ordered the necessary design, engineering, and parts, and coordinated the assembly of the vehicle to exactly satisfy the requirements of each client. Much of the work, including design and engineering, was subcontracted to individual engineers and machine-shop owners scattered throughout Paris.

Thus, the P&L craft production system was a job process with a low volume motor vehicles made to customer order and produced by skilled craftspeople with a flexible and unique sequence of tasks. This production process did not, however, yield economies of scale. Even if P&L had tried to gain some economy of scale by building identical cars or ordering a large quantity of parts and components, this would still have eluded them, due to lack a standard gauging system and the inability of the machine tools of the time to cut hardened steel.

The P&L contractors used slightly different gauges when making the individual parts and components. After the parts were machined, they were moved through an oven to harden the surfaces enough to withstand heavy use. During this process, the parts would frequently warp, and require further filing to restore them to the intended shape. When these parts (with approximate measures) arrived at P&L for the final assembly, skilled fitters were required to file them down to ensure that all the parts fitted together perfectly. This process of filing and fitting each part to the next part had to be performed until the hundreds of parts of each motor vehicle were complete. As a consequence of this sequential fitting of each part, each completed motor vehicle would differ significantly in the dimension of its parts from others, even if they had been built with exactly the same specifications.

Panhard et Levassor responded to these technical limitations by concentrating on the tailoring each vehicle to the precise requirements of each buyer. The emphasis of P&L was on vehicle performance and hand-fitted craftsmanship, and the gaps between individual parts were nearly invisible. At that time this approach made perfect sense, as the wealthy customers usually employed chauffeurs and mechanics on their personal staff. Thus factor such as cost, driving ease, and simplicity of maintenance

were secondary concerns to factors of speed and customization (Womack et al., 2007).

By the end of the 19th century, the craft production system for motor vehicles had the following characteristics (Womack et al., 2007):

1. A workforce that was highly skilled in design, machine operation, and fitting.
2. Decentralized organizations, with much of the design, engineering, and machine-shop work performed by contractors.
3. Owner/entrepreneurs who coordinated production in direct contact with everyone involved: customers, employees, and suppliers.
4. General-purpose machine tools to perform drilling, grinding, and other operations on metal and wood.
5. Very low production volume, with no vehicle exactly alike because the craft techniques of the time inherently produced variations.

The success of P&L in the 1890s was soon copied, and by 1905, less than twenty years after they had produced the first commercially successful motor vehicle, hundreds of companies in Western Europe and North America were turning out motor vehicles in small volumes using the same craft techniques. The motor vehicle industry progressed to the mass production system after World War I, and P&L eventually floundered when trying to make the conversion (Womack et al., 2007). Some companies using craft production systems have survived up to the present day, including Aston Martin and Morgan (in the United Kingdom) and Ferrari (in Italy).

The mass production system

The craft production system for motor vehicles reached maturity in the 1910s. The general design of motor vehicles had converged to the P&L design of four-wheel, front-engine, and internal-combustion that still is the industry standard today. Because the high costs of producing motor vehicles did not drop with production volume, only the wealthy could afford to buy them. The many small independent craftsmen producing motor vehicles, parts, and components were unable to produce any fundamental innovation

to reduce costs and make the vehicles more affordable. Any real technological advances to reduce production costs would have required expensive research that was beyond the resources and capabilities of the technical craftspeople.

During this time, Henry Ford was trying to overcome the problems inherent to the craft production system. In 1908 he introduced the *Model T*, his twentieth design over a five-year period that had begun with the production of the original *Model A* in 1903. With the Model T, Ford finally archived his objective of a motor vehicle that was both easy to produce and user-friendly. By adopting the idea of *user-friendly*, Ford envisioned a motor vehicle with two innovates: almost anybody could drive and repair them, with no need for a chauffeur or mechanic (unlike most other motor vehicle models of the time). This laid the groundwork for the revolutionary change in direction of the entire motor vehicle industry (Womack et al., 2007).

Ford's key innovation to what he called *mass production* was the complete and consistent interchangeability of parts and the simplicity of attaching them to each other. To achieve this he vertically integrated production of all parts and components for the Model T, developed dedicated machines to produce these parts and components, and standardized the gauging system. He also benefited from the advances in machine tools which were now able to work on pre-hardened metals. By adopting this, he avoided the problems of warping that had occurred when parts were hardened after being machined which had previously made standardization impossible.

All these factors taken together gave Ford a tremendous advantage over his competitors: a single model that was simple to produce and easy to use, the vertical integration of production of parts and components, the standardization of parts that fitted perfectly together, the use of dedicated machines to produce these parts, and the elimination of the skilled fitters who had comprised the bulk of the craftspeople used to assemble motor vehicles.

The assembly of Ford's motor vehicles began in 1903 with the Model A. This process involved setting up assembly stands on which a whole vehicle was built, often by one fitter. In 1908, on the eve of the introduction of the

Model T, an individual worker's task cycle (the amount of time worked before repeating the same operation) averaged 8.56 hours. With the introduction of the Model T and its perfect interchangeability of parts, Ford decided that each assembler (there was no need for fitters because parts were perfect) would perform only a single task and move from vehicle to vehicle around the assembly hall. By August of 1913, just before the introduction of the moving assembly line, the average task for an assembler had been reduced from 8.56 hours to 2.3 minutes. The introduction of the moving assembly line further reduced the average cycle time, from 2.3 to 1.19 minutes (Womack et al., 2007).

Ford had taken Adams Smith's (1864) idea, first published in 1776, of the division of labor as being essentially positive in yielding increased productivity, and Charles Babbage's (1832) idea of the necessity of matching skills and job tasks. In 1911, Frederick Winslow Taylor (2008) built on these ideas to define the relationship between the worker and the work. The primary objectives of standardization for Taylor were first the fragmentation of skills into their smallest components (division of labor), and second, the separation of mental and physical work. As a consequence, the complex set of skills a craftsperson used to build a motor vehicle prior to the introduction of mass production were fragmented into individual units, with each worker merely performing one particular task in a manner considered to be the most effective and efficient.

Due to this specialization, an assembler in Ford's plants required only a few minutes of training. The performance of each assembler was relentlessly disciplined by the pace of the assembly line, which sped up the slow workers and slowed down the fast workers. The foreman, who previously had wide-ranging duties and had been responsible for a whole area of the factory, was reduced to the role of a semiskilled checker, whose role was to identify any failures in the allocated tasks on the assembly line. As a result, the workers on the line were as replaceable as the parts in the motor vehicles, and came to be seen as variable costs in the mass production system.

Ford divided labor in the engineering shop as well as the factory. The knowledge-workers who, according to Taylor, managed ideas and

information but rarely touched an actual car or entered a factory, were also divided into specialized niches: industrial engineers, manufacturing engineers, and product engineers. This basic division was further split into industrial engineers who specialized in either specific assembly operations or dedicated machine design. Increasing specialization was also applied to the manufacturing and production engineers, and time went on, the engineering profession branched into more and more subspecialties. As the role of engineering professionals became more and more specialized, they lost their overview of the other specialties.

To cope with the increasing complexity of new motor vehicles, the U.S. companies adopted increasingly bureaucratic organizational structures, with many procedures, protocols, and regulations introduced to manage product development. These bureaucracies became cumbersome and discouraged talented people from joining or staying in the companies. These major factors explain why most technological innovations in the 1960s and 1970s came from Europe; examples of European innovations during this period are front-wheel drive, disk brakes, fuel injection, unitized bodies, five-speed transmissions, and engines with high power-to-weight ratios (Womack et al., 2007).

Ford's total vertical integration of the mass production system had introduced bureaucracy on such a vast scale that it brought its own problems, and with no obvious solutions. Alfred Sloan at General Motors (GM) complemented Ford's ideas with his own basic management ideas to solve the problem of how to manage the complexity of the mass production system that was now inhibiting its spread (Sloan, 1990). Sloan innovated the concept of decentralized divisions that were managed objectively "by the numbers" from a small corporate headquarters. He also created the new professions of financial manager and marketing specialist to complement the engineering professions specialized by Ford, so that every area of the company now had its dedicated experts. This completed the division of professional labor that had been proposed by Taylor.

The consequence of Taylor's basic separation between mental and physical workers was that the shop-floor workers (also called blue-collar workers) in the mass production system had no career path, except perhaps

to become a foreman. The mental workers or professional specialists (also known as white-collar workers) had opportunities to directly climb up the career ladder, although unlike the skilled craftsmen of the 19th century their career path didn't lead toward ownership of a business; these professionals could only aspire to a career in the company's bureaucracy, a factor which obviously turned many talented young entrepreneurs away from careers in the motor vehicle industry. Due to this, many of these entrepreneurs went to more promising industries, such as electronics.

Sloan's organization created a revolution in management and marketing in the motor vehicle industry. However, his approach had not changed the fundamental idea, institutionalized by Ford, that workers on the shop floor simply represented interchangeable parts and variable costs of the mass production system. As a result, dissatisfaction on the shop floor worsened. Ford himself temporally calmed the situation in 1914 by doubling wages to the famous five dollars a day. Ford was able to take advantage of his company's much higher efficiency over its competitors to portray himself as a paternalistic employer and so, for a time, avoid the desire for unions among his workers (Womack et al., 2007).

The introduction of higher wages was effective in reducing turnover of labor, but created another problem: the potential for stability afforded by this wage rise meant that workers stopped dreaming about returning to the farm or to the old country from which they immigrated, and realized that a job at the assembly line was likely to be their life's work. When that realization dawned, their conditions of employment rapidly came to seem less and less bearable to them. Additionally, since the U.S. motor vehicle companies considered their workforce a variable cost, they would dismiss workers at the first sign of a downturn in sales. All this meant that by the time of the Great Depression the conditions for a successful union movement in the U.S. motor vehicle industry were fully in place. This was a mass production union movement whose leadership fully accepted both the role of management and the role inherent nature of work in an assembly-line factory. In the late 1930s, the United Auto Workers (UAW) signed an agreement with the companies who had come to be known as the *Big Three* (GM, Ford, and Chrysler), in which the main issues were seniority and job

rights. This union movement was called *job-control unionism* (Womack et al., 2007, p. 40-41).

These, and subsequent, negotiations between the union and management of the Big Three concentrated on confrontational negotiations with each side trying to obtain as much leverage as possible from the other in a win-lose setting. A win-win proposal was never presented because of Taylor's segregation of the workforce into blue-collar workers and white-collar workers: as the blue-collar workforce had no career prospects, the union's negotiations were always aimed at gaining more financial concessions, reducing working time, and ensuring job security. Management, on the other hand, considered the workforce a variable cost, and so were always trying to reduce this cost to improve their company's bottom line.

During the 1950s and 1960s, as a consequence of the UAW negotiations, members had become one of the best paid groups of industrial workers in the country, placing them solidly in the middle class of American society. Additionally, as well as receiving their high wages, the union workers were also provided with generous benefits compared to those working at non-union Japanese auto plants in the U.S. Sorkin (2008) pointed out that, counting benefits (including health care and pension costs), each UAW worker received 70 U.S. dollars per hour, while Toyota U.S. workers received about 10 to 20 dollars less per hour for the same jobs. Sorkin also noted that because of the union contracts GM at the time employed about eight thousand people who did not perform any actual work. These employees benefited from a supplemental unemployment benefit that gave laid-off workers most of their take-home wages.

The predicament of the U.S. motor vehicle companies in 2008 was the consequence of the confrontational management-labor relations, and this was one of the primary reasons for the poor competitiveness of the Big Three. Another reason was that the large bureaucracies of the U.S. car companies discouraged ambitious and talented young people from joining them: this meant that they were not able to keep up the fast pace of innovations characteristic of the Japanese and European manufacturers in terms of designing and building small and efficient vehicles.

The reflective production system

The European motor vehicle companies that had copied Ford's mass production system experienced, in the 1950s, what the Big Three U.S. companies had experienced in the 1930s. After World War II, the European plants employed large numbers of immigrants in the assembly lines. There was a mass influx of Turks and Yugoslavs available to work in Germany, Moroccans and Algerians available to work in France, and Sicilians and other southern Italians available to work in the motor vehicle plants of Turin and Milan in Northern Italy. Some of these workers returned home after the postwar boom eased, but many assimilated and were joined by native workers. As in the U.S., these workers also realized that they would not progress to become independent craftspeople as their fathers and grandfathers had, and that dead-end monotony of mass production was going to be their life's work. This realization made working in the mass production system unbearable and waves of unrest followed in Turin, Milan, Paris, and Wolfsburg.

The negotiations between management and workers in Europe at first took the same confrontational tone as in the U.S. The largest difference was that European countries had much better social systems, with medical care and pension plans, and there was not as wide a gap in salaries between shop floor workers and top managers as in the U.S. For this reason, the medical care and pension plans that were part of the packages negotiated by the U.S. unions were not on the negotiation agenda in Europe. Negotiations about salaries were reasonable, because the differences between workers and engineers were relatively modest in Europe. The modest salary differences in Europe in contrast to the U.S. focused the management-labor negotiations upon the reducing hours spent in the plant doing dull work. In some cases workers were even willing to take salary reductions for fewer hours spent in the plants.

The European motor vehicle manufacturers, realizing the problem of dull work, attempted some experiments in job enrichment. The most radical at the time was undertaken in the early 1970s by Volvo's new CEO, P. G. Gyllenhammar, who had strong appreciation of the social dimension of work (Ellegärd, 1996). To mitigate the problems associated with workers' low

commitment to the work and the low degree of work satisfaction in the Volvo plants, he opened a new plant in Kalmar, which was designed and operated with the goal of humanizing the work and promoting teamwork on the shop floor. In the Kalmar plant, the assembly line was literally broken into sections. All work was organized in teams, each of which had its own section in which team members performed their extended assembly work tasks. Using this approach, the physical and social environment was greatly improved in comparison to other traditional Volvo plants applying Ford's mass production system.

Volvo innovated again in the mid-1980s with a new plant in Uddevalla (Ellegärd, 1996). The company had realized that the number of young people in the European labor force would decline by the mid-1990s, so they decided to build a factory that could attract not only young male workers but also females and older people. In this new plant, the assembly line approach was completely abandoned, and small teams, working parallel to each other, were responsible for the assembly of complete motor vehicles. The central problem that this approach attempted to correct was the difficulty of developing ways to teach the workers how to perform the varied work tasks required in order for only a handful of workers to be able to assemble a complete vehicle. To achieve this, Volvo adopted a holistic learning strategy where skilled workers taught newly employed workers how to assemble the vehicles. Employees not only learned how to build motor vehicles, they also learned how to perform several supporting tasks, economic tasks and so on. The teams planned their own production and were able to make plans in pursuit of their educational needs.

The production system developed for the Uddevalla plant was called the *reflective production system*, because workers were required to reflect over their work during the work process in such a way that the product reflected each workers' performance, which made it possible for workers to improve their working methods. The developments at the Kalmar and Uddevalla plants inspired managers and trade unionists in Europe to begin thinking in new directions with respect to the organization and content of work. Furthermore, the reflective production system was later applied by Saab at its Trollhättan plant, and influenced the Rastatt I plant of Mercedes-

Benz, as well as the introduction of the modular units at GM and Volkswagen (VW).

Unfortunately Volvo suffered severely from the fall in worldwide demand for cars in the early 1990s, and after the Volvo Car Company was sold to Ford in 1999 the two innovative plants in Kalmar and Uddevalla were closed. Since then, the Volvo Car Company under Ford has had no unique alternative to assembly line production. Nevertheless, the Uddevalla plant was reopened by Autonova AB and Volvo maintained a 49 percent share in the plant. The principles of the reflective production system continue to be developed by Autonova AB at this plant (Ellegärd, 1996).

The lean production system

The Toyota Motor Company was founded in 1937 by the Toyoda family. During World War II, Toyota built trucks largely using the craft production system. In the thirteen years between the founding of Toyota and 1950, Toyota had produced a total of 2,685 motor vehicles. This was also the year that the young engineer Eiji Toyoda made a three month visit to the Ford Rouge plant that produced 7,000 motor vehicles in a single day. This plant was the largest and most efficient in the world. After his return to Nagoya, Eiji Toyoda and the production genius Taiichi Ohno concluded that Ford's mass production system could never work in Japan for the following four reasons (Womack et al., 2007):

1. The Japanese domestic market was very small and demanded a wide range of vehicles.
2. The Japanese workers were not willing to be treated as variable cost or interchangeable cost.
3. Management's right to lay-off people was severely restricted in Japan, and the bargaining position of company unions, who represented all employees (including managers) had been greatly reinforced based on labor laws introduced by the U.S. occupation authorities that had strengthened the position of workers in negotiations.

4. The war-ravaged Japanese economy was starved for capital and foreign exchange, which made it difficult to purchase the latest Western technology.

These factors forced Toyota to develop techniques that allowed them to produce small batches efficiently with fewer flexible machines instead of the enormous runs on dedicated machines (which was the norm in mass production). By doing this, they made two fundamental discoveries: that producing small batches cost less because it eliminated the need for large inventories, and that assembling them immediately allowed mistakes to show up almost instantly. The consequence of this second discovery was enormous: the workers making the parts received immediate feedback on their quality and began to pay more attention. This approach helped to reduce the waste of large numbers of defective parts.

The drawback of the system was that if workers failed to anticipate a problem before it occurred, and did not take the initiative to correct it immediately, the work of the plant could easily come to a halt. Any holding back of knowledge and effort (as was common among the workers who had a low commitment to work and low degree of work satisfaction in Ford's mass production system) would lead to constant problems at the Toyota plants. Fortunately, this did not occur, because Toyota had negotiated a compromise formula with the company's union in the crisis of 1949, which allowed them to terminate a quarter of the workforce. The formula, which is still applied in the Japanese motor vehicle industry, gave the remaining employees two guarantees: one was life-time employment, and the other was for pay to be steeply graded by seniority rather than by specific job function with total remuneration tied to company profitability through bonus payments (Womack et al., 2007).

The implication of this historic agreement was that following this agreement the workers were on a fixed wage, which increased the longer they stayed in the company. Thus, Toyota was incentivized to continually enhance the skills of their workers, and thus benefit from the seniority of their long-term workforce in terms of knowledge, experience, and commitment. These ideas were similar to those developed for the Volvo Uddevalla plant, which had evolved into the reflective production system.

Toyota's approach to human resources made it possible to group workers into teams, to perform a set of assembly steps under a team leader. The team leader would perform assembly tasks, as well as coordinate the team, and, significantly, could fill in for any absent worker. Additionally the team had the tasks of housekeeping, minor tool repair, and quality-checking. Besides this, the teams periodically took time to collectively suggest ways to improve the process: this collective work to improve the process, *kaizen* in Japanese, became known in the West as *quality circles*.

The team effort approach was easier to implement in Japan than in the U.S., because the Japanese workforce was never as extensively divided into blue-collar and white-collar workers. Also, the difference in salaries between engineers and workers was very modest. To further stress the teamwork aspects the Toyota engineers wore the same work clothes as the common workers.

In sharp contrast to the situation in Japan and Europe, management-labor negotiations in the United States have remained an obstacle to implementing teams in manufacturing. The UAW in the U.S. has not supported self-managed teams, loose job classifications, or the combination of direct and indirect labor tasks. This is because these organizational innovations have been perceived as in the U.S. as providing ways of compelling employees to perform more work for the same pay. Also, strict job classification is considered to have been an important contributor to the decline of U.S. manufacturing productivity. At one time some assembly plants listed as many as 50 to 100 different work classifications. These detailed classifications limited flexibility, because workers were not required to perform tasks outside of their classification and corresponding pay scale. In contrast, plants modeled after the Japanese team concepts have typically had only about four or five job classifications (Fuxman, 1999, July).

Taiichi Ohno, the production genius at Toyota, had fully developed the Toyota production system (TPS) by the end of 1960s. He had introduced *the five whys* for production workers to trace systematically each error back to its ultimate cause by asking "why" as each layer of the problem was uncovered, and then to devise a fix so that it would never occur again. He

had also developed a new way to coordinate the flow of parts within the supply system on a day-to-day basis (the now famous *just-in-time system*, called *kanban* at Toyota). This last idea simply converted the suppliers and parts plants into one large system. In this system, each part was only produced at each previous step to supply the immediate demand of the next step (Liker, 2004).

Toyota did not adopt Ford's organization model of dividing engineering into specialties. Eiji Toyoda and Taiichi Ohno decided early on that product engineering encompassed both process and industrial engineering. They formed teams with strong leaders who contained all relevant engineering expertise. Career paths were structured to reward strong team players rather than individual specialists. As a consequence, Toyota's engineering excelled in productivity, product quality, and responsiveness to changes in consumer demand (Womack et al., 2007).

The TPS was developed to achieve maximum economic efficiency with a minimum of available resources. Thus the key focus is to reduce any kind of wasteful, non-product-value adding activity. For this reason the TPS became known as the *lean production system*.

The current trend in production systems

During the 1980s and 1990s all the world's car manufacturers redesigned their production system to incorporate variants of Toyota's lean production system. Some of the key elements that were copied were statistical process control, just-in time scheduling, quality circles, teamwork, and flexible production (more than one model manufactured on a single production line). One of the important practices that were introduced was the transition from static concepts of efficiency optimization towards continuous improvement to which every employee contributed.

A MIT study by Womack, Jones, and Roos (1990) propagated the TPS as the basis of the universal principles of the lean production system that later was termed lean thinking. Western motor vehicle manufacturers examined the claims of this study, and benchmark trips to the Toyota plants in Japan were organized for these companies' senior production managers

by McKinsey and Andersen Consulting. As a result, the lean production system became the model for most companies in developing their own production system (Clarke, 2005).

The transition to new manufacturing methods required heavy investment by the companies in terms of both capital equipment and training. The 1980s were a period of unprecedentedly high investment expenditure. However, according to Grant (2004), the critical elements of Toyota's lean production system were not new production "hardware" in the form of robotics and computer-integrated manufacturing systems: as GM learned after spending ten billion dollars in upgrading its plants. The critical elements were the "software" that operated the plants, particularly the management-labor relations, the teamwork required, the workers' skills, the shop-floor organization, and the relationship with suppliers. Unfortunately, because of the confrontational management-labor negotiations with the UAW and the lack of vision of both the union leadership and the bureaucrat-managers of the Big Three, these critical elements were never completely understood and implemented. This deficiency was probably the most important factor that precipitated the decline of the U.S. motor vehicle industry. The Europeans, in contrast, because of their strong appreciation of the social dimension of work had a much easier task in adopting the new concepts.

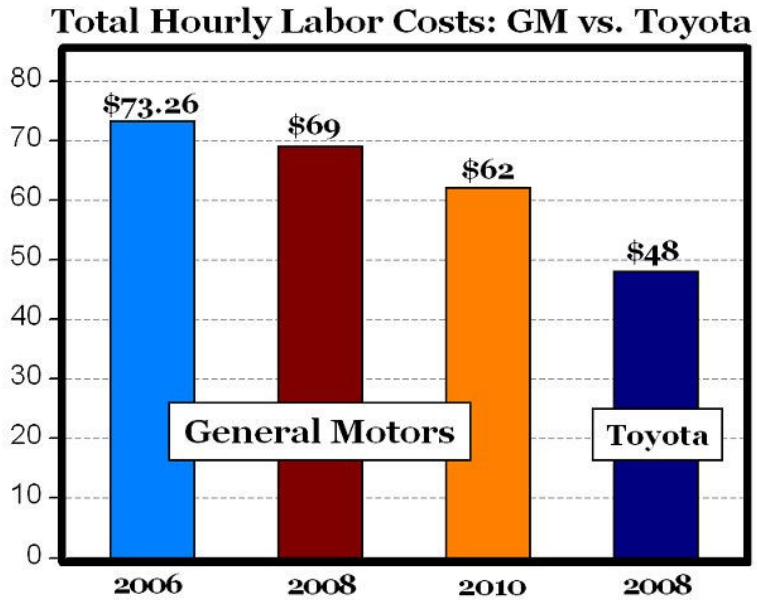
Discussion

The U.S. motor vehicle companies were never able to change from Ford's mass production system to the Japanese lean production system because of the confrontational management-labor relations. Neither the management-bureaucrats nor the UAW leadership could overcome Taylor's fragmentation of skills into their smallest components (division of labor) or the separation of mental and physical work. This fragmentation was responsible for the excessive specialization of engineering and management in the U.S. motor vehicle industry, which transformed it into a cumbersome bureaucracy that scared away entrepreneurial talents and slowed down innovation. The separation of mental work and physical work created an apparently insurmountable barrier between the college educated white-

collar workers and the poorly schooled blue-collar workers. Furthermore, the white-collar workers considered the blue-collar workers to be variable costs that could be hired and fired according to the production needs, while the blue-collar workers wanted more and more pay and benefits to compensate for the hours spent doing dull work in the mass production assembly line.

A consequence of this bureaucracy was that, unlike the Japanese and the Europeans, management in the U.S. was not creative enough to overcome the confrontational negotiation mode with the UAW, and change it from the win-lose mode to a win-win mode. The large income inequality between management and workers, and the exclusion of the workers from any career possibility in the U.S. motor vehicle industry led to a form of class war between the white-collar and the blue-collar workers. Managers made their careers by cutting costs at the expense of workers, and union leaders made their careers by confronting management and squeezing more and more concessions in the form of salaries and benefits. The result was a constant escalation of the costs of the U.S. motor vehicle companies. Toyota and other non U.S.-owned motor vehicle producers were careful to not get into the confrontational management-labor negotiations of the Big Three U.S. producers, and so avoided the labor cost escalation. As a consequence, Toyota in 2008 enjoyed a lower total labor cost advantage over GM of 21 USD per hour (see Figure 1).

Figure 1. In November 2008 GM and the UAW were negotiating a new contract. Even with the new contract, there was still approximately $14/hour pay gap in total labor costs between GM and Toyota, and a more than a 29% wage premium for UAW workers compared to their non-union counterparts at Toyota.



Source: Perry (2008, November 24)

The slowness of the GM bureaucracy to respond changing customer preferences was also a factor that led to a decrease in market share in the U.S. and contributed to the company's decline. An example of the inefficiency of the GM bureaucracy was the case of sport utility vehicles (SUVs). In 1990, GM was taken by surprise when customers started to prefer SUVs, such as the Explorer model that Ford had launched that year. General Motors overreacted by pouring time and money into SUVs at expense of car development. When the market changed, GM was stuck with its SUVs in a market awash in new models and needed to offer substantial discounts to keep up sales. A symbol of the lack of product foresight was the launch of the high-end Hummer in 2003 and the compact H3 in 2005.

Another example of poor management by GM was the case of the EV1 electrical car. General Motors started working on the EV1 at about the same time that Toyota started working on the *Prius* (a full hybrid electrical mid-

sized car) in the 1990s. Toyota started selling the Prius in Japan in 1997, around the same time as GM was fleet testing its EV1. Because of the public relations debacle when the test cards had to recalled, GM abandoned the EV1 program and its lead in electrical car technology, thus handing the lead to Toyota with its Prius (Carty, 2009). To further worsen this situation, in the same year as Toyota was launching the environmental conscious Prius worldwide, GM launched the Hummer with its absurd gasoline consumption (some of the larger Hummers barely managed 10 miles per gallon). The cost disadvantages compared to its foreign competitors (such as Toyota), along with the incapability of its management-bureaucracy to respond to changing customer preferences, ultimately led to GM's bankruptcy on June 1 2009.

Chrysler filed for bankruptcy in April 30 of 2009, before GM, for the same reasons (management-bureaucracy and confrontational management-labor negotiations) that had contributed to its lack of innovation and high labor costs. The irony in the case of Chrysler is that the UAW, with fifty-five percent participation, is now the majority owner of company. Chrysler has always been the weaker of the Big Three and became the first major American automaker to seek bankruptcy protection since Studebaker did so in 1933. General Motors followed Chrysler into bankruptcy June 1st, 2009. These two bankruptcies were humbling moments for the U.S. motor vehicle industry, which had dominated the world markets in 1950 with almost 80 percent of the total world production of 8 million motor vehicle and 95 percent of all sales of motor vehicles in the U.S. (Grant, 2004). Previously, Chrysler had recovered strongly after a near bankruptcy in 1979 with the help of U.S. government before entering again in decline under the ownership of Daimler-Benz and as of 2007 under Cerberus Capital Management.

Ford, the last of the Big Three, was able to survive the financial crisis of 2008 without U.S. government help and seems to be slowly recuperating. However, it has the same problems as GM and Chrysler. As Ford chose not to file for bankruptcy, the UAW is unwilling to give it the same concessions that it gave the other two of the Big Three (Bunkley, 2009). This has meant that Ford's labor costs were higher than those of GM and of Chrysler, and

Ford has also had to recoup the financial costs of its substantial debt, whereas the debts of its U.S. competitors were written off by their bankruptcies. With these two substantial competitive disadvantages, Ford's recuperation continues to be a difficult process.

However, two years after the 2008 crisis, GM, Ford, and Chrysler (the latter now managed by Fiat) have returned to profitability, and in 2010, the U.S. Big Three gained a market share for the first time since 1995 (The White House, 2011). The question that remains to be answered is if these companies have been able to definitively break away from Fordism and Taylorism, or if they have only gained a temporary respite as a result of the U.S. government bailout.

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