The Machine That Changed The World

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Introduction

This classic book explains the evolution of lean manufacturing practices in the automobile industry. As the authors put it, the off repeated statement that the world faces a massive overcapacity crisis in automobile production is a misnomer. The reality is that the world has an acute shortage of competitive lean-production capacity and a vast glut of uncompetitive mass-production capacity.

The automobile industry has come a long way since the days of craft production. The craft producer used highly skilled workers and simple but flexible tools to make exactly what the consumer asked for one item at a time. Goods produced by the craft method cost too much for people to afford. So mass production was developed at the beginning of the twentieth century as an alternative.

Mass-producers began to use narrowly skilled professionals to design products made by unskilled or semiskilled workers tending expensive, single-purpose machines. These churned out standardized products in very high volume. The machinery was expensive and intolerant of disruption. So the mass-producer added many buffers - extra supplies, extra workers, and extra space to ensure smooth production. The consumer got a cheaper product but at the expense of variety. Moreover, most employees found work boring and dispiriting.

Today, lean producers led by Toyota have emerged as global leaders. The lean producer, combines the advantages of craft and mass production, while avoiding the high cost of the former and the rigidity of the latter. Lean producers employ teams of multi skilled workers at all levels of the organization and use highly flexible, increasingly automated machines to produce volumes of products in enormous variety.

The most striking difference between mass production and lean production lies in their ultimate objectives. Mass-producers set a limited goal for themselves. This translates into an acceptable number of defects, a maximum acceptable level of inventories and a narrow range of standardized products. To do better, they argue, would cost too much or exceed inherent human capabilities.

Lean producers, set their sights explicitly on perfection: continually declining costs, zero defects, zero inventories, and endless product variety. No lean producer may have achieved perfection and none ever will. But the endless quest for perfection, on the part of lean producers, continues to generate surprising results.

Henry Ford and the rise of Mass Production

Craft production had the following characteristics:

- A work force that was highly skilled in design, machine operations, and fitting.
- Organizations that were extremely decentralized, although concentrated within a single city.
- The use of general-purpose machine tools to perform drilling, grinding, and other operations on metal wood.
- A very low production volume – 1,000 or fewer automobiles a year, only a few of which were built to the same design.

It was Henry Ford who really understood the drawbacks of craft production. With his Model T, Ford achieved two objectives. He had a car that could be easily manufactured, and that was, also user-friendly. Almost anyone could drive and repair the car without a chauffeur or mechanic.

The key to mass production was not the moving, or continuous, assembly line. Rather, it was the complete

and consistent interchangeability of parts and the simplicity of attaching them to each other. These were the manufacturing innovations that made the assembly line possible. Taken together, interchangeability, simplicity, and ease of attachment gave Ford tremendous advantages over his competition. Besides cutting costs, he could also eliminate the skilled fitters who had always formed the bulk of every assembler 's labor force.

The assemblers/fitters performed the same set of activities over and over at their stationary assembly stands. They had to get the necessary parts, file them down so they would fit and then bolt them in place. Ford made this process more efficient by delivering the parts to each work station. Now the assemblers could remain at the same spot all day.

Then, around 1908, Ford finally achieved perfect part interchangeability. He decided that the assembler would perform only a single task and move from vehicle to vehicle around the assembly hall. By August 1913, just before the moving assembly line was introduced, the task cycle for the average Ford assembler had been reduced from 514 to 2.3 minutes.

Ford soon recognized the problem with moving the worker from assembly stand to assembly stand. Walking took time and jam-ups frequently resulted as faster workers overtook the slower workers in front of them. In 1913, Ford introduced the moving assembly line, which brought the car part to the stationary worker. This innovation cut cycle time from 2.3 minutes to 1.19 minutes.

Ford wanted to produce the entire car in one place and sell it to the whole world. But the shipping systems of the day were unable to transport huge volumes of finished automobiles economically without damaging them. There were also trade barriers. So Ford decided to design, engineer, and produce his parts centrally in Detroit. The cars, were assembled in remote locations. By 1926, Ford automobiles were assembled in more than thirty-six cities in the United States and in nineteen foreign countries.

But Ford quickly realised that one standard product just wasn 't suited to all world markets. For example, to Americans, Ford's Model T seemed like a small car, particularly after the East Texas oil discoveries pushed gasoline prices down and made longer travel by car economically feasible. However, in England and in other European countries, with their crowded cities and narrow roads, the Model T seemed much larger. In addition, when the Europeans failed to find any oil at home, they began to tax gasoline heavily in the 1920s to reduce imports. The Europeans soon began to clamor for a smaller car.

Moreover, massive direct investment in foreign countries created resentment of Ford 's dominance of local industry. In England, for example, where Ford had become the leading auto manufacturer by 1915, his pacifism in World War I was roundly denounced, and the company 's local English managers finally convinced Detroit to sell a large minority stake in the business to Englishmen to diffuse hostility. Ford encountered barriers in Germany and France as well after World War I, as tariffs were steadily raised on parts and complete vehicles. As a result, by the early 1930s, Ford had established three fully integrated manufacturing systems in England, Germany, and France. These companies offered customisd products to suit national tastes and were run by native managers who tried to maintain their autonomy.

Sloan's approach

At General Motors, Alfred Sloan 's innovative thinking seemed to resolve the conflict between the need for standardization to cut manufacturing costs and the model diversity required by consumers. He achieved both goals by standardizing many mechanical items, such as pumps and generators, across the company 's entire product range and by producing these over many years with dedicated production tools. At the same time, he annually altered the external appearance of each car and introduced an endless series of "hang-on features," such as automatic transmissions, air conditioning, and radios, which could be installed in existing body designs to sustain consumer interest.

Ford's factory practices, combined Sloan 's marketing and management techniques, and organized labor 's new role in controlling job assignments and work tasks, took mass production to its final mature form. For decades, this system was the norm. The U.S. car companies dominated the world automotive industry, and the U.S. market accounted for bulk of the world 's auto sales. Companies in practically every other industry adopted similar methods, leaving behind a few craft firms in low-volume niches.

Three giant enterprises – Ford, GM, and Chrysler accounted for bulk of all sales, and six models accounted for 80 percent of all cars sold. All vestiges of craft production once the way of all industry, were now gone in the United States.

The decline of US car makers

By 1955, the Big Three American firms were losing their competitive advantage. Mass production had become commonplace in countries across the world. In Europe, the diffusion of the technology had taken place somewhat slowly. The basic ideas underlying mass production had, been freely available in Europe for years before the onset of World War II. However, the economic chaos and narrow nationalism existing there during the 1920s and early 1930s, along with a strong attachment to the craft-production traditions, prevented them from spreading very far. At the end of the 1930s, Volkswagen and Fiat began ambitious plans for mass production at Wolfsburg and Mirafiori, but World War II soon put civilian production on hold.

So, it wasn't until the 1950s, more than thirty years after Henry Ford pioneered high-volume mass production, that this technology, fully diffused beyond Ford 's native turf. By the late 1950s, companies like Volkswagen, Renault, and Fiat were producing on a scale comparable to Detroit 's major facilities. Some craft-production firms, also made the transition to mass production.

The Rise of Lean Production

It was the Japanese who set out to change the rules of the game. By purchasing a few used American presses and endlessly experimenting from the late 1940s onward, Ohno eventually perfected his technique for quick die changes. By the late 1950s, he had reduced the time required to change dies from a day to an astonishing three minutes. He also eliminated the need for die-change specialists. In the process, he made an unexpected discovery. It actually cost less per part to make small batches of stampings than to run off enormous lots. Making small batches eliminated the carrying cost of the huge inventories of finished parts that mass-production systems required. It also caused stamping mistakes to show up almost instantly.

The consequences of this latter discovery were enormous. It made those in the stamping shop much more concerned about quality, and it eliminated the waste of large numbers of defective parts – which had to be repaired at great expense, or even discarded – that were discovered only long after manufacture. But to make this system work at all, Ohno needed both an extremely skilled and a highly motivated work force. If workers failed to anticipate problems before they occurred and didn 't take the initiative to devise solutions, the work of the whole factory could easily come to a halt.

Ford's system assumed that assembly-line workers would perform one or two simple tasks, repetitively. The foreman did not perform assembly tasks himself but instead ensured that the line workers followed orders. These orders or instructions were devised by the industrial engineer, who was also responsible for improving the process.

Special repairmen repaired tools. Housekeepers periodically cleaned the work area. Special inspectors checked quality, and defective work, once discovered, was rectified in a rework area after the end of the line. A final category of worker, the utility man, completed the division of labor. Since even high wages were unable to prevent double-digit absenteeism in most mass-production assembly plants, companies needed a large group of utility workers on hand to fill in for those employees who didn 't show up each morning.

Managers at headquarters generally graded factory management on two criteria – yield and quality. Yield was the number of cars actually produced in relation to the scheduled number. Quality was measured after vehicles with defective parts had been repaired. Factory managers knew the assigned production target had to be met at all costs. Mistakes could, if necessary, be fixed in the rework area, after the end of the line but before the cars reached the quality checker from headquarters stationed at the shipping dock. Therefore, it was crucial not to stop the line unless absolutely necessary. Letting cars go on down the line with a misaligned part was perfectly okay, because this type of defect could be rectified in the rework area, but minutes and cars lost to a line stoppage could only be made up with expensive overtime at the end of the shift.

Ohno, who visited Detroit repeatedly just after the war, quickly realised this whole system was rife with muda, (waste). None of the specialists beyond the assembly worker was actually adding any value to the car. Ohno was convinced that assembly workers could probably do most of the functions of the specialists and do them much better because of their direct acquaintance with conditions on the line.

Ohno began to experiment. The first step was to group workers into teams with a team leader rather than a foreman. The teams were given a set of assembly steps, their price of the line, and told to work together on how best to perform the necessary operations. The team leader would do assembly tasks as well as coordinate the team, and, in particular, would fill in for any absent worker concepts unheard of in mass-production plants.

Ohno next gave the team the job of housekeeping, minor tool repair, and quality-checking. Finally, as the last step, after the teams were running smoothly, he set time aside periodically for the team to suggest ways collectively to improve the process.

When it came to "rework," Ohno reasoned that the mass-production practice of passing on errors to keep the line running caused errors to multiply endlessly. Ohno placed a cord above every work station and instructed workers to stop the whole assembly line immediately if a problem emerged that they couldn 't fix. Then the whole team would come over to work on the problem. Production workers were taught to trace systematically every error back to its ultimate cause then to devise a fix, so that it would never occur again.

Not surprisingly, as Ohno began to experiment with these ideas, his production line stopped all the time. However, as the work teams gained experience identifying and tracing problems to their ultimate cause, the number of errors began to drop dramatically. Today, in Toyota plants, where every worker can stop the line, yields approach 100 percent. The line practically never stops.

Toyota did not wish to vertically integrate its suppliers into a single, large bureaucracy. Neither did it want completely independent vendors. Instead, Toyota spun its in-house supply operations off into quasi-independent first-tier supplier companies in which Toyota retained a fraction of the equity and developed similar relationships with other suppliers who had been completely independent. As the process proceeded, Toyota 's first-tier suppliers acquired much of the rest of the equity in each other.

Ohno developed a new way to coordinate the flow of parts within the supply system on a day-to-day basis, called kanban. Parts would only be produced at each previous step to supply the immediate demand of the next step. This simple idea was enormously difficult to implement in practice because it eliminated practically all inventories. When one small part of the vast production system failed, the whole system came to a stop. This was precisely the power of Ohno's idea. It removed all safety nets and focused every member of the vast production process on anticipating problems before they became serious enough to stop everything.

The dealer became part of the production system as Toyota gradually stopped building cars in advance for unknown buyers and converted to a building-to-order system in which the dealer was the first step in the kanban system, sending orders for presold cars to the factory for delivery to specific customers in two to three weeks.

Toyota had come to grip with the principles of lean production by the early 1960s.

GM & Toyota: A Contrast

The differences between Takaoka (Toyota) and Framingham (General Motors) were striking, as observed by the authors. For a start, hardly anyone was in the aisles in Takaoka. The armies of indirect workers so visible at GM were missing, and practically every worker in sight was actually adding value to the car. This fact was even more apparent because Takoaka's aisles were so narrow.

Toyota's philosophy about the amount of plant space needed for a given production volume is just the opposite of GM 's. Toyota believes in having as little space as possible so that face-to-face communication among workers is easier. There is no room to store inventories. GM, by contrast, has believed that extra space is necessary to work on vehicles needing repairs and to store the large inventories needed to ensure smooth production.

The final assembly line also revealed further differences. Less than an hour 's worth of inventory was next to each worker at Takaoka. The parts went on more smoothly and the work tasks were better balanced, so that every worker worked at about the same pace. When a worker found a defective part, he carefully tagged it and sent it to the quality-control area in order to obtain a replacement part. Once in quality control, employees subjected the part to what Toyota calls "the five why's" in which, the reason for the defect is traced back to its ultimate cause so that it will not recur.

Each worker along the line can pull a cord just above the work station to stop the line if any problem is found. At GM only senior managers can stop the line for any reason other than safety – but it stops frequently due to problems with machinery or materials delivery. At Takaoka, every worker can stop the line but the line is almost never stopped, because problems are solved in advance and the same problem never occurs twice. Clearly, paying relentless attention to preventing defects has removed most of the reasons for the line to stop.

Exploding some myths

It is wrong to equate "Japanese" with "lean" production and "Western" with "mass" production. In fact, some plants in Japan are not particularly lean, and a number of Japanese-owned plants in North America have demonstrated that lean production can be practiced far away from Japan. At the same time, the best American-owned plants in North America show that lean production can be implemented fully by Western companies. Moreover the best plants in the developing countries show that lean production can be introduced anywhere in the world.

An important point the authors make is that high-tech plants that are improperly organized end up adding about as many indirect technical and service workers as they remove unskilled direct workers from manual assembly tasks. What's more, they have a hard time maintaining high yield, because breakdowns in the complex machinery reduce the fraction of the total operating time that a plant is actually producing vehicles. Lean organization must come before high-tech process automation if a company is to gain the full benefit.

The truly lean plant has two key organizational features: Tasks and responsibilities are transferred to those workers actually adding value to the car on the line. There is a system for detecting defects that quickly traces every problem, once discovered, to its ultimate cause.

This, in turn, means teamwork among linen workers and a simple but comprehensive information display system that makes it possible for everyone in the plant to respond quickly to problems and to understand the plant 's overall situation.

In the end, it is the dynamic work team that emerges as the heart of the lean factory. Building these efficient teams is not simple. First, workers need to be taught a wide variety of skills so that tasks can be rotated and workers can fill in for each other. Workers also need to be good at simple machine repair, quality checking, housekeeping, and materials-ordering. They must also have the ability to think proactively to devise solutions before problems become serious.

Lean Product development

All large automobile companies face the same basic problem in developing a new product. Different functional departments must collaborate intensively over an extended period of time to develop the new car

successfully.

Most automotive companies develop some sort of matrix in which every employee involved in developing a product reports both to a functional department and to a development program. The leadership challenge is managing the matrix to satisfy the needs of both the functional department and the product-development program.

Clark found that a totally new Japanese car required 1.7 million hours of engineering effort on average and took forty-six months from first design to customer deliveries. By contrast, the average U.S. and European projects of comparable complexity and with the same fraction of carryover and shared parts took three million engineering hours and consumed sixty months.

The lean producers invariably employ some variant of the shusa system pioneered by Toyota. The shusa is the leader of the team which designs and engineers a new product and gets it fully into production. In the best Japanese companies, the position of shusa carries great power and is, perhaps, the most coveted in the company.

In Western team, the leader has to convince team members to cooperate. It's a frustrating role, because the leader really has limited authority. Few team leaders report enjoying their job. Indeed, many company executives view the job, as a dead end in which success leads to little reward and failure is highly visible.

The shusa assembles a small team, which is then assigned to a development project for its life. These employees come from functional departments of the company - market assessment, product planning, styling, advanced engineering, detail engineering, production engineering, and factory operations. They retain ties to their functional department but for the life of the program they are clearly under the control of the shusa. How they perform in the team, as judged by the shusa, will control their next assignment, which will probably be another development team.

By contrast, in most Western companies, a development project consists of individuals, including the team leader, who are on short-term loan from a functional department. Moreover, the project itself is moved from department to department along a sort of production line. The members of the team know that their career success depends on moving up through their functional specialty. They work very hard in the team to advance the interest of their department.

Many Western development efforts fail to resolve critical design trade-offs until very late in the project. This is because they show great reluctance to confront conflicts directly. They make vague commitments to a set of design decisions – agreeing, that is, to try to do something as long as no reason crops up not to. In Japan, by contrast, team members sign formal pledges to do exactly what everyone had agreed upon as a group. So conflicts about resources and priorities occur at the beginning rather than at the end of the process.

In the best Japanese lean projects, the numbers of people involved are highest at the very outset. All the relevant specialties are present, and the shusa's job is to force the group to confront all the difficult trade-offs necessary to agree on the project. As development proceeds, the number of people involved drops as some specialties, such as market assessment and product planning, are no longer needed.

By contrast, in many mass-production design exercises, the number of people involved is very small at the outset but grows to a peak very close to the time of launch, as hundreds or even thousands of extra bodies are brought in to resolve problems that should have been cleared up in the beginning.

The mass-production approach to die-making is simple. Wait until the product designers give precise specifications for the stamped part. By contrast, the best lean producers begin die production at the same time they start body design. This is possible because the die designers and the body designers are in direct, face-to-face contact and probably have worked together in previous product-development teams. The die designers know the approximate size of the new car and the approximate number of panels so they go ahead and order blocks of die steel. Then they begin to make rough cuts in the steel, so it 's ready to move to final cutting as soon as the final panel designs are released.

Companies that have mastered lean design will offer a wider variety of products and replace them more

frequently than mass-production competitors. And this is exactly what has been happening in the auto industry across the world in the 1980s. The Japanese lean producers exercise extreme care not to isolate their advanced technologies from the day-to-day workings of the company and the incessant demands of the market. Based on their observations of U.S. and European mass-producers, they long ago concluded that, to be effective, even advanced engineering, must be tied into the key market-driven activities of the company.

Lean Supply Chain

At best, the typical mass-production supply system can succeed in keeping the suppliers ' profits very low. The assembler's purchasing department may cite this fact as the primary evidence of its success. However, parts costs may remain very high, and quality may prove both unsatisfactory and resistant to improvement, usually because of poor communication across the value chain.

A third to an eighth as many suppliers are involved, compared with a mass-production company, because lean producers assign a whole component to a first-tier supplier. The first-tier suppliers typically have teams of second-tier suppliers. These companies may, in turn, engage helpers in a third or even fourth tier of the supplier pyramid. These lower tiers make individual parts according to drawings supplied by the second-tier firm.

The nature of the supply arrangements means that the assembler may actually know relatively little about certain parts or systems. But the lean assembler does not delegate to the supplier the detailed design of certain parts considered vital to the success of the car, due either to proprietary technology or to the consumer's perception of the product. Leading examples of parts usually reserved for the assembler 's in-house supply divisions are engines, transmissions, major body panels, and, increasingly, the electronic management systems that coordinate the activities of many vehicle systems.

Even when it comes to parts where the assembler is only loosely acquainted with the technology and totally dependent on a single outside supplier, the lean producer takes care to learn an enormous amount about the supplier's production costs and quality. According to the authors, the system works precisely because a rational framework exists for determining costs, price, and profits. This framework makes the two parties want to work together for mutual benefit, rather than look upon one another with mutual suspicion.

In short, the contract lays the basis for a cooperative relationship, one that is fundamentally different from the relatively adversarial relationships between supplier and assembler in the West.

All producers try to analyze costs, but lean production makes it much easier to do this accurately. Where set-up times have been honed always to require only a few minuses and where production runs are frequent, short, and uninterrupted, cost estimators do not have to wait around for days or weeks to average the performance over several production runs. They can quickly collect data that is accurate and representative. Indeed collecting the data can be left to the machine operators themselves. This makes it possible to do a complete cost analysis several times a year and to monitor progress in cutting costs accurately.

A second feature of lean supply is continually declining prices over the life of a model. Mass-producers assume that bidders are actually selling below cost at the outset of a contract and will expect to recoup their investment by raising prices each year. Lean producers know that the price for the first year 's production is a reasonable estimate of the supplier 's actual cost plus profit. The assemblers are also well aware of the learning curve that exists for producing practically any item. So they realize that costs should fall in subsequent years, even though raw-materials costs and wages may increase.

By agreeing to share the profits from joint activities and letting suppliers keep the profits from additional activities they undertake, the assembler relinquishes the right to monopolize the benefits of the supplier 's ideas.

The practice in the best lean-production companies is to deliver components directly to the assembly line, often hourly, certainly several times a day, with no inspection at all of incoming parts. This procedure is in keeping with the famous just-in-time system, the invention of Taiichi Ohno.

The Japanese practice production smoothing and ensure a steady volume of business for the suppliers.

Assemblers give suppliers advance notice of changes in volume. If the changes are likely to persist, the assembler will work with the supplier to look for other business.

The lean producer has no reserve stocks. A faulty shipment could prove catastrophic. Yet, this disaster almost never happens in practice, despite the fact that parts are not inspected until they are actually installed on the car or truck. The parts supplier knows what faulty parts can mean and takes pains not to let it happen. And, in the rare event a defective part is found, the assembler 's quality-control department goes to the root of the problem. Both the supplier and the assembler are determined to trace every defective part to its ultimate cause and to ensure that a solution is devised that prevents this error from ever happening again.

When a supplier falls short on quality or reliability, the assembler does not cancel the contract. Instead, the assembler shifts a fraction of the business from that supplier to its other source for that part for a given period of time as a penalty. Because costs and profit margins have been carefully calculated on an assumed standard volume, shifting part of the volume away can have a devastating effect on the profitability of the uncooperative supplier. Toyota and other companies have found that this form of punishment is highly effective in keeping the suppliers on their toes, while sustaining the long-term relationship essential to the system.

Lean producers do occasionally fire suppliers, but not capriciously. The system is transparent. Suppliers are never kept in the dark about their performance. Manufacturers maintain relatively simple supplier grading systems. The suppliers receive scores based primarily on the number of defective parts found on the assembly line, the percentage of on-time deliveries in the proper quantity and sequence, and performance in reducing costs.

Many observers have argued that single-sourcing is a useful technique Western assemblers can learn from the Japanese. But this is a rather simplified view of the reality. Japanese long-term relationships do not depend on single-sourcing but on a contract framework that encourages cooperation.

Many American manufacturers are reducing inventory. But often, this is not a move toward lean supply. Rather, it is an attempt to cut the amount of inventory in the assembler 's plant. The suppliers, instead, keep the inventories. So the change is simply an attempt by assemblers to shift costs to their suppliers.

Moreover, it is one thing to deliver smaller lots of parts more frequently to the assembler, but quite another to produce these parts in smaller lots, as a lean supplier would do.

While many of the changes resemble what Japanese lean supply looks like from the West, nearly all have been driven by cost pressure and existing mass-production logic: single-sourcing for achieving economies of scale, just-in-time for shifting the burden of inventories, and more.

Indeed, without a fundamental shift away from a power-based bargaining relationship, it is almost impossible to move toward lean supply. If the assemblers don't establish a new set of ground rules for joint cost analysis, price determination, and profit sharing, the suppliers will continue to play by the old rules.

Confronted with this power-based relationship, the suppliers will try to shift any advantages to their side. Their chief way of doing so has been to introduce new technologies and bring together discrete components into systems. Without detailed value analysis, the assembler is unable to do more than guess the price of a complex component or to play off one supplier against the other.

In Europe, the situation has been a little different from that in the U.S. Although the mass-production assemblers in Western Europe are now the world 's most orthodox followers of Henry Ford in their own factories, the European supply system has always differed from mass-production methods and has been somewhat closer to lean supply. That 's partly because European assemblers have always been smaller and more in number. Six companies divide the mass market with shares of 10 to 15 percent of total production, while a half-dozen specialists companies split the rest of the market.

These smaller assemblers never had the scale or the funds to contemplate doing everything themselves, as Henry Ford did initially and GM very nearly did for fifty years. What's more, there have always existed a number of strong European suppliers like Bosch, GKN and SKF with a clear technical lead in certain

component areas. So the tradition in Europe has always been for large talented suppliers who have engineered complete sub assemblies and components for the assemblers.

An additional feature of the European components industry that makes it more similar to lean than to mass supply is the grouping of suppliers around their home-country assemblers, both physically and in terms of long-term relationships. The French assemblers, for example, have historically drawn on French suppliers, concentrated in the Paris area, with whom they have worked for decades.

But the main departure from the lean supply system in Europe is the large number of suppliers to each assembler – between 1,000 and 2,000. Now, European mass-market assemblers are trying to reduce the complexity of their supply systems by designating suppliers for whole components. Because of the greater strength of many European components suppliers, particularly in Germany, as many Japanese suppliers may not come to Europe as have come to North America.

Japanese suppliers do not love their customers any more than their counterparts in the West. But, they operate in a completely different framework that channels the efforts of both parties toward mutually beneficial ends with a minimum of wasted effort. By abandoning power based bargaining and using a rational structure for jointly analyzing costs, determining prices, and sharing profits, adversarial relationships give way to cooperative ones. Cooperation does not mean a cozy relaxed atmosphere. Japanese suppliers face constant pressure to improve their performance, both through constant comparison with other suppliers and contracts based on falling costs. However, they also have much greater discretion than in the West, with greater responsibility for designing and engineering their own products.

Customer Relationship Management

The success of mass production has been so geared to the needs of the manufacturing and design processes that the customer has tended to come last. The coordination between the sales division and product planners in the big mass-production companies is poor. While the product planners conduct endless focus groups and clinics at the beginning of the product-development process to gauge consumer reaction to their proposed new models, they haven ’t found a way to incorporate continuous feedback from the sales division and the dealers. In fact, the dealers have almost no link with the sales and marketing divisions, which are responsible for moving the metal. The dealers ’ skills lie in persuasion and negotiation, not in feeding back information to the product planners.

Salespeople, aren ’t really interested in the customer ’s needs or desires. They want to close the deal as soon as possible and will present only selected bits of information about the product to achieve that end. Once the deal is signed, the salesperson has no further interest in the customer. The entire selling and negotiating system is based on giving the customer as little real information as possible – the same principle on which the relationship between dealers and manufacturers is based.

Because the customer is buying a car tailored to his or her needs, the haggling that Western car buyers find so distasteful is almost eliminated in the Japanese system. The salesperson doesn ’t need to discount the product in order to get rid of a car that the customer would rather not have.

In the West there is a lot of pressure to make the most out of a one-off transaction between two strangers with no subsequent loyalty or commitment. In the Japanese system the aim is to maximize the stream of income from a customer over the long term.

With very few defects in Japanese cars and intense competition in the Japanese car market, it is clearly understood that the dealer will fix any problems the owner encounters with the car even after the end of the formal warranty. The customer need not argue with dealers to get them to accept responsibility for warranty claims. In the west, this is an unpleasant experience that usually convinces customers to look elsewhere for their next car, particularly to a brand that has a reputation for few flaws.

The industry in Japan is very much more concentrated. There are only a total of 1,621 dealer firms in Japan, compared with some 16,300 dealer principals in the United States, a market two and a half times larger than Japan. Almost all Japanese dealers have multiple outlets and some of the largest easily match the megadealers found in the United States. In the same way as lean producers only have a limited number of

suppliers, they only work with a limited number of dealers, who all form an integrated part of their lean production system.

The lean selling system also reduces inventory costs dramatically and smoothes the flow of production in the factory. By making sure its sales force has a clear understanding of the needs of the factory, in particular for a smooth flow of total orders even as the mix of orders fluctuates, it 's possible to make the factory work better.

The Japanese system also helps fine-tune new products and catch embarrassing or dangerous errors before massive-and highly visible-public recalls are needed. Finally, the lean selling system instills channel loyalty in the buyer and makes it extraordinarily hard for new competitors to gain share.

What we have seen in Japan, then, is that distribution is a fully integrated part of the entire production system. It is not simply an expensive door-to-door selling system. In essence it is a system that provides a high level of service to the customer and a high level of real feedback to the manufacturer. When product planning, marketing and distribution costs, together with the benefits of more accurate matching of production to demand and better production scheduling are added in, the Japanese system is already delivering a higher level of service for much lower real cost than Western analysts have realized. Lean distribution will form the front end of a system that is driven by the needs of the customer, not by the needs of the factory. In an increasingly competitive world market where, more affluent customers are seeking and able to pay for a greater choice in personal transportation, this reorientation of the entire mass-production system will be critical for survival.

The Keiretsu

The keiretsu system on average has exhibited superior performance compared with both the Anglo-Saxon and continental European systems of finance. Western finance tends to be either impatient and largely uninformed about a company 's problems or patient but passive. External directors have often failed to confront the problem of clear slippage in competitive position until very late in the game.

By contrast, the Japanese group system is patient and extremely long-term in orientation. At the same time, it is very well informed and highly critical of inadequate performance. The groups can afford to invest heavily to finance corporate turnarounds, because their considerable knowledge reduces the risks of failure.

The global challenge

A vital feature of lean production is still not fully appreciated. This mode of production achieves its highest efficiency, quality, and flexibility when all activities from design to assembly occur in the same place. For this reason, lean producers in the 1990s will need to create top-to-bottom, paper-concept to finished-car manufacturing system in the three great markets of the world – North America, Europe, and East Asia.

Meanwhile, the Japanese companies received a windfall from North American and European quotas. When the Japanese were told they could sell only a fraction of the cars they had sold previously, they simply raised their prices until sales fell to the required level. And they reaped huge profits in the process. Indeed, Western quotas are arguably the biggest public-policy boost the Japanese auto industry has ever received. The Japanese companies used their profits to wage a market-share war in Japan, probably selling below cost in many cases and ensuring that Western importers would have little success selling there, even if there were no trade barriers at all.

According to the authors, the management challenge for the big car makers is simple in concept: to devise a form of enterprise that functions smoothly on a multiregional basis and gains the advantage of close contact with local markets and the presence as an insider in each of the major regions. At the same time, it must benefit from access to systems for global production, supply, product development, technology acquisition, finance, and distribution.

Unfortunately, the three models developed so far for this enterprise are inadequate. The first is extreme centralization of decision-making at headquarters, located in the home country and staffed by nationals of the home country. Centralization produces bad decision-making and generates intense resentment in other

regions.

The commonly pursued alternative has been extreme decentralization into regional subsidiaries, each developing its own products, manufacturing systems, and career ladders in isolation from the other regions. This was the position of Ford of Europe in the 1970s and still describes GM of Europe. This hermetic division by regions results in a narrow focus, ignores advantages of cross-regional integration, and creates gilded cages for highly paid national executives unable to rise any further in their organization.

Strategic alliances with independent partner firms from each region, is the third model. Unfortunately, these arrangements leave the central question of coordination and overall management unanswered. Given this fact, it is hardly surprising that most strategic alliances in the motor industry have proved undynamic and unstable.

What is needed is an integrated, global personnel system that promotes personnel from any country in the company as if nationality did not exist. Also needed is a set of mechanisms for continuous, horizontal information flow among manufacturing, supply systems, product development, technology acquisition, and distribution. Teams must stay together for the life of the product. They must then be rotated to other product-development teams, quite possibly in other regions and even in different specialties. Everyone will stay fresh and a broad network of horizontal information channels will develop across the company. Also necessary is a mechanism for coordinating the development of new products in each region and facilitating their sale as niche products in other regions. One additional element of the post-national enterprise must be in place: international financing and equity.

Concluding Notes

Lean production should be viewed as a strategy for achieving value leadership. It goes well beyond cost cutting. First, lean production dramatically raises the threshold of acceptable quality to a level that mass production, cannot easily match. Second, lean production offers over-expanding product variety and rapid responses to changing consumer tastes, something low-wage mass production finds hard to counter except through ever lower prices. Lean production also dramatically lowers the amount of high-wage effort needed to produce a product of a given description, and it keeps reducing it through continuous incremental improvement. This means competition from low wage workers is not a threat. Finally, lean production can fully utilize automation in ways mass production cannot, further reducing the advantage of low wages.