

Thought Leaders - Lean On Me

Lean guru Jim Womack believes the world -- though not necessarily manufacturing -- is marching in a lean direction.

The Machine That Changed the World, published back in 1990, has proved to be one of the books that has changed the manufacturing world. The lean movement in the United States was jump-started when James Womack, Daniel Jones and Daniel Roos introduced the Toyota Production System to a U.S. manufacturing industry that was still pretty much baffled by the Japanese automakers and their unconventional insistence on eliminating waste everywhere they saw it.

Today, of course, lean manufacturing has caught on in a big way, and thanks to his subsequent books as well as his founding of the Lean Enterprise Institute, Womack is very much the face of the U.S. lean movement.

Interest in lean topics in the United States appears to be at an all-time high, but is the actual adoption of lean manufacturing on the rise?

Womack: We're seeing a transition from lean tools to lean management. Most people understand the tools. They understand that you need quality at the source and to put things into continuous flow, that pull is better than push in terms of scheduling, and that the correct way to maintain machines is proactively rather than reactively. But we've been struggling to make the leap to management systems that can deploy these tools every day, month after month, year after year, and get the results we should be getting.

The question is: Can we implement a lean management system that can use the tools effectively on a continuing basis? In most businesses, there is a complete disconnect between the metrics the business is using and the lean methods they're deploying. For example, if you tell purchasing you're looking for the lowest piece part price today, that runs completely contradictory to having a small number rather than a large number of suppliers.

One of the hallmarks of an inadequate management system is that you have, for example, a big kaizen campaign. You 5S everything, then cellularize and put everything into continuous flow. You get rid of your MRP system and you try to run a pull system, and so forth. The individual techniques work and every-thing looks great on the day the consultant leaves, but six months later there's been significant deterioration. Two years later, you've regressed to the mean. No one in management was assigned on a continuing basis to maintain the process, and there are a bunch of corporate metrics that don't support doing the right thing. So once the hubbub is gone and the spotlight moves on to a new area, you get this regression phenomenon -- what we call the sustainability issue -- that we're still struggling to deal with.

Lately there has been a much higher awareness that lean management is the real issue -- not lean methods as such -- and there's a lot of curiosity about what it's going to take to change the way companies are managed, to actually get the full benefit on a sustainable basis from these techniques. It's going to require both experimentation and a fair bit of change in what managers do, and what they think management is. Most managers think their greatest contribution to the business is doing work-arounds on broken processes, rather than doing the hard work to get the process right so that it never breaks down.



The biggest single change needed in management mentality is to be able to step back and say, "The reason we're fighting fires all the time is because we don't have any fire marshals. We have an incredible fire department with the best equipment and the fastest, brightest trucks, but we don't do any fire prevention." That describes American management at this point: brilliant at fighting fires, but not adept at all at preventing them.

Historically, Toyota has gotten most of the credit for being a lean pioneer, but what about the rest of the Japanese automakers? Do they all practice lean manufacturing?

Womack: Japanese car companies approached quality based on Deming Prize criteria and so forth in the 1960s and 1970s. They tried to get from end-of-the-line inspection to inspection at the source. They did a pretty good job. Toyota developed an engineering system that got the product to market faster with less effort -- a product with more refinement and fewer mistakes, but done faster and with less effort.

Toyota was always the leader in productivity and effectiveness at the plant level. Toyota also has a supplier management system that is still best-in-class, and a good part of its recent quality issue has been bringing in non-Toyota suppliers and trying to teach them the system. They're struggling because it's hard to get people to change old ways of thinking.

Toyota was without question better in the early going at running plants, designing products and managing suppliers. They were also better (in Japan only) at supporting customers in a system that they've never been able to export. Therefore, Toyota was the best in class, Honda was an earnest emulator, and Mazda was a pretty good company that made a mistake with the wrong engine technology that took them out of the game. Nissan, Isuzu, Mitsubishi and the rest of these companies were pretty good at quality, but not at management.

Now it's more apparent that lean is not a Japanese thing as such, nor is it a Toyota thing. It's a set of ideas that Toyota has done the best job at implementing. But they are certainly not perfect, so there is a gap between the lean ideal and what Toyota is able to do every day. It wasn't just a gap for the other Japanese companies, it was a chasm. In fact, they never got across the canyon.

Do any U.S. companies excel at lean?

Womack: There are five elements to the system. There's a factory element, which is what people can see. There's a product development element, which is harder to see, and a supplier management element that's harder still. The customer support element is really hard to see because it's still early. Finally, there's a management system, which is how managers align the company. So when you look around, you see pieces of the puzzle that some companies have been able to put together pretty well.

Danaher, a growth-by-acquisition company, has been more successful than General Electric in the last 25 years. It has a policy management system from some ex-Toyota guys that is probably the most effective thing out there. It's utterly simple, but it's very effective in terms of getting the business aligned. Boeing has mostly focused on the production part of the process. The 787 is just coming into production now, and they have really rethought the whole production process (in addition to the design process) to build a big airplane the way Toyota would. All of these aerospace companies struggle with their supply base, so getting it right is the central challenge. Boeing is an example of a company that has made a lot of progress in becoming lean -- most of which is visible in the fabrication assembly activity. We see a lot of partially lean businesses, but not many totally lean

ones. Danaher probably comes the closest [in the U.S.]. But the "secular" trend is that the world is marching in a lean direction -- not in the opposite direction.

Do all Japanese automakers today practice Lean?

Womack: Well, not just today. I think you could argue that many never did very well. We say somewhere near the end of the book [*The Machine That Changed the World*] that probably some of the Japanese car companies are going to fail. As of the early 1980s, [co-author] Dan Jones and I concluded -- I remember the moment it happened, while on a trip to Japan, we looked at each other and said, "There is no such thing as Japan. It's an American invention that the Japanese also believe." In fact, if you look at the business system that Nissan has developed and compare it with the system that Honda has and compare that with the system that Toyota has, there's more variation within that category, "Japanese," than there is between the categories "Japanese" and "U.S." So therefore if you have a category where the difference between categories is less than the difference within categories, you don't really have useful categories.

And that was our way of thinking at the time, actually sort of a nice thing to discover because if this lean thing had just been some sort of ethnic or DNA kind of thing -- and we all talk about the DNA of the Toyota Production System (TPS), but talk about the DNA of a country -- then it would have been of limited interest to anybody and would have been pretty negatively received because the word would have been only a certain kind of people in a certain kind of place can actually do this. But we never believed that after 1982. We had spent a lot of time going through Toyota, Honda and Nissan, and it was just so apparent that Nissan was not in the same league with Honda and Toyota, and that Honda basically copied Toyota but always gave everything a different label. The Honda guys just couldn't stand the sight that they were copying Toyota, which they were. And the other guys who sadly got caught up in the wrong technology were Mazda, which was a brilliant company then and now but they made a catastrophic error with the wrong engine technology back at the end of the 1960s/beginning of the 1970s, when they put all their money on their Wankel technology which they've never been able to get to work fuel-effectively. So Mazda never really caught up, so when their banks lost confidence in them, they fell into the orbit of Ford. And the bizarre thing is that Ford has never been able to actually learn much till just very recently from Mazda, even though it's been there all the time.

So the companies that we thought were the real class acts were Mazda, Honda and Toyota. And you can't say that about Mazda to anybody these days because they look like a failure, but just in terms of how they did product development and how they did production, these guys were really good, but as I say, they made a catastrophic error which meant their drive trains were just worthless after 1973, and they lost so much money and got so deeply into debt that they never could get back.

But let us be concise here. All the Japanese car companies did the quality thing based on the Deming Prize criteria and so forth back in the 1960s and 70s. What that meant was, they tried to get from end-of-the-line inspection to inspection at the source. And they did a pretty good job on that, no question about it. Initially there was a big difference in delivered defects as traced by J.D. Power. And then over time there became a difference in durability -- that if you build products with less vibration and tighter tolerances and so forth, they'll run longer. All the Japanese companies did that. What Toyota was able to do in addition was an engineering system that really got the product to market faster with less effort -- that was the amazing thing. A product with more refinement, fewer mistakes, but done with less effort and faster. And then in terms of the production, the famous TPS, Toyota was always the leader in terms of productivity and effectiveness at the plant level. And then, not seen and still not understood, and I was just in Detroit where people still struggle to understand, Toyota has a supplier management system that is still the best-in-class, and a good part of Toyota's



recent quality issue has been bringing in a whole bunch of non-Toyota traditional suppliers and trying to teach them the Toyota Management System, and they're struggling because it turns out -- and I should know this better than anybody, it's what I've been doing for the last 20 years -- it's hard to get people to change old ways of thinking.

So you had these elements of the system where Toyota was without question better in the early going at running plants, designing products and managing suppliers. Also, in Japan only, they were better at supporting customers in a system that they've never been able to export, which is a curious story but for another day. So therefore, Toyota was the best in class, Honda was an earnest emulator, Mazda was a pretty good company that made a mistake that took them out of the game. And then Nissan, Isuzu, Mitsubishi and the rest of these guys were pretty good at quality and as it turned out, not very good at management. So who would think that Nissan could fall under the control of Renault, a French car company not known for being the Toyota of Europe, and yet that's what happened. So it's been interesting. Isuzu basically dropped out of the car business. Mitsubishi has lost half or more of its market share and has never been able to figure out how to make any money at cars. And Nissan basically went bankrupt, so therefore it's a mixed deal.

But as time goes on, it's become more and more apparent that this is not a Japanese thing as such, and it's not a Toyota thing as such. It's a set of ideas that Toyota has done the best job at implementing, but certainly not perfect, so there is a gap between the lean ideal and what Toyota is able to do every day. And then for the other companies it wasn't just a gap, it was a chasm, and in fact they never got across the canyon. So that's the Womack wrap-up on the Japanese car industry in terms of lean stuff.

If we don't just restrict ourselves to automotive companies, who are the best U.S. companies at Lean? Do any American companies excel at Lean, or approach Toyota?

Womack: There are really five elements to the system. There's a factory element, which is what people can see. And then there's a product development element, which is harder to see. And a supplier management element that's harder to see. And a customer support element that's really hard to see because it's still early days on that, and the book Dan Jones and I wrote, *Lean Solutions*, tried to get peoples' heads around it. And then finally there's a management system, about what the managers do and how do you align the company. So when you look around, you see pieces of the puzzle that some companies have been able to do pretty well. If you look at Danaher, a company that's been more successful than GE over the past 25 years, it's a growth-by-acquisition company. They take companies with some technology but not much in the way of management, typically kind of Larry Lightbulb companies where the founding owner wants out, and then tries to fold them into Danaher's different sectors. They've got a policy management system that they got from some ex-Toyota guys that is probably the most effective thing out there. It's utterly simple -- some would say it's simple-minded -- but it's very effective in terms of getting the business aligned. They've been very, very good at fixing plants so that the plants really do look pretty good. And they've been pretty good at the process design part of product development. We've got now a nation full of kaizen consultants doing kaizen, and almost all of that kaizen would be unnecessary if the production process had been laid out the right way the first time, which is what Toyota does. Kaizen at Toyota is a very short tail on a very large dog, and the American approach to it has been that it's the whole dog -- let's do some kaizen. So Danaher has been very effective at policy alignment, that overall management issue. They've been very effective at running plants. They've been very effective at putting processes into production that actually don't need a lot of kaizen. How they've done on the supplier management and the customer support and so forth, I don't actually know, but my guess is they've done a lot less there.



So you can find a company like Danaher that's highly successful -- it's now about a \$12 or \$14 billion business -- that has really been a very earnest student of Toyota, and they're actually willing to talk about it now. Larry Culp, the new president, unlike George Sherman, the old president, is actually willing to talk. So there's a nice example of a company that has practically no automotive. They started out in their engine brake business at the beginning of the 1990s or the end of the 80s, but since then they're not an automotive company at all really. They make all kinds of equipment, much of it capital goods type stuff. They sell into healthcare and construction and so forth.

There are a lot of other folks out there who have made I would say pretty impressive progress in different parts of the system. I had the great thrill of going up to Boeing in 1985 and then having a frank exchange of views with Boeing, including its commercial president Alan Mulally, now president of Ford Motor Co. And they were just sort of incredulous at the idea that you could make airplanes the same way that Toyota makes cars because there's such a volume difference that this just didn't seem plausible. And what they were doing is what a lot of companies did -- they had a very loopy-goopy design process, quite safe because of all the fail-safe features. And they had a very loopy-goopy production process, and a very loopy-goopy supply chain, and everything was run on adrenaline, so that it was all work-arounds. Managers were geniuses at work-arounds, and that's what people thought managers did -- work around. So every process is broken, but we've got brilliant people doing work-arounds so we're going to be okay, and that had served Boeing pretty well. But then coming out of the recession of 1995 -- the aerospace order book always lags a recession by about three or four years -- so that the recession of 1991-92 produced the bottom of the trough in aerospace in 1995. As they came out of it, they were trying to ramp very quickly. The industry structure was changing, they bought McDonnell Douglas and Fokker exited, so there were really just two players. And they were determined to go for share with absolutely no production ability to ramp at the rate they wanted to ramp. So they actually hit the ground in 1998, and it was a much worse thing than this Airbus thing with the A380 -- they had to stop the whole company for three or four months because they just couldn't get any parts to the line. But that was the event they really needed. Most organizations to make a leap into lean-land need an emotional event, and that shouldn't be and gosh I'd do everything I can to make that unnecessary, but we see it over and over again that you really do have to have your old system brought into profound question before you're willing to jump to a new system.

So with the 787 which is just coming into production now and we'll see if they can really do it, they've really rethought the whole production process in addition to the design process to try to, if I may say, build a big airplane the way Toyota would. And we'll see -- the proof will be a year from now when they actually start serious production, but so far so good. But one of the interesting metrics there is they've gone down from time in the big assembly area up in Everett [Washington] for a 747; it was seven or eight months when I first showed up, and they say they can now assemble a 787 in less than 80 days. And if they're doing it right, they ought to be able to do it in less time than that. So there's a nice example of a company -- Boeing -- that I think really has to Alan's credit made a whole lot of progress, but mostly focused on the production part of the process. Not to say that they haven't done good things in design, but all of these aerospace guys struggle with their supply base, and when you figure that most of an airplane these days is a vendor airplane and the OEM is a system integrator, getting the supply base right is the central challenge. I'm just an outside observer, but I see less progress there than in other elements of the system. So there's an example of a company that's made a whole lot of progress trying to become a lean company, with most of that progress visible in the fabrication assembly activity.

What you see right now is an enormous number of points of light, of people who've been able to take their best plant and make it very good indeed, and have able to take their best business unit and make it very good indeed. They demonstrate for every industry that you can actually make all of



these methods work, and by the way we haven't encountered anything yet where you can't. But it's hard to find, if you will, the total business. What we see is a lot of partially lean businesses but not much to show in the way of totally lean businesses, and I would say that Danaher probably comes the closest. So the prize is still out there to be gotten by somebody, and of course Toyota as they try to continue this breakneck ramp-up, which in some ways is not all that different from Boeing in 1998, except the problem here is the constraint is not suppliers but management. Can Toyota train enough young managers to understand its management methods to keep managing the way it's managed that's put it on top?

So even Toyota faces a struggle to keep on top of the game -- but hang on, having said that, the secular trend as we used to say at MIT is that the world is marching in a lean direction. The world is not marching in the opposite direction. Partly the old system had reached its limits so there really wasn't anywhere to march, and people discovered a whole lot about how simple technological overlays -- either software or hardware -- were unlikely to produce a sustainable advantage. So the alternatives having failed, and there being lots of points of light coming out of the lean world, history is marching in our direction. I would say that what's not happened is that out in this newly forming universe that we've not gotten the molecules to come together to a point that we can light off some true stars, which is to say lots and lots of Danaher-type organizations. We've got some points of light that need to coalesce within businesses to get them to a point where they're really ready for the big ignition, that big boom that puts you in a different position and confirms the hypothesis that you can do this on a total business basis.

Today China is seen as a major source of low-cost manufacturing, which gets me to wondering if there's any indication that lean manufacturing is coming to China or if any Chinese manufacturers are looking at it? And are any U.S. manufacturers looking into outsourcing Lean principles along with their manufacturing over to China, and starting Lean from scratch?

Womack: In general, greenfields have a better shot at making rapid progress than brownfields, so if you're going to go to China to do your own greenfields, it would make some sense to try to do it the right way. A company which I've observed for a long time, a very sad situation, is Delphi. GM decided that it would be better for Delphi to go bankrupt than for GM to go bankrupt, so therefore it's awkward always to raise the example of Delphi. But they have operations in China which are greenfields, and they've done really a very good job of trying to do it from the start the way, well, Toyota would.

But so much of what's gone on in China is the following: you're either outsourcing your production altogether so that the American company doesn't actually know much about how they make the product other than they've got a bunch of quality engineers over there trying to get it made right, or they've gone in and hired local managers who understand local people and local practices and build plants that work in local ways. Again, those are the two easy things to do: just outsource it and hope for the best, and just basically compete on the basis of low labor costs. The other is to basically build Chinese factories rather than lean factories. And so one of the things you see when you go to China is staggering amounts of capital equipment lying around. They've got lots of money and so they've bought the best, but don't even know how to install it. It always knocks me back -- I go there once a year -- to look at the amount of money that has been spent for no particular purpose. So those are two paths that in the long run don't really lead anywhere.

Here's my view about what happens with China. Over time, wages will become much pricier, and it's already happening on the coast fairly dramatically. And it's absolutely not the Chinese game plan that they're going to work for peanuts wages forever for you and me. This is not the plan. And so it follows that if you're going to develop a country, you have to move from a lower to a higher wage



situation. And so when you talk to the guys in the central government, they absolutely want to employ the best methods and they want to be the best in their industry rather than just the cheapest. But of course this is a long gradient to get there. We have an institute in China that we've set up as a non-profit. There's an enormous demand, and our problem is to have Chinese speakers who can teach the material that we teach all over the world. Our problem is not lack of demand; it's a lack of supply. And I would say for the intermediate term that's an enormous problem for the Chinese because they never really had until very recently a Honda and Toyota presence there, and even the presence they've had has been in a joint venture format where it's harder for the incoming company to actually do it the right way because they're tied in to a venture, and there's all kinds of politics and so forth. So there's been very little demonstration effect on the ground in China of what lean really means. So there's no shortage of desire to know but there's a shortage of ability to teach, so that what you see right now in China is a country that is basically a mass production juggernaut, and that works for a while. For those here who think, gosh, maybe there's some hope that rising Chinese wages will re-right the trade deal, you just have to realize that labor productivity in China is awful, and most of these companies that I've looked at if they adopted Toyota methods could quadruple their labor productivity. That ought to take care of wage increases for a while. So don't count on the fact that wages are going to rise is going to deal with the current imbalance.

However, on the flip side -- let's be lean people for a second -- most companies in my view are pretty abysmal at calculating total cost, and I was just up in the Midwest talking to a big company that has absolutely no way to figure out total acquisition costs for materials that they are buying in. Which is to say they've still got a purchasing organization that whatever they may say, is incentivized on lowest piece part right now, and so it's lowest piece part plus slow freight is what purchasing is doing. And then it turns out that nothing ever comes on time so there's lots of expediting, but that's on the logistics budget. And they've got big quality problems, but that's on the quality budget. And then the biggest thing is they've got very long lead times so they're always ordering the wrong stuff, which means that they're either remaindering or they're doing more expediting, and that goes on the SG&A budget. So you say, gee, can anybody count? All you have to do is add up the quality budget, the logistics budget, the SG&A budget and the purchasing budget, and what you'd see is that an awful lot of what you're buying is not cheap the way you think it is. It just amazes me every day -- big companies can't do simple math. If you did do simple math, does that say people would quit going to China? Well no, not for certain categories of things, but there are a lot of other places like Mexico that would be an awful lot better for the North American market, and Eastern Europe for the Western Europe market if you did what we call lean math and counted in all of the factors.

And then there's no question that an awful lot of companies are now deeply exposed to both currency risk and country risk because China is stable as long as it keeps growing, but who know what happens when it isn't, and then there's going to be a depreciation of currency -- I think it's pretty much unavoidable. And then wages are going up as well. So you look at companies that have made a very heavy bet on the long term for China, and I say they're not saving as much as they think they are right now, and they're likely to be saving a lot less in the future, so they really ought to be thinking this through. That's a tough one, and I must say it's one of the larger surprises in the work that we've done around here, in that it's just so difficult to find companies that do what I would call sophisticated cost calculation in which they do total factor for the whole business rather than just doing point cost. But there it is, that's how our world works today.

From my perspective, interest in Lean right now is extremely high, maybe as high as it's ever been. From your perspective, do you see that the adoption rate -- not just interest in it, but the actual adoption of Lean -- is on the rise in the U.S.?



Womack: Where we are right now is a transition from tools to management. We have a lot of experience now with lean tools, and look -- these tools are all fine, they're absolutely necessary, and one of the things we've tried to do in the last ten years, the first decade of our existence here [at LEI] is to write down all of the methods, write down the tools in plain language. We've done maybe half or two-thirds of what we need to do. So we're making real progress that most people understand the tools. They really do understand in a fairly profound way that you really need to have quality at the source, that you need to put things into continuous flow, that pull is better than push in terms of scheduling, that the correct way to maintain machines is proactively rather than reactively. They understand lots of things. But what we've been struggling to make the leap to is management systems that can every day, month after month, year after year, deploy these tools and get the results you should be getting.

So where we stand is this: There's a tremendous interest in the tool part, and we see that here every day because we sell product and our sales are going steadily up and our phone rings, though mostly it's on the web. So there's a tremendous interest in the tools, and this is partly because so many other things that have been tried really haven't worked, and these tools do work. But we do run the risk of just having a wave, and we've had so many improvement waves in industry that when you come a few years ahead and look back, well it was great but there's nothing sustainable. The real question now is, can we implement a management system that can use the tools most effectively on a continuing basis? And that's our key focus here at LEI, trying to explain what we call lean management and trying to get people to understand that in most businesses there's just a complete disconnect, for example between the metrics the business is using and the lean methods that they're deploying at the same time. If you really are telling purchasing that what you're looking for is lowest piece part price today, that just runs completely contradictory to trying to develop your suppliers and to have a small number rather than a large number of suppliers and get consistent brilliant performance rather than one year's good results before the supplier dumps you because they can't afford to work for you. That's where we are right now -- the tools are widely accepted.

When I started going to Japan in the early 1980s, I would come back and was told that the whole thing was a mirage and a fraud, that they had secret workers and secret factories, and all of that kind of stuff. Or that it was a trick currency -- they had this weird trick currency. Or that there was something strange about the company calisthenics and the company song -- there's just something strange about these people, it can't be their methods, it must be the people. By the time *The Machine That Changed The World* came out in 1990, basically all of the intellectual opposition collapsed because we had the goods, and we said, "Here's the data. Tell me one more time about the secret factories and the weird workers." So that was the end of the serious intellectual opposition.

The next thing that came up was: "That's very interesting, but we just can't do it here. So for a manufacturer in the U.S., we ought to move everything to Mexico to get low wages, and then when Mexico was superseded by China, well, let's go to China to get low wages," end of discussion. Now I think we've reached a point where most companies are smart enough to realize that if you're not good at doing something, why are you going to be around? Outsourcing is not something that gives you something that gives you competitive advantage when you're outsourcing to the exact same guy in the exact same country that your competitor is. Now I think managers are older and wiser and soberer, and realize that actually the tools are important but it's how you use them in the business that's what's really important. And so we're all kind of struggling and experimenting with regard to how you really get the maximum benefit out of the tools.

The thing we probably spend the most time on is trying to get people to do pathway analysis for a whole product family all the way through the business, and to have someone who's responsible for looking at the total process of going from concept to launch, from order to delivery, and then



customer support, who actually understands the value creating processes and can see the gap between the way the company is now doing it and what the company would have to do if it really wanted to deserve the name of a lean enterprise. But it's the early days on trying to get those management systems in place. One of the hallmarks of an inadequate management system is that you have, for example, a big kaizen campaign and you get a whole lot of results. You go out and 5S everything and then you cellularize and you put everything into continuous flow and you get rid of your MRP and you try to run a pull system, and so forth. And what we see is that the individual techniques work and it looks great on the day the consultant leaves or the internal lean team leaves, and you come back six months later and there's been significant deterioration and you come back two years later and what you've got is regression to the mean. Of course, the reason simply is that there was no one in management who was assigned on a continuing basis to maintain the process, and you've got a whole bunch of corporate metrics that don't support doing the right thing anyway. So that once the hubbub is gone and the spotlight has moved on to a new area, you get this regression phenomenon, what we call the sustainability issue, that we're still struggling to deal with.

But hang on -- certainly I'm looking at the responses I get at conferences and what we get in e-mail that there's now suddenly a much higher awareness that the real issue here is lean management and not lean methods as such, and a whole lot of curiosity about what it's going to take to change the way companies are managed, to actually get the full benefit on a sustainable basis from these terrific techniques. That's our primary activity here at the institute now, and we think we know how to do that, but it's going to require both experimentation and a fair bit of change in what managers do, what managers think management is. Most managers think that their greatest contribution to the business is doing workarounds on broken processes rather than doing the hard work to get the process right so it never breaks down so you don't need to do workarounds.

I would say that's the biggest single change in management mentality, to step back and say, "Gosh, the reason why we're fighting fires all the time is we don't have any fire marshals around here. We've got an incredible fire department with the very best equipment and the fastest, brightest trucks, but we don't do any fire prevention at all." That I would say describes American management at this point: brilliant at fighting fires, but not adept at all at preventing fires. And to take our poster boy company, that's what Toyota historically has done so well is to put bullet-proof processes in place for product development, fulfillment, order delivery and supplier management so that actually things work, as opposed to "nothing works but that's okay because we've really got some bright people on it and we'll get back to you, boss, in four days with an answer." That's a big, big difference in what managers think they do.

In terms of future trends, the 'Machine' book was obviously about the automotive industry. Today, in 2007, are there other industries that are even better situated to adopt Lean? Can any industry use Lean?

Womack: When we started this in 1990, the thinking on lean was, "Yeah, you can do lean with cars because it's high volume/low variety." Well, that's not completely true, but okay. One of the most interesting things about the Danaher achievement is that none of these Danaher companies are high volume companies, that these guys are doing often custom-made equipment with much lower volumes and higher variety. They haven't had any problem adapting these ideas to lower volume/higher variety. If you're doing just a one-off like the space shuttle, that's a little different, but most of the world's work is not ultra-high volume automotive nor is it one-offs. It's relatively low volume, relatively high variety, but still quite repeatable business. I was just out looking at an airplane company, not Boeing, a couple weeks ago, where they're making spectacular progress applying these ideas to a production operation which is making an airplane a week, whereas Toyota in a car plant is making a thousand cars a day. That translation is not a problem at all.



So, all kinds of companies got with the program in the 1990s, of which aerospace was a leading example. The aerospace guys were really very good during World War Two because they had ultra-high volume and zero variety. They did block builds, and would build 8,000 B-17s that were identical. And so they really got it down to a very robust process. But then that was all thrown away at the end of the war. And so what happened in the 1990s was the aerospace guys rediscovered some stuff they had actually learned once already 50 years earlier, so therefore all across aerospace I don't think you'd find anybody who has any intellectual problem with the concepts, varying degrees of success in implementing them. So then you say, okay, lower volume, higher variety, lots and lots of industries, that's manufacturing. Our audience is increasingly not manufacturing, and that's not to say that the number of people in manufacturing who are part of our community -- that the absolute number of manufacturing people is falling. It's not, it's rising.

But there's a much, much more dramatic rise in people in service industries -- maintenance, overhaul, healthcare, which by the way is a maintenance and overhaul business when you think about it -- that the single biggest point of interest right now is healthcare, and partly because the patient is so sick and desperate, having tried all kinds of quack remedies, that increasingly we get calls from health systems that say, "Hey, look, we've tried everything else. And now we've done some little experiments that have produced some very dramatic results. How can we apply this all the way across the enterprise?" And that's a particular challenge in healthcare because the management is just so hopelessly screwed up with the doctors, the managers and the nurses pulling in opposite directions. These kind of three big factions of doctors who are point optimizers, managers who are asset optimizers and nurses who are process optimizers, except historically they didn't have any method, they were just workaround specialists. So you put that together, and the challenge in healthcare is not whether these ideas work -- they absolutely do, and we've seen demonstration after demonstration -- the problem is how do you change the management system and the mentality of the professionals working in the system so that you can actually sustain them?

I don't have the exact number, but I would say a distinct minority of the new people who call us are from the manufacturing world. A great majority are from everything from retail to maintenance, overhaul, service, car dealing, to construction to healthcare. And that's great because that's where the economy is. This is not anything that China did -- in every advanced country the manufacturing fraction has fallen over time. It's not a sign necessarily that anything is wrong; it's just that in advanced economies you get off the farm and go to the factory, you get out of the factory and you go to services, and that's how it works. So therefore that's where the real action is right now in the lean world, and that's not to forget about our manufacturing folks at all. But as I look at the next ten years, the predominant focus will be on what we loosely call service activities rather than what we would narrowly call manufacturing activities.

If services is where we are now in the Lean evolution, what would be beyond services?

Womack: The Jones/Womack answer is solutions. We did the *Lean Solutions* book about a year and a half ago, and our argument is that we've gotten really great at what we call isolated objects and isolated services, but what consumers really want when you think about, and think about your own life, is they'd like to find somebody who can solve their problems. Everybody's got a mobility problem and a shelter problem and a healthcare problem and a financial management problem and what we call a personal logistics problem, which is going to a big-box retailer on Saturday and getting all the stuff you need to run your life during the week. My view is that most people are a lot less interested in objects and in isolated services than the organizations providing those think.

Let's imagine you have a problem with your car. You need a car, and you need a service organization, and you've got some financial inputs to finance it and some insurance inputs to insure and some



inspection inputs to inspect it and some maintenance inputs to maintain it, and you start to add it up, and the consumer is actually constructing their own solution. And it involves dealing with many vendors, and by the way your experience if you buy a car is you never want to go back to the same dealer twice because you feel so burned the first time. You probably don't want to go back to the same repair shop twice because you got an unsatisfactory result. And you have this feeling you're being ripped off on your insurance but you don't quite know what to do about it. So what's the consumer's real problem, and isn't that where industry should be? And the consumers' real problem is that they've got a relatively small number of relatively large problems that they'd like a partner to help them solve, and that partner is nowhere in sight. And by the way, a young fellow, a Japanese engineer, just joined the product planning organization at Toyota, and he came to me all bubbly, wanting to talk about new product concepts, and I told him, "You know, the problem with you product planners is that you think people are actually interested in cars. And yeah, there's something to that, but for the most part, they just need to get from A to B, and they would like you to do that where they don't have to put any mindshare, any hassle, works every time, and it's cost effective. That's what your customer, in most cases, wants and you're trying to sell them some new tailfins. Come on, think about what product planning should really be about."

Look, here's the problem. All across industry, we have been in an age of deintegration where a typical solution has more not fewer companies touching it, so that you've got lots of choices in car companies and lots of choices in insurance, finance, maintenance and so forth, and there's nobody putting all those pieces together. And so that would mean that companies would have to work together without vertically integrating. Vertical integration is just an unmanageable mess -- Toyota gave up on it many, many years ago. That's the real challenge for industry: trying to figure out how to take a value stream, let's say to solve a problem which is going to involve eight or ten companies working together, and collectively solve the problem. If you've ever had a computer, you've had the simple experience where you call the software guy and he says it's the hardware and you call the hardware guy and he says it's the software. You get a tech in to work on it and he says it's both of their fault, and you're standing there with this smoking crater, and everybody is blaming everybody but nobody is solving your problem.

So you ask what comes next after you apply these lean concepts to isolated services, having applied them already with significant success to isolated goods, is what we need to do is apply these lean ideas to comprehensive solutions. And it just happens that I've got a product to sell you, the *Lean Solutions* book, but the problem with the book is that guys in the industry read it and they say, "You're absolutely right. We're in the hardware business, and we ought to be dealing with people in the service business and in the software business, but we hate those guys, and we can't work with those guys. They're outrageous people." And so right now we're still struggling for mechanisms for collaboration where you've got a whole bunch of people touching the elephant and they don't even know it's an elephant, and all the consumer wants is to be able to take their elephant home and get on with their life. And we're just not quite there yet.

So that's the future to me, integrated solutions as opposed to isolated goods and services, and I think this lean mentality is the ticket, it's the way to get there, but it's still early days on that.