Chapter Twelve

DISCUSSION AND CONCLUSIONS

TRANSITION TO LEAN MANUFACTURING

The components of the lean manufacturing system have been widely publicized over the past few years; how the specific improvement efforts operate to form an efficient synergistic whole is no secret. However, companies that have successfully implemented lean manufacturing throughout their enterprises are the exception. Why have so few firms successfully adopted these techniques? More specifically, why is the lean enterprise model so scarce in defense aircraft production?

One answer lies in the difficulty of enacting any large-scale organizational change, especially one where the benefits to the companies are mixed with costs (as is the case in defense manufacturing, where more efficient production in cost-plus or cost-based contracts means lower profits for the manufacturer). Research on lean manufacturing indicates that it can take up to seven years of consistent effort before the factory is truly lean. And this transition does not just happen but requires a significant commitment and level of effort by the organization, its suppliers, and even its customers. Literature on organizational change recommends a formal, structured approach to change. Successful change efforts require leadership support, a clear vision, a case made for change, communication, training, resources, incentives, and a plan, including pilot projects, full deployment, and, finally, monitoring the change to make sure it is sustained.

Our interviews at airframe contractors showed that it took significant pressure from their customer to spur them to begin implementing lean. In spite of being part of the LAI for five or more years, major

contractors pointed to recent DoD or budgetary pressure as the primary reason they instituted pilot programs to test lean principles. Indeed, program office requirements that the contractors "prove out" lean is probably the single most important reason there is any data at all available on lean manufacturing in defense aircraft production. A major airframe subcontractor similarly indicated that customer pressure was the major cause of the focus on cutting costs in their production. One important customer's demand for a 20 percent reduction in costs led the subcontractor to dedicate itself to searching out and eliminating waste within its organization as part of its effort to become more efficient.

It was not clear from the interviews that the prime contractors had a formal approach toward the transition to lean manufacturing. They pointed to pilot projects of varying scales, but RAND's attempts to ascertain what the schedule was for deploying lean principles throughout the plant were not generally successful.

FURTHER DISCUSSION

The pilot projects seen on factory tours combined with a theoretical understanding of how lean works leads us to expect that lean manufacturing has the potential to be a source of savings in military aircraft production. Results from a large number of pilot projects and implementation to a greater or lesser extent at prime contractors indicate that the potential definitely exists. However, the conclusion of this study is that participating aircraft manufacturers have not provided adequate evidence to demonstrate that they are producing in an entirely lean way. This does not mean that they are not trying or will not do so in the future.

Savings estimates from lean manufacturing pilot projects range as high as 66 percent. We would opine more conservatively that savings of between zero and 20 percent against total aircraft historical cost projections based on aircraft built using traditional manufacturing methods are more within the bounds of possibility, assuming that lean is implemented throughout the value chain.[1] Indeed, contrac-

[1]The fact that aircraft have become significantly more complex will mean that absolute costs may continue to rise, however. Lean means that DoD can buy more effec-

tors and prime subcontractors in the aircraft industry have already proved out some savings from a number of initiatives and pilot programs and should be given specific credit for the initiatives that have produced real quantifiable cost reductions. Projecting the same across-the-board savings demonstrated in these pilots and initiatives to an entire aircraft is probably being overly generous and may include double counting.

An issue of somewhat more concern is that much of the lean efforts at the aircraft prime manufacturers was focused on reducing the direct labor hours that go into fabrication and assembly. When asked about their lean implementation, the sites visited during the course of this research for the most part described efforts on their factory floors. This signals a very limited view of the lean approach. Some estimates suggest that as little as 10 to 12 percent of the total costs of aircraft production stem from direct manufacturing labor at the prime contractor level. Even a savings of 50 percent of direct labor would result in a savings of only about 5 or 6 percent of total program cost. A more conservative 20 percent savings results in less than a 2.5 percent savings.

For true lean implementation, contractors must focus on the other major cost areas as well, such as purchased materials and overhead. Purchased materials can make up two-thirds of an aircraft cost stream at the prime contractor level. Thus, focusing on generating savings throughout the supply cost stream offers considerably more opportunities for cost reductions. Similarly, a plan for cutting overhead can have significant cost reduction possibilities because overhead may constitute twice the value stream cost as manufacturing labor.

Companies reported many results from lean pilot projects, which generally were in small, localized cells. Direct labor savings results from these pilots were excellent. However, these pilots were rarely on the critical path of the aircraft production process and resulted in direct labor savings that were a minuscule percentage of total product costs. The pilots did not contribute greatly to flow because they

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tive weapons systems for less than historical models would imply and could conceivably buy aircraft in historical configurations for less than it had in the past.

did not represent areas of bottlenecks in the plant, so overall savings were limited.

It became clear during the course of this research that the greater the size of the effort, the harder it was to get very high savings percentages. Within one work cell, labor hours were reduced by two-thirds. In a major area of the plant, however, savings at this rate would be much more difficult to achieve and would require much more concerted effort. It is impossible to predict potential savings from an entirely lean factory, because no examples of this exist in the military airframe sector. Savings from lean implementation throughout the entire company enterprise were even more remote.

Figure 12.1 graphically summarizes the dilemma about how well the savings results of lean pilots can be used to predict savings at higher levels of a company, incorporating the concern that companies might not implement lean beyond pilot projects.

Figure 12.1 shows three possible savings curves for the ultimate lean manufacturing results. The first (1) and least positive suggests that

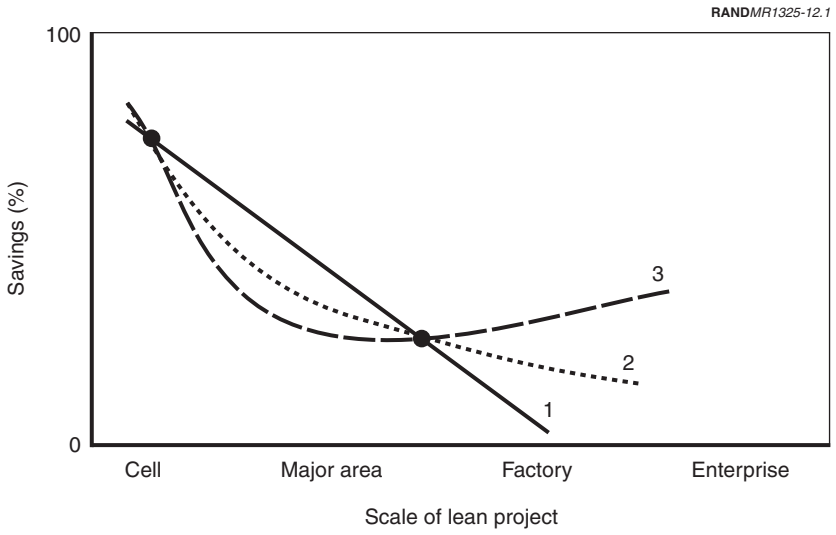

Figure 12.1—Notional Chart: Slope of Savings Curve from Lean Implementation Not Known

companies only implement lean in limited areas throughout the factory, and resulting savings are extremely limited at the plant/enterprise level. The supporting condition for this type of curve is a lack of continued customer pressure for improvements. Without such pressure, the contractor's efforts run into increasing internal resistance with the net effect that no real lean savings occur at more aggregated organizational levels, and the contractor continues with "business as usual" in many areas. In the second case (2), the contractor might try to implement lean savings in the factory, whether through pressure from a particularly powerful customer or a more generalized desire to compete in world markets. In this case, savings are reduced at some higher scope but are nonetheless real and show up in bottom-line aircraft prices. In the third case (3), the contractor makes a genuine commitment to the lean enterprise, not just in the factory, but also across the entire enterprise. Here, exact savings are unpredictable but certainly could grow with the level of management commitment and continued success with larger and larger lean efforts.

The site visits for this project were made in the summer of 1998, and the data reported in this document were collected at that time. In nearly every case, the firms visited reported small successes with their initial lean efforts and had more or less ambitious plans to move forward with implementing lean manufacturing through their factories. One check on how serious the companies are would be to do a second round of data collection to determine if the plants have made further progress in improving their production processes since the 1998 data collection.

In any case, DoD has only one way to guarantee that aircraft contractors keep their costs down. DoD can get better performance out of its contractors if it changes the way it does business. It is not an easy job, although some efforts are being made in this direction. What has to be kept front and center is the fact that lean manufacturing is based on the concept of *continuous improvement in the value stream.* It does not end when the manufacturing line is designed or when the suppliers are chosen. Instead, lean firms engage in a consistent regular attempt to locate sources of waste and reduce associated costs. The pressure to reduce costs never abates.

Hence, by working with its contractors to get them to improve performance continually at all levels of the supply chain, to engage in *kaizen* events to improve manufacturing, and to use the many other lean tools available, DoD should be able to generate improved performance at reasonable prices. In fact, evidence shows that under this approach, the price may even go down (although it remains to be seen if it will decrease more than historically predicted reductions stemming from learning and rate effects). DoD itself is a critical part of instituting lean production at the aircraft manufacturers. It is the final customer and should incorporate the lessons from best practice purchasing and supply management in its dealings with its suppliers of weapons systems. We contend that DoD cannot get out of the PSM game the day it completes source selection. By setting up a system to encourage and monitor improvements in cost and quality, DoD can increase the chances of purchasing future aircraft at reasonable costs.