

What Does It Take?

A white paper on the aerospace supply chain and what it takes to achieve lasting competitive advantage

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Background

There's been plenty of work done on the various elements of a successful aerospace industry supply chain. The work done by IAQG on AS9100 is an example. The work on NADCAP, as well as the work of LAI, ExoStar, and many other industry initiatives, has already improved industry productivity by 227 percent since 1994, according to AIA statistics.

Unfortunately, productivity doesn't equal effectiveness. For instance, you can purchase a new machine that can reduce cycle time by 50 percent, thus reducing cost, only to discover that the recommended batch size is now 25 units instead of 5. Net effect: more of the parts must be produced, requiring more orders and more time to produce, thus reducing overall on-time delivery effectiveness.

The demand for lower prices and faster delivery coming from the airlines and the defense industry alike is becoming deafening. Space is also adding its voice, as the demand goes up for affordable and reliable satellite communications support. Aerospace must reconfigure to ensure that its customers are successful.

Today we find that major OEMs in every equipment manufacturing industry are speeding up their production and business cycles. We have identified that there are tremendous cost factors involved in producing expensive equipment on longer cycles. OEMs have adopted, as their future business model, a close derivative of the Dell Computer model – mass customization with overnight delivery.

But in the aerospace industry, this represents a challenge. In order for the suppliers to perform in such a radically new supply chain, most will need to re-conceptualize how they do business.

In a presentation provided to the Supplier Excellence Alliance membership by Pratt & Whitney Canada, speaking about the PW600 engine, P&W Vice President of Operations Benoit Brossoit described how they designed a new production line from the ground up to produce engines every four hours. Clearly this kind of effort represents a major investment that many suppliers will not be willing to make.

And so the question arises—from the very smallest to the very largest supplier: What does it take to be successful in this new aerospace industry?

What does it take from a supplier?

To answer this question, we first have to make the vision for a competitive aerospace industry clear.

Imagine that an OEM builds an aircraft every four days. And in order to build that aircraft cost-effectively, the parts and assemblies for that aircraft must be delivered just-in-time to the “wingtip,” ready to bolt on and plug into the moving aircraft. And the part or assembly must be perfect in every way, because there are no backups and extras if it isn’t.

Now imagine that major tier-one suppliers are delivering those major assemblies to the wingtip at the exact rate of production. And those major tier-one suppliers in turn are building their assemblies at the rate of one every four days and *their* suppliers are delivering the parts needed just-in-time and perfect to the tier-one production line.

And imagine this picture all the way down the supply chain to raw materials. And now imagine that this supply chain “pulls” what it needs just exactly at the time it is needed—and that signal tells the supplier of that part or assembly to delivery the next.

Now imagine that each supplier is capable of customizing parts and assemblies to varying customer requirements for each part or assembly delivered. And imagine that when the OEM requires a change, this change ripples down the supply chain and is immediately implemented by every level with minimal obsolescence.

Most suppliers in our supply chains today cannot imagine this picture. There are too many barriers and too many traditions and too many machines designed around the opposite reality.

So what does it take to become a supplier capable of 100 percent on-time delivery and 100 percent quality day-in and day-out?

Consider a typical aerospace supplier. This supplier may be a machining shop. On-time delivery is 85 percent - fairly good among peers in the industry. Quality is five sigma – about 200 defective parts per million – also a good achievement. Setup times on most machines are four hours or less. A few are more. And batch sizes are anywhere from 24 to 60 units. Lead

time from this supplier might be as low as eight weeks, except for the outside content. An outside forging and casting house must forge many of the parts. Lead times for these parts are 16-40 weeks. Most parts need special heat treating or anodizing, which requires another four to six weeks turnaround from another outside supplier. So the supplier routinely quotes lead times of 40 to 52 weeks for a first article. But even then, on-time delivery suffers when one or both of these outside suppliers get busy.

So now this supplier invests in getting leaner. Changeover times for machines are the first target. The work on setup time is incremental – that is, it takes continuous improvement work over time to achieve. It needs to come down under 10 minutes. In some case, machine changeover can be as low a one to two minutes.

Once changeover time is down, batch sizes can be reduced. The ideal would be to achieve the capability to produce parts in quantities of one. Once you produce parts in small batch sizes, and still keep machines running, you can reduce the number of parts you have to produce to deliver your first part to the customer.

But now that you've reduced lead time to one week instead of eight, you still have 40 weeks or more of lead time from your suppliers—not to mention in raw materials shortages. So why bother? Good question.

So the solution to achieving the supply chain performance we'll need doesn't rest within the four walls of one supplier, but rather it requires collaboration between perhaps three suppliers. Each of these suppliers must take the same journey – reducing batch sizes, and minimizing cycle time and lead time.

Experience tells us these changes are not minor. Consider the following example in order to develop a better understanding of the amount of work required to achieve these improvements.

The average supplier company usually has two or more value streams. What is a value stream? A value stream is a series of processes or steps used to produce a valuable product, starting with the order processing and ending usually with shipment. Suppliers often can have more than one value stream per customer if they are supplying greatly differing products to that customer. Products that are similar – as in a family of products – may

be produced in the same value stream. When this is the case, the value stream is referred to as a “mixed-model” value stream.

A value stream that consists of multiple processes or steps therefore can include the quoting process, engineering, production (including a number of steps in production) and shipping. When an area is selected for improvement, a kaizen event is scheduled. A kaizen event is a project that involves a team made up of those who work in the process. An example might be a project to improve changeover time on a particular machine.

The kaizen event may greatly reduce the changeover time, but because this is only one step among many, the overall value stream may not improve its performance at all. Kaizen events will need to be scheduled in *each* of the process areas—often one or more times—in order to affect overall value-stream performance.

Because kaizen events take manpower off the job and stop or slow down the production process, a small supplier only has a limited amount of time each month to execute these kaizens. Meanwhile, the other value streams are waiting.

Assuming the above rate of progress, it is easy to see why for most suppliers it will take two to three years of hard work and investment to begin to see significant improvements in metrics.

Take the typical metrics used to gauge supply chain performance improvement: inventory turns, sales per employee, on-time delivery, and defects per million opportunities. Inventory turns will tell us when materials velocity has significantly improved, but until all steps in a value stream have increased, inventory turns likely will not change a lot. Meanwhile, on-time delivery and defects likely will not move until significant progress has been achieved not only in-house, but also with the upstream suppliers who are still the significant contributors to lead time and quality issues.

What is the cost of this two to three years of work? Putting one person capable of conducting kaizen events on the payroll will cost \$7,000/month, plus benefits. If kaizen events were all there was to do, this might be the end, but in successful implementations there is work to be done with the management team and the workforce in general. Therefore, costs for

suppliers can easily reach \$10,000/month or more. Experience tells us that off-the-job time for employees involved in the effort will equal this amount.

No wonder so many people are looking for a quick fix. Most people refuse to believe that it will take two to three years and almost half a million dollars to achieve even the beginning stages of the improved performance required by the new supply chain.

It is this disbelief and the search for a quick fix that has stalled our industry's development for the past 12 years. Thinking that supply-chain performance will improve if every supplier works to improve on their own illustrates a profound lack of understanding of the problem. In this new supply chain, if one special processor fails to make improvements, and others rely on that supplier for work, then the performance of the entire supply chain will be limited by the performance of one.

Is this a path that every supplier is willing to follow? Experience tells us that most will not. Although return on investment has been demonstrated to be very high, an investment of \$20,000/month for a small supplier is often judged only based on monthly income and expenses. Some suppliers would have to mortgage their homes to make such improvement – and some would and some wouldn't.

Nevertheless, this is a path that a number of small suppliers have already embarked on. Not only have they established a track record of investment, but they have begun to work on integration of their supply chains in order to address the overall performance required to meet the new customer requirements.

What does it take from a customer?

Suppose that the hypothetical supplier described earlier has traveled the continuous-improvement path for two to three years and can now deliver parts at the rate of customer production. And let's say, just for illustration, that the customer needs five units per month for production. But instead of ordering the five units per month, the customer orders through their MRP system, and the supplier gets orders for 30 units, then eight, then 25, etc.

Now the supplier is going to build a production line capable of five units a month, but not 30 units. Plus, the supplier has to deliver these units to other customers and therefore operates a mixed-model production line.

So before long, the supplier shows up on the customer report card – with late deliveries and some early deliveries. “Late” occurs when MRP spits out an order for 30 units, and “early” occurs when the supplier tries to deliver what he knows the customer needs based on their production rate, but won’t accept because their MRP hasn’t placed an order.

Now imagine that the same customer comes to the supplier and asks them to develop a new product. This new product is a part that will go through some complex machining and have a fairly high volume – 80 to 100 units per month. So the supplier agrees to dedicate a complete machining cell to the customer’s requirement.

Now the supplier will have to purchase the machine, hire someone to operate it, document the work instructions, train the operator, certify the operator, develop the tooling, and produce the first article. Let’s say the supplier can complete all this in four months at a cost of about \$2 million.

Now imagine what happens if you place the supplier on production status during that time, and your MRP begins to request parts and establish delivery dates. You could end up with a supplier who looks very bad on your scorecard before they’re even ready to deliver on the new part.

Now imagine that the contract provides for escalation of the price based on raw materials price escalation. The cost of aluminum travels upwards rapidly, and the request comes in to revise the price. But new invoices are rejected when they have the wrong price, and the change doesn’t get processed for another five months, causing the supplier to have to float the entire amount.

These and many other stories serve to illustrate the need for the customer to cooperate with the supply-chain transformation. How does the customer cooperate?

The customer needs to “enable a winner.” The customer must have a policy of ensuring that suppliers who are investing in building capabilities for them are not penalized, punished, or mistreated while doing that. In

addition, customers will have to work with a supplier who is developing the capability to produce parts at the rate of demand. The supplier who does this will decrease their cost dramatically and can pass it on if they are allowed to deliver at the proper rate. If they are forced to deliver to stock orders that vary widely, then their report card will look bad and disenchant the supplier in the process.

They say that whatever you acknowledge, you get more of. Customers need to focus on recognizing and acknowledging investment, instead of acknowledging the problems in growing more capability or the mistakes as a supplier accelerates improvement efforts. The customer must learn to encourage investment and motivate those who are investing their own time and money in this direction.

Customers must change their systems when those systems don't aid in the above imperatives. Anything that doesn't support and encourage investment in growth and more effective production should be changed quickly.

Customers should focus on becoming a "customer of choice." When this transformation began, there were close to 50,000 suppliers in the U.S. alone, and within the next five years there are likely to be closer to 15,000 to 20,000 suppliers. Those suppliers who survive the change will be smart enough to be doing business with all of the customers. They will pick and choose who to bid to and who to continue working with, as they evaluate who has the friendliest system for dealing with suppliers. Some customers will make it hard to do business with them and some won't. That will be the difference, and will determine how suppliers will pick their customers.

The worst thing that can happen is for a supplier to select their favorite customers and then plan their deliveries around those priorities. A customer can get some fairly big surprises when this is how the supplier chooses to manage their "good" and "not so good" customer mix.

There is a lot of talk about "trust" in the supply chain, and this is certainly important. The best metaphor so far about partnering with a large customer is "dancing with an elephant." It illustrates another aspect of trust. An elephant really can't help it – they step inadvertently on small creatures every day. So there is something more required from an elephant than just a promise not to step on you. Elephants must demonstrate they are willing

and can change their habits and follow an agreed-upon path that doesn't involve stepping on little guys.

In the same way, customers must demonstrate they can change processes and procedures that are unhealthy to the supplier. They must demonstrate that they are willing to establish a process and follow it when the survival of the little guys is at stake.

What does it take from service providers?

For almost 15 years, we have been applying resources to the problem of building a better supply chain in aerospace. Every service provider, even government-funded service providers such as the Manufacturing Extension Partnership "MEPs", have been delivering lean implementation services into our industry.

In addition, primes and tier ones have been sending out teams to work with suppliers to implement lean manufacturing methods.

During this time, inventory turns—the absolute bottom line on lean production—has not moved from two to three turns. The velocity of materials through our supply chains has not moved at all.

Why not? Doesn't it make sense that if someone implements lean production—*any* lean production—they're going to get better? And in general, the answer is "YES" – IF they can sustain the improvements and IF the entire supply chain cooperates to implement the same basic system.

Those are big IFs, and it turns out that randomly sending suppliers out to improve their operations doesn't address these two BIG IFs. The proof is clear.

But is it up to the service providers to coordinate their efforts and give us a uniform method for sustaining improvement? And is it up to them to address an overall system for supply-chain integration? Perhaps; but it is doubtful they will be able to do that without our help.

Aerospace needs a roadmap for sustaining improvement and integrating the entire supply chain. Aerospace owns the problem, and we need to provide the solution.

“But we don’t want to tell suppliers what to do or that they have to do something!” Well, it’s a little late to take that position, since ISO9000, AS9100 and NADCAP have already done just that.

But unfortunately none of these standards have hit the nail squarely on the head. We need a roadmap, just like you would get at a car rally. How will we know that we’re all going to the same place without a roadmap?

The challenge for service providers is this: Each service provider has an investment in materials and technical know-how. And each service provider has a unique chosen path. Some offer to implement the Toyota Production System; some offer Flow Manufacturing, and some offer Just-in-Time delivery. And each believes in their process for implementing lean—and most probably works.

So service providers, including those who work for a customer and provide assistance to suppliers, have selected their own path and have a significant investment in that path.

But now the suppliers in the industry have published a Roadmap, and they have said, “If you want to provide services to me, please use this Roadmap to guide you.” The service provider can still teach me how to reduce setup and changeover time, and still help me arrange a cell and implement visual controls. All of these things remain the same. But now they are put into a framework that classifies them and provides for assessment to establish progress against the Roadmap.

And the Roadmap has a proven track record in addressing sustainability. And the Roadmap has a step-by-step process for achieving integration of the supply chain.

What does it take from a leader?

Leadership may be the most illusive quality we require. In the past, most lean experts believed that by doing a series of kaizen events, a supplier could reconfigure their operation, and sustainability would be automatic.

Time has proven differently. Today suppliers report results that sound very much like the modern American diet: lose 10 pounds, regain 10 pounds.

Except in the case of lean, it's reduce setup time by three hours, increase setup time by three hours.

In the case of dieting, it is the brain's job to establish a habitual pattern that can support the new lifestyle. When a person treats a diet as just that—a temporary course of action designed to lose weight—they will always regain the weight when the diet is over. For those who treat a diet as a new lifestyle that will have to be followed for the remainder of their natural life, weight loss is much more successful.

In any organizational change, it is the leader's job to develop the context and plan for sustaining the improvement efforts. Just as in the case of an exercise program, where if you lay off for a week, you come back to sore muscles and pain, so it is with the company's continuous improvement efforts. You must sustain a rate of improvement and investment of time and money. It must become a part of what is considered standard operating procedure. A leader makes sure this is the case.

Leaders must become leaders by setting aside their long time responsibilities as worker, as problem-solver, and taskmaster. They must take up the role of mentor, coach, and organizational planner/builder. They must concern themselves with building an organization to last.

This new role requires a new language—the language of an organization builder. And it needs to include terms such as:

Process Owner: Someone assigned the responsibility for improving a process.

Champion: Someone who takes the responsibility for improving an overall group of processes or a value stream.

Process Maturity: A method for classifying and maturing organizational processes to promote stability, sustainability, predictability, and integration.

Master Trainer: Someone assigned the responsibility of training and cross-training others.

Process Capability: A way of measuring the maturity of a process.

The most important role of the leader is that of Change Manager. Most organizational systems that involve humans have an innate resistance to change—even when that change has been proven to improve conditions for workers, customers, and for owners.

Change requires hard work. We must set aside the old and proven way of doing something and try a new, unfamiliar method that often is not as efficient in the beginning as the old way. Change requires flexing unfamiliar muscles and experiencing new kinds of pain. People who are involved in change often have more need to talk to others and compare notes or even complain. Therefore, productivity often goes down during change--and this is used as evidence that the change isn't working.

For any great endeavor that was successful, there has always been someone who stood up and said, "We can do this. We're going to make it through this. Let's push forward." The most effective exercise programs typically include a trainer who keeps you moving, asks you for one more repetition, and keeps telling you that you're doing great. You don't have to have a title like "president," "CEO," or even "manager" to be a leader. Leaders are those individuals who can motivate others, irrespective of whether they have formal authority.

Leaders are those who are willing to focus on the positives and give recognition for effort and acknowledgement for moving forward. In a mature organization, there may be a time for holding people's feet to the fire and pointing out where they missed and only achieved 99 percent. But the Change Leader must suspend those kinds of actions, because he or she knows that only positive feedback helps people to learn and change. It is human to only embrace change when conditions are favorable and mistakes are allowed. It is also human to find fault with changes and test the waters with leaders to see what kind of response a complaint will solicit. If the leadership water seems more favorable to complaints than risk taking and more agreement can be garnered when complaining, then people will decide that it is safer to resist—covertly perhaps—than to move ahead full speed where the waters are deep and unfriendly.

Summary

The answer to “What does it take?” is not a simple one. The complexity comes from the need for collaboration between suppliers, customers, service providers, and leaders.

We have come to believe that in order for this massive transformation and collaboration to be successful it has to be:

- Supplier-led and customer-empowered. Sub-tier suppliers should decide and drive performance through their own industry standard roadmap.
- Performance-centered. Those suppliers who invest and improve their performance should be the central focus of this effort.
- Focused on cooperation, not duplication. The members of the collaboration should commit to the reduction of duplicate efforts through out the supply chain.

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