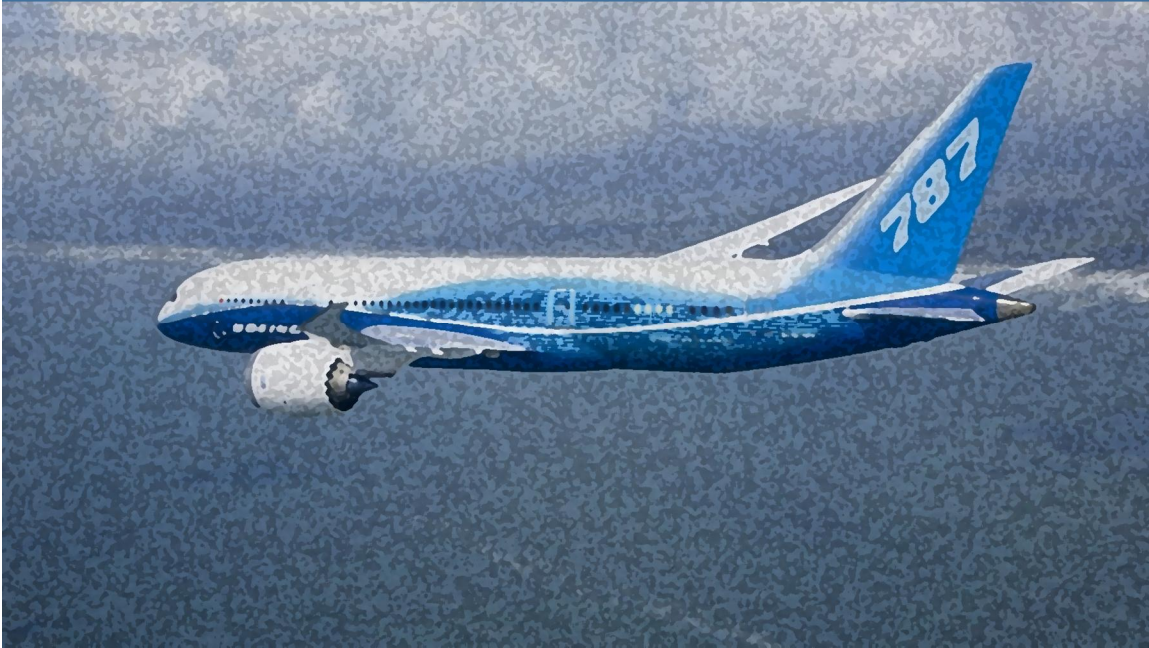
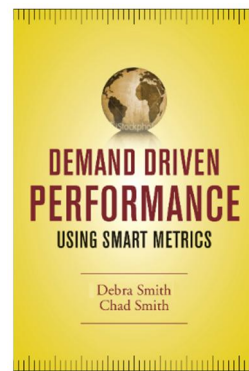


The Cost of Trying to Control Cost: The Boeing 787 Dreamliner



The Boeing Dreamliner is a perfect example of how outdated assumptions and inappropriate metrics can lead to strategies with disastrous bottom line implications. Excerpted from the book Demand Driven Performance – Using Smart Metrics (Smith and Smith, McGraw-Hill, 2013) this case provides three key lessons that businesses should pay attention to in today's complex and volatile circumstances.



Case Study Introduction

What are the “right” Metrics?

Einstein once said, “The significant problems we face cannot be solved at the same level of thinking as when we created them.” When it comes to the metrics that most of industry uses the problem that we face is insidious. It permeates nearly everything we do as manufacturing and supply chain entities – it has everything to do with the way we think and behave as organizations. Thus we cannot simply jump into the “right” metrics without first addressing a much deeper issue; the reason why we will fail to see what the “right” metrics are.

Much of industry has lost its way in this more complex and volatile world. Read *Demand Driven Performance – Using Smart Metrics* and you will discover when and how the way was lost. Furthermore, you will find a different way to think, design, operate and measure a system in a more complex and volatile world; a way that is both simpler and smarter.

Metrics tell us how we are doing based on what we want to achieve. Yet it seems most companies struggle to define what they really want to achieve. In the “for profit” world it should be relatively simple – the maximization of shareholder equity. The insidious problem referred to above is the route most organizations assume is the way to get there – a route that is totally and unequivocally wrong.

A Deep Truth lies at the heart of how we perceive reality and how we behave in light of that perception. It is simply what we know. Challenging a Deep Truth is extremely difficult, even perceived as crazy. The Nobel Prize-winning physicist Niels Bohr once said the evidence to replace a Deep Truth must be so compelling, so obvious that people must let go of their attachment to the status quo. In other words, once you see a deeper truth, you simply can’t go back. “It is the hallmark of any Deep Truth that its negation is also a Deep Truth.”

Today in industry we have a Deep Truth. It permeates all of our operational decision making and behavior. That Deep Truth is the

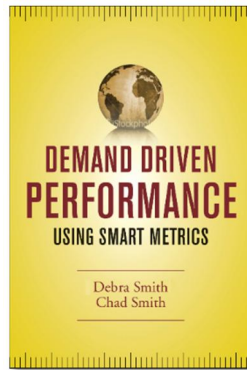
assumption that Return on Investment (ROI) is maximized through and directly corresponds to the minimization of unit cost. Challenging this deep truth can career limiting. Today, who would stand in front of the CEO and the Board of Directors and say, “We absolutely should not direct our people to minimize unit cost?”

Everything from curricula approved by academia to the approaches and solutions offered by consulting firms to the major ERP software providers is a part of this Deep Truth. Indeed entire corporate careers have been built around it and devoted to promulgating it. Exposing today’s Deep Truth would be threatening to many who are invested heavily in the old and they will act accordingly.

What if today’s Deep Truth is totally, completely, unequivocally false?

- What if the whole idea of a least unit product cost is simply “bad math” – an inappropriate use of an equation that both economics and even physics would reject?
- What if legislation created a reporting requirement that has become the focus of accounting information and replaced, almost by accident, the real definition and rules for relevant information for decision making and product costing?
- What if all of our information systems are hard-coded to compile cost reporting and resource area measures from the wrong or misapplied rules and assumptions about how costs and revenue behave?
- What if unit cost has become such a Deep Truth that an entire discipline about what defines relevant information has been all but lost?
- What if even those who know what relevant costs should be operate inside a system that is not capable of providing relevant information in a relevant time frame to act on?
- What if people no longer question taking actions they know will lead to predictable and dire negative consequences that they must deal with later?

Answering these questions is the journey *Demand Driven Performance – Using Smart Metrics* is designed to take the reader on. The bottom line is that our operating methods and measures lost their way AND have failed to adapt to significant changing circumstances. That failure has left companies with little relevant information at all levels of the organization. The Boeing Dreamliner Case Study is an example of what happens when poor and outdated assumptions leave companies starved for relevant information.



Visit the official book website at:
www.demanddrivenperformance.com

Chapter 9

a Case Study—the Boeing Dreamliner

Companies need to be looking at every decision from the standpoint of ROI opportunity for the whole system not just the cost component. Companies have chased the focus on labor reduction past the point of diminishing returns and into the realm of negative returns. One of the most damaging GAAP misuses has been the use of full absorption unit costing to drive outsourcing decisions. Bad outsourcing decisions were first driven by comparing unitized labor and overhead costs to the outsourced part purchase price. If neither labor nor the overhead cost assigned to the product cost will actually be reduced when a part is outsourced, then there is no real dollar savings.

Developing economies, with “very” cheap labor have invested in both the latest technologies and infrastructure to take advantage of the offshoring opportunities created by the knowledge transfer from skilled labor to technology. This has resulted in global oversupply and excess capacity across the world, as well as very complex global supply chains.

This transfer of knowledge to technology has made offshoring feasible. However, companies have flawed assumptions about relevant cost information making offshoring both attractive and “profitable,” which have led to a series of very bad decisions to go offshore. There are some very good reasons to go offshore. Those reasons have everything to do with strategic contribution and nothing to do with unit cost savings. When a company doesn’t understand the relevant information to make a good

offshoring decision has been illustrated in a very well-publicized case that continues to make headlines as this book is being written.

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The biggest irony with outsourcing and offshoring is that the wait time in the supply chain increases with outsourcing and offshoring. The increased lead time requires greater investment in inventory to buffer between the customer's tolerance time (little) and the time to order, make, and ship the product to the point of its pull (a lot more). None of this increased "investment" is considered as relevant information in the decision to offshore. More often than not, the fixed costs remain unchanged and the remaining products are left to absorb all of the overhead (a lower volume of work over the same fixed costs). As a result, more products are outsourced because it is *cheaper* to buy them than to make them. Ultimately the organization's abilities to design and manufacture are simply gone. In many ways this is the story of lots of manufacturing leaving the United States and Europe.

Businesses are waking up to the negative effects of losing control of their supply chain. The trend to outsource operations has leveled off and actually decreasing in the United States compared with five years ago. According to a recent study published by DVV Media Group GmbH, 2013 (www.bvl.de); Trends and Strategies in Logistics and Supply Chains Management—Embracing Global Complexity to Drive Market Advantage states: "Outsourcing operational activities has previously been emphasized but is decreasing in the United States. Today less than 30% of logistics activities is outsourced compared with 39% in Germany and 50% in China. One reason for the absence of increased outsourcing may be due to dissatisfaction with the outsource provider performance." Examples abound, but at the time we are writing this book, the Boeing Dreamliner is grabbing big headlines. It illustrates all of the lessons of a complex supply chain being managed with cost-centric efficiency rules and the rules of complex systems not being understood by top management.

the Boeing Dreamliner

On July 8, 2007, Boeing rolled the Dreamliner out of a hangar in Everett, WA before a crowd of thousands. The aircraft's design attributes included its highly fuel-efficient composite exterior, powerful engines, and game changing interior. Boeing had already taken 677 preorders, making it the

first commercial plane to pass the 500 mark for orders ahead of first delivery. At the time, the company said it would put the first Dreamliner in the air by September of that year, 2007. The first passengers would be transported in the new plane by May 2008. From there, things unraveled quite quickly.

As we are finishing this book (March 2013) the 50 Dreamliner jets Boeing has delivered are grounded due to the battery packs spontaneously combusting and there appears to be no quick fix on the horizon. On January 16, 2013, the Dreamliner was grounded by the FAA for all U.S. airlines. Japanese, Indian, and European aviation authorities followed quickly with their own grounding orders. Boeing continues to assemble Dreamliners but they cannot deliver them. They cannot fly them to their customers even if their customers wanted them. They are running out of places to park them. Airlines are lining up to demand that Boeing pay them delivery penalties, lost compensation for canceled flight schedules, and loss of revenue from their existing fleet of Dreamliners. The current scenario is a lengthy recertification with the FAA to recertify flight worthiness.

To further complicate the situation, in July 2012, Boeing top management replaced Jim Albaugh, the Boeing Commercial Airplanes (BCA) CEO who had regained both the trust and respect of his engineers. He is also credited with rescuing the Dreamliner. He was replaced with Ray Conner, who was more aligned with top management thinking. This strongly signals a return of BCA leadership, to the strategy and tactics of the pre-Albaugh days that led to the current situation. At a time when they critically need the help of their engineers, they face a strike initiative vote with members of the Society of Professional Engineering Employees in Aerospace (SPEEA), a possibility that was unthinkable 8 months ago under Albaugh's leadership.

Regardless of the outcome in the next six months, we have tremendous faith that the very talented people at Boeing will resurrect the Dreamliner. The question isn't: Will the Dreamliner be salvaged? The question is: What will Boeing executive management and the rest of industry learn from the experience?

As demonstrated by the Dreamliner, Boeing appears stuck in the conventional cost-centric deep truth, which has been described at length in the previous chapters. For the Dreamliner, Boeing executives chose a dramatic departure from Boeing's previous successful airplane launches because Boeing was no longer "Boeing." This shift in strategy can be traced to the 1997 merger with McDonnell Douglas that saw Harry Stonecipher and Phil Condit ascend to lead the new Boeing. Ironically, Stonecipher has a

degree in physics and Condit was by all accounts a talented engineer. The Dreamliner was to be their legacy, and they are largely responsible for the shift to a cost-centric efficiency strategy that has been at the heart of the culture clash since the merger.

The following is an excerpt from James Surowiecki's article, "Requiem for a Dreamliner?" (*The New Yorker*, February 4, 2013):

The Dreamliner was supposed to become famous for its revolutionary design. Instead, it's become an object lesson in how not to build an airplane.

To understand why, you need to go back to 1997, when Boeing merged with McDonnell Douglas. Technically, Boeing bought McDonnell Douglas. Richard Aboulafia, a noted industry analyst with the Teal Group described it as follows: "This is when McDonnell Douglas in effect acquired Boeing with Boeing's money. McDonnell Douglas executives became key players in the new company, and the McDonnell Douglas culture, averse to risk and obsessed with cost-cutting, weakened Boeing's historical commitment to making big investments in new products. After the merger, there was a real battle over the future of the company, between the engineers and the finance and sales guys." The Dreamliner's advocates came up with a strategy that was supposed to be cheaper and quicker than the traditional approach: outsourcing. And Boeing didn't just outsource manufacturing parts; it turned over the design, the engineering, and the manufacture of entire sections of the plane to some 50 "strategic partners." Boeing itself ended up building less than 40 percent of the plane.

This strategy was trumpeted as a reinvention of manufacturing. But while the finance guys loved it—since it meant that Boeing had to put up less money—it was a huge headache for the engineers.

Boeing and McDonnell Douglas appeared to be a match made in heaven. Boeing had a strong commercial air program but was weaker on the space and defense side. McDonnell Douglas had a strong space and defense program but was quickly becoming irrelevant on the commercial side. McDonnell Douglas leadership speculated that they would have to invest \$30 billion in development just to get back in the commercial air

game.¹In the years following the merger, with Condit driving strategy and Stonecipher focused on operations, the relationship between Boeing management and its unions had deteriorated dramatically and there had been no spending on new airplane programs. It culminated in a contentious strike with SPEEA in 2000 with outsourcing as one of the major issues. SPEEA represents roughly 23,000 Boeing employees and had traditionally viewed itself as both loyal and important stakeholders in the Boeing business. Stonecipher's outspoken determination to break the family culture of Boeing and make it a business had not been well received.

In addition, Stonecipher's strong support of cost-cutting initiatives was widely believed to be flawed and in fact credited with taking the company in the wrong direction both in quality and overall system efficiency. With Stonecipher's exit, there was hope that the company would move forward with the 7E7 (the original designation until being changed to 787 in 2005) and the oversight and management of the program would remain inside Boeing.

Stonecipher retired in June 2002, and analysts, union leaders, as well as many workers believed that the company would get back on track as the leader in commercial aviation. Stonecipher had been widely criticized as so focused on profits, shareholders, and the bottom line that he had lost sight of what made Boeing great: being a company not afraid to take huge financial gambles, such as with the development of the 707, 747, and 777.

While Airbus got bigger, "Boeing stagnated." They failed to formulate a strategy that could keep up with an emboldened Airbus, as Boeing fell behind in both technology and manufacturing efficiency during the '90s. Boeing, once the manufacturing marvel of the world, now spent 10 to 20 percent more than Airbus to build a plane. The loss in market share—from nearly 70 percent in 1996 to roughly 50 percent in 2003—marked an astonishing reversal.²

After Stonecipher's retirement there was a concerted effort by Boeing senior management to take back their company. In an article published March 9, 2003, in the *Seattle Times*, "Boeing buzzes about 'source' of work," the

¹ Callahan, Patricia, "So Why Does Harry Stonecipher Think He Can Turn Around Boeing?" 2004, Chicago Tribune Company, LLC.

² Holmes, Stanley, "Boeing: What Really Happened," *Business Week*, December 14, 2003.

concern over just how much of the work on the 7E7 would be outsourced exposed a focus much larger than the loss of jobs in Seattle. While Stonecipher had retired, his legacy was very much alive and engineering management continued to struggle to communicate their concerns. Surprisingly, it was the work of Dr. John Hart-Smith, a Boeing senior technical fellow that ended up making headlines in Seattle. His 2001 paper on outsourcing, presented at a Boeing conference, became so widely read in Boeing it ended up coming to the attention of the *Seattle Times*. The struggle for control of managing the 7E7 moved to a public arena, when the article was published by the newspaper:

A controversial internal paper warns that excessive outsourcing could lead to the loss of the company's profits, its core intellectual assets, and even its long-term viability. The most important issue of all, is whether or not a company can continue to operate if it relies primarily on outsourcing the majority of the work that it once did in-house. The author is John Hart-Smith, a senior technical fellow at the Phantom Works research unit in Southern California and one of Boeing's most eminent engineers.

Boeing officials declined to respond directly to Hart-Smith's paper but agreed to discuss their outsourcing strategy: Boeing, they argue, bring together the best technology from partners around the world. And as it faces relentless competition from European rival Airbus, Boeing has no choice but to manufacture planes more efficiently— which means letting suppliers build more complex components.

Hart-Smith, however, argues that even if outsourcing makes sense in some circumstances, Boeing's reliance on it is excessive. "Outsourcing all of the value-added work is tantamount to outsourcing all of the profits," his paper concludes. "It is time for Boeing to reverse this policy."

His argument has created a lot of buzz inside the company, according to a senior program manager who asked not to be named. But it has been largely dismissed by Wall Street. Chris Mecray, an analyst with Deutsche Bank, called Hart-Smith's paper "more of a rant than anything."

"Hart-Smith's McDonnell Douglas heritage is crucial to his paper, which repeatedly cites the case of the Douglas DC-10 as the apotheosis of outsourced aircraft manufacture. The excessive use of subcontractors on the DC-10, Hart-Smith asserts, eroded most of the commercial-

airplane unit's profits and thus its ability to fund new jets. By the time it merged with Boeing, McDonnell Douglas had all but exited the commercial-airliner business in favor of building military aircraft.

Hart-Smith has not been cleared to discuss the details of his paper. Boeing allowed him to provide only a written response to emailed questions about his background.

"My motive," he wrote in a note accompanying his responses, "was simply to save Boeing suffering the same fate as befell Douglas. I became concerned about seeing too many of the same policies being advocated."³

Hart-Smith's paper was anything but a rant. His background was extremely relevant in making the argument against excessive outsourcing in the Dreamliner program. Before the 1997 merger, Hart-Smith had spent 29 years with McDonnell Douglas. Hart-Smith's comment points out how both the financial institutions and the top management of companies are laboring under the same flawed assumptions connected to the deep truth of the cost-centric efficiency strategy and financial statement information.

Hart-Smith's paper is not only logically sound; it is based on very relevant experience. It is a clear statement of the predictable negative effects when irrelevant costs, information, and performance metrics are used. It is not surprising that an engineer of his background and experience would come to the same conclusions as both Henry Ford and F. Donaldson Brown. We have read Hart-Smith's paper and there are six key points to be summarized in relation to this book.

1. Selective outsourcing can be beneficial to all concerned as a supplement to sales activities outside a company's fixed cost volume range. It is an additional cost to receive the additional sales and contribution margin that could not be satisfied otherwise. This is known as offloading a constraint.
2. As a tool for reducing costs, outsourcing is most commonly flawed because of the misleading cost accounting practice of including irrelevant information from unitized fixed overhead in comparing part cost. These "costs" will not be reduced; the potential "savings" is distorted and overstated.

³ Gates, Dominic, "Boeing Buzzes About 'Source' of work," *Seattle Times Aerospace reporter*, March 9, 2003.

3. In the event the fixed overhead in both skill sets and machinery are eliminated to reduce the net asset investment of the company as a strategy to improve RONA (return on net assets, another version of ROI) the company will place itself at the risk of not being able to compete in the future when new products requiring these scarce skill sets and machinery are needed. As described previously, this was the exact place the commercial air division of McDonnell Douglas found itself in during the mid-1990s, requiring Stonecipher to seek a merger with the Boeing company. This assessment on the need for periodic investment spending on new products is validated by Richard Aboulafia's analysis and commentary on why the 2003 decision to invest in the 7E7 was critical for Boeing to remain competitive in the commercial airplane market.
4. Ignoring the increase in overall costs from both additional tasks and additional investment in inventory to protect, synchronize, and speed the assembly, flow must be assessed both from a cost standpoint as well as a risk standpoint. Carnegie and Ford both understood this point, which is the reason they pursued strategies of vertical integration and insourcing. They did not want to lose control of their supply chain and risk losing control of both their costs and ultimately their market. The additional tasks are not trivial and in the case of a new airplane program they are immense.
 - a. If outsourcing is to be employed it is critical that detail parts and subassemblies be designed with that purpose in mind to avoid the situation whereby major subassemblies do not fit together at final assembly and then require rework and/or redesign, increasing both the costs and cycle time by orders of magnitude.
 - b. To address this requires considerable *additional* upfront effort in planning and the prime contractor must provide on-site quality, supplier management, and technical support.
 - c. Off-site production increases the total span of time and transportation costs. In order to compensate for variation in time, the prime contractor must invest in additional inventory of all of the subassemblies and parts to protect the assembly line from disruption. Inventory must be sized to protect the assembly pull against the reliable time to replenish from the source. The longer the replenishment cycle time, the larger the inventory on hand must be. Hart-Smith said it well, "Inventory costs accrue throughout the span time between installation (no matter by whom) and sale of the

(final) product, *not* throughout the span time for final assembly alone! ‘Creating’ that same reduction by merely transferring work to suppliers is *not* a system efficiency gain!” In other words the total cost of the investment of the supply chain in time expansion will end up being passed through to the end consumer. The end cost of the product will go up.

5. The risk-sharing partners by definition do not recoup their investment in the product program until their parts are used in the final assembly. Suppliers that are on time and on specification are punished when other parts of the supply chain do not perform. Hart-Smith made this point in his paper: “The prime manufacturer can never exceed the capabilities of the least proficient of their suppliers.” And in a *risk-sharing partnership* neither can the rest of the supply chain partners. They will not recoup their investment any faster than the product can flow to the market. This is a physical law and the basic tenet of the Theory of Constraints as well as Plossl’s first law of manufacturing.
6. “RONA is an excellent goal by any standards. Only when it is converted into a performance metric do its devastating effects become apparent.” What Hart-Smith is discussing here is exactly our discussion in early chapters regarding the interdependence of ROI on five key objectives: sales, costs (spending), quality, due date performance, and investment (inventory and capital). They do not move in isolation of each other and any attempt to push RONA to a local level for tactical decisions results in a compromised tactical decision and action with a deleterious effect on the whole system of which RONA and ROI are the measurement after the fact.

In his 2001 paper, Hart-Smith went on to predict several outcomes if Boeing applied their strategic partner outsourcing policies to the new 7E7 program.

1. They would be unable to make the pieces fit together in final assembly.
2. They would lose control of their supply chain and be forced to send their engineers and technical experts into the field to solve the problems their suppliers would encounter.
3. They would be forced to salvage the program by buying and or bailing out their strategic partners by paying them for the research and capital costs.
4. Both the cycle time to produce and total cost for the plane would increase by orders of magnitude.

5. The product would require redesign and rework that would be unknown until after all certification tests were done and known.

In December 2003, Stonecipher was called out of retirement and was again at the helm of Boeing after Condit's forced resignation. Despite the marketing hype and strong suggestions that Boeing would launch both the 7E7 (the Dreamliner) and the 747-8, Condit had not pulled the trigger. The board was expected to decide whether to commit to the development of the 7E7 jetliner by the end of the year. The 7E7 would be Boeing's first new airplane in a decade. The decision would determine Boeing's commitment to the commercial airplane market. "This is really a pivotal moment," says Aboulafia. "Failure to invest in the 7E7 could mean the beginning of the end for Boeing's storied airplane business."⁴

In January 2004, the board approved the 7E7, soon-to-be-named the *Dreamliner*. Simultaneously, Boeing made permanent the appointment of James Bell as chief financial officer. Bell had been acting CFO since the firing of his predecessor Mike Sears a few months earlier. Unlike Sears, who had an engineering background, Bell had always been a numbers guy, with a 31-year track record in corporate finance. Together with Mullaley, the thenCEO of BCA, they put together a plan to spread the risk of development costs for the 7E7 among "50 strategic outsource partners" as a way to make the 7E7 more palatable to their board and the financial community. This strategy was sold as a reinvention of manufacturing instead of the same "old" McDonnell Douglas strategy and approach.

Stonecipher was wholly focused on cost reduction as *the* strategy. Between 1998 and 2001, when he oversaw Boeing operations, his unrelenting drive to cut costs—and his sharply critical, outspoken approach—made him widely unpopular with rank-and-file employees and with unions. Stonecipher went on to defend Boeing's continued globalized outsourcing. In a *Seattle Times* interview on August 2, 2004, Stonecipher was very clear in discussing Boeing's prospects, global competition, local jobs, and the "strategy."

We're going to continue to reduce costs. We have a plan, and [Commercial Airplanes CEO Alan Mulally and his team] are developing it very nicely. It's going right down the road, and where we've done it, it

⁴ Holmes, Stanley, "Boeing: What Really Happened," *Business Week*, December 14, 2003.

⁵Gates, Dominic, and David Bowermaster, "Blunt Boeing CEO Bullish on Company's Prospects," *Seattle Times*, August 2, 2004.

works fine. This is not about monetizing assets. It's not about getting rid of people. It's about lowering the cost of the product.

Every time we've done this, we get significant cost reductions in the hardware. That's what we want.⁵

Boeing executives mandated the outsource tactics for the Dreamliner for the simple reason they believed it would maximize their return on net assets (RONA) by spreading the capital investment and the risk necessary for the development of the 787 across a broad range of suppliers—the 50 “strategic partners.” They believed that the 787 could be reduced to 50 different smaller projects, discrete independent events, and more easily managed, hence development would be faster. By structuring the suppliers' arrangements such that their development costs could only be recovered over the life of the program, Boeing originally believed its total investment in R&D would be under \$6 billion.

They appeared to ignore many of their own engineering experts and external supply chain experts who tried to explain the flaws of the approach. They wholly discounted the risks associated with their decision to not just outsource manufacturing but the engineering as well. They received congratulations and accolades from the financial community for their “new strategy” to spread the risk of the invested capital. The expectation of success would be measured in the long run by RONA but the market rewarded them immediately. Table 9.1 shows a timeline of the progress (or lack of progress) of the Dreamliner. Remember the objective was flight certification by 2008 and Boeing believed that it would invest less than \$6 billion.

In February 2010, the Boeing Company released its financial statements for 2009 showing a write-off of \$2.7 billion out of the capitalized R&D in the inventory/program account for the 787 as a year-end adjustment to its 2009 financial statements. Per the annual report, they elected the writeoff because three of the first six Dreamliners were not salvageable due to reengineering.

In January 2011, Boeing announces its seventh Dreamliner delay and schedule slide. This set off another barrage of articles focused on the Dreamliner and for the first time a public admission by BCA CEO Jim Albaugh that they are re-examining and adjusting some outsourcing decisions. Not surprisingly, it brings Dr. Hart-Smith and his original white paper back under scrutiny and numerous articles cite his report from 2001. As of February 2011, he was batting a thousand with a better track record as a prophet than Nostradamus. *Seattle Times* reporters conducted interviews with both Dr. Hart-Smith and Jim Albaugh for their article, “A ‘prescient’ warning

to Boeing on 787 trouble” (*Seattle Times* business staff, *Seattle Times*, February 5, 2012). Hart-Smith had retired from Boeing in 2008. When he was asked, “Where did a structures engineer get that kind of expertise?” Hart-Smith replied, “It’s common sense.” Table 9.2 continues the saga of the Dreamliner’s progress.

table 9.1 The Dreamliner Timeline, January 2003–January 2011

January 2003	Boeing sets up a team of executives to design the new plane.
June 15, 2003	The company says the plane will be called the <i>Dreamliner</i> after 500,000 people from more than 160 countries voted on the name.
December 16, 2003	Boeing announces that its board of directors has given final approval for the plane. The company starts taking orders from airlines.
July 26, 2004	Japan’s All Nippon Airways becomes the launch customer for the 787 with an order for 50 planes.
December 2004	Boeing ends 2004 with 56 orders for the plane. Its goal had been 200.
December 2005	Boeing ends 2005 with a total of 288 orders for the plane.
June 2006	Assembly begins at the company’s plant in Everett, Washington.
June 2007	Engineers assembling the first plane find a 0.3-inch gap between the nose-and-cockpit section and the fuselage section behind it.
July 8, 2007	The world gets its first glimpse of the Dreamliner as it is paraded in front of a crowd of 15,000. (The plane turns out to be just a hollow shell, rushed together for the event.)
September 2007	Boeing announces the first of many production delays, starting with a shortage of bolts and problems with flight-control software.

2008	<p>Boeing announces four more delays during the year. Among the reasons: a 57-day machinists strike, problems with improperly installed fasteners, and trouble with the company's global supply chain.</p> <p>SPEEA adopts media tactics to highlight the "disaster of the 787 program" keeping the spotlight on the outsourcing problems plaguing the company. (Source: June 10, 2011, Leadership Conference, Seattle Airport Hilton, Ray Goforth, Comments to the SPEEA council.</p> <p>Full text of the speech is available on www.speea.org.)</p>
June 2009	Boeing reports 59 cancellations for the 787.
July 2009	Boeing spends nearly \$1 billion to acquire two plants from Vought Aircraft Industries; the supplier had been responsible for large parts of the 787 air frame and continual part shortages and delays.
June 23, 2009	Boeing announces another delay, citing the supply chain.
December 15, 2009	The first 787 test flight leaves from Paine Field, adjacent to Boeing's factory in Everett, Washington.
February 2010	The Boeing company correctly elects to write-off \$2.7 billion out of the capitalized R&D in the inventory/ program account for the 787 as a year-end adjustment to its 2009 financial statements. Per the annual report, they elected the write-off because three of the first six Dreamliners were not salvageable due to reengineering.
November 9, 2010	During a test flight, a 787 loses electrical power after fire breaks out in an electrical control panel. Test flights are delayed six weeks.

January 2011

In an appearance at Seattle University, Boeing Commercial Airplanes CEO, Jim Albaugh, had some comments about the 787's global outsourcing strategy as well as the lessons learned from the disastrous three years of delays on the 787 Dreamliner. One bracing lesson that Albaugh was unusually candid about: the 787's global outsourcing strategy—specifically intended to slash Boeing's costs—backfired completely.

"We spent a lot more money in trying to recover than we ever would have spent if we'd tried to keep the key technologies closer to home," Albaugh said.

Boeing was forced to compensate, support, or buy out the partners it brought in to share the cost of the new jet's development, and now bears the brunt of additional costs due to the delays. Albaugh said that part of what had led Boeing astray was the chasing of a financial measure called RONA, for return on net assets. "We went too much with outsourcing," Albaugh said in the interview. "Now we need to bring it back to a more prudent level." Albaugh balked at going that far, referencing Hart-Smith's assertion that Boeing should keep most of the work it has traditionally done in-house.

"I haven't said keep *most* of the work in-house," Albaugh said. "I still believe we need to make sure we try to access the best technologies and capabilities that are available around the world."(Source: "A 'prescient' warning to Boeing on 787 trouble," Seattle Times business staff, Seattle Times, February 5, 2012.)

Source: Unless other sources are cited, a timeline of Boeing's 787 Dreamliner, Associated Press, January 25, 2013.

table 9.2 The Dreamliner Timeline, February 2011–February 2013

February 2011	<p>Boeing is more than \$2 billion over budget (120%) and 3 years late. Journalists, aerospace analysts, and Boeing’s customers are all raising the same three questions posed and answered by Peter Cohan:</p> <ol style="list-style-type: none"> 1. Specifically, did Boeing outsource too much of the Dreamliner’s components to other companies in other countries? 2. Will the 787’s outsourcing problems persist? 3. What might this mean for airlines, passengers, and investors in Boeing stock? <p>The short answers are: yes, probably, and it’s too early to tell. (Source: Cohan, Peter, “Boeing’s Dreamliner Delays Outsourcing Goes Too Far,” <i>Daily Finance</i>, January 21, 2011; http://www.dailyfinance.com/2011/01/21/boeing-dreamlinerdelays-outsourcing-goes-too-far/)</p>
June 2011	<p>Ray Goforth, executive director of SPEEA, announces a dramatic change from the negotiation tactics of 2008 and proposes adopting binding binary arbitration. He summarizes the progress Boeing management has made and the shift in the relationship as follows: “That was then. This is now. 2012 is not 2008. In the interim since 2008, many things have changed at the company. Boeing has embraced a return to engineering excellence. The company has admitted its outsourcing mistakes and is actively reversing many of them. The company has built upon the original SPEEA-sponsored crosstalks to start fostering a culture that surfaces problems early. BCA president Albaugh has brought a different management style . . . one that recognizes that labor unions can be used by management as an early warning system to identify problems. (Source: June 10, 2011, Leadership Conference, Seattle Airport Hilton Ray Goforth-1.jpg, Comments to the SPEEA council. The full text of the speech is available on www.speea.org.)</p>
August 26, 2011	<p>The Federal Aviation Administration and the European Aviation Safety Agency certify the plane to carry passengers.</p>
September 25, 2011	<p>Japan’s All Nippon Airways takes delivery of the first 787.</p>
October 26, 2011	<p>Three and a half years behind schedule, the first paying passengers step aboard the plane. The four-hour charter flight on ANA goes from Tokyo to Hong Kong.</p>

table 9.2 The Dreamliner Timeline, February 2011–February 2013 (*Continued*)

July 2012	<p>July 28. Debris falls from a 787 engine during a test, sparking a grass fire at South Carolina’s Charleston International Airport.</p> <p>Boeing’s top management replaces the engineer CEO Albaugh, who was credited with turning around BCA and making it better again. They replaced him with a non-engineer CEO, Ray Conner.</p>
January 7, 2013	<p>The battery pack on a Japan Airlines 787 catches fire after the flight landed at Boston’s Logan International Airport. Passengers had already left the plane, but it took firefighters 40 minutes to put out the blaze.</p>
January 11, 2013	<p>The FAA launches a review of the entire plane, even as top transportation regulators insist it is safe.</p>
January 16, 2013	<p>An ANA 787 makes an emergency landing after pilots are alerted to battery problems and detect a burning smell. ANA and Japan Airlines ground their entire Dreamliner fleets.</p>
January 16, 2013	<p>The FAA grounds all 787s flown by U.S. airlines. Japanese, Indian, and European aviation authorities follow with their own grounding orders.</p>
February 2013	<p>February 8. SPEEA and Boeing not in agreement. In a lastditch attempt to avert a strike by his engineers and technical workers, Boeing CEO Ray Conner (Albaugh’s replacement) sent a letter to all SPEEA members asking them to accept the company’s offer. With strike authorization ballots arriving in the mail this week, Conner is hoping to avoid a strike when he needs all of his SPEEA members on the job. He wrote it’s time to come together as a team to work for the company’s future.</p> <p>“Nobody wins in a strike,” he wrote. “While hurting Boeing and our employees, it would also impact our customers who’ve put their trust in Boeing’s people and products. It’s important that we protect our competitiveness in the longrun, even if that means some short-term pain.”</p> <p>SPEEA executive director Ray Goforth said the letter was not well-received by his members. “Boeing corporate is trying to take advantage of that by telling people the company’s in trouble, just accept this terrible offer and help us get these 787’s back in the air,” he said.</p> <p>Goforth said it’s strange that Conner would be getting involved at this late date. “He’s played no role in these negotiations . . . “</p> <p>(Source: Sullivan, Chris, “Boeing takes SPEEA union appeal directly to workers,” MyNorthwest.com, February 8, 2013.)</p>

Source: Unless other sources are cited, a timeline of Boeing’s 787 Dreamliner, Associated Press, January 25, 2013.

Not surprisingly the January 16, 2013, grounding of the Dreamliner brought the program management and the supply chain outsourcing of the 787 back to the forefront as journalists and analysts scrambled to make sense of both the past and the future of the Dreamliner.

Repeatedly over the past 18 years, one name continues to appear in articles and commentary from both industry analysts and business journalist alike: Richard Aboulafia. His commentary and insight are sought after with good reason. His newsletters are pointed but balanced with both compelling strategic assessment as well as numbers. He is a respected and longtime aerospace industry analyst and is frequently cited as an aviation industry authority by trade and news publications as well as television news and radio programs.

The following is an excellent summary on the Boeing Dreamliner from Aboulafia's January 2013 newsletter, which can be found online at: <http://www.richardaboulafia.com/shownote.asp?id=373>:

I don't like change. But every so often, I'm forced to re-examine my long-held beliefs. This is one of those moments.

During my 25 years as an aerospace industry analyst, Boeing looked more competitive than Airbus. My job is to forecast and provide recommendations to industrial and financial clients, and Boeing almost always delivered better results. When random Euro-sycophants accused me of being "anti-Airbus," (as if it were a cultural/national bias) I merely offered to discuss numbers (i.e., financial returns and benefits to industrial partners). They'd get that confused deer-in-headlights look (which confirmed that many people in this business don't quite understand market economics), and sadly mope away.

I expected this routine to continue for the next 25 years. Yet times have changed. A client recently showed me some jarring numbers. As of January 25, EADS's stock has returned 137% or 7.1% annualized since it was listed in July 2000. In the same period, Boeing has returned 117%, or 6.4% annualized. This trend, of course, is quite recent. Boeing stock has been impacted by the 787's problems. It has significantly underperformed broader U.S. stock averages with a total return of about 1% (including dividends). EADS, on the other hand, has been soaring and is up 36% since the start of 2012, with about 20% of that in the past month. Before that steep rise, Boeing's stock would have still performed better than EADS's. Underperformance or outperformance obviously depends on the starting and end dates.

Yet EADS has risen while battling its own serious headwinds over the past year, and while generally underperforming Boeing in revenue and profit. Boeing jetliner output rose 47% by value in 2012 over 2011, while Airbus rose just 12%. Boeing's profit margins are considerably better than EADS's. With the 777 and 787, Boeing has a better twin-aisle product line, while Airbus is stuck with that A380 albatross. EADS/Airbus still has serious governance and ownership issues. EADS has seen more savage home market defense budget cuts than Boeing has. It also has seriously underperformed Boeing in defense export markets, as evidenced by the F-15's continued long run and Eurofighter's string of campaign failures. The battle over share prices and investor returns shouldn't be a battle at all. Boeing should be way ahead.

How to explain this disconnect? I've got a theory. The jetliner business is a duopoly, and the jetliner market is growing faster than any other manufacturing industry. Investors want to be part of it. And Boeing is starting to scare them. After all, Boeing's stock price hasn't been clobbered by the 787 problems; rather, it has simply stayed stagnant. Airbus/EADS, by contrast, has been benefiting from a strong jetliner market without any program disasters. In other words, it isn't that there's something particularly right with Airbus's strategy. Rather, there's something wrong with Boeing's strategy, and their execution.

Let's review. Last summer, Boeing's top management axed the engineer CEO who had been turning around BCA and making it better again. They replaced him with a non-engineer CEO. Then, management got into a confrontation with the engineer's union (which may also partly be the union's fault, but it's not a battle management can afford right now). Then Chicago put off the very promising 777X until the next decade, which, from a customer perspective, might as well be an indefinite postponement. These moves were on top of a 787 development model that de-emphasized in-house engineering and relied on industry partners for much of the development work.

Since the 787 appeared to be out of the woods, and the 777X was put off until the next decade, Chicago likely didn't think it needed much from engineers. Then that damn 787 battery thing happened. Oops. Back in Seattle, engineers, represented by a disgruntled union and forced to report to multiple layers of nonengineer management, are working overtime on the problem, but after several weeks, nobody appears to be close to a solution. As this is written, the likely outcome is a six- to nine-month grounding (due to the need for recertification).

This terrifying state of affairs for the Dreamliner, of course, was merely background for Boeing's fourth quarter earnings call this month. The 787 fiasco wasn't discussed, except that (a) the investigation was continuing and couldn't be discussed and (b) 787 production was continuing full speed ahead, despite uncertainties about what needed to be done for the battery system, or any other aspects of the plane's design. If these planes being built need major retrofit work in the future, well, that's for the engineers to worry about.

Meanwhile, there was no contrition or soul-searching on the call about how the 787 could have gone this wrong, or what could be done within the company to make it right (once again, 787 program analysis was left to the journalists). Instead, the call emphasized some impressive sales and profit numbers. It was like a farmer showing off a great crop, but not mentioning that the tractor just broke, he fired the mechanic, and outsourced tractor maintenance to Bolivia. And that customers for next year's crop had been promised penalty payments if the farm didn't deliver.

Chicago's view of engineering, as seen in management changes, union negotiations, product launch decisions, and design outsourcing moves, is that it's a secondary consideration, far behind financial and market considerations such as return on net assets (RONA). But clearly this strategy of downplaying engineering is starting to have a deleterious effect on the company's financial performance, at least in terms of equities returns relative to the competition. Sure, investors may be scared by the high compensation costs associated with the 787's woes.

But it's also possible that investors may be getting spooked by a company that seems to lack a proactive approach for dealing with a serious crisis. Even when the 787 gets back to service, it may face further difficulties. There's also the likelihood that Boeing may be returning to the bad old days of 1998–2003, when it spent next to nothing on new product development.

In other words, Boeing's problem isn't just that the engineers have been nudged aside by the bean counters. It's that the bean counters need to rethink the way they manage the company. Until that changes, investors may continue shifting their focus towards Airbus's virtues, particularly if Airbus continues to emphasize spending on new products.

Nothing makes a more compelling statement for the necessity of change in current supply chain management strategy and tactics than Boeing's Dreamliner. Sadly, it was predictable and it was predicted repeatedly by both their internal and external experts as early as 2000. The roots of the problem tie directly into Aboulafia's assessment regarding the "bean counter mentality," and where that mentality originated. The 1996 merger with McDonnell Douglas and Harry Stonecipher's influence with Phil Condit who was focused on an acquisition strategy to diversify Boeing put the efficiency and least cost strategy firmly in the driver's seat. It overtook the company culture and sanity. Boeing is no stranger to large variances to plan but the point of variances analysis is to point out you have a problem and need a course correction. Large aggressive projects have variances. The outsourcing trend Boeing followed was simply one of the inevitable outcomes of using the cost-centric efficiency strategy to manage a complex supply chain, a strategy Stonecipher followed at McDonnell Douglas to its detriment as well. This strategy first raised its head under Condit in 1995 but under Stonecipher it appeared to become a full-blown mode of operation. The Dreamliner was a perfect storm and Boeing's current dilemma has three key lessons that every company should pay attention to:

Lesson 1: Creating Unnecessary Supply Chain Complexity

Many top executives in large organization have little understanding of the realities of the supply chain they are managing and the technical realities of the projects and products they are bringing to the market.

The increase in complexity in the technology of the Dreamliner coupled with the complexity Boeing added to its supply chain by increasing not only outsourcing content (30 percent of content – 5 percent for the 747) but also created a level of supply chain complexity impossible for them to control let alone synchronize and manage. They had no visibility and no proactive management of their supply chain. They were forced into a reactive mode beginning in 2007 with their attempt to assemble the first Dreamliner. It was the second, and third, and fourth before they got the major components to fit. Costs spiraled out of control as they did everything necessary to rescue the program including flying hundreds of their internal experts to supplier sites, purchasing underperforming suppliers and repeated redesign.

Figure 9.1 is a recreated depiction of the change in supply chain structure for the 787 from previous airplane programs as depicted and

presented by Christopher Tang and Joshua Zimmerman of the UCLA School of Business.

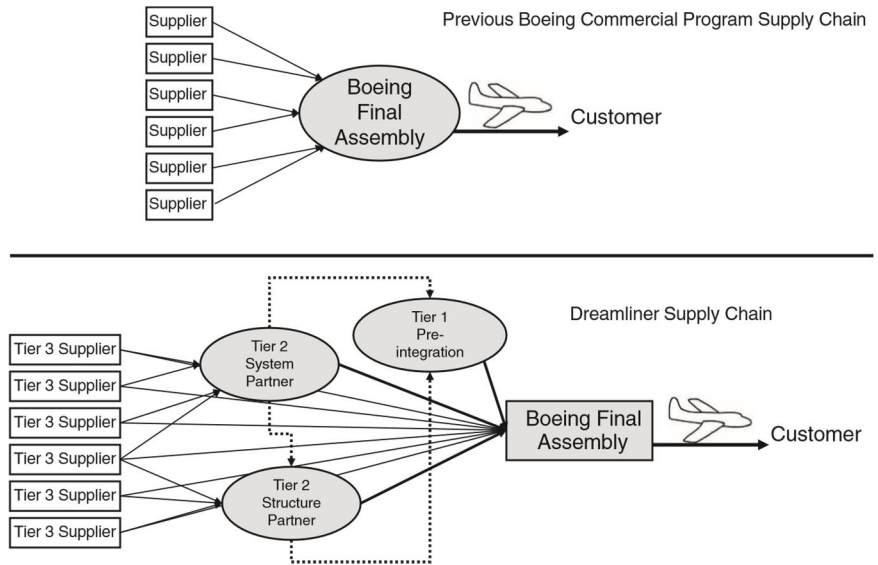


Figure 9.1 The Change in Boeing's Supply Chain Configuration

To reduce the 787's development time from six to four years and development cost from \$10 to \$6 billion, Boeing decided to develop and produce the Dreamliner by using an unconventional supply chain new to the aircraft manufacturing industry. The 787's supply chain was envisioned to keep manufacturing and assembly costs low, while spreading the financial risks of development to Boeing's suppliers. Unlike the 737's supply chain, which requires Boeing to play the traditional role of a key manufacturer who assembles different parts and subsystems produced by thousands of suppliers [top of Fig. 9.1], the 787's supply chain is based on a tiered structure that would allow Boeing to foster partnerships with approximately 50 tier-1 strategic partners. These strategic partners serve as "integrators" who assemble different parts and subsystems produced by tier-2 suppliers [bottom of Fig. 9.1]. The 787 supply chain depicted in Fig. 9.1 resembles Toyota's supply

chain, which has enabled Toyota to develop new cars with shorter development cycle times.⁵

Their conclusion was Boeing dramatically increased the complexity of their supply chain for the 787 without assessing or understanding the increased risks of supply, process, management, labor, and ultimately the risk to their market. Furthermore, they concluded Boeing did not have the expertise, visibility, or supply chain management tools and structure to undertake such a dramatic shift. The lack of any risk assessment and mitigation strategy and no proactive supply chain management visibility forced Boeing into a continuing series of reactive responses resulting in cascading delays backward and forward through the supply chain. The study was conducted in 2009 and Boeing was still two years from a successful first delivery. The following excerpt is the conclusion of Tang and Zimmerman's article.

Besides the need to perform due diligence in key supplier selection to ensure that the selected supplier has the requisite capability and the commitment for success, a company should consider cultivating stronger commitment in exchange for accurate information in a timely manner. Overly relying on IT communication is highly risky when managing a new project. To mitigate the risks caused by partners further upstream or downstream, companies should strive to gain complete visibility of the entire supply chain. Having clear supply chain visibility would enhance the capability for a company to take corrective action more quickly, which is more likely to reduce the negative impact of a disruption along the supply chain. See Sodhi and Tang (2009b) for a discussion of the importance of timely response to mitigate the negative effects of supply chain disruptions . . .

Boeing took something inherently complex and made it an order of magnitude more complex. Furthermore, while making the supply chain more complex they appeared to use no decoupling and dampening and feedback mechanisms to break the predictable increased supply chain dependent event variation. With the increase in dependencies and

⁵ Tang, Christopher S., and Joshua D. Zimmerman, "Managing New Product Development and Supply Chain Risks: The Boeing 787 Case," *Supply Chain Forum An International Journal*, Vol. 10, No. 2, 2009, page 77

connections without decoupling and dampening and feedback mechanisms they literally created a perfect recipe and environment for the bullwhip effect.

The speed of flow of relevant information and materials was a trickle.

Boeing's management thinking, business rules, and information system tools were completely inadequate for the task. They were and are based on old science, as are 99 percent of businesses today, but few have their level of complexity. Their Newtonian approach to attempt to control and manage both risk and complexity was to break the supply chain apart into independent events and manage and control each piece as if they didn't have to fit together at the end. To say it didn't and doesn't work is an understatement at this point. Over the last 20 years, companies' complexities have increased and their thinking and tools have been increasingly failing. They have sought to push their problems and risk onto their suppliers. The trend has been away from the vertical integration.

Vertical supply chain integration not only makes controlling the system easier it also allows for dramatic profit potential in industries with aftermarket service parts. Markets and profit multiples are won and lost on the companies' abilities to manage and service their spares business. This is a key point Dr. Hart-Smith made in his paper—a significant portion of the profit margin in an airplane program is in those spare parts. The average piece of equipment with a life longer than 10 years will pay its original selling price again over its 10-year life. Airplanes have a practical life of 20 years.

Mandated maintenance and the necessity to purchase parts from only Federal Aviation Agency approved suppliers mean that spare parts in the commercial aircraft industry are a gold mine.

Lesson 2: Industries with Program Accounting Should Beware

The ability to derive relevant information at all levels becomes more challenging when given the use of Program Accounting, an aerospace GAAP staple. Program accounting is only used for firms with very large R&D investment and capital requirements to startup a product line. Overhead and indirect labor spend as a ratio to direct labor dollars are very large and hence the misplaced focus on cost-cutting and reduction efforts aimed at indirect labor—outsource engineering—save money and drive up RONA. Program accounting is simply a version of GAAP absorption costing on steroids. The shift in supply chain design driven by a cost-centric efficiency strategy

obscured and distorted the ability to judge the progress and status of the program's RONA.

The problem with program accounting is you get to pretend your RONA is great and following your plan right up until after you start to ship the first plane. It is only then a company understands the magnitude of the capitalized overhead and R&D each plane will have to absorb over the program life. The 787 has become a very expensive airplane and "it ain't over yet." Program accounting for financial statement purposes is a valid approach for financial statement presentation for a company like Boeing, and is based on a core GAAP principle known as matching. It allows firms that must make very large capital and or R&D expenditures, to produce the first shippable product and then spread the investment over all products shipped over the life of the program. It requires companies to estimate the life of the product and the number of products that will be shipped over that timeframe.

Boeing has a track record of actual volume sales far exceeding both the number of planes as well as the number of years the program remains active (e.g. the Boeing 737). This is a very good thing as it means they have consistently outperformed their projected payback and return on their airplane programs. It also causes a very odd anomaly only seen in program accounting, negative inventory. When the number of planes exceeds the original program life, program accounting continues to allocate the standard full absorption overhead cost to each and all additional aircraft to be expensed as the cost of goods sold.

So even though the total investment has been recovered and the inventory balance of the program startup dollars capitalized has been fully allocated out—zero dollars—credits are still applied against the program inventory balance sheet account and debited to the cost of goods sold account for every additional airplane sold. This results in a negative dollar value program inventory account balance. This of course dramatically understates net income and cash flow for mature programs and overstates net income and cash flow for startup programs such as the 787 Dreamliner. But it does fulfill the GAAP matching principle designed to spread the expected development costs over the life of the airplane program and match the cost of each plane to the sales revenue in the period the sale takes place.

An outside analyst or investor cannot possibly know the cost associated with any single airplane program, as all program inventories are collapsed into a single number on the balance sheet. The negative inventory balance from all programs that have exceeded their program life

are netted against new programs and existing programs with life remaining. It is a black hole; what has really been spent on the Dreamliner is openly speculated to be somewhere between \$12 billion and \$18 billion. Dramatically different than the \$6 billion originally estimated when Boeing management sold their innovative supply chain risk sharing methodology to Wall Street.

The last thing to note is the decision to expense the cost of the first three Dreamliners rather than capitalize them was not really a choice. We are certain Boeing's auditors (Deloitte) required the write-off as the variances were both large (almost half of the original expected development cost) and unusual. The first three Dreamliners produced could not be sold because they couldn't get the pieces to fit together. It was determined they could not be salvaged for sale due to extensive redesign and rework after testing. This was exactly Dr. Hart-Smith's point and prediction in his 2001 paper. In Boeing's 2010 annual report and financial statements, Boeing referenced the 2009 write-off and stated that additional write-offs might be necessary in 2011 if additional technical or supply chain issues arose. The \$2.7 billion is not considered part of the program overrun—it was expensed. Today (June 2013) Boeing still does not know the total cost of this airplane.

Boeing management appears to have refused to acknowledge the reality of what was happening and what was not working or they simply were so focused on the individual part and supplier problems they never saw the systemic problem until it was too late to prevent the write off of four entire airplanes and years of program delay. Either way it does not reflect well on upper management or the strategy they chose.

Lesson 3: Understand and Value Your Organization's Human Capital

Top management risks the loss of confidence of both their stakeholders and their stockholders if they do not understand the meaning or value of all of their assets, let alone how to maximize the return of their assets. Boeing executives appear to have discounted the value and the talent of their workforce and its place in the past and future success of Boeing.

Dr. Hart-Smith, a Boeing Senior Technical Fellow, used Brown and Ford's definitions of flow, synchronization, and relevant cost and benefit information coupled with constraint-based principles in his internal paper on Boeing outsourcing. The Hart-Smith paper is worth reading in its entirety and

is available on the web. The journalistic shortcuts to explain it are reduced to out-of-context sound bites, but the exposure it received and continues to receive has endured for 13 years for good reason. He was right and it is indisputable. Seldom is there the opportunity to follow and compare such well documented and specific predictions from an inside expert, over the span of time necessary to test the conclusions...and both it and him were available to Boeing management from the beginning. The utilization of this knowledge could have dramatically changed the 787 program for the better.

When a company doesn't understand the value of their people or recognize them as an asset, they don't know how to drive return from their total organization. In almost every organization the authors have experienced, the collective knowledge and intuition in a company's work force is one of its most valuable assets. Treating human capital as a commodity is a poor business decision especially "knowledge intensive" human capital.

In the New Normal human capital has become as important to business as it was before the Industrial Revolution. Chapter 10 will explain the importance of human capital to supply chain management given they are complex adaptive systems.

A Final Thought on Complexity and Cost

The deep truth of cost-centric efficiency is at the core of both companies' outsourcing decisions and local cost efficiency improvement actions and projects.

1. Companies and their managers believe in a linear, Newtonian view of the world. Every efficiency gain, anywhere, translates to an increase in system productivity because Newtonian math is additive. Additive math only works for an independent or single-event system. An efficiency gain at any one resource translates to an increase in total system speed but does not change the rate of output (governed by the slowest unit) or the truly variable cost of producing any product.

Today parts and product spend 93 percent of their time waiting. A 10 percent speed increase in a resource that only accounts for some small percent of the total potential touch time is an infinitesimal gain in the system flow and speed.

2. Companies believe in the linear Newtonian approach to problem solving, the reductionist approach. The best way to gain control is to break everything into individual pieces and manage each optimally.

The more complex the system the more quickly this approach will lose control. This approach actually makes the outcome of the project and/or product less predictable in terms of quality and reliability, elongates the market lead time, and escalates the total cost.

3. Companies act as if they believe in the GAAP standard absorption unit cost as a true representation of cash flow. The assigned standard fixed dollar cost rate, coupled with our Newtonian view of the world, leads managers to believe or act as if they believe that every resource minute saved anywhere is computed as a dollar cost savings to the company. GAAP unit costs are used to estimate both cost-improvement opportunities and cost savings for batching decisions, improvement initiatives, and capital acquisition justifications.

In reality the “cost” being saved has no relationship to cash expended or generated and will not result in an ROI gain of the magnitude reported. Cost savings are being grossly overstated. Today it is not uncommon to find plants running with burden rates over 1000 percent. (Source: Miller, Jeffrey G., and Thomas E. Vollman, “The Hidden Factory,” *Harvard Business Review*, September 1985.)

Maximizing local efficiencies does not maximize system efficiency. Carnegie, DuPont, Ford, and Brown understood this. Unitizing a fixed cost never entered their paradigm. They were solidly focused on flow-centric efficiency and ROI.

Authors’ Note:

Living in the Pacific Northwest, the authors have a heightened level of interest in Boeing as well as direct access and contact with the company, even nondisclosure agreements in place. Given our backgrounds, our areas of expertise, and this access and connection we feel we are uniquely qualified to assess Dr. Hart-Smith’s paper. Boeing invented program accounting. In particular, Debra Smith is very familiar with both Boeing and program accounting, as she spent the first years of her career in public accounting, on the audit staff of Touche Ross, now Deloitte Touche, assigned to the Boeing account and the Commercial Airplane Division. During her tenure as a professor at the University of Puget Sound and the University of Washington, she sat on advisory boards for Boeing and served with Boeing executives. When Dr. Noreen and Debra Smith received a grant from the IMA Foundation for Applied Research, the research affiliate of the Institute of Management, the IMA assigned Bob

Miller as our grant handler and he worked with us throughout the project. This was 1993 and Bob Miller was the corporate controller for the Boeing company as well as the chairman of the IMA Foundation's Project Committee. In 1998 Smith was invited to provide a day-long workshop for the controllers of all the airplane programs (727, 737, 747, 757, 767, and 777) to help them assess both their costing and decision-making system. They got it but it was clear to them and they made it clear to Smith that Stonecipher was taking BCA down the opposite road from what she was proposing. Boeing engineers, their managers, and operation managers continually filled our workshops and conferences, and constraints-based thinking was not only popular but repeatedly proposed to upper management without gaining major traction.

In 2000 prior to the strike, we were contacted by Charles Bofferding, the then executive director of SPEEA, in hopes that we might be able to help them better communicate to top management their concerns regarding both the dangers of a strategy to increase outsourcing as well as how to debunk the cost savings numbers for both the proposed outsourcing and their current process improvement initiatives focused on cost cutting. All of these used financial absorption costing as the basis for the tactics and local performance metrics, which are outlined succinctly in Dr. Hart-Smith's paper. We had been recommended to him by senior managers in the Boeing company in both engineering and operations based on both our familiarity with Boeing, our expertise in management accounting, constraints management principles, and supply chain expertise. There was hope of averting the strike and of generating a rational dialogue of the risks and assessment of the outsourcing issues. As evidenced by the quality of the Hart-Smith's paper, it was not that Boeing did not have internal expertise in these areas, but they hoped outside "experts" would be helpful. Unfortunately for all, there were no opportunities for constructive dialogue. The train had left the station and we were not on it and neither were Boeing's team of experts. Boeing had entered the era termed by Boeing insiders as management by magical thinking—no logic and deep denial of the reality of the outcomes.

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IMPLEMENT DEMAND DRIVEN SMART METRICS TO DRIVE DRAMATIC GAINS IN FLOW AND IMPROVE ROI PERFORMANCE

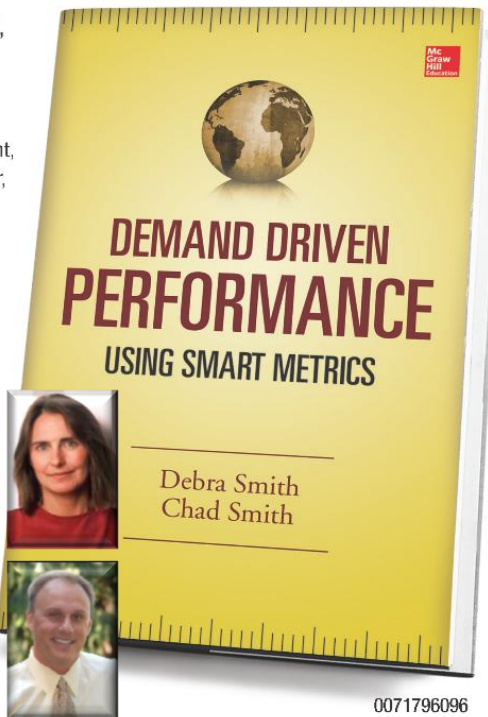
“The methods described in this book worked in one of the most complex manufacturing operations that you can imagine with very effective results.”

—From the Foreword by Dan Eckermann,
former President and CEO,
LeTourneau Technologies, Inc.

In today's volatile, globally competitive environment, new decision-making tools are required to monitor, measure, and improve total organizational performance. Cowritten by internationally recognized experts in the field, *Demand Driven Performance* explains why current measurement forms must be replaced. The authors present a demand driven blueprint and the smart metrics to maximize flow and ROI.

Debra A. Smith, CPA, EMBA, is a cofounder and partner with Constraints Management Group, LLC, a leading services company specializing in demand driven operating models for midrange and large manufacturers.

Chad Smith is a cofounder and partner with the Demand Driven Institute and Program Director of the Certified Demand Driven Planner Program for the International Supply Chain Education Alliance (ISCEA).



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