What is SMS, really?

Safety Management System (SMS) is the use of modern quality improvement techniques to improve aviation safety. The United States, a signatory to ICAO, has committed itself to deploy SMS in this country. Part 135 and 91K operators need to show they have started working on SMS to go to Europe. The FAA Air Traffic Organization has already implemented an SMS program. SMS for Part 121 carriers and airports is in various stages of rulemaking. The FAA is encouraging other aviation organizations to implement SMS on a voluntary basis. You can read about it in the FAA SMS Implementation Guide.

This paper describes the key points on which management must decide whether and when to embark on an SMS initiative, and if so, how to integrate it with a business model that continues to make money.

SMS includes elements you may recognize from Total Quality Management (TQM), Six Sigma, Kaizen, and ISO 9000. By the FAA's own description, SMS is a program modeled after the Capability Maturity Model for Software, "The phases of implementation are arranged in four levels of implementation 'maturity', similar to that developed as the Capability Maturity Model (CMM) by the Software Engineering Institute of Carnegie-Mellon University."

Insofar as the goal of SMS is to improve safety, it is easy to argue in its favor. Upon closer examination, SMS is a complex undertaking. An SMS effort has the potential to consume large quantities of management time, company resource, and can negatively affect customer satisfaction.

The FAA disregards the commercial realities, suggesting that profit be abandoned in the interest of safety. The full quote from its document SMS Framework says:

> "It is the expectation that aviation service providers will manage their operation based on an objective assessment of safety risk, rather than customer satisfaction with products or other conventional commercial goals. "

SMS in Simple Terms

- Forget all the abbreviations and jargon.
- Keep track of your operation's glitches.
- Foster an environment in which the team can discuss and develop solutions to safety problems without fear of retribution.
- Any time you introduce a new procedure or policy, make sure you consider the safety implications.

Safety, Mom, and Apple Pie

Safety is a good thing, like Mom and apple pie. But you cannot live on apple pie alone. We need to look at safety as simply another attribute of the aviation services we provide. The FAA itself recognizes that the risk of aviation activities cannot be driven to zero. That's where the term *Acceptable Level of Safety* comes from. The FAA and insurance carriers describe in stark economic terms the reasonable cost to make aviation safe. That value is the Value of Statistical Life (VSL). The Department of Transportation's latest guidance for economists is $5.8 million. In simple terms, a life saved is worth spending six million. If the cost to save an additional life is $60 million, then the money would be better spent elsewhere.

Quality is also a good thing. You just need to remember that *quality* is not *perfection*. It is not the objective of a quality effort to make every product perfect. The goal is to make most of your products within the customer's tolerances. *Most* is a high bar. Jack Welch of GE set the target at six sigma, which is 2 defects per billion opportunities. Six Sigma practitioners take a 1.5 sigma discount, which brings the target down to 3.4 defects per million. Although the number of defects is a small number, it is not zero. The cost of perfection is too high. That is the same conclusion we came to for aviation safety.

Six Sigma and its threshold for quality are very close to that of the current standard for commercial aviation safety. If our standard for success is a flight without a fatality, let's see how well the North American airline industry is doing. Over the last twenty years, Part 121 carriers have made 134 million flights. There have been twenty-two fatal crashes. We plug that into a calculator and find a fatal accident rate of 0.19 per million flights. That a level of 6.57σ (sigma).

Do the same calculation for the last ten years, when there were only 2 fatal crashes in 65 million departures, and our value jumps to 6.91σ.

If you look only at the last three years, in which the American airline industry has suffered no fatal crashes, the record of safety looks pretty good. Three years is probably too short a time frame from which to make predictions about the future.

Things are not as rosy in the Part 135 world (on-demand air taxi). The National Institute of Health estimates the crash rate for Part 135 operators at 6.0 per million departures (2003-2007). That's one sigma behind the scheduled carriers. Now comes the question: is it worth it to seek to match the record of the scheduled carriers?

Process Improvement is not a cheap undertaking. Most organizations require a cultural shift. It always takes longer than expected. It always costs more than expected. The boss will ask the same question as Jack Welch: What is the Return on Investment (ROI)?

Every day management needs to take hard decisions in the deployment of company resources. Shall we spend the next margin dollar on advertising, quality, safety, acquisition, or dividend? It is not enough to allocate company time and treasure to safety just because it sounds like the right thing to do. NASA reported that 40% of the software budget for the space shuttle was devoted to a software quality initiative. That was an initiative out of control. Given the complexity of the recommendations for SMS, there is exactly the same risk for an out-of-control safety initiative. It will do no commercial organization any good to achieve a sublime level of safety if the costs make it unprofitable or the procedures drive away customers.

SMS: If you don't do it for love, then you do it for the money. If you run a safe operation, your insurance rates ought to decrease. Perhaps. But not many organizations have proven it. Insurance savings alone are not enough. Frankly, insurance is not such a significant factor for airlines; it doesn't even appear as a line item in financial reports.

Safety efforts, when coupled with other process improvements, can deliver cost savings. Studies in Canada have shown that an integrated approach to safety can decrease cost. An effective approach to ramp management keeps hangar rash low and on-time departures high. Diversions are associated with safety threats as well as huge customer costs. Practices that make diversions less common are both safety-oriented and cost-reducing. When safety is included as a goal in an integrated and balanced process improvement program, safety improvement can be free. The secret is to slip safety into a productivity effort. Management will understand and shareholders will applaud.

There is a time when safety becomes the imperative for an operator – when times are hard. Accidents have proven to be the death knell for many air carriers, particularly the ones that were on shaky financial ground to start. While an accident was not the only cause of failure, a crash was the proximate trigger for the failure of the following airlines: Air Florida, ValuJet, Pan Am, Swissair, and TWA.

The FAA regulatory scheme makes safety off-limits for advertising. Nonetheless, the flying public is sensitive to the publicity of a crash. That's why an already weak airline tends to fail a couple of years after a nasty crash.

My premise is that safety is simply another element of the service package you offer clients. The customer wants a competitive price for air travel. She wants an on-time departure and arrival. She wants a flight attendant who isn't grumpy. She wants a flight that is not too bumpy. She wants a seat that reclines. And she wants to get to the destination without crashing. These are the challenges every day. They are all important. On-time arrivals we try to achieve more than 90% of the time, but the consequences for a late arrival are relatively minor. Fatality-free flights we try to achieve 99.9997% of the time. The consequence of a fatality is higher. It is possible to manage them the same way. What you do for on-time arrivals benefits safety. By definition an on-time arrival is a fatality-free arrival.

> By definition an on-time arrival is a fatality-free arrival

SMS Framework based on Capability Maturity Model

Before I joined the aviation industry, I was a senior manager at Andersen Consulting (now Accenture). We were an early adopter of CMM – the model for the SMS Framework. Twenty years ago I led my team of 120 software developers through a CMM process improvement effort. During that time I was flown all over the world for training in CMM. I was a CMM assessor, qualified to evaluate the performance of other software-building organizations, and did so on multiple occasions.

While I was involved in that effort, my belief and commitment to CMM wavered from cynicism to support and back, with the time interval lengthening. When I left the field, I had for some time come to believe in the notion of continuous improvement measured by CMM. I still hold some reservations about the value it brings to an organization and its members, but not enough to keep me from being a supporter.

I hold no doubt that we need to employ the same sorts of procedural rigor and numbers-based approach to aviation safety. Nevertheless, when I read the FAA implementation guide, I was shocked. It was as if no one had asked a software developer what lessons it had learned from CMM.

SMS, like CMM, is a model under which an organization earns one of five rankings. These levels are successive, ranging from chaotic at the bottom to a sort of process nirvana at the top. When CMM was first introduced, there was a race to see what organizations could achieve Level 5 "Optimizing." After twenty years of deployment, most of the software producers who are committed to CMM have recognized that Level 3 "Defined," represents the best balance of achievement and cost.

CMM differs from Six Sigma and other quality management processes insofar as cost reduction, elimination of waste, and return on investment are never explicitly described in the model. The first engagement in CMM – and SMS – is based on faith that the outcome will be profitable. The Six Sigma guys don't operate that way. A project won't get past the Define stage unless the business case is crisp and the ROI positive.

What may surprise many observers is that the Capability Maturity Model for Software and the Software Engineering Institute at CMU were originally funded by the United States Air Force. The CMM was superseded in 2002 by a more robust model. What will probably not surprise readers is that the FAA did not adopt the most current learning.

You may not want to do it the FAA way

The FAA recommendation for a new SMS participant requires as a part of the first level of achievement a comprehensive plan for the entire organization. That plan must include reaching the top level. This is an impossible task. At this stage, the organization doesn't even know what resource, training, and schedule is required, or even what risks it hopes to eliminate.

It is presumptuous for the FAA to choose the SMS level an organization should achieve or plan to achieve. This is a voluntary program. Nonetheless, the FAA has made it obligatory that any organization's participation in SMS will be overseen by the FAA — in various forms, depending on whether the organization is an air carrier, school, manufacturer, or whatever.

In the software world, assessment of progress is done by peers, which is to say that managers of a particular level (with specialized assessment training) will be looking over the shoulders of similar-level managers to make assessments. The FAA is not an organization of peers. It is a regulator.

The FAA regulatory scheme injects an asymmetry not found in commercial organizations. In most organizations, managers have authority *and* responsibility. An FAA Inspector has authority over a commercial operation, but no responsibility. The manager has responsibility for safety and customer satisfaction and cost.

There is another SMS solution that doesn't include the FAA. It is an IS-BAO audit, described below

What is missing from the FAA SMS approach?

Successful implementations of Six Sigma, ISO 9000, and CMM all have one thing in common: they are integrated with other planning and commercial activities in the organization. In no successful case has a manager or team been sent out, told to improve quality, and report back when they've completed their mission. We can expect exactly the same with safety. Sure, a team can identify safety gaps and propose new processes that are safer. Without an understanding of the company's business model, existing culture, and cost drivers, these new processes will be a net drain on the company. New processes need to be better, faster, cheaper, and safer. Safety alone is not enough.

Remember always that safety is simply one more attribute of the product or service you provide. Keep this thought as you approach any process improvement effort; you will be successful.

Putting safety into perspective

Safety is the reduction of undesired outcomes. It's probably worth it to look at an imaginary example. The dollar figures I use as examples will of course vary for your organization, but the gist remains the same.

Stale Pretzels

Your organization seeks to provide passengers with amenities they appreciate. Occasionally, your offering will fail to meet the customer's expectations. While they complain, it's unlikely that a stale bag of pretzels will cost the carrier much, whether in time to replace or in lost future business.

Significant Delay

Your organization seeks to provide on-time service. Passengers are happy when they arrive on time. The carrier is more profitable when it does not have displaced aircraft and displaced passengers. The costs of a significant delay include direct costs for meals, hotels, and interline replacement flights. It includes the cost of lost future revenue from passengers who vow never to fly with you again. And it includes the costs for maintenance overtime, crew, and aircraft repositioning. These costs are hard to quantify. Customers have a way of coming back, so perhaps the loss is not great. The ripple effects from system wide delays are often massive.

Crushed Winglet

Your organization seeks to keep ground-handling accidents to a minimum. Mashing a million-dollar winglet or flooding a hangar with foam is an expensive event.

Fatality

Most carriers will tell you their goal is zero fatalities. Furthermore, the speaker probably believes it to be true. In real life, aircraft operators have some tolerance for risk. When the weather is bad, a captain has two choices: accept a bumpy ride to an on-time arrival, or ask for deviation for weather. When a captain wakes up with a cold, he can choose to take the trip and retain his job, or turn down the trip at the peril of his career. The training department can prepare pilots for every emergency, or it can seek to contain costs. The maintenance department can choose to inspect jackscrews every 300 hours or every 2000 hours.

These decisions are made millions of times each day. The record will show that they are made well. The cost of a bad decision is very high though. A fatality costs $5.8 million.

Undesired outcome	Cost Each	Frequency (defects per million embarkations)	Frequency (percent)	Cost per embarkation
Stale Pretzels	$0.10	100000	10.000000%	$0.01
Significant Delay	$500.00	40000	4.000000%	$20.00
Crushed Winglet	$1,000,000.00	1.27	0.000127%	$1.27
Fatality	$5,800,000.00	0.19	0.000019%	$1.10

A solid approach to SMS will require that the organization flesh out a chart like the one above with real costs and real frequencies. Then it can make cost justified efforts to improve the things that need improving, starting with the low-hanging fruit. And it can make rational decisions about the gaps in its approach to safety.

What SMS will require of you and your organization

If you lead your organization, you must be a champion for the effort. You will be personally invested in the effort. You will supply moral support. You will referee disputes between the process improvement effort and the entrenched processes in your organization. And frankly, you will be committing to a budget that is unknown at the start. Even if the ROI is high, there will be investment up-front.

When your organization commits to an FAA-sponsored SMS program, you agree to even more oversight by the FAA. While one hopes that the FAA adopts a no-fault attitude toward self-reported errors and defects, there is no guarantee that information disclosed for one purpose cannot be put to another, i.e. enforcement.

If you expect the best results from a process improvement or safety program, you will have to devote your best people to the effort. They know the existing process; they have the smarts to discover where the holes are, and the imagination to propose innovative solutions. One of the first cultural shifts in most organization is identification of these people and their reassignment to this project. If they are good, their managers won't want to see them go. This is a significant cultural shift for most companies. No one else will say it, but I will: safety and security are often the hierarchical equivalent of the paper clip department.

You may be tempted to assign people to the SMS effort on a part time basis. Executive management will only spend a part of its time on safety. The safety champion (usually the manager of a department) will spend a part of his or her time on safety. And people in the department will spend only a portion of their time on SMS activities. One of the lessons GE learned in its six sigma efforts was that the person in charge of the process improvement effort needs to be full time. In six sigma terms, this person is called a black belt. It's your choice what to call him or her in the context of SMS. In any but the smallest organization, if you don't commit at least one person full time to the effort, the rest of the team will get the message that safety is not that important.

Your best people will need to use their imaginations to develop processes that are safe and further the commercial goals of the organization. When we introduce SMS training to the organization, we will recall the fast and cost-effective method of switching engines on a DC-10. We will also recall that this process introduced progressive damage to the rear pylon mount, eventually leading to separation of the engine from airframe. Your people need to consider the downstream effects of the processes in your organization.

If you engage in a process improvement or safety program, you better have patience. It's going to take time to train the staff, so everyone is using the same vocabulary. SMS suffers from government's incurable use of abbreviations, acronyms, and jargon. It's going to take time to develop a statistical picture of your processes that you can analyze. Unless your organization is unusually immature, there will be no "quick wins."

If you engage in a process improvement or safety program, you should expect disruption. Old Joe who has been maintaining batteries for years without serious complaints or an accident may have been lucky or he may have developed a process with built-in inefficiencies. When someone takes a hard look at his operation, Joe may feel threatened, no matter how much training he has received or pro-progress communication has filtered through the company. The same will apply to your pilot community.

The biggest change for many organizations is the creation of a *Just Culture*. This is an organizational mindset in which an individual can submit, review, and discuss safety related data without fear of reprisal. The FAA itself is struggling with the just culture concept in its own implementation of SMS. If there is an activity in the company that is unsafe, or a recurring incident, the team needs to discuss it, propose solutions, implement them, and make sure the problem is dealt with. Old school techniques of discipline and firing are not effective.

A just culture makes a distinction between errors and omissions, from which the organization can learn and remediate, and those that are willful or grossly negligent. For most organizations, the dividing line between

"things we will discuss and fix" and "things we will fire you for," becomes more tolerant from the individual's perspective. In a just culture, that line is also more clearly defined.

Management needs to consider carefully its approach to just culture. Within the FAA, the Air Traffic Organization gets a pass on self-reported problems, but the pilot community is seeing a higher level of enforcement actions as a result of issues reported by ATO. It's not enough to introduce just culture to an organization using happy talk and memos. There will always be members of the community who will game the system. You need to anticipate and design away (or at least minimize) negative second and third order effects.

SMS in a box

A Google search for *SMS* produces three families of results. The first is another SMS – Short Messaging Service – which we know as text messaging. The second is a series of SMS checklists for OSHA workplace safety compliance. The third is a collection of offerings of an IS-BAO audit. IS-BAO is the International Standard for Business Aircraft Operations, a standard developed by the International Business Aviation Council (IBAC). IBAC provides the only independent registration service for SMS compliance. One can undergo an IS-BAO audit, or one can work with the FAA to earn a Letter of Acknowledgement. The FAA is careful to say that a Letter of Acknowledgement is not approval of an SMS, but it is sufficient to meet international requirements for proof of participation in SMS.

Like a checklist in the cockpit, a checklist is insufficient to manage a project. A pilot using a checklist, or a manager using a checklist, needs to have knowledge of the underlying systems. The first time you see an SMS checklist or an IS-BAO audit tick-list, there will be a tendency to mentally assign a tick, "Yes, we do that." The checklist item is likely more involved than the short description.

Take for example the requirement to document the SMS process. This implies that the SMS documents are controlled with version numbers, dates, approval on each changed page, paper or electronic. The documentation process must include a records retention policy. Your attorneys will argue for a short retention period. Your analysts will argue for long-term statistics. You will have to referee this clash.

If you interview several of the 300 approved IS-BAO auditors and you are told the effort can be subcontracted, beware. You can hire help, facilitation, and the audit; you cannot outsource the underlying effort.

You will have three choices: Do nothing until SMS is required for your organization type. Adopt a *de minimus* approach – do just enough to meet the requirement, while keeping costs low. Or you can introduce a program with high expectations, like Jack Welch of GE did.

Collateral Benefits of SMS

Every time an organization looks at itself in a new way, it will discover new things. Your organization continually seeks to develop a competitive advantage in the marketplace. The deep analysis that will come as a part of an integrated process and safety improvement effort will uncover opportunities to make your organization more successful.

What next?

Do seek outside help. An outsider will ask difficult questions that will stimulate you to think about your organization in a different way.

Then make a plan and execute, the way you have done everything else that has made your company a success.

The author

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