安全管理系統—進一步討論

以互動式課程探討安全管理系統的真實面向

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Kent Hollinger此本有關安全管理的專書以一種有別於以往傳統教科書的方式來呈現。MITRE公司是一家由美國政府資助的非營利研究發展機構，書中模擬了他在MITRE公司領導一個安全管理訓練課程時，所經歷的課堂討論過程。

如同實際的教學過程，書中包含了Hollinger在MITRE公司5天的SMS課程中所進行之對話。作者表示，這本書的對象是每天直接面對SMS業務的實際安全從業人員，而此種呈現方式正是為了避免內容流於學術探討。書中先解釋相關概念，但重點放在實際的運用與案例。

12位虛擬學員來自性質不同的業務部門，有駕駛員、客艙組員、安全主管、維修經理、航務經理、安管人員及資深的檢查員。Hollinger主導整個課程進展但鼓勵學員分享他們的想法與經驗。

書中編排與實際課程模組相當，包含有簡介、SMS圖示(以圖像表現SMS組成與元素間的相互關係)、一個SMS的企業案例、以SMS看人為疏失、正向的安全文化、SMS的需求與標準、SMS政策、SMS管理架構、安全風險管理、安全保證、安全提升及其進一步發展，最後並有完整的重點歸納作為附錄。

在設定過程中，Hollinger引證了David Marx「Whack-a-Mole: The Price We Pay for Expecting Perfection」書中內容。Hollinger表示，沒有人從來未曾犯過錯誤，我們只能冀望能在事情變壞前，發現並矯正錯誤。人生而犯錯，無論他如何努力地想要正確地作好每一件事情。

所以如果一個系統僅能依賴每一份子精準無誤地完成工作，否則就會崩潰瓦解，那就不能稱之為好系統。我們

需要設計一個能降低錯誤機會的系統，錯誤允許被發生，並在產生不良結果前被阻止；該系統並能夠容忍那些未被阻止的錯誤所造成損失。

以下是有關於風險識別與追蹤的一段對話範例:

Keng(Hollinger): 如果一個危害的風險值很低，為什為我們還要持續追蹤這項危害?

Hans: 因為它的風險有可能在未來變高。

Kent: 在接下來的例子中，我們將會在模組10詳細討論風險分析的作法，通常它包括一個事件後果的頻率與嚴重度。嚴重度是指後果所帶來的損失，頻率則是危害發生的可能程度。在風險的這兩個維度中，我們有一個能不錯地預估，但另一個維度則作得沒有這麼好。你們認為在頻率與嚴重度的預估工作中，哪一個可以預期有較好表現?

Derek: 嚴重度!人們總是可以預見將會有什麼樣的事情發生，但卻無法取得足夠資訊去預估什麼時候這個預見會成為事實。這也是為什麼人們都喜歡玩樂透彩。

Kent: 一點都沒有錯，我們班上共有14個人。假設我

們今天都在同一家公司上班，我們每個人都分別知道在去年發生過一件性質相似但不同的事件。如果有人在進行風險分析時詢問我們其中任何一人:「去年我們公司類似的案件發生過幾次?」他將會得到「僅發生一次」的答案，但實際上，性質相同的案件在去年一年就發生了十四次之多。這就是風險曝露值的問題。如果沒有採行中央式的安全管理系統，這些案子會被分別儲存在十四個單獨的資料庫中，從而降低了應有的風險曝露程度，使風險頻率被嚴重低估。

接下來是另一段課堂中對話的例子

Kent: 如果想要表達天氣狀況，你會用什麼樣的指標(indicator)來描述?

Felix: 溫度。

Ali: 風速。

Linda: 風向。

Pedro: 濕度。

Kent: 如同天氣可以用許多指標來完整描述，我們也可以用指標來表示安全。安全目標(target)就是指安全指標預計達成的數值或程度…一個國家可以說:「在未來的3年內，我們想要降低跑道入侵的頻率到每百萬次作業不超過0.5次。」為了達成這個目標，國家可能會擬訂一個行動計畫，以12個月為期，在3個主要的機場投資興建場面活動監視雷達，其可用率高達98%...如果使用結果顯示3個主要機場不再發生跑道入侵事件，使頻率降到了0.7次/百萬作業，則應該進一步考慮在其他機場也興建相同的雷達系統。

如果能經由此類投資而能有效降低跑道入侵的機率，我們可以說這個國家的空域系統是安全的嗎?

Ali: 比較安全了。

Kent: 是的，但是能說它是「安全」的嗎? 如果完全消除了跑道入侵的可能性，就可以稱為「安全的航空系統」嗎?

Derek: 不行，搞不好每天都還會發生空中接近事件。

Kent: 一點都沒有錯! 單一的指標遠遠無法滿足對安全管理系統的描述。如同天氣報告一樣，安全管理系統需要許多指標以及伴隨的目標值；特別是不同的組織間，所適合的安全指標可能也不儘相同。

Hollinger也開發了新方式來表達傳統安全管理主要論點，使其不流於俗套。例如有名的James Reason「瑞士起司」理論，每一層的風險防禦都像一層層起司片，雖能阻隔風險但仍存有露洞，一旦層層露洞串成一線，所有防禦都宣告失敗，也無法阻止事故發生。Hollinger則將瑞士起司騰空旋轉，創造出一個稱為「stuck 7s」(通通停在7)的理論，其構想是來自一種有5個轉輪的老式賭博遊戲機檯，當玩家拉動桿子時輪子開始轉動，轉動停止時停在中心線上的圖案決定玩家取得的點數，如果5個轉輪都停在7的圖案，則可贏得頭獎。如果有一個轉輪停在7的位置，則就其他轉輪也停在7的勝率就相應增加，雖然機率不高，但藉由精巧地操作配合，仍然是有望達成。

Kent: 這和飛安模型有何關連呢? 簡單說，我們建立了多重的防禦機制，然後我們有時候會疏於其中之一，此時就如同拿了一個「stuck 7」。

「Stuck 7s」總在我們不遵守標準與程序時來到、在我們依照記憶去執行檢查項目時來到…，這些都是使我們陷於麻煩的原因。走捷徑使我們得到一個「stuck 7」，但似乎並沒有其他的事情發生，所以我們更因此…

Greg: 更因此而產生信心。

Kent: 一點也沒有錯。3個星期後，你覺得這樣作應該還可以，而3個月後，你會覺得這樣作根本就是對的…接著你會製造出第2個「stuck 7」，直到最後真正的大麻煩來臨為止。

通常SMS都被形容為一套組織與程序、或某種基本的工作態度。但課堂中的一名虛擬學員Greg對此有另一個角度的看法。他提到他和太太在超級市場採買家用時，目睹一罐泡菜自貨架上滑落而摔破於地上，玻璃碎片四溢，他找到賣場人員並向其報告該情況。但他隨後並未立即離去，而是在一旁等候直到該處被清理乾淨為止。他太太因為購物的興緻被打擾而有點不高興。

Greg: 我向她解釋說四溢的碎片和水漬可能讓老人家不慎滑倒、傷到身體，甚至必需就醫，只因為我們沒有多花10分鐘來確保店家把污損清除乾淨。我們不能讓這種事情發生。

Kent: 雖非該店的股東，也不知道會不會有人因此而摔倒，但你已掌握了所謂安全責任的內在因素…以此類推，如果在你公司中，有人發現了溢濺的燃油，或地板上有殘存液壓油，他們會認為「管理人員自然會在人員受傷前負責找人把它們清理乾淨」?還是會認為「應該找適當的單位回報」?還是他們會等在原地一直等到該情況被清理完畢?如果他們手上還有其他事情需要處理，他們會不會擺置三角錐或其他醒目的物品以提醒走動人群注意? 這是腳踏實地的實踐安全而不僅是口頭上告訴每個人如何叫作安全。

雖然航空業內的每位安全從業人員都已通曉SMS內容，但藉由Hollingers的書和生動活潑的課堂互動，將對此基本精神更有發揚、提醒之作用。

譯自 Aero Safety World Oct, 2014

SMS: Up for Discussion

An interactive course probes the practical dimensions of safety management systems.

RICK DARBY

BOOKS

Safety Management Systems for Aviation Practitioners: Real-World Lessons

Hollinger, Kent. Reston, Virginia, U.S.: American Institute of Aeronautics and Astronautics, 2013. 221 pp. Figures, tables, references, appendixes, index. Hardcover.

Kent Hollinger's account of safety management systems (SMS) is presented in an unusual and possibly unique format. It approximates a classroom experience of the kind led by Hollinger on behalf of The MITRE Corp., a not-for-profit company that operates research and development centers funded by the U.S. government.

As in an actual interactive teaching situation, the text incorporates dialogue involving Hollinger and the students in one of MITRE's five-day SMS classes.

"This book is specifically intended to avoid an academic approach," the author says. It is written for "practitioners, those people on the front lines who will benefit from, and interact with, SMS every day. SMS principles are introduced to explain and give context to the concepts, but the emphasis is on actual usage and examples."

The 12 students quoted, given fictional names, represent a cross section of aviation personnel. Among their functions are cabin crewmember, pilot, safety director, maintenance manager, operations manager, safety office manager and senior inspector. Hollinger leads the class but also encourages the students to discuss their own thoughts and experiences.

The book is arranged according to modules like those of the class: an introduction; the SMS "table" (a pictorial representation of the system elements and how they relate to one another); the business case for SMS; an SMS look at human error; positive safety culture; SMS requirements and standards; SMS policy; SMS management structure; safety risk management; safety assurance; safety promotion; and next steps. An appendix summarizes key points.

In setting the stage for the discussions that follow, Hollinger cites David Marx's Whack-a-Mole: The Price We Pay for Expecting Perfection. Hollinger says, "Has anyone here not made an error yet today? No one? It is to be hoped that you recognized your mistake and

corrected it before anything bad happened. Humans will always make errors, no matter how hard they try to do the right thing.

"So, if we have a system that relies on everyone doing everything perfectly every time or else it falls apart, that's not a very good system, is it? … We need systems that are designed so that the chance for errors is reduced, those errors that do occur are captured before creating a bad result, and the systems are tolerant of those errors that are not captured."

As an example of the discussion format, here is an exchange about hazard identification and tracking:

Kent (Hollinger): If we have a hazard that poses a low risk, why would we want to track that hazard?

Hans: It might trend upward in the future.

Kent: And in that case, it might present a high risk. We will discuss risk analysis in Module 10, but it involves looking at the severity and the likelihood of a consequence (or outcome) arising from a hazard. Severity means the degree of harm posed by the outcome, whereas the likelihood (or probability) is how often it would occur. Of those two dimensions of risk, studies have shown that people are good at estimating one and not so good at the other. Which one do you think we are good at — estimating the probability of something happening or estimating the severity if it did happen?

Derek: Severity. People can always envision what might happen, but they usually don't have enough information to accurately predict the probability. That is why they play the lottery.

Kent: Exactly. There are 14 of us in this class. Let's pretend we all work for the same company. What if something happened and each one of us knew about one different occasion of this thing happening in the past year? If someone doing a risk analysis asked us, "How often does this event happen at your company?" I would say, "Once a year." You would say, "Once a year" and the rest of us would say, "Once a year," but it really occurs 14 times a year. Is that a different risk exposure if it's happening 14 times a year instead of once a year? This is another benefit of a centralized safety database, because if we had 14 different data storage locations, each one might know about it happening once and we would underestimate our exposure.

The following is another example (abbreviated) of the dialogue format in Hollinger's classes.

Kent: If I asked you to describe the weather, what indicators would you use?

Felix: Temperature.

Ali: Wind speed.

Linda: Wind direction.

Pedro: Humidity.

Kent: There are many indicators to describe the weather and there are many indicators to describe safety. Safety targets are the indicator values that we want to achieve. … The state might say, "In three years, we want to reduce runway incursions to a rate of not more than 0.5 per million operations."

To achieve the target, the state could create an action plan to install surface movement radar systems at the three largest hub airports within the next 12 months, with a 98 percent availability rate. … If there were zero incursions at the three largest hub airports, and the national rate would only reduce to 0.7 per million operations, perhaps the radar system should be installed at more airports.

If the state were able to achieve this target and reduce runway incursion, does that mean it has a safe airspace system?

Ali: It's safer.

Kent: Yes, but is it safe? If there were zero runway incursions, would the aviation system be safe?

Derek: No, there might be a midair collision every day.

Kent: Exactly. The point here is that just one indicator is not sufficient. Just like in describing the weather, it takes numerous indicators, along with their targets, to know if we have a safe system or organization. The indicators can be very different across the organization.

Hollinger finds new ways to frame principles that may have become clichés that no longer register strongly. Take, for instance, safety theorist James Reason's famous model of layered defenses against risk,

each layer represented by a slice of Swiss cheese, with the holes representing gaps in each layer of the defense. The slices are constantly shifting, so that occasionally some holes line up, the defenses fail and an accident results.

Hollinger found the idea of spinning cheese slices unrealistic, so he created a new model to illustrate Reason's thesis. His version is called "Stuck 7s," based on old-style gambling machines with five wheels that turn when the player pulls the lever. Depending on what symbols are visible on the centerline when the wheels stop, the result may be (but usually is not) a money prize. If all five wheels stop at 7, the gambler hits the jackpot.

Should one wheel be stuck showing a 7, that slightly increases the odds of five 7s lining up. The probability is still low, but not as low as with a correctly operating machine.

Kent: How does that relate to the aviation safety model? Well, when we've established multiple defenses, and then we negate one of them, basically we have given ourselves a Stuck 7.

Stuck 7s come when we do nonstandard procedures or workarounds, when we do a checklist by memory because, "Oh, I have that thing memorized. Why do I need to pull the card out?" … That's how we get into trouble in aviation. We do this shortcut, this omission or this nonstandard practice and give ourselves a Stuck 7 and nothing bad happens. Everything's fine. So we gain …

Greg: Confidence.

Kent: You get confident with this new shortcut or workaround. You keep using it for three weeks and now you're really feeling good about it. Three months go by and you're convinced that it is the right thing to do and there is no harm. … You may even go on to create a second Stuck 7. Then finally the odds catch up with you.

An SMS is often described as being more than a kind of organization or a set of procedures, as an underlying attitude. Greg, one of the class members, describes how he and his wife were walking down an aisle in a grocery store when he saw a glass jar of pickles fall onto the floor, spreading broken glass and liquid. He found an employee and reported it.

But he also guarded the mess until it was cleaned up, which he says "drove my wife crazy." She wanted to get on with shopping.

Greg: I explained that an elderly person might come around the corner, not see the spill, slip on it, fall down, break a hip, have to go to the hospital and get a hip replacement, all because I couldn't spend 10 minutes on guard until the store cleaned up the spill. I couldn't live with that.

Kent: You have no stake in the store and do not know the person who might slip, but you have an inner sense of responsibility for safety. …

So, what would people in your organization do if they saw a fuel spill, or some hydraulic fluid on the floor? Would they think, "Management had better clean that up before someone getshurt"? Would they report the spill? Or would they also take action to make sure no one was injured until the spill is cleared? If they are too busy to stand by the spill, they could always place some cones or other objects around the spill. That is what is meant by a shared responsibility for safety, not just telling everyone to work safely.

By now, most people in safety-related positions in aviation are familiar with the basics of SMS, but even those who have been introduced to them through classwork will find Hollinger's book a vivid and thought-provoking refresher.

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