正確的飛航

有其他研究失事與意外事件的方式嗎?

孟磊 譯

參考書

工作的執行

安全-I與安全-II: 安全管理的過去與未來
英格蘭Hollnagel, Erik與美國佛蒙特州Burlington：
Ashgate出版社 2014, 200頁, 圖片, 表格，詞彙集，
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南丹麥大學教授Hollnagel主張對於安全管理是該有一個新對策的時候了，他從他稱為安全-I的舊有程序中分別出一項他叫做安全-II的新程序。

以下是他對於此二者的定義：

安全-I:“安全是一種惡劣結果(失事/意外/空中接近)越低越好的狀態，安全-I是透過排除故障或危害的因子，或減輕其影響，以確認事情不會出差錯來達成。”

安全-II：“安全是一種圓滿結局越高越好的狀態，那是一種在時刻變化的狀況下也能成功的能力，安全-II是透過試圖確認事情做對，而不是防止事情出錯來達成。”

Hollnagel說：安全-I自從人們開始以有條理的方式追求安全，即在風險管理中盛行，他探討了幾個發展階段。

三個時期

在他所稱為第一時期中，“安全最絕對性的威脅來自於所運用的科技，一方面來說乃是科技…它本身就是拙劣且不可靠的，另一方面則是人們不曉得如何有系統地分析並防範風險，當時主要的考量是找出技術性的方法來保護機械、防止爆炸與防止結構崩潰。”這大致盛行於工業革命開始的18世紀末期一直到二次世界大戰之後的數年期間。

“對於能夠控管風險來源從而有效地管理工業安全的感覺，在1979年3月28日三哩島核能電廠[在美國賓夕法尼亞州中部]災變中被一夕摧毀。”Hollnagel說，這將時間帶向他所謂的第二時期，由一項對新的風險因素－人類操作者的研究所標註。

儘管在某些方面是一大進步，人為因素的研究太常導向另一個誤導的解方，那就是把操作者盡可能地排除在安全管理系統之外，“在一般的觀點中，人類已經被視為容易失敗與不可靠的，甚且是系統安全中較脆弱的環節”侯

FAA數據：飛機空中接近事件增加百分之600

華盛頓時代雜誌報導：據美國FAA表示，過去四年飛機空中接近事件劇增百分之600。

今年稍早，美國運輸部助理主任檢查員Jeffrey Guzzetti告訴國會：這些”嚴重的錯誤”是因為空中交通管制員對飛機的隔離不足所導致。

調查員說：2009年有報告的空中險撞事件為37件，到了2012年跳到大約275件。

華盛頓時代雜誌報導：有關飛機空中接近，但尚未到達有嚴重碰撞危險的報告也同樣在增加中。

那些較輕微的錯誤在2006年到2009年間還算持平，但在之後不到兩年的期間卻從1200件增加到1900件，根據主任檢查員辦公室預估，當2012會計年度數據統計完成，該數字將再度劇增到約2500件。

不過主任檢查員也警告：飛機接近事件的確實數目可能無法完全確定一也甚至可能更多一因為FAA對於該項數據的收集是不完整的。

以上資料從Newsmax 網站上綜整

納傑爾說：“最”明顯“的解決方案就是用自動化取代來減低人類扮演的角色，或是嚴格要求遵從以限制人類表現的差異性。”就如即將在安全-II的探討中可見，這個差異性恰恰就是據說能提供進一步降低風險的關鍵。

對於人為因素設計與程序極致功效的信念”持續將近十年”，然而幾件包括挑戰者號太空梭失事、前蘇聯車諾比爾電廠核子反應爐爆炸，還有在加納利群島特內里費發生兩架波音747客機在滑行階段中相撞的事件，在在證明除了人為因素外，組織也必須被重新思考。

“一個結果就是安全管理系統成為發展與研究的焦點，甚至必須把它們的名相出借給這第三個時期:‘安全管理時期’。”

無意義的問題?

Hollnagel並不認為在第二與第三時期中所揭露出對應安全威脅的嘗試是足夠的，他說:“儘管我們對於技術系統安全評量的答案可以有些信心，當我們對於人為因素或組織安全做評估時卻無法等而視之，原因純粹就是比起技術系統，對於人為因素與組織的問題雖不至於毫無意義，但卻也較無意義。”

他認為雖然技術性議題可以被分析，而且防範技術失誤也可以相對的更明確，但是同樣的問題在針對人時就無法適用，更不用說組織了。

安全-I在降低風險上已獲致巨大成就，對於商用航空失事率的急速下降是沒有太大爭議的，特別是從噴射時代開始或是在全世界各區域持續明顯改善的安全紀錄，然而Hollnagel並非暗示安全-I的作為阻滯了發展，他說:“雖然安全-II對於安全的改善方法在很多方面不同於安全-I，必須強調的是它們是對於安全的兩個互補的觀點，而不是兩個不相容或矛盾的觀點。”

更大的複雜性

從工業時代早期主要目標是監控像火車引擎之類的裝備不致爆炸或是傷害人命或財產迄今，安全管理的複雜性已經有極大的擴展，現今安全的著眼點包括各種操作系統與它們之間的交互關係、維護、自動化、組織與人的心理-生理學，因此，侯納傑爾說，在安全-I中，無可避免地在所謂“工作的設定”(由設計者，管理者與其他非工作執行者；也就是在所謂的“第二線”)與“工作的執行”(由維修技師、飛行員與其他在飛機“第一線”的人員)之間產生分歧。

“從第一線的觀點看來，不意外的是基於工作設定的描述無法用在實際的作業上，也就是實際的工作與描述的工作是不一樣的”侯納傑爾說”但是這個差異對於第二線的人是很不容易察覺的，部分原因是從外面與一定的距離處來觀看，部分也是因為存在的數據有著可觀的延遲或是部分已經過多重組織階層的過濾。…

“從長久的經驗我們確知要在每個細節上設計極端複雜的[科技]系統，並透過嚴密地確保每個組件都按照它們的規範運行來確認其可以運作是可能的，進一步說，機器不需要調整其功能，因為我們已經很大地注意到確保它們的工作環境保持穩定，作業狀況可以維持在很狹幅的限度中。”

對抗差異性

在第一線的人員被視為有同等能力執行被設定的工作一而且被鼓勵或威脅所驅動，Hollnagel說：“根據這種世界觀，一個必然的結果就是透過標準化作業...或是抑制各種執行的差異來降低或排除表現的差異性，如此效率可以被維持而失效或失敗被避免。”

Hollnagel區分了兩個系統－易於控制的與不易控制的系統：

“如果一個系統它的作用原理是可知的、描述是簡單的，細節是少的，而且最重要的是在它被描述的過程中不會改變，那它是易於控制的系統。

如果一個系統它的作用原理只有部分可知(或是在極端的狀況下，完全不可知)、描述中含有太多的細節、或是在描述完成前系統已經改變，那它是不易控制的系統。”一個系統越複雜，越不易控制，而它牽涉到人類的層面越無法被完全界定，某些情況只能由人類依當時的狀況做決定來解決。

非預期的情況

因為這些原因與其他書中所討論的話題，Hollnagel歸結出“人們總是需要按照實際的狀況調整作業，大體上與所預期的有所差異一而且大部分的時候很明顯地是如此，這就是在安全-II核心中的執行調整或執行差異性。”

相反於安全-I中人為因素頂多被視為不幸的必要，甚至是必須被減低的威脅，安全-II承認以下幾點：

“系統不是完美無瑕的，而人們必須學習去確認並克服設計瑕疵與功能的差錯；

“人們能夠認知實際的要求並據以調整他們的執行；

“當程序必須被應用，人們可以解讀並應用之以符合當時的狀況；[與，]

“人們在事情出差錯或即將出差錯時可以感知並改正之，進而在情況嚴重惡化前介入。”

合理的調整

這些例子都是事情順利的情況，但它們經常是不被注意的，甚至是直接牽涉的人，Hollnagel說：“絕對不要坐等不好的事情發生，而是要在一切看似正常的情況中試圖了解實際的狀況，安全-I假定事情都會順利，因為人們只要按照程序與工作設定去執行，安全-II則是假定事情都會順利，因為人們總是會依照現在與未來情況的需求來做出他們認為合理的調整，找出那些調整是甚麼並試著從中學習可能比找出不常發生的惡劣情況的成因來得重要！”

每一次成功的作業，例如一趟安全的飛航，包含無數正確的作為，但那些作為如何能被研究？很多國家的安全主管機關連調查失事與意外事件的適當資源都沒有，更不用說調查看似沒有狀況的事情了。

Hollnagel建議了一些技巧，主要是訪談第一線的人員，他相信這是可行而且會有成果的，因為訪問人們有關他們成功的程序可以避免導致他們自我防衛的傾向，他說訪談的問題可以包括像以下這些：

“如果某些非預期情況發生時，你會怎麼做?例如，一個打岔、一項新的緊急任務、一個非預期的狀況改變[或]資源的丟失?

“你的工作是很例行性的或是需要很多的即興發揮?

“如果資訊缺乏時，或是你無法找到特定的人時，你會怎麼做?

[與，]

“你多常改變你工作的方式?”

“一個安全-II的觀點將需要[他們]本身有方法與技巧能夠去觀察進行順利的事情，分析事情如何運行並且能夠應付執行的差異而不是只去抑制它，”侯納傑爾說。

譯自Aviation Safety World September 2014

Right Flight

Is there an alternative to studying accidents and incidents?

Tom Topousis

BOOKS

Work-As-Done

Safety–I and Safety–II: The Past and Future of Safety Management

Hollnagel, Erik. Farnham, Surrey, England, and Burlington, Vermont, U.S.: Ashgate, 2014. 200 pp. Figures, tables, glossary, index. Hardcover, paperback, ebook PDF, ePUB PDF.

Hollnagel, professor at the University of Southern Denmark, argues that it is time for a new strategy in safety management. He distinguishes the new process, which he calls Safety–II, from the traditional one that he names Safety–I.

Here is how he defines the two:

Safety–I: “Safety is the condition where the number of adverse outcomes (accidents/ incidents/near misses) is as low as possible. Safety–I is achieved by trying to make sure that things do not go wrong, either by eliminating the causes of malfunctions and hazards, or by containing their effects.”

Safety–II: “Safety is a condition where the number of successful outcomes is as high as possible. It is the ability to succeed under varying conditions. Safety–II is achieved by trying to make sure that things go right, rather than by preventing them from going wrong.”

Safety–I, Hollnagel says, has prevailed in risk

FAA Data: Aircraft Near-Misses Up 600

Near misses between aircraft have shot up an alarming 600 percent over the last four years, according to the Federal Aviation Administration, the Washington Times reported.

The "serious errors" are caused by air-traffic controllers who leave too little distance between aircraft, Jeffrey Guzzetti, the U.S. Transportation Department assistant inspector general, told Congress earlier this year.

There were 37 reported near-collisions in 2009. By 2012, that number jumped to an estimated 275, investigators said.

Reports of planes that get too close, but are not in serious danger of colliding, also are on the rise, The Washington Times reported.

Those lesser errors remained relatively flat from 2006 to 2009, but rose from 1,200 to 1,900 in less than two years afterward. The inspector general's office estimated that the number will rise again sharply, to 2,500, when the data for fiscal 2012 is compiled.

But the inspector general warned that an exact count of incidents in which aircraft come too close is impossible to accurately nail down — and could be even higher — because the FAA's collection of that information is incomplete.

Digested from Newsmax website

management since people started pursuing safety in a disciplined way. He discusses several phases of development.

The Three Ages

In what he calls the First Age, "the dominant threats to safety came from the technology that was used, both in the sense that the technology … itself was clunky and unreliable, and in the sense that people had not learned how systematically to analyse and guard against the risks. The main concern was to find the technical means to safeguard machinery, to stop explosions and to prevent structures from collapsing." This prevailed roughly from the beginning of the Industrial Revolution period in the late 18th century through World War II, and for some years afterward.

"The feeling of having mastered the sources of risks so that the safety of industrial systems could be effectively managed was rather abruptly shattered by the disaster at the Three Mile Island nuclear power plant [in central Pennsylvania, U.S.] on 28 March 1979," Hollnagel says. This led to what he calls the Second Age, which was marked by the study of a new risk factor — human operators.

While a step forward in some ways, human factors research too often led to another misguided solution, namely, writing the operator out of safety man¬agement as much as possible. "In the general view, humans came to be seen as failure-prone and unreliable, and so as a weak link in system safety," Hollnagel says. "The 'obvious' solution was to reduce the role of humans by replacing them by automation, or to limit the variability of human performance by requiring strict compliance." As will be seen in the discussion of Safety–II, it is precisely this variability that is now said to offer a key to further risk reduction.

Belief in the supreme efficacy of human factors design and procedures "lasted barely a decade." Several events, including the space shuttle Challenger disaster, the explosion of a nuclear reactor at the Chernobyl power plant in the former Soviet Union, and the taxi-phase collision of two Boeing 747 airliners at Tenerife, Canary Islands, "made it clear that the organisation had to be considered over and above the human factor.

"One consequence was that safety management systems have become a focus for development and research, and even lend their name to the Third Age: 'the age of safety management.'"

Meaningless Questions?

Hollnagel is not convinced that the attempts to counter the safety threats revealed in the Second Age and Third Age are adequate. He says, "While we can have some confidence in the answers when the safety of technical systems is assessed, we cannot feel the same way when the safety of the human factor or the organisation is assessed. The reason for that is simply that the questions are less meaningful than for technical systems, if not outright meaningless."

He argues that although technical issues can be analyzed, and defenses against technical failure can be reasonably precise, the same cannot be said about people, still less about organizations.

Safety–I has led to huge success in risk reduction. There is no debate about the steep decline in commercial aviation accident rates, particularly since the beginning of the jet era, or the remarkably good safety record that continues in most regions of the world. Hollnagel does not suggest, however, that progress is being held back by Safety–I practices. He says, "While Safety–II represents an approach to safety that in many ways differs from Safety–I, it is important to emphasise that they represent two complementary views of safety rather than two incompatible or conflicting views."

Greater Complexity

Safety management has vastly expanded in complexity since the early industrial age, when the goal was mainly to see that equipment such as railroad engines did not blow up or otherwise harm people and property. The safety focus now includes operational systems and their interrelationships, maintenance, automation, organizations and human psycho-physiology. As a result, Hollnagel says, in Safety–I, a split inevitably arises between what is called Work-As-Imagined (by designers, management and others removed from the task; that is at the so-called "blunt end") and Work-As-Done (by maintenance technicians, pilots and others at the "sharp end" of an airplane).

"Seen from the sharp end, it is no surprise that descriptions based on Work-As-Imagined cannot be used in practice and that actual work is different from prescribed work," Hollnagel says. "But this difference is not at all easy to see from the blunt end, partly because it is seen from the outside and from a distance, partly because there is a considerable delay and partly because any data that might exist have been filtered through several organisational layers. …

"We know from a long experience that it is possible to design even extremely complicated [technical] systems in every detail and to make certain that they work, by rigourously ensuring that every component func¬tions according to specifications. Machines, furthermore, do not need to adjust their functioning because we take great care to ensure that their working environment is kept stable and that the operating conditions stay within narrow limits."

Against Variability

People at the sharp end are assumed to be equally capable of performing Work- As-Imagined — and to be motivated by encouragement or threat. Hollnagel says, "According to this way of looking at the world, the logical consequence is to reduce or eliminate performance variability either by standardising work … or by constraining all kinds of performance variability so that efficiency can be maintained and malfunctions or failures avoided."

Hollnagel distinguishes between the terms tractable and intractable systems:

"A system is tractable if the principles of its functioning are known, if descriptions of it are simple and with few details and, most importantly, if it does not change while it is being described. … A system is intractable if the principles of its functioning are only partly known (or, in extreme cases, completely unknown), if descriptions of it are elaborate with many details and if systems change before descriptions can be completed." The more complicated a system, the more intractable, and the less its aspects involving humans can be fully specified. Some situations can only be resolved by variability determined ad hoc by humans.

The Unexpected

For these reasons, and other issues discussed in the book, Hollnagel concludes that "people always have to adjust work to the actual conditions, which on the whole differ from what was expected — and many times significantly so. This is the performance adjustment or the performance variability that is at the core of Safety–II."

Whereas in Safety–I, the human factor was considered at best an unfortunate necessity and at worst a threat to be damped down, Safety–II acknowledges the following:

"Systems are not flawless and people must learn to identify and overcome design flaws and functional glitches;

"People are able to recognise the actual demands and can adjust their performance accordingly;

"When procedures must be applied, people can interpret and apply them to match the conditions; [and,]

"People can detect and correct when something goes wrong or when it is about to go wrong, and hence intervene before the situation seriously worsens."

Sensible Adjustments

All these are examples of things that go right, but they usually go unnoticed, even by the people directly involved. Hollnagel says, "It is essential not to wait for something bad to happen, but to try to understand what actually takes place in situations where nothing out of the ordinary seems to take place. Safety–I assumes that things go well because people simply follow the procedures and Work-As-Imagined. Safety–II assumes that things go well because people always make what they consider sensible adjustments to cope with current and future situational demands. Finding out what those adjustments are and trying to learn from them can be more important than finding the causes of infrequent adverse outcomes!"

Every successful operation, such as a safe flight, involves countless actions that go right. But how can those actions be studied? Many national safety authorities scarcely have the resources to investigate accidents and incidents adequately, let alone investigate what seem like non-events.

Hollnagel suggests several techniques, primarily interviewing the people at the sharp end. He believes that this is feasible and likely to bear fruit because asking individuals about their successful procedures avoids any of their tendency toward defensiveness. Interviews can include questions like these, he says:

"What do you do if something unexpected happens? For example, an interruption, a new urgent task, an unexpected change of conditions [or] a resource that is missing?

"Is your work usually routine or does it require a lot of improvisation?

"What do you do if information is missing, or you cannot get hold of certain people? [and,]

"How often do you change the way you work?"

"A Safety–II perspective will … require methods and techniques on [their] own to be able to look at things that go right, to be able to analyse how things work and to be able to manage performance variability rather than just constraining it," Hollnagel says.

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