公務出國報告
（出國類別：實習）

參加「安全管理系統（航空）」課程出國報告書

服務機關：交通部民用航空局
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出國地區：美國洛杉磯
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參加「安全管理系統〈航空〉」課程出國報告書

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關鍵詞: 安全管理系統（Safety Management System）,風險管理（Risk Management）,危害確認（Hazard identification）,安全文化（Safety Culture）

內容摘要: 一套完整的「安全管理系統」應配合組織之安全文化、可實現之目標、明確的個人負責制度、完善的文件記錄、有效的保證和策略推廣以及各專業領域經驗豐富的人員，對航空業的發展扮演極重要的角色。首先介紹安全管理系統之基礎，包括安全文化及風險管理，安全文化係預防事故發生的基礎，且唯有以良好的安全文化作爲根基，才能建構出穩固之安全管理系統；然因航空作業環境複雜且詭譎多變，因此航空業具有高的營運風險之特點，此時便需適切的風險管理方式，藉由風險評估（含危害確認、風險分析）及風險控制的方式來降低航空業所面臨之高風險。其次利用前面介紹之理論爲基礎，描述安全管理系統之架構，最後再就實務方面應如何建置一套安全管理系統之過程作一詳盡介紹。

本文電子檔已上傳至出國報告資訊網

目 次

1. 目的 1
2. 過程 1
   2.1. 往返行程 2
   2.2. 課程內容 2
   2.3. 學員簡介 3
3. 安全管理系統之理論 5
   3.1. 安全管理系統之起源 5
      3.1.1. 危害（Hazard）及風險（Risk）之定義 5
      3.1.2. 危害之特性 5
      3.1.3. 風險之成本 6
      3.1.4. 適用於航空界之風險管理系統 8
   3.2. 安全文化（Safety Culture） 9
      3.2.1. 安全文化概述 9
      3.2.2. 安全文化之內涵 9
   3.3. 風險管理（Risk Management） 10
      3.3.1. 風險管理概述 10
      3.3.2. 風險管理實施步驟 11
4. 安全管理系統之應用 17
   4.1. 何謂"航空方面之安全管理" 17
   4.2. 安全管理系統之定義 17
      4.2.1. ICAO 對安全管理系統之定義 17
      4.2.2. 其他國家之定義 17
   4.3. 安全管理系統之目的 18
   4.4. 安全管理系統之架構 18
      4.4.1. 經營者之安全目標及安全策略 20
      4.4.2. 內部溝通及諮詢 20
      4.4.3. 風險及變遷管理 21
      4.4.4. 安全管理通報 23
      4.4.5. 錯誤或違反之管理 23
      4.4.6. 訓練 23
      4.4.7. 變遷管理 24
      4.4.8. 內部稽核 24
      4.4.9. 失事及重大意外之紀錄、通報及調查 25
      4.4.10. 矯正、調查及改善行動 25
      4.4.11. 文件及紀錄之管控 25
      4.4.12. 安全管理系統之改善及預防行動 26

5. 如何建立一套安全管理系統.....29
5.1. 前言.....29
5.2. 管理階層之承諾.....29
5.3. 設立安全管理之策略及目標.....30
5.4. 指定安全負責人.....32
5.5. 成立安全委員會（視需要）.....32
5.6. 建立管理風險之程序.....34
5.7. 建立通報系統來記載危害、風險及採取行動。.....37
5.8. 員工訓練及教育。.....39
5.9. 建立組織查核、失事及意外事件調查之機制.....39
5.10. 建立文件及資料管控系統.....42
5.11. 評估系統是否仍具成效。.....43
6. 心得及建議.....45
7. 附錄.....47

1. 目的

「安全管理系統（Safety Management System, SMS）」最初係國際民航組織（International Civil Aeronautical Organization, ICAO）於 2001 年提出之構想，並於 ANNEX 14 第三版第四次修訂中，於第 1.3.4 節中新增一節，其內容為「每個獲頒空側使用許可證之機場得運作在安全管理系統之下」，雖然該節目前僅屬建議措施尚不具強制性約束力，然於第 1.3.6 節則將各機場應於 2005 年 11 月 24 日前完成安全管理系統建置之規定列為一項標準。

囿於政治因素，我國並非 ICAO 之締約國，但民航事業係一全球化、現代化的事業，我國當然不能置身於事外。近年來，我國逐步將原本參考美國聯邦航空總署（FAA）Advisory Circular 等文件所訂定之規定及標準，變更為符合 ICAO 相關附約及文件之規定及標準。另為確保機場空側設施符合國際規定，正逐步推行機場認證作業，安全管理系統除為確保機場安全及正常運作中即重要之一環，亦為未來機場認證作業中的重點之一。

因 ICAO ANNEX 14 中對於安全管理系統僅作規定上之敘述，至於應如何推行至機場實務運作之上，則並未加以著墨，僅能自相關文件中略窺一二，然卻無法全盤了解其內容及建置方式；為能儘早協助各航空站完成安全管理系統之建置，遂派員赴國外受訓，藉以參考國外實際做法並蒐集相關資料，為安全管理系統之實施預做準備。

2. 過程

本次出國預算原係為配合辦理「機場檢核機制建置」案編列之參加美國聯邦航空總署舉辦之「機場檢核訓練」課程，然因主辦單位於本年度停辦該項訓練課程，遂派員轉赴新加坡航空學院參加與「機場檢核機制建置」相關之安全管理系統課程，復因報名參訓者眾，致滿額無法參加該學院於八月間舉辦之類似課程，轉赴另一 ICAO 認可之訓練機構－南加州安全協會（South California Safety Institute, SCSI）所舉辦之訓練課程。茲將往返行程、課程內容及參訓學員資歷簡述如下：

2.1. 往返行程

1. 92.09.07 搭乘長榮航空公司 BR006 班機，由台北出發，並於當日抵達美國洛杉磯機場。
2. 92.09.08~92.09.19：於南加州安全協會（South California Safety Institute, SCSI）進行安全管理系統課程。
3. 92.09.20~92.09.26：自費停留當地旅遊。
4. 92.09.27~92.09.28：搭乘長榮航空公司 BR012 班機，由美國洛杉磯機場起飛，當日返回台北中正機場。

2.2. 課程內容

本次訓練課程內容及授課時數如下：

	9月8日 星期一	9月9日 星期二	9月10日 星期三	9月11日 星期四	9月12日 星期五
0800	簡介/歡迎 Richardson	財務管理 Gardiner	人為因素管理 Gary Hook	風險管理 Mike Doiron	風險管理 Mike Doiron
0900	安全管理系統之概述 Richardson				
1000	安全管理之背景 Richardson				
1100					
1200	午餐	午餐	午餐	午餐	午餐
1300	安全之管理 Gardiner	組織行為及文化 Hook	人為因素管理 Gary Hook	安全查核 McFall	風險管理 Mike Doiron
1400					
1500					
1600					

	9月15日 星期一	9月16日 星期二	9月17日 星期三	9月18日 星期四	9月19日 星期五
0800	安全資訊 Richardson	失事及重大意外調查 Richardson	安全案例之必備條件	扼要重述及複習	安全管理系統計劃討論
0900			安全管理練習	目標設定練習	
1000					
1100	安全委員會 Richardson				畢業式
1200	午餐	午餐	午餐	午餐	
1300	安全報告 Richardson	停機坪及維護安全 Richardson	安全管理系統之準備	發展安全管理系統計劃練習	
1400	安全訓練 Richardson				
1500	緊急應變計畫 Richardson	安全分析 Richardson			
1600					

課程內容之投影片資料詳如附錄。

2.3. 學員簡介

本次參加學員連同職共七員，其中三位服務於航空公司，一名韓國人，服務於韓國航空公司擔任地面機務經理職務，一名美國人、一名挪威人，均為商業包機公司之機師；另外三位服務於軍方，二名比利時人，服務於比利時空軍，其中一位係直昇機駕駛員上尉官階，另一位負責航空器維修少尉官階，一名荷蘭人，係運輸機機師少校官階。因參訓人數不多，主辦單位將原本預定於飯店內舉辦之課程，轉移至該協會之會議室內舉行，並將學員名牌上連同各國國旗一併印出，主辦單位的一個小動作，卻讓人覺得十分貼心；課堂上及休息時間大家均聚在一起討論及聊天，學習氣氛十分融洽。

3. 安全管理系統之理論

3.1. 安全管理系統之起源

高風險之職業如核能及石化等工業，於達成其目的之行動過程中，因不安全的行為、動作或不安全的狀態，導致突然發生的、與人的意志相反且事先未能預料到的危害（Hazard），若危害情節重大時，均將造成極大之財產損失、生產中斷及人員傷亡；相關高危險性之工業為維持其永續之經營，遂逐漸衍生出一套系統化之安全管理方式，藉由積極的、正面的、有效的管理來提升各項作業之安全以降低危害發生之風險。

3.1.1. 危害（Hazard）及風險（Risk）之定義

許多人都對「危害」與「風險」這兩個名詞的定義有所混淆。所謂危害就是「具潛在性特性，會造成人員死亡、職業性傷害、職業病；或可能造成重大財產損失、生產停頓；或對鄰近區域之社區和居民構成傷害、不適或恐慌的物質、設備或運作」。所謂風險即是指特定威脅利用弱點，造成資產遺失毀損的潛在可能，於管理實務上，通常都將風險加以量化，使得風險轉變成「一個會造成人員傷害或經濟損失的危害事件之量度；包括潛在危害發生的可能性（Likelihood）與該事件發生後的嚴重性（Magnitude）兩項因素，風險即為兩項因素相乘後的綜合性指標」。

3.1.2. 危害之特性

雖然危害之發生無法事先進行預測，然仍可歸納出危害具有之因果性、隨機性、潛伏性、可預防性等四項特徵，茲分述如下：

1. 因果性：詳如圖 1 危害之發生係因相互聯繫的多種因素共同作用所導致之結果，引發危害的原因通常是多方面的；於危害調查分析過程中，應釐清危害發生的因果關係，並找出危害發生的各項原因，這對預防類似危害的重複發生特具成效。
2. 隨機性：危害發生的時間、地點及危害後果的嚴重程度均係是偶發且無法預測的，此對預防危害的發生帶來極高的困難性；但是，發生危害之隨機性在一定範圍內仍可藉統計獲致其規律性，我們可從危害的統計資料中，找到危害發生的規律性。因此，危害統計分析對制定正確的預防措施有重大意義，如波音公司統計危害好發性，大半均集中於降落階段，詳如圖 2。

圖 1 危害發生之因果性

3. 潛伏性：表面上，危害是一種突發事件，但是危害發生之前有一段潛伏期。危害發生之前，系統（人、機、環境）所處的這種狀態是不穩定的，也就是說系統存在著危害隱患，具有危險性。如果這時有一觸發因素出現，就會導致危害的發生。人們應認識危害的潛伏性，克服麻痺思想。生產活動中，某些企業較長時間內未發生傷亡危害，就會麻痺大意，就會忽視危害的潛伏性。這是造成重大傷亡危害的思想隱患，詳如圖 3。
4. 可預防性：為避免危害的發生，不變的法則即是任何大小危害皆可藉由適當的措施加以預防的；也就是說，任何危害，只要採取正確的預防措施，皆可防止危害的發生於未然。一旦瞭解此一特性，便可堅定信心徹底執行任何律定之措施，對於防止危害之發生有其極正面的影響。因此，我們必須通過危害調查，找到已發生危害的原因，採取若干預防危害發生之措施，便可從根本上降低危害的發生頻率。

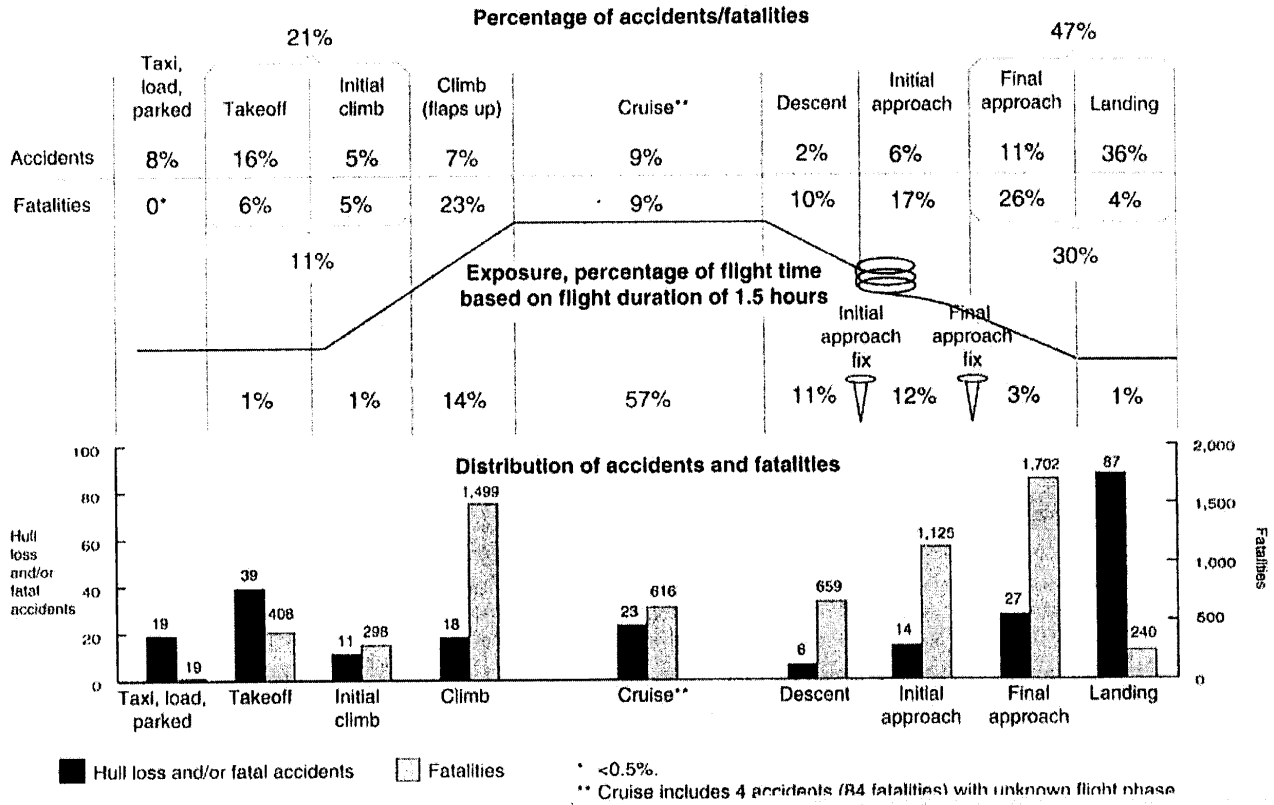
3.1.3. 風險之成本

一家保險公司已經計算與風險相關之成本（1998 年的資料）如下所示：

1. 詳如單就停機坪意外事件估算，每年就可讓業界損失美金 30 億，相當於每架噴射機損失美金 30 萬
2. 間接成本、不能保險的成本、營收損失等可能超過直接成本至少 20 倍以上。

Accidents and Onboard Fatalities by Phase of Flight

Hull Loss and/or Fatal Accidents — Worldwide Commercial Jet Fleet — 1988 through 1997



BOEING

圖 2 有關航空方面意外事件發生之隨機性

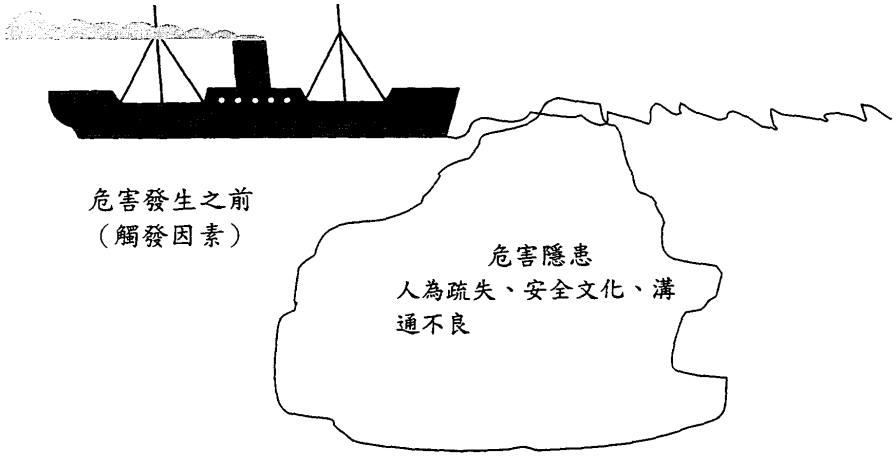


圖 3 安全之冰山理論（The Ice Berg Theory of Safety）

事　　件　　種　　類	直接成本	間接成本
飛機被餐車撞到	$17,000	$230,000
飛機滑行時被另一架飛機撞到	$1,900,000	$4,900,000
停止的飛機被移動中的空橋撞到	$50,000	$600,000
飛機在後推時被拖車撞到	$250,000	$200,000

註1. 上述範例所提到的只是經常發生之停機坪事件。一般人都不曾了解到一個停機位每年約需超過100萬次的勤務車輛進出俾提供各項服務之同時，其中的管制與協調溝通過程經常不良。

註2：如果意外事件發生在一偏遠地區，則直接與間接成本將會大幅增加。

表 1 停機坪上有關風險之成本

3.1.4. 適用於航空界之風險管理系統

風險評估可依對象與目的之不同，一般可分為安全風險（Safety Risk）、健康風險（Health Risk）、生態與環境風險（Ecological and Environmental Risk）及財務風險（Financial Risk）等。

由現今保險公司紛紛以高價格競標以取得於機場內設置保險櫃檯經營權之趨勢獲知，一般人咸認為於搭乘航空器的過程中，可能發生危害之風險仍偏高，且若一旦發生事故，所導致財務及生命上的損失，更是難以估計；另以一般商務航空公司而言，其風險管理之過程在於尋求、確認、分析、評估及控制航空公司作業所引起的風險，俾獲致最高標準的安全。然必須接受的事實是在天候因素、機件性能、人為因素、場面

設施...等諸多因素影響下，雖然無法達到絕對安全之要求，但確可使整個營業範圍獲致確實且合理的安全。因此如何可隨者航空運輸業之蓬勃發展致使航運量增加的情形下，利用有限之資源，獲致最大之管理效益（即能維持事故發生率之持平或降低），著實是負責全國民航運輸事業的我們一項極重要的課題，為有效管理航空器失事及重大意外事件發生時所造成危害之風險，因此必須建立一套有效之安全管理系統。

3.2. 安全文化（Safety Culture）

3.2.1. 安全文化概述

「文化」一般指觀念形態的文化，指人類創造的精神世界及與之相適應的管理方式。人類的一切生活及生產都是在一定的文化背景下進行的，都離不開文化的作用和影響。除了目前尚不能預知的自然災難之外，生活及生產中發生的事故在某種程度上都來源於人的失誤。人的安全素質和意識於尋找及消除潛在危害方面可產生決定性之作用。

安全是航空界最主要的目標，而綜合國家文化、組織文化和專業文化即可界定一安全的文化或是不安全的操作環境。

安全文化就是指人們為了安全生活和安全作業所創造的文化。作業中常常出現執行者違規，甚至管理階層違規指揮。於分析違規的原因時，常常指出“違規者缺乏遵守安全規範的自覺性”。自覺性是人的意志品質，是指人能意識到自己行為目的和意義程度的大小，由於對行為後果認知的不同，人們即使面臨一個相同的環境卻會採取不同的行為方式。這種支配行為能力的形式，主要取決於人的文化素質。

安全文化是指安全價值觀和安全行為準則的總合，體現於每一個人、每一個單位、每一個組織內、外與安全或危險有關之信念、規範、態度、角色、和社會與技能實務有關之一套行為表徵。據此，此套信念或系統對於個體或其所屬之團體極為重要，並能解釋他們對於生、死、工作和危險之關係或影響。安全文化不僅是針對成員頒發一些安全守則來規範其行為，尚含括成員共有的安全信念、共享的安全規範，也願意協助其他成員達到安全目標之意願。而這些安全文化的內涵最終即可透過組織前線成員的外顯行為和表現加以彰顯。

3.2.2. 安全文化之內涵

安全管理系統於組織內推行是否能內克竟其功，端視組織內之安全文化，基本上，良好的安全文化之內涵或特徵可分為四個層面：

1. 策略管理（Strategic management）及組織氣候（Organization climate）

a. 策略管理：是第一個也是最主要的因素。若管理階層無法真正地接受安全至上的法則，一旦執行者感受到管理階層的言行不一：表面上談安全，但實質上卻僅重視操作面本身或以營利為主，則經營者極可能做出危及飛安之決策或行動。因此上層之管理階級對於飛安之信念與態度極為重要。

b. 組織氣候：由管理者和被管理者間關係所決定之組織文化是決定組織氣候的關鍵因素。組織氣候係不同於組織文化，其特別強調成員於組織內工作感到的榮耀或情感部分，以及是否能將自己視為組織內大家族的一份子而言。組織氣候對於個體之工作動機與壓力知覺、壓力因應有重要的影響。更甚者，其也與個體有效的操作或行為表現及外界對該組織團隊之印象有關。

2. 對安全的關注與在乎之態度的傳播(Care and concern)：有了上層管理者之支持前提下，飛安的實務落實仍需靠組織內對於飛安之「關注與在乎」的傳播，感染每一個體，而對於飛安之關心的有效傳播，則必須仰仗組織內具代表性的人物，以及所有與飛安相關之政策措施都不應是為了處罰之目的而設定的。唯有如此，理想的飛安概念才能深植民心，並且確實付諸於言行之中。在此種情境下，飛安及相關之危安處置才能成為個體及集體之共同目標。

3. 對危急處置有效地規範和規定(Rules and norms)：有關組織內對安全之規範和規則也是安全文化的核心之一。因為這些規定都會影響個體或團體於運作中，決定那些行為被視為是安全或不安全、或是適當的行為反應的重要依據。

4. 持續地將安全有關之信念或態度反映至安全實務中（Ongoing reflection in practice）：安全文化的另一重要成份即是持續地應用在實務作業之中。應用的過程不僅只是被動地將所有的規範或有關之信念確實執行於實務運作中，尚包括主動積極地將一些不合時宜之法規或信念提出，有效地反覆修改相關之法規、信念或態度，如此安全文化方能深植至組織內每位成員之中，而非僅是口號、沉重負擔。

3.3. 風險管理（Risk Management）

3.3.1. 風險管理概述

風險管理（Risk Management）與風險評估（Risk Assessment）之間關係密不可分，風險評估必須考慮每種危害發生的機率與可能造成的衝

擊，以計算資產的風險值。風險評估的理論並不艱深，市面上亦有現成的風險評估工具程式可供利用，各種計算方式各有千秋，過程則大同小異，選用時應考慮其有效性、可重複性與可持續性。不過，每一個組織具有其獨特的價值判斷標準，如何將理論轉變成實務，並儘量以客觀的分析衡量取代主觀的價值判斷，則有賴於反覆詳細的斟酌與調適。

至所謂風險管理，即是針對風險評估出來之結果與改善建議，透過系統化之體系、決策過程與執行之落實與追蹤考核等程序，以達到保護員工、社會大眾、環境及避免作業中斷造成損失的目的。基本上風險管理是在強調危害控制技術和管理知識整合，全世界工業先進國家開始對工業安全投以高度的重視後，風險管理即成一項世界性的潮流。圖 4 是風險管理的流程架構模式，其過程簡單的描述為先對相關運作進行危害鑑識，經確認危害確實會對運作產生嚴重影響後，利用系統化的安全評估與管理技術，計算或估計危害狀況發生的可能性及發生後的嚴重性，進而提出最有效的管理控制及改善措施，以便達到一最低合理風險的管理目標。

3.3.2. 風險管理實施步驟

由風險管理的執行架構可知，風險量化與評估實為主要關鍵步驟，亦即需透過定義來進行風險量化、系統化的描述以掌控作業流程、進行危害確認、事件列舉、選擇分析事件，才可建立量化風險的分析模式。依據組織作業與設備之特性，選擇適當之危害分析技術並收集相關之安全資料，才能有效評估和辨識潛在危害源與作業之弱點，以達成後續風險管理的實質目標。

於執行風險評估應遵守之準則如下：

- 資訊收集與作業分類：準備有關之組織、人員、設備、作業程序等相關資料。
- 危害確認與評估：確認與每項作業相關的重大危害，考慮在何種什麼狀況下可能會產生危害。
- 風險等級判定：假設計畫中或現行控制措施運作的情況下，以主觀的方式先評估與每項危害相關的風險，評估人員亦須考量控制措施的有效性和控制措施失效可能造成的後果。
- 判斷風險可否接受：判斷計畫中之預防措施是否足以控制危害之發生。
- 擬定風險控制計畫(必要時)：擬定計畫以因應評估所發現的問題，組織應確保執行中及將執行之控制措施之延續性及有效性。

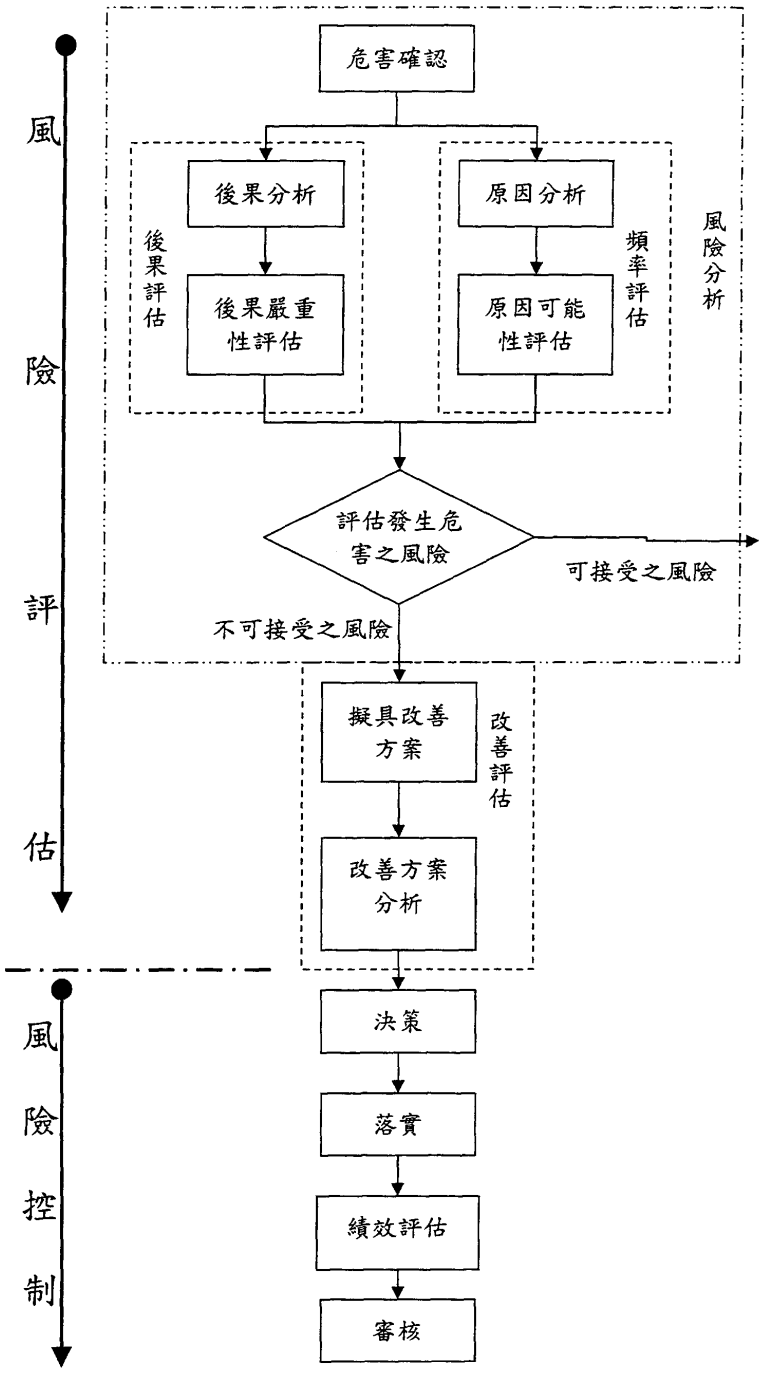

風險評估
危害確認
後果分析
原因分析
後果評估
後果嚴重性評估
頻率評估
原因可能性評估
風險分析
評估發生危害之風險
可接受之風險
不可接受之風險
擬具改善方案
改善評估
改善方案分析
風險控制
決策
落實
績效評估
審核

圖 4 風險管理架構

➢ 檢討計畫之適用性：以修正後的控制措施為基準，重新執行風險評估，並檢討修正後之控制措施所具有之風險是否可接受。

風險評估作業之實施流程可簡化成如圖 5 所示並簡述如下：

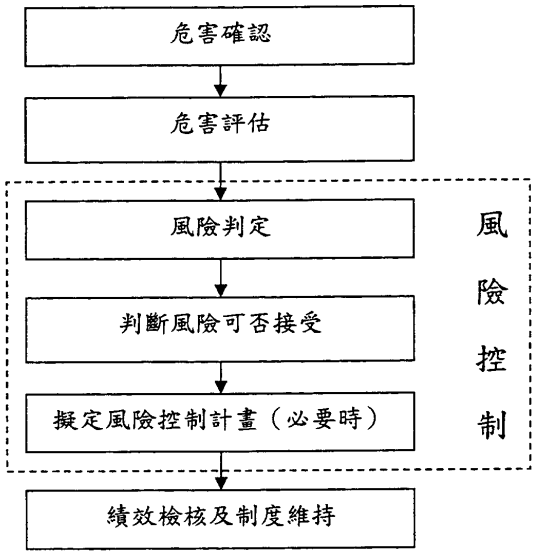


圖 5 風險評估簡化流程

1. 危害確識：危害確認的方法包括了 What-if、Checklist、 FMEA、HAZOP、FTA...等。經危害確認即能找出危害發生原因，再針對發生原因與產生之後果加以評估，並將風險加以量化，判斷是否是可接受的風險（Acceptable Risk），再決定以何種危害控制的方法來改善。因此危害確認與評估是風險管理與決策的手段，維有透過系統化之危害評估後，才能確實有效降低各項作業之風險。
2. 危害（風險）評估：作業危害分析方法有相當多的方法可供利用，常用的有：
   a. 初步危害分析（Preliminary Hazard Analysis）：初步危害分析最早是由美國軍方所發展的危害分析方式，主要是以工廠之危害物質與主要作業區域為評估對象，用於作業研發與基本設計階段較為適合。一般透過危害物質之特性確認、設備規格／清單、作業區配置（Layout）、作業操作環境、系統間之介面等，進行分析。最後藉由不同危害等級之分類，排定安全改善建議之優先順序。
   b. 相對危害等級（Relative Ranking）：相對危害等級評估法可以

界定出作業之火災、爆炸或毒性危害以及相關之安全、衛生、環境與經濟之影響。依據物質性質、作業條件及特性來評定排序出各作業區的相對危害等級，找出範圍內最具危害的單元，目前較常用之方法有火災爆炸指數與化學暴露指數。

c. 檢核分析表（Checklist Analysis）：由有經驗之專業人員事前規劃出危害分析的檢核項目並製成表列式之檢查要項，再由查核人員針對被檢討的區域，回答檢核表上的問題，因此查核表本身即可說是此分析方式的指導原則，評估人員只需逐條檢討，並根據查核結果進行分析並提出改善建議。

d. 安全審核（Safety Review）：安全審核是較傳統的危害分析方式，用於作業運作期間之任一階段，一般經由巡查（Walk-through）、人員訪談、過去運轉維修與意外事故記錄、工程標準／規範的適用性評估等方式來進行。由以往的經驗或事故來對製程的安全做研判，是屬於定性之方法，重點主要在找出重大潛在危害，並建議防制對策，詳細之分析則需與其他方法相互配合。

e. 如果-會如何（What-if）：如果-會如何分析法與查核表分析是兩種完全不同的方式，查核表分析是將所有考慮因素事先加以設計；如果...會如何則對於考慮因素採開放式問答，分析每一階段的作業或設施，藉由「如果作業失誤或設施失效時會造成什麼影響？」的問題來辨識出潛在危害，是一種非結構性的腦力激盪方法。優點是可激發提出更多被忽略的潛在性危害，缺點是難於引導及規範危害分析之進行，尤其對於缺乏工作經驗的人員更是無法產生效用。

f. 失誤模式與影響分析（Failure Modes and Effects Analysis, FMEA）：失誤模式與影響分析所引用的引導原則是將作業中相關設備事先列出，評估時逐一分析各設備，並分析設備失效或不當操作時檢討其可能的後果或危害，再對危害加以定量分析，同時亦辨識出其安全防護，並判斷是否足夠。

g. 危害與可作業性分析（Hazard and Operability Study, HAZOP）：危害與可作業性分析（HAZOP）與失誤模式與影響分析（FMEA）不同的地方在於引導方式，本項分析係以作業偏離（Process Deviation）來引導危害分析之進行，係屬一種較完整的定性分析技術。由不同背景的專家組成，藉助結構化的腦力

激盪來辨識出問題，逐一對所有的設備、操作步驟與程序來評估當作業流程偏離正常設計時的可能原因、可能後果或危害，同時亦辨識出其現有之安全防護措施，並判斷是否足夠，及應增加何種改善措施。

由於危害與可作業性分析（HAZOP）因利用系統化之作業偏離來引導危害分析之進行，並且涵蓋所有作業與設備甚至操作步驟，故其探討問題的空間更大，除失誤模式與影響分析（FMEA）中的設備故障外，更廣及於人為失誤、材料劣化、上下游作業流程之影響、系統失常、作業程序設計不當等，是目前最被廣泛採用的危害分析方法。因其牽涉範圍十分寬闊，一般皆以小組討論方式進行。

h. 失誤樹（或故障樹）分析（Fault Tree Analysis, FTA）：失誤樹分析是屬於一種演繹（Deductive）的安全評估方式，主要是針對一特定之意外事件或系統失誤，抽絲剝繭地找出其基本原因。是屬於定性與定量之方式，一般之失誤樹為樹狀之圖形，藉由圖形中之數學與統計邏輯關係，描繪出意外事件中的人為錯誤與設備失效之組合。

i. 人為可靠度分析（Human Reliability Analysis，HRA）：人為可靠度分析是屬於一種系統式的評估方式，用以找出影響操作人員、維修保養人員及技術人員等之工作成效的因素，一般之人為可靠度分析需進行任務分析（Task Analysis），包括該任務之物理上與環境面之特性，以及執行該任務人員之技能、知識、資格等。藉由此分析可確認造成意外事故之潛在原因與環境狀況，亦可用此來探討人為錯誤之原因。

3. 風險控制（策略）：一旦評估出風險後，即須將不同的風險等級加以定義並決定出可接受風險（Acceptable Risk）之等級，供決策參考。風險控制之策略，即在於如何將風險降低至可接受風險等級之內，因風險是由危害事件發生之機率與嚴重性組合而成，則控制風險不外乎由如何加強預防措施（亦即減少事故之發生機率）或加強保護措施（亦即減輕事故造成之嚴重性）兩大方向思考。當然在技術與經費許可範圍下，當以能夠同時達到本質較安全（Inherently Safer）與失效也安全（Fail-safe）的最高境界為最終目標。執行上可大略分成工程控制（Engineering Control）和管理控制（Management Control）兩大類：

a. 工程控制：藉由改善或增建各項設施之方式來提昇其可靠度及降低危害的風險。

b. 管理控制：藉由人員之管理、專業訓練與工廠作業方式來改善製程操作安全，例如：

   a) 修改作業方法與作業條件。

   b) 修改或重新設訂定期檢查頻率及預防保養制度。

   c) 加強人員作業技術與專業知識之訓練。

   d) 加強人員安全教育與安全意識。

   e) 依員工能力指派工作，例如考慮個人的生理及心理狀況。

   f) 加強作業變更之管理。

   g) 建立適當之通報流程，以快速找出製程異常狀況。

   h) 加強人員之緊急應變訓練與演練。

4. 績效檢核及制度維持：危害評估的結果之實質意義在於進行預防改善和提昇作業安全；但各種改善風險的方法如何取捨，其執行績效如何檢核，即是風險管理計畫之施行與制度之維持所需考慮之重點。因此績效檢核是管理系統重要之工作，主要的目的是：

   a. 判定風險控制是否已確實執行並具成效。

   b. 擷取各項作業失敗的教訓，包括意外事件之調查與檢討。

   c. 提供回饋資訊予各部門，以促進風險控制措施之執行。

   d. 提供可檢討的資訊，作為改善各項作業之依據。

   故有必要建立一套能顯示風險管理計畫之目標達成程度之績效檢核方法，以供依循。改善措施於實施前應予思考的相關問題有：

   a. 改善措施是否可降低風險達到可以接受的程度？

   b. 應當詳加考慮的改善措施是否會產生新的危害？新增設施是否真能排除高風險之威脅？

   c. 是否選擇最符合經濟效益的方案？

   d. 相關人員是否認為有必要修改預防措施？

   e. 修改後的改善措施是否確實可行？例如，施工人員是否會因趕工的壓力而忽略相關之改善措施？

4. 安全管理系統之應用

4.1. 何謂"航空方面之安全管理"

有關航空方面之安全管理為何呢？根據英國民航局所作之定義為：「系統化管理與飛航運作、相關地面運作及航空器維護工作之風險，已獲得高標準之安全表現。」

4.2. 安全管理系統之定義

4.2.1. ICAO 對安全管理系統之定義

ICAO 於相關 ANNEX 中對安全管理系統所下之定義為：

一套機場安全之管理系統，包含組織架構、責任、程序、流程及機場經營者為實現機場安全政策的條款，以管控機場安全及運作上的安全，詳如圖 6 所示。

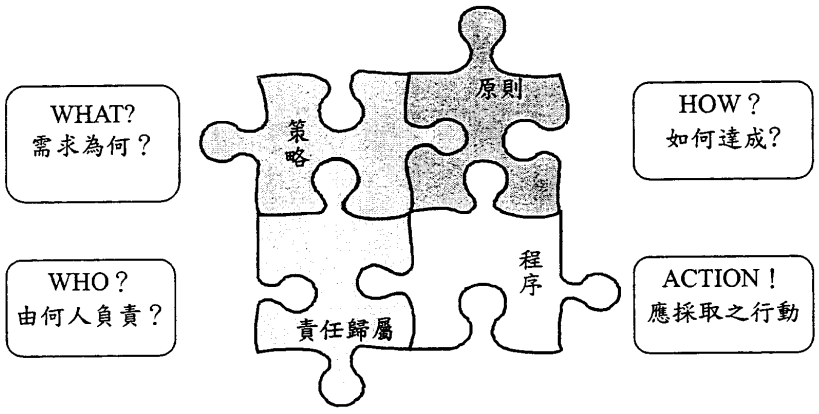


圖 6 安全管理系統

4.2.2. 其他國家之定義

根據蒐集所獲得之資料，已完成安全管理系統建制之國家有加拿大、澳洲、新加坡等國家。各國民用航空局雖自行對安全管理系統作出不同形式之定義，然基本上仍以 ICAO 之定義為基礎，再加以衍伸其意涵，如加拿大民用航空局對安全管理系統之定義為：

安全管理系統係指一套系統的、明確的及完善的程序，用來管理與航空經營或經核可獲頒證照之維護機構相關工作安全之風險；並將與運作及技術系統與財務及人力資源管理互相結合。

4.3. 安全管理系統之目的

為何航空站需要安全管理系統？前任國際航空站會議（Airport Council International）主席 Dr. Dunham 曾表示：

由經驗中顯示大多數發生於機場內的失事均可事先予以預防，因此對於機場負責人而言最重要的課題便是建立並維持一個安全的機場環境，用以保護乘客、工作人員、航空器及裝備。因此國際民航組織最近發展並提供一套完整的、用來協助機場負責人提升安全認知的指導方針，因此安全管理系統即是用來填補航空安全指導內容間的缺漏。

又以前通常將機場查核的重點集中在硬體方面（如裝備、機場配置及目視助航設施），然於軟體方面（如責任歸屬、程序、組織、品質、能力）則並未進行相關查核，為避免疏漏，遂實施安全管理系統將軟硬體（含管理、能力、設施及裝備、程序、安全策略）集中統籌管理。

因此 ICAO 所頒布之 DOC 9774 機場驗證手冊中第 5 章述及：

機場經營者應建立一套機場之安全管理系統用以確保與下列作業相關之各項程序均能正確有效的施行並視需要進行改善。

- 有關法律規章
- 通報
- 活動區出入管制
- 緊急應變計畫
- 救援與消防
- 活動區檢查
- 目視助航設施
- 施工管理
- 停機坪安全管理（含車輛）
- 野生動物危害管理
- 障礙物管制
- 故障航空器
- 危險物品
- 低能見度運作
- 助導航設施

4.4. 安全管理系統之架構

安全管理系統之架構詳如圖 7，系統內必須包括下列各項：

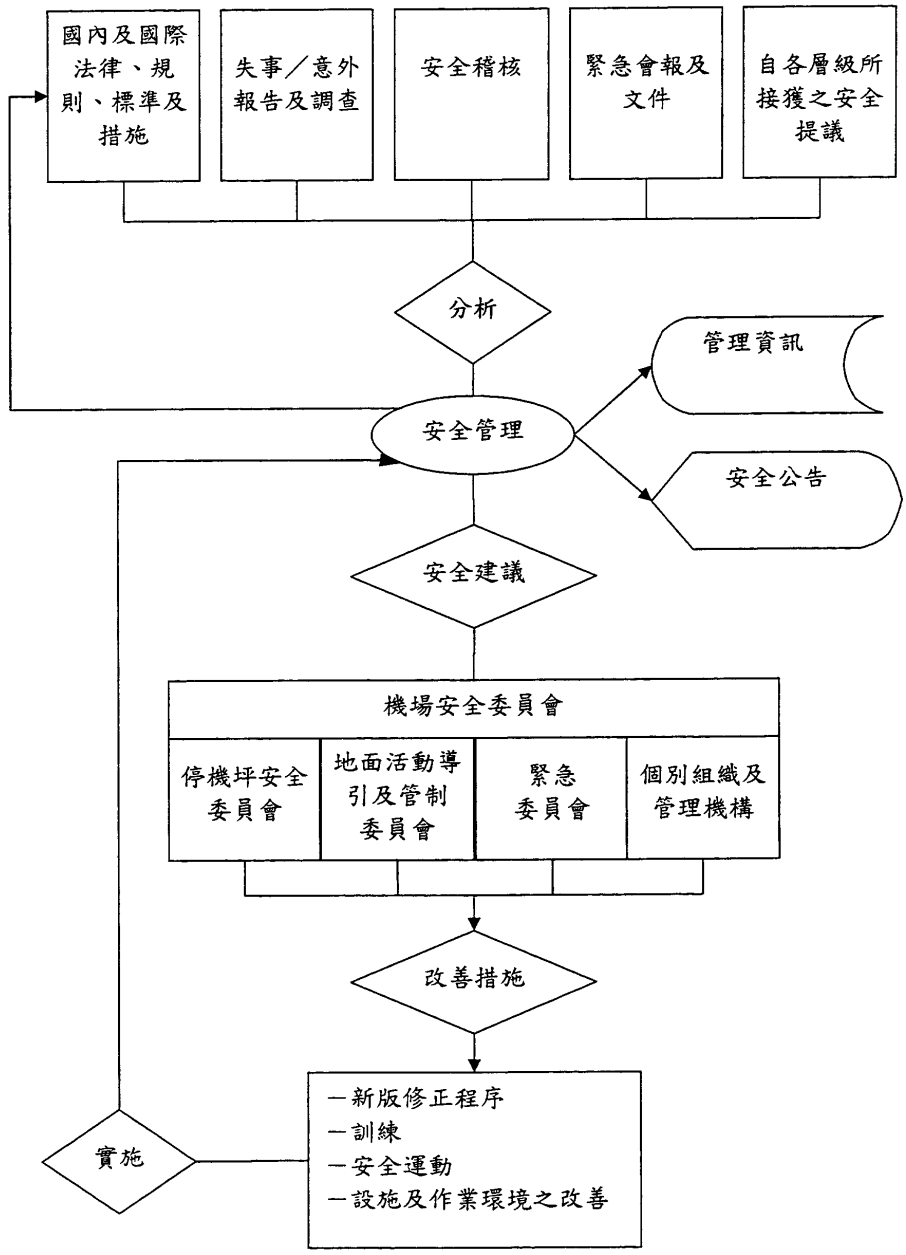


圖 7 安全管理系統之架構

1. 經營者之安全目標及安全策略。
2. 內部溝通及諮詢。
3. 風險及變遷管理。
4. 安全管理通報。
5. 錯誤或違反之管理。
6. 訓練。
7. 變遷管理。
8. 內部稽核。
9. 失事及重大意外之紀錄、報告及調查。
10. 矯正、調查及改善行動。
11. 文件及紀錄之管控。
12. 安全管理系統之改善及預防行動。

各架構內容分節敘述如下：

4.4.1. 經營者之安全目標及安全策略

1. 安全目標應陳述一個預期的安全成效並可能包括長期目標及短至中程目標；安全目標必須：
   a. 是具體的、可預見的、可達成的及實際可行的。
   b. 具有明確指定時間及限時完成之時間表。
2. 安全策略應以文字方式說明並由經營者之執行長簽署並承諾：
   a. 達成並維持經營組織安全目的之任務。
   b. 於經營者組織內強調積極性安全文化之重要性。
   c. 承諾建立及檢討經營者之安全目的：
      a) 已傳達至整個組織。
      b) 經定期地檢討以確保維持其於組織內之適當性。

4.4.2. 內部溝通及諮詢

1. 安全管理系統應：
   a. 於組織內提供溝通管道。
   b. 與組織內人員進行有關安全管理系統之諮詢。
2. 內部溝通及諮詢之程序應與企業營運之大小及複雜度相稱；譬如營運規模較小之優點在於工作人員間彼此熟識，可以較直接的方式進行溝通及諮詢且經常可以非正式之方式進行討論。

3. 經營者應建立並維持一套資訊管理程序，以確保所有成員均可存取相關資訊庫，使得任務之執行更具效率；資訊管理程序包括發布與安全相關之文獻、雜誌、期刊、教材、海報、錄影帶、CD、DVD及網站等方式（但不侷限於上述方式），到適用於較小組織之討論（經常且可能非正式）方式。
4. 安全管理系統應經常備妥與其相關經妥善規劃且資訊豐富的簡報供組織內所有成員參考，簡報應包括下列內容：
   a. 安全管理系統之基本原則及使系統可在組織中產生成效的方法。
   b. 符合經營者安全策略及構成經營者安全管理系統之程序需求的重要性。
   c. 於達成符合安全策略及程序過程中，相關人員之角色及責任。

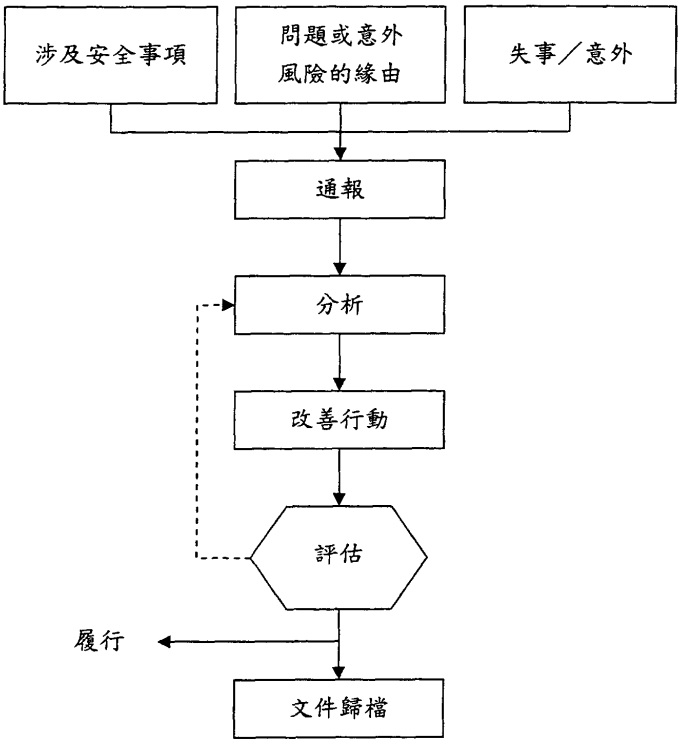
4.4.3. 風險及變遷管理

1. 經營者於建立預防行動之程序時應包括下列需求：
   a. 發現潛在的失事、嚴重的意外或通報之問題及原因。
   b. 實施必要之預防行動。
   c. 紀錄採取行動後的結果。
   d. 檢討所採取之預防行動。
2. 於經營者組織內必須建立並維持安全管理系統用以管理風險及變遷之程序，詳如圖 8，其中包括：
   a. 風險確認－為確認、管理組織的風險及導入適當做法使得航空器運作安全不致降低，風險確認應包括一系統化定期會議之過程，組織的風險應經由類型鑑別及下列任一方式個別地予以確認：
      a) 對經營者組織所授權的運作造成改變。
      b) 對內部或外部產生之新的影響。。
   b. 風險分析及評估－風險分析應包括決定每個確認的風險於發生時之嚴重性及其發生的可能性，風險一經通報，即需採取議定之作法針對疏失及結果加以研析，以找出其究屬系統及(或)個人的問題所導致，風險評估應包括：
      a) 決定一個已確認風險的重要性。
      b) 對既存用以避免風險之防禦方式及其適切性加以評估。

c. 風險管理及最小化－風險管理應包括建立適當的程序用以將風險減輕或將其降至最低，風險最小化之方式應包括：

a) 解決方式之提供及實施。

b) 程序之研擬。



c) 人員訓練。

圖 8 安全管理系統中相關程序之處理原則

d. 通報程序－有效安全改善措施之確認、通報、分析及管理等相關程序，應以文件說明及予以推行，並應視為風險管理程序的一部分。由於通報之方式通常取決於經營者組織之大小及複雜性和潛在風險的性質，因此適切的通報方式將包括下列其一或更多：

a) 直接通報至安全經理。

b) 經由安全委員會。

c) 經由匿名方式通報或建議信箱方式。

3. 較小的企業可採取較不正式的通報方式，例如在職員會議中以公開的方式討論相關議題，無論採行的方式為何，其目的係以文件說明及紀錄之方式來記錄組織內為降低未來風險所採取之行動。
4. 經營者應建立並維持一套程序並視需要使用適當的統計方式，用以分析自內部及外部來源蒐集所獲得的資料。

4.4.4. 安全管理通報

1. 安全管理系統應建立一套安全改善通報程序之架構，以便於：
   a. 定期評估各項運作以找出其中需進行安全改善之處。
   b. 經營者組織內的每位員工均負有以書面及適當途徑通報其所察覺之潛在的安全風險的責任。
2. 有關安全管理系統之報告應提供給經營者之安全經理並以書面方式答覆提出報告的員工，其內容應陳述針對其報告所採取之行動，然而上述方式並不適用於以匿名方式提送之報告。
3. 於擷取與員工報告相關之內容或資訊陳報至監督單位時，可能需要採取除名之作業方式。
4. 較小之企業不但可接受書面方式之報告，同時亦接受口頭方式之報告（可採匿名或其他方式）。

4.4.5. 錯誤或違反之管理

1. 安全管理系統應包括錯誤及違反之管理程序，經由下列方式之設計用來降低錯誤及違反事實發生的頻率：
   a. 確認並分析這些錯誤及違反事實發生之原因
   b. 提供適當之人為因素訓練。
2. 此外，對於缺乏證據證明錯誤或違反事實係因人員的疏忽、輕率或蓄意所造成時，不得對相關人員進行處分。

4.4.6. 訓練

1. 經營者應確認其新進人員於其初始訓練課程期間中均受過與安全管理系統運作相關之訓練。
2. 關於組織之安全管理系統的人員訓練範圍，可從使用結構完整的教材及訓練輔助等正規的訓練方式，到較不正式且較基本的訓練課程；訓練的類型端視運作的大小及複雜度而定，訓練之目的在於使整個組織內的人員均能熟悉安全管理系統之重要性及其對安全管

理系統所作之承諾。

4.4.7. 變遷管理

1. 於設計及導入任何新的勤務時，經營者應建立並維持一套用以確認該項新勤務於發展過程中已經妥適規劃之程序，對於新勤務運作及安全上之需求（包括調整的需求）應明確定義並以文件方式說明。
2. 經營者應確認以下各點：
   a. 於適當時機檢討新勤務研發過程的結果。
   b. 檢討結果之紀錄。

4.4.8. 內部稽核

1. 內部稽核至少應包括下列過程：
   a. 明確的稽核範圍。
   b. 計畫制定和事前準備工作。
   c. 相關證據的蒐集及紀錄。
   d. 證據之分析。
2. 經營者於內部稽核時應考慮使用下列方法以獲致資料：
   a. 檢討與被稽核運作相關之既有程序。
   b. 與作業人員面談或討論。
   c. 包括與被稽核運作相關活動之事證。
   d. 檢查足夠的記錄樣本。
3. 可由一或多個內部稽核員來進行內部的稽核工作，經營者可以全職或兼職方式予以聘僱。內部稽核員應具有相關運作及維護上的經驗，以便執行運作之內部稽核工作，並負有適當的責任及授權以便執行下列工作：
   a. 執行內部稽核。
   b. 找到關切事項及調查結果並提供解決方案予經營者之安全經理。
   c. 確認解決方案已於規定的時限內施行。
   d. 直接向安全經理報告。
4. 於決定某項運作之內部稽核的頻率時，其內部稽查程序應考量：
   a. 被稽核運作之重要性。

b. 有關組織、管理、運作、相關技術及需求調整等重大改變之頻率。

5. 當有趨勢指出確有潛在問題存在時，應立即實施不定期的內部稽核程序，若於內部稽核過程中顯示與被稽核的運作相關之程序能夠予以改進，則經營者必須立即採取步驟進行相關程序之改善。

4.4.9. 失事及重大意外之紀錄、通報及調查

1. 通報系統之目的為：
   a. 可對每一個發生的失事、重大意外或意外進行評估並考量任何先前發生之類似情況，以便採取任何必要的防制行動。
   b. 確定透過失事、重大意外及意外調查所獲得的資訊均可有效的向外傳送，使得其他經營者及其職員、及其他有興趣的組織，可藉此改善其運作安全方面的缺失。
2. 為通報系統所制定之程序應可供所有人員使用。

4.4.10.矯正、調查及改善行動

1. 經營者應發展一套程序以便於處理下列情況：
   a. 矯正（remedial）行動：為回應稽核所發現的缺失，應採取相應之行動，用以糾正現況並使得運作的安全係數提升至容許值，並直到矯正行動開始實施後，運作才可繼續進行。
   b. 調查（investigative）行動：於失事、意外或問題發生時必須採取調查行動並決定其意外事件發生之主因。
   c. 改善（corrective）行動：為使失事、重大意外、意外或問題不再發生，必須採取用以消弭其根本原因之行動。
   d. 預防（preventive）措施：根據內部及外部取得的資料進行內部分析後所採行之措施，用以消除產生潛在問題的肇因。
2. 經營者應建立並維持一套監控之程序用以檢討改善行動及確保改善行動之有效。

4.4.11.文件及紀錄之管控

1. 對較小之企業而言，其文件紀錄之控管方式也許僅是確保紀錄已適當儲存的一個簡易步驟而已，文件控管之程序應：
   a. 包含確定任何與安全相關文件之最新版本的方法，以便於決定有效之文件其所應歸檔的位置。

b. 確定任何與安全相關文件之內容改變可以明確地予以確認，並分送給所有與此文件相關的人員。

2. 紀錄可以任何形式（包括以電子方式）進行儲存並應：

   a. 適當的分類及歸檔。

   b. 儲存方式應預防遺失及損毀。

   c. 經授權之人員可易於取得。

3. 程序應明確指定：

   a. 記錄應保存之期間。

   b. 紀錄處理的方法。

4. 未經授權或已淘汰之與安全相關的文件應：

   a. 清楚的標明其未經授權或已淘汰。

   b. 自工作場所移除以防止其被誤用。

5. 與安全相關之文件經更新後，為了保存歷史的更新紀錄任何被取代的文件之存檔副本必須至少保存三年。

4.4.12.安全管理系統之改善及預防行動

1. 安全管理系統應經由年度策略檢討及次數較高的戰術檢討之組合來檢討其施行成效；安全管理系統之檢討每年至少應進行乙次。

2. 每年應根據相關負責人員通報至經營者安全經理或較小企業之執行長有關下列議題之統計資料，以便對安全管理系統之成果及持續的適用性進行年度策略檢討：

   a. 安全管理系統。

   b. 安全策略。

   c. 安全目標。

3. 實施戰術檢討之頻率較策略檢討來得高，其重點通常集中於下列事項：

   a. 失事、重大意外事件及意外事件之調查及後續改善行動之進度。

   b. 進行中之改善及預防行動。

   c. 包括安全改善通報之風險管理程序。

   d. 緊急應變計劃練習及後續的行動之結果。

4. 每次檢討應：
    a. 是經營者管理會議計劃表不可或缺的一部分。
    b. 依據適當會議之協議，包括會議記錄之結論、先前的會議紀錄及行動項目之檢討、行動項目之記錄及指派。
5. 經營者之執行長連同經營者之其他重要主管人員應：
    a. 建立定期檢討緊急應變程序之機制，特別應在失事、意外及緊急情況發生之後。
    b. 於實際可行之情況下，定期地進行程序測試。
6. 上述之指導內容係針對於較大的組織，對較小企業而言可能無法一體適用，然而較小之組織可援用類似之原則，可依經營者組織大小及複雜度進行適度的修正；惟必須牢記其重點在於程序之檢討、確定關切之範圍、需改善之範圍並將潛在失事及意外事件之原因減至最低。

5. 如何建立一套安全管理系統

5.1. 前言

如何於組織內建立一套完整的安全管理系統呢？或許目前於各組織及單位內早已推行若干與安全管理系統相關之措施及行動，但重點在於如何將上述既行措施及行動予以修正、整合，使其系統化、整體化並與組織安全文化彼此無間隙的搭配，以確實達到提升飛航安全之成效。以下列出建立安全管理系統之十大基本步驟：

1. 管理階層之承諾。
2. 設立安全管理之策略及目標。
3. 指定安全負責人。
4. 成立安全委員會（通常僅適用於較大或較複雜之組織）。
5. 建立管理風險之程序。
6. 建立通報系統來記載危害、風險及採取行動。
7. 員工訓練及教育。
8. 建立組織稽核、失事及意外事件調查之機制
9. 建立文件及資料管控系統
10. 評估系統是否仍具成效。

5.2. 管理階層之承諾

於要求所有職工參與安全管理事務時，倘未受到管理階層的承諾及重視，則安全管理系統將無法收效。

1. 不論組織之大小、複雜度及運作模式，管理階層必須：
    a. 展示對安全及安全管理系統之承諾
    b. 建立作業之安全標準及策略。
    c. 鼓勵參與安全管理之人員。
    d. 提供安全管理系統足夠的資源。
    e. 促進安全資訊之的流通。
2. 安全管理系統需要哪些資源？

完善的安全管理並不需要增加額外昂貴的費用，其重點在如何將安全管理之觀念灌輸在每位職工心中。於規劃實施安全管理系統時，可能需要使用到下列（但不侷限於此）資源：

a. 時間－用來召開會議、資料蒐集、規劃及溝通。

   時間通常是需求最大的資源，尤其是開始實施安全管理系統之初期必須以召開會議之方式來建立安全管理系統中的各個角色及責任，於此同時亦須時間與所有職工進行溝通，使其能了解安全管理系統之內涵。先前使用於與所有職工進行策略與目標溝通之時間，可於職工承諾遵守安全管理系統時產生效益。

b. 安全資訊：管理階層可藉由提供與安全相關之文獻、課程、研討會及訓練等方式來具體證明組織推行安全管理系統之決心與承諾。

c. 專業技術：係最重要的一項資源，需要提供專業技術予安全管理系統俾使其正確運作，可從各作業中找到各類具專業技術之人員來撰寫與安全相關之資料。

d. 專業訓練：所有職工必須經由訓練來瞭解組織安全管理系統之目的及其本身在安全管理系統中所扮演之角色。

e. 因應危害情況及事件時之計劃：於處理危害狀況及事件等意外事故時，時間及專業技術等兩項資源將是扮演極重要的角色。一旦危害經確認之後，管理階層必須立即將資源投入進行危害處理，若危害無法妥適處理，則安全管理系統之效能將立即衰退。

5.3. 設立安全管理之策略及目標

1. 何謂安全策略及目標？

設定安全管理策略及目標之目的，是要建立組織全體需努力實現的目標及達成之方式，上述之安全策略及目標必須以文件的方式進行傳遞。

a. 安全策略：敘述欲藉由安全管理系統達成之目的，係描述組織為達成其要求之安全結果將採行之方法及程序，此策略擔任一

明確的指標，指引每個人作業之進行方式，此一明確的指標係高級管理階層對安全所作之承諾，並期待所有人能有高水準之安全表現。

b. 安全目標：係建立運作之安全標準，其必須是具體的、可預見的及實際可行的並經頒布者同意，包含短期及長期之目標設定且需符合組織需求。

2. 如何制定安全策略

安全策略可以是一份單獨存在之文件，亦可以併入作業手冊之中，安全策略之副本必須放置在公開且所有職工都能看得見的地方，於制定安全策略之前，高級管理階層應廣泛地與職員商議，此舉可確保策略內容與所屬職工及運作相關，並可讓職工認為其擁有安全策略之所有權而更有參與感。

a. 與行動一致的策略才是有效的策略，其必須：
   a) 包含管理之總體目的，組織之方向及目標。
   b) 包括策略實施之安排。
   c) 成為組織採取行動之標準。
   d) 與其他經營策略一致，設計用來供所有職工承諾遵守並身體力行。

b. 組織之策略聲明必須明確陳述：
   a) 高級管理階層對安全管理系統之承諾。
   b) 主管、經理及員工之職務及應負之責任。
   c) 組織將如何來達成訂定之安全目標。
   d) 職工、經理、立契約者所期待的安全結果。

c. 應由組織內最高級之管理階層所簽署，通常是持有人、執行總裁或局長。

d. 策略可有效實施之關鍵在於事前妥善的規劃。

3. 如何制定安全目標

安全管理目標是係以結果為基礎以期能符合組織之安全策略，例如，可訂定安全目標為於未來 12 個月降低工作區域之事故發生率 15%，傳達安全目標之目的在於促使所有人均能瞭解欲達成之目標。

a. 於訂定目標時應考慮：
   a) 所欲呈現之標準或目標為何？

b) 由誰負責？

c) 應負責任之內容？

b. 組織之安全策略必須定期檢討以確保其持續與安全目標及組織之運作相關，並可針對策略、目標、計劃之成效進行評估。

5.4. 指定安全負責人

1. 安全負責人係組織內的一員，其負責安全管理系統每日的作業，較大的組織可設立一安全主管或安全經理之職位。
2. 視組織之大小，安全負責人之職務可能需要以全職指派或兼任方式進行，於較大的組織中安全負責人可能需要其他人的協助。
3. 安全負責人必須擁有可直接與執行總裁溝通的管道，此舉係確保安全通報及建議能獲得高層的重視且相應的解決方案得以及時的實施，安全負責人必須獲得執行總裁的保證，確保其可在不受任何威脅報復的情形下提出報告。
4. 安全負責人於技術能力上必須能瞭解並勝任組織內一或多個任務單位之作業內容，不論其專業技術能力為何，最有效之安全負責人必須是對任務持有熱情及具有高度興趣，如果安全負責人的工作係強迫指派給一位對安全未抱持強烈興趣的人，那麼由其來鼓勵組織內其他人實施安全管理系統更是不可能的。
5. 安全負責人之職責為：
   a. 維持、檢討、修訂安全管理計劃。
   b. 於安全事件上提供及時的建議及協助予相關職工。
   c. 維持妥適的通報系統用以進行危害確認。
   d. 監控安全通報之進展並確保能即時進行危害處理。
   e. 提供推行中安全議題之各項回應。
   f. 依法律規定進行失事或意外事故通報。
   g. 發布相關及即時的安全資訊予職工及管理階層參考。
   h. 確定安全訓練之需求。

5.5. 成立安全委員會（視需要）

視組織性質及大小，可設立一安全小組或委員會來協助安全負責人。

1. 安全委員會功能為：
    a. 提供專業技術及建議來源。
    b. 檢討失事／意外事故之進展及採取之行動。
    c. 檢討危害／風險通報之情況及採取之行動。
    d. 作出危害處理之安全建議。
    e. 檢討內部查核報告。
    f. 檢討並同意有關查核之回應及採取之行動。
    g. 鼓勵水平（側面）思考及具創造力的解決方案。
    h. 幫助確認及預防危害。
    i. 準備及提送報告供執行總裁復審。
2. 由組織之大小來決定安全委員會之架構及委員人數，然安全委員會織成員應包括：
    a. 安全負責人。
    b. 高級管理階層之代表並經授權核准相關之安全建議。
    c. 同時應包括來自各任務單位的代表。
3. 由誰擔任安全委員會之主席？

    安全負責人、高層管理階級、或其他委員均可輪流擔任主席主持會議。
4. 會議紀錄及議程
    a. 會議記錄：所有會議應由委員或指定專人作成紀錄，會議記錄必須於會後儘快提送給所有委員審閱，會議記錄之副本應公開或利用其他方式通知所有職工。
    b. 議程：通常由安全負責人負責制訂會議議程，計劃提送討論之項目應交由安全負責人彙整，議程應於會議前一週送交委員參考。
5. 通常議題內容應包括下列項目：
    a. 檢討前次會議未決事項。
    b. 檢討安全行動計劃。
    c. 檢討事故調查報告。
    d. 檢討先前安全建議之有效姓。

e. 通知委員相關之活動。

f. 評估並解決經確認之危害。

g. 檢討安全查核及行動計劃。

h. 監督及提出與安全相關之事務。

i. 對新裝備、航路或程序進行風險評估。

j. 計畫並安排職工訓練。

k. 研究運作上的改變對安全所產生之衝擊。

6. 安全委員會議之頻率應由組織之大小、經確認危害之數量及嚴重性而決定。有些安全委員會每週均召開會議，有些僅每兩個月召開乙次會議，但是會議至少應每三個月召開乙次。

7. 若發生嚴重安全事件且需緊急的解決方案時，應立即召開安全委員會之特別會議；至於時間緊迫之問題或辦法，可由安全負責人即時提供相關建議。

8. 是否需要成立安全委員會？

若組織規模較小且複雜度不高時，或許可不必成立安全委員會。

a. 較小之組織：人數不超過 20 人之組織，通常較適合使用非正式之方式來討論並解決相關之安全事件；只要組織內存有良好之溝通管道，且職工與管理階層皆樂於提供建議及協助予安全負責人時，安全管理系統即可不需安全委員會而仍可正常運作。此外，較小的組織可選擇與同區域之其他經營者共組一聯合安全委員會並共同分享資源，此類安全資訊和專門技術的分享方式將可使彼此獲益。

b. 較大之組織：超過 20 人或由數個作業中心所組成之組織，因為彼此間溝通不易，因此此類組織內之安全委員會對於安全管理系統的運作佔有極重要的地位。

5.6. 建立管理風險之程序

1. 危害確認

a. 危害確認之目的係允許組織進行風險評估及採取有效之作法以降低或消除危害。

b. 當危害確認後，管理階層及職工應朝運作方式多方面考量並確

認出任何可能危及安全之區域或情況。

c. 危害確認系統應該是非懲罰性、機密的、簡單且易於使用的系統，可採用書面通報表格、會議記錄或電腦資料庫方式來紀錄危害。

2. 風險管理是一套決策輔助工具用以持續改善安全之表現，且必須遵循下列步驟：。

a. 建立風險管理之範圍：

a) 建立風險管理之範圍是在定義欲進行檢視之計劃或活動的程度及深度。

b) 必須熟悉計畫或活動之所有元件以決定需要採取何種標準來評估所面對之風險。

c) 建立範圍便於在風險管理之過程中，集中在可管理之事務上。

b. 危害確認：以下列出數種可用來進行危害確認之方法。

a) 檢查表。

b) 依據先前經驗判斷。

c) 紀錄及趨勢分析。

d) 與職員或顧客進行腦力激盪會議。

e) 流程圖。

f) 系統分析，可從分歧中了解系統運作的情形。

g) 情境模擬分析，可探討出危害或錯誤之可能性。

一些用於確認危害之方法可能需要一些不受過去觀念或經驗影響的人員從其他各種不同角度來思考問題。

3. 風險分析

a. 風險分析係用來估計每一危害之可能性及後果嚴重性，用以瞭解所面臨之風險及其重要性，仔細的分析危害並依加以分類，並儘可能以其風險的可能性進行排序。應具備一份風險清單，以便將有限的資源分配在最具威脅的風險之上。

b. 於進行風險分析時必須決定：

a) 危害發生之可能性。

b) 危害發生後結果之嚴重性。

c. 可使用表 2 之方式將可能性及後果嚴重性以矩陣方式排列並

予以量化，以便決定所有風險之優先順序，若其發生後結果十分嚴重且其發生可能性屬於中至高等之任何風險應擁有處理之最高優先權。

	後果（consequences）				
可能性 Likehood	輕微的 Insignificant 1	不嚴重的 Minor 2	一般的 Moderate 3	嚴重的 Major 4	災難的 Catastrophic 5
A一定（certain）	H	H	E	E	E
B很可能（likely）		H	H	E	E
C一般的（moderate）			H	E	E
D不太可能（unlikely）				H	E
E罕見的（rare）				H	H

E：風險極高；需採取立即之行動

H：高風險；於高級管理階層之職責中負責業管。

M：中風險：於經理之職責中負責業管。

L：低風險：以例行程序加以管理。

表 2 風險矩陣表列法

4. 風險鑑定：

   a. 一旦危害經確認且經適當排序後，應進行風險等級之鑑定，由組織之安全策略依風險之等級決定應由誰負責業管。

   b. 如何鑑定風險等級？

      a) 經由集體討論，成員包括各專業領域之代表。

      b) 由安全負責人進行研究。

      c) 由其他來源（包括職工、顧問、航空器或引擎製造商、安全刊物等）獲致之資訊

5. 採取防範措施：每個危害及其防範措施必須被嚴格的檢查以瞭解風險是否已被適當的管控；存在之經確認的風險應進行處理，以下是處理風險之對策。

a. 排除風險。

b. 降低風險之等級、或其後果嚴重性及發生可行性之等級。

c. 避開風險。

如果風險可以解決，則相關之行動或任務方可持續實施，否則，則必須進行防範措施改善、或移除或避免危害等步驟，應對現存與每個確認危害相對應之防範措施的適切性、效用及是否能預防危害之發生等事項進行評估，可藉由下列方式，確保防範措施之效用。

a. 是否所有職工均瞭解防範措施之內容？

b. 實施前是否已經妥適之防範措施訓練？

c. 是否使用適合之工具或裝備來預防風險？

d. 在緊急事件時，職員是否須經授權才能使用預防措施？

6. 監督並檢討防範措施：當進行任何改變，必須實施進一步的風險管理以確保危害仍處於有效的控制之下，且防範措施不因改變產生其他的危害。

5.7. 建立通報系統來記載危害、風險及採取行動。

1. 通報系統係一正式用來蒐集、紀錄、及當運作時面臨危害及風險時提供職員回應及應採取之行動。
2. 已通報之風險係指那些業經確認及可加以管理之風險，至於那些未通報之風險及危害都是由於難以確認，因此需要特別予以重視。
3. 良好的通報系統應具備下列重要之特性：

   a. 確認所有與危害相關之事項。

   b. 蒐集目前且合用之資訊。

   c. 是一個用來接收報告及行動報告之程序。

   d. 是一個可靠之方法，用以精確紀錄、儲存、取回及維護相關之安全通報。

   e. 用以發布相關或適當的資訊予職工（及有關外包承商）的程序。

   f. 能夠進行查核。

4. 可由職工、經理、顧客或乘客及外包廠商來完成危害通報。

5. 任何危害其可能造成危險或傷害、或威脅企業生存均應加以通報。
6. 可藉由正式及非正式程序之使用，蒐集組織內來自職工有關危害之資訊，危害通報之方法包括：
   a. 機密的危害報告：
      a) 機密危害報告之格式應設計得使職工進行危害報告時可不必畏懼遭受懲罰。
      b) 於規模較小之作業方面，可能難以做到不使提交報告之人員曝光，在此情形之下，極重要的事是要讓職工能夠了解任何安全之議題均可進行討論，而不必害怕遭受報復。
      c) 所有人應熟悉組織內之通報系統。
   b. 祕密的職員調查或意見徵詢：
      a) 可用祕密的調查或意見徵詢之方式，獲得有關組織內特定區域的狀況。
      b) 祕密的調查或意見徵詢之方式可鼓勵職工表達意見或提出對組織作業方式的回應。
      c) 此方式具有多種用途，例如進行改變時可用來先行確認危害或用來評量最近之改變措施是否奏效。
   c. 非正式的溝通：
      a) 一個最簡單的且最有效用來確認危害之方式就與職工對談。
      b) 應建立「門戶開放」策略邀請職工就其關注事項直接向經理以非正式溝通方式進行表達，可採取暫離工作約一杯咖啡的時間之方式來進行溝通。
      c) 也可由安全負責人或資深經理於工作區域走動時實施，詢問現場人員是否有任何問題。
      d) 蒐集來自職工於安全方面所提出關切事項之安全論述，通常較正式管道獲得之資訊更為真實且精準。
   d. 工作過程及流程之觀察：
      a) 於各項作業中嚴格檢討特定之工作情況，可用以確認先前已經初略檢視或已認定安全的範圍中之危害。
      b) 欲了解作業中工作流程是否完妥，可藉由不涉入並採取全面性觀察的過程，來確認組織內之瓶頸及潛在的風險。
      c) 應確保組織內備有適當的人選以便針對確認之風險提供解決方案。
      d) 對於重複發生之議題通常可由不涉入之人士提供新的見解。

e. 應對提交報告之職工回應下列事項：

a) 報告的處理進度。

b) 因應提出之報告所採取之行動。

為使職工能瞭解通報系統運作正常，且其對安全管理系統所作之貢獻係非常重要的，因此必需對其報告作出回應。

5.8. 員工訓練及教育。

1. 承諾對所有職工提供入門及持續精進的訓練並加以查核，對任何安全管理系統來說，係擔任一個必要的環節。
2. 入門訓練應由安全負責人及未來工作領域之專家來進行，內容包括安全管理系統、安全負責人、安全小組或委員會及所有參與安全管理系統人員之職責的資訊。
3. 參訓人員之紀錄應予保留。
4. 現任職工及新進職員必須針對安全管理系統的運作加以訓練，並鼓勵其在組織內推行各項安全措施，專精訓練可用以加強所有職工於實際運作上之安全行為、風險管理之決策、品質管理程序上之觀念。
5. 當使用新技術或裝備時、或運作上之改變均需提供訓練，同時也可因應管理上之需求對所有職工進行特殊訓練及檢查，技術精進訓練。
6. 評估訓練的成效可包括檢討職工之能力、了解使用於工作廠所之程序及措施之程度、及任何運作中要求之特殊技能。
7. 經由提供與安全相關之文獻、派職工參加與安全相關之課程及研討會之方式使職工了解並熟悉現行之安全論述，將可改善組織之安全環境。

5.9. 建立組織查核、失事及意外事件調查之機制

1. 查核機制

何謂查核？

a. 查核是藉由有方法的、有計畫的檢討例行運作之功能，內部安全查核的實施應視為整體安全計畫中的例行工作，工作系統之每一部分應嚴格的檢查，已確認其所具之優缺點或風險之範

圍，安全查核可對陳述之目標及作業程序與實際工作方式作一比較。

b. 所有查核程序都必須以文件方式完整說明，如此任何缺失均能十分容易的確認，查核紀錄及結果必須精確、完整、可靠且易於存取以便於進行比較或趨勢分析。。

c. 任何安全查核應包括影響操作安全之的外包承商（如施工及維護承商）之活動。

由誰進行查核／評估？

a. 內部安全查核可由各位員工職工從每天工作的區域開始實施，運用來自其他工作區域的職員進行查核較有助益，由於其較不熟悉此區域內複雜之日常任務或工作環境，因此可產生不同的查核結果。

b. 較大的組織可以採小組方式進行，而非個人進行；較小的組織則可透過其他區域之安全負責人或職工進行查核工作為佳。

c. 最適合擔任安全查核工作的人員為：

a) 安全負責人。

b) 安全小組之代表。

c) 外聘之安全顧問。

d) 品質／查核部門。

應該如何進行查核／評估？

a. 視組織特性及大小，可於固定期間（雙月）或作業上有任何改變時進行查核，然所有作業區域每年應至少查核兩次且應為年度評估計畫之一部分。

b. 查核過程包括與重要員工面談，策略與工作措施間的相互關係及工作環境之觀察。

c. 於查核實應考慮：

a) 查核時間。

b) 查核實施前需準備之事項。

c) 欲使用之查核表。

d) 不在檢查表內之有關項目檢查後之評論。

e) 確定發現之內容。

f) 查核報告分送給相關之部門經理及執行總裁。

g) 查核結果及發現已告之相關職工。

d. 應進行查核之作業範圍（但不侷限）包括：

a) 維護安排

b) 實際工作環境

c) 裝備安全

d) 作業之安全系統

e) 緊急應變程序

e. 查核時常囿於檢查表之內容，而使得查核內容受限，如欲避免上述情形，則查核相關文件必須定期進行內容或版本更新。

f. 進行查核工作之職員必須是稱職的且熟悉欲進行查核之區域。

g. 查核結果之報告通常以書面方式表示並發送給執行總裁及負責經理以便進行改善。

h. 查核後提出之建議行動及其相應為消除或控制危害之所需費用，可根據其風險等級分階段實施。

i. 較小之組織應持續不斷更新運作方面之知識及檢查以確定運作符合組織所定之標準是必備之工作，是否職工均忠實通報反應危害？若無，應究其原因。每年應至少執行安全評估乙次。

j. 較大之組織應由安全負責人及品質／檢查部門（若可應用）負責計畫並實施定期查核／評估。

k. 每個作業區域每年至少實施查核乙次。

2. 調查內容及其目的

a. 調查針對一個事件週遭的環境進行詳細的研究。

b. 當員工提交一份失事或意外事故報告時，安全負責人將進行調查找出導致事件、事件原因或事件本身之情況。

c. 安全負責人同時亦負責通報任何事件對組織運作的安全上所產生之短期或長期的影響。

d. 於失事或是意外後的調查行動通常由一組專家及那些參與例行作業之人員。

e. 安全負責人可能需要經過特殊的訓練，以便於進行調查工作及準備報告提交予執行總裁及外面之調查機關。

f. 已有許多商業機構均會舉辦與飛安調查有關之訓練課程。

g. 視失事或意外的性質及後果，需配合外面機關共同進行事件之調查，如行政政院飛航安全委員會。

h. 經調查後的建議事項將提供組織改善安全系統之防範措施並預防失事或意外再度發生。

i. 以作業之觀點，調查應包括 (但不侷限)下列：

a) 管理和監督之程序。

b) 身體工作之條件。

c) 事故預防策略。

d) 安全資訊之分送。

e) 職員及外包單位之訓練。

f) 安全表現。

g) 組織之安全標準和措施。

h) 安全事件之調查和矯正的行動。

5.10.建立文件及資料管控系統

1. 文件建立部分

a. 組織之安全管理系統必須文件化，其必須符合組織及適用人員之需求，文件之範圍及內容將視運作之複雜度、技能、訓練、人員之專業技術及能力而定。

b. 文件應放置於政策及程序手冊之中，其內容應包括：

a) 由執行總裁所作之政策陳述。

b) 安全負責人及安全委員會之通報路徑及其責任。

c) 組織之危害確認及風險管理系統。

d) 安全通信之路徑

e) 安全訓練計畫

f) 緊急及意外事故應變計畫

g) 風險管理方法

h) 查核時程及調查標準。

i) 安全管理系統之評估程序

j) 所有與安全管理系統相關之其他活動。

c. 文件必須易於取得，且包括線上文件、海報及錄影帶。

d. 以下過程之紀錄應予保存：

a) 所有涉及危害確認及評估及其防衛措施、及任何已發生之意外事件的所有活動。

b) 任何發布或接收之報告。

c) 任何安全建議。

d) 任何管理行動。

e. 文件控管程序必須符合組織及下列之需求。

e) 目前版本文件之存放位置。

f) 定期檢討之週期及授權由誰進行文件更新工作。

g) 如何處理已失效之文件。

h) 重要文件的識別和儲存。

f. 較小之組織可將安全管理系統併入與現行之手冊（如操作手冊）中之方式可能較適合於較小的組織。

g. 較大之組織可能較適合將其安全計畫歸納在一個專用之手冊或文件之中。

2. 資料管制

a. 可從飛航或維護報告、安全報告、查核、人員及工作成效之檢查及評估中蒐集大量的資料，俾尤其中獲知組織運作之狀況，上述資料可用電子或紙本方式儲存。

b. 藉由資料之分析可量測朝向目標趨近之進度及針對安全議題作出有效益之決定。

c. 資料的管理及控制可能會影響到欲使用資料進行分析結果之品質，目前市場上已有用以處理及追蹤資料之電腦系統，然而所選擇之電腦系統應允許你保護並備份相關資料。

d. 確認所收集到的資料具有相關性，而非大量的吸引人但無相關的資訊。

5.11.評估系統是否仍具成效。

1. 執行總裁應確保安全管理系統在固定期間內適當檢討及評估。
2. 執行總裁及安全負責人雙方必須確保安全管理系統之運作持續向更好的系統逐步改善。

3. 執行總裁需要確保計劃擁有充分的資源，並由各管理人員所支持並持續朝安全目標邁進。
4. 評估之過程應包括一般採取之行動及對安全表現所造成之影響。
5. 應給予職工提供建議之機會。
6. 安全管理系統開始時總是充滿熱情及活力，然初始的興趣逐漸消逝時，系統將隨之鬆懈。
7. 由於隨著系統各部分逐漸建立，重點便移轉至系統維護及發展方面，以確保系統內無間隙存在並鞏固安全文化。
8. 如果安全通報次數減少了，並不代表以危害已經降低了，或許是因為系統中出現了某些問題。
9. 可藉由與職員溝通之方式，以查明他們不提交報告的真正原因。

6. 心得及建議

1. 此次出國受訓之目的是為了符合 ICAO ANNEX14 建議措施之規定，即各個機場應於 2005 年完成「安全管理系統」之建置；職於全然不瞭解管理及安全管理系統的情況下奉派出國受訓，於課程研習過程中，藉由講師精闢之解說，著實獲益良多，吸收到許多有關於管理方面的知識，如風險管理、危害辨識、組織安全文化、人為因素、失事調查等，然不可諱言的是，由於職未具管理方面之專長，所以在受訓的過程中，因孤陋所以一直覺得莫名，大範圍的授課內容好像跟機場應如何建置安全管理系統間的關係似乎不大，然經過回國後慢慢的消化終於有了大致的輪廓；此次參訓的感覺與職初進入民航局飛航服務總台服務時的感覺有點類似，因缺乏助導航設施相關的知識，所以需花費較長的時間自行摸索或藉由長官非正式的經驗傳承，方能略知一二；而此次受訓，對個人而言是一個嶄新的領域，同時亦感謝各級長官的認可並同意予職此次的參訓機會，在此想進一步強調的是「訓練」之重要性，同時訓練也是安全管理系統中極重要的一環，為能有效提升組織之安全文化，建議於各式訓練課程中應加入「安全管理系統」之訓練課程。

2. 在安全文化的概念尚未經學術單位明確進行論述之前，因其係屬一種意識形態，可能早就存在於民航界相關文件及各式對談之中，然眾所皆知的安全，目前是否僅停留在一種概念或是一種想法之上，確未加以落實呢？又雖然航空意外均可藉由標準作業程序（SOP）等措施來加以預防，消弭意外事件發生之機率，然飛安意外事件仍不時發生，即使採用強而有力的手段，依法令或獎懲規定來執行管理，仍會出現安全上的疏漏。唯有管理高層率先建立組織之安全政策、全面改變組織之安全文化、培育由上至下正確之安全價值觀，並確實以自我要求式地執行安全目標管理，才能有效推動民用航空整體之安全，遏止失事或意外事件的再度發生，藉以提升飛航服務水準與其他先進國家並駕齊驅。

3. 依照第 5 章如何建立一套安全管理系統之說明，逐步建置與機場運作相關之安全管理系統的基本架構應不成問題，其中一項係指定安全負責人

並視需要成立"機場安全管理小組" 的單位協助安全負責人推動機場安全管理系統之建置，此舉於現階段可能推動不易但卻必須推動的措施，安全負責人可挑擇一位瞭解機場內不同組織及人員間相互關連性的人員擔任小組長，因為長時間下來，機場已轉變成由各區的專家分別進行運作，試著去找出瞭解各區間運作關係的適當的人選，由此安全管理系統之人員將所有領域專家整合在一起，其首要任務即是細究所有不同的手冊、文件、程序及工作（這也是目前機場驗證工作中極重要的工作項目之一），檢視其中相關之標準作業程序是否窒礙難行或不合乎時宜及是否符合安全之需求以降低事故發生之風險。

4. 然對於負責監督民航業運作及提供飛航服務的民航局而言，首要的工作亦是指派安全負責人及成立更高層級之安全委員會，召集機場運作、飛航管制、商業航空公司管理、助航設備維護管理等各個範疇之代表人員，共同為安全管理系統建立一致的架構及規範、訂定安全目標並提供有安全方面之問題諮商。

5. 現存之通報系統，如局長信箱、局長飛安信箱、駕駛員報告表雖已具備風險管理之功能，然其與安全管理系統中所要求之通報系統似乎仍存有一段差距，因健全完善之通報系統對於發掘存在於飛航環境中的潛在危害具有決定性的助益，而目前各式通報系統常因安全文化致使職工躊躇於提報其所觀察到之不安全情況，因此如何朝向一套完善通報系統的建置，藉由資訊分享（Information Sharing）功能提升民航組織之安全文化亦是刻不容緩。

6. 目前各機場都面臨到滑行道與跑道中心線間安全間距不足之問題，亦瞭解間距不足時有發生嚴重危害之可能性，此可能性就算機場已按規範保留足夠之間距，亦無法百分之百避免危害之發生；因此於安全管理系統之風險評估過程中，下列事項應如何量化或評定，建議應委由專業顧問公司進行。

    a. 可能造成的危害嚴重程度。
    b. 危害發生之可能性。
    c. 經量化或評定後可接受之最高風險水準。
    d. 評估採取改善行動後之風險改善程度。

7. 附錄

Safety Management Systems

Southern California Safety Institute
2003

ADMINISTRIVIA

- Safety briefing
- Administration
- Local area overview
- Layout of notebook
- Course material

ADMINISTRIVIA

- Safety briefing
  - Exits
  - Environment
  - Area traffic
  - Other seasonal factors

ADMINISTRIVIA

- Administration
  - Bio sheet
  - Critiques
  - Local phone numbers
  - Lodging
  - Schedule
  - Other

ADMINISTRIVIA

- Local area overview
  - Restaurants
  - Sports activities
  - Sightseeing activities
  - Shopping
  - Other

ADMINISTRIVIA

- Notebook
- Texts
- Other course material

The Instructors For This Course

- John Richardson
- Peter Gardiner
- Gary Hook
- Mike Doiron
- Tommy McFall

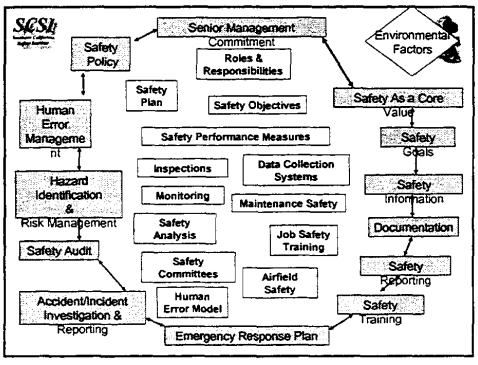
Introductions

- Name
- Organization
- Functional role
- What brings you to SCSI and this course?

Safety Management Systems in Aviation

What is "Safety Management"in Aviation?

- The systematic management of risks associated with flight operations, related ground operations and aircraft maintenance activities to achieve high levels of safety performance. (CAA, UK)



What is A Safety Management System?

- A systematic, explicit and comprehensive process for managing safety risks.

SMS Overview

- Senior management commitment
- Safety policy
- Safety information
- Establishing safety as a core value
- Setting safety goals
- Hazard identification and risk management
- Establishing a safety reporting system

- Safety audit/assessment
- Accident and incident reporting and investigation
- Safety orientation and recurrent training
- Human factors
- Emergency response plan
- Documentation

Changes?

- Taking the Aviation Safety Management series out of theory and into a process that is:
  - Data-driven, and
  - Risk-based
  - Systems focused

Safety Management Systems

- Endorsed by several countries
  - Australia, Canada, United Kingdom, USA
- Recognized internationally as a method of proactive aviation safety management.
  - Recommended by ICAO
  - GAIN Operator's Flight Safety Handbook
- Adaptable to all disciplines of safety

Goals For This Course

- After completing this course, you will:
  - Be aware of the advantages of a data-driven, goal oriented approach to safety management.
  - Be familiar with the elements of a safety management system.
  - Develop a preliminary set of safety goals for YOUR organization.

Your Organization?

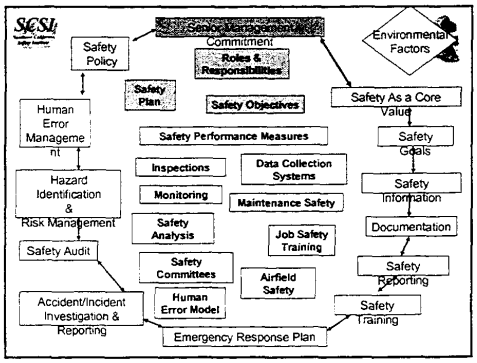
- Does your organization have a written safety policy?
- Is management – to include the CEO – supporting safety within your organization?
- What is the role of safety in your organization
- What authority does safety have?

Your Organization?

- What is the safety planning schedule?
- How is safety training conducted?
- Who investigates accidents and incidents in your organization?
- How are investigations accomplished?
- And……

GETTING STARTED

SAFETY POLICY



STEP ONE

- **SENIOR MANAGEMENT COMMITMENT**
  - **Specify company standard's**
  - **Communicate those standards throughout the organization**
  - **Establish a system to recognize, report and correct deviations from those standards**
- **This ONLY works if senior management is truly committed to safety. This is the "Safety Culture" of the organization**
- **Safety must be a company "Core Value"**

Who's In Charge?

- Senior Management
- Safety Manager
  - Full-time, part-time
- Line Managers
- Individuals

Safety Policy Manual

- CEO Policy Statement
- Safety Objectives
  - Specific and achievable
- Flight Safety Policy
- Health & Safety Policy
- Quality Policy
- Corporate Safety Standards

Safety Policy Manual

- Flight Safety Services
  - Responsibilities
  - Safety Cases
  - Communication with senior management
  - Auditing and Monitoring Safety
  - Training
  - Emergency Planning
  - Etc.

The FSO

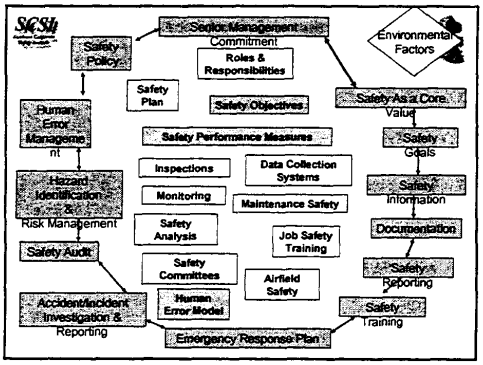
- Job Description
- Qualifications
- Authority
- Training
- Responsibilities
- Tools and Equipment
- Expanding the Safety Staff

Background to Safety

Where we have been

Where we are

Where we are going



Why do we need a safety management system?

Rates and Accidents

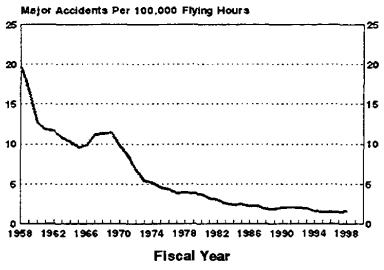
- These two elements of a program drive the need to have safety management
- The key of the program is to reduce rates and accidents

Examples of Rates

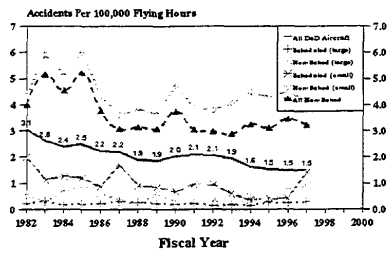
- DoD class A
- Military and commercial rates
- Accidents and fatalities by phase of flight
- Accidents by primary cause
- Accident by year
- Accident by type of operation
- Accident by airplane type

DoD Aviation Class A Accident Rate

1958 to 1998



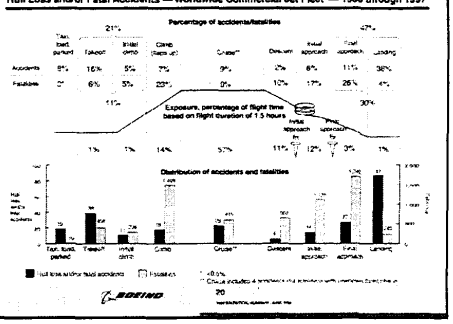
Military and Commercial Aviation Accident Rates



Military includes all DoD aircraft (fighters, bales, transports.)
Commercial includes just passenger-carrying aircraft.
"Large" and "small" denote aircraft size based on # of seats (FAA part 121 vs. 135)

Accidents and Onboard Fatalities by Phase of Flight

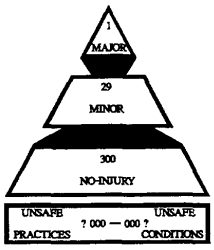
Hull Loss and/or Fatal Accidents — Worldwide Commercial Jet Fleet — 1988 through 1997

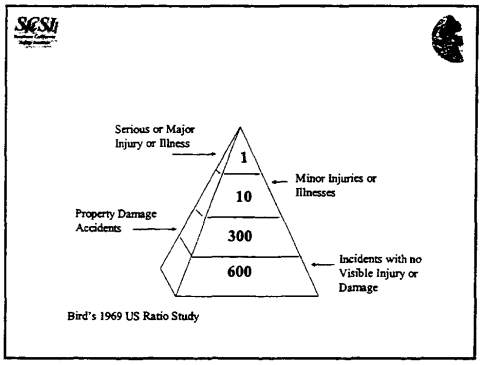


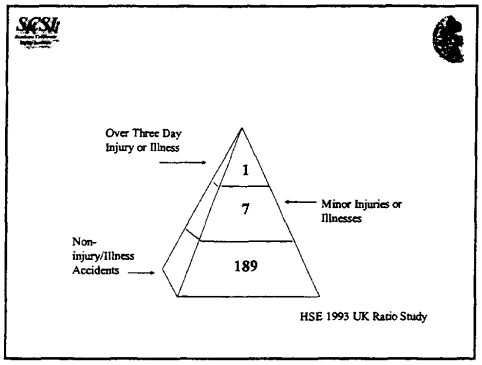
Accidents

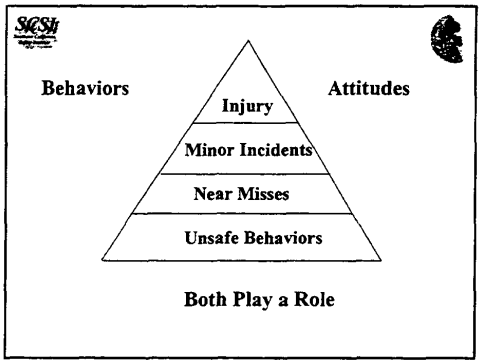
- The following triangles reflect the beginning of accidents
- Triangles show the potential of near misses and every day actions
- Triangles are based on the iceberg theory

Heinrich's Triangle









Why Do We Need This Info?

- To focus on why we are here in SMS
- To evaluate our program efforts for effectiveness
- To see where we fit into the big picture

Safety --WHERE ARE WE TODAY?

- The crossroads
  - Compliance vs. Performance
  - Training vs. Realism
  - Standards vs. Realism
  - Unsafe conditions vs. Unsafe acts
  - Leadership/management failures
  - Human behavior
  - Integrating quality and safety

Basic Safety Concepts

- Safety First!?
  - Safety or Mission
- Blood Priority
  - "We haven't had an accident from that"
- Known Precedent
  - The hazardous conditions were known before. We can identify and control them

Basic Safety Concepts

- Randomness of damage or injury
  - Red traffic lights
- Zero accident rate
  - The ultimate goal

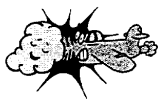
Unsafe Acts

- Unsafe performance of persons (acts)
  - Errors
  - Mistakes
  - Etc.

Always Trust Your Instruments, Son.

Unsafe Conditions

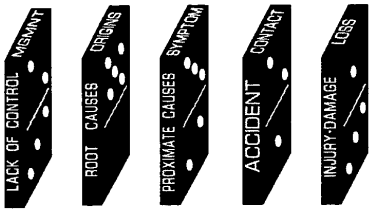
- Mechanical or physical hazards (conditions)
  - Weather
  - Insufficient lighting
  - Mechanical Failures
  - Etc



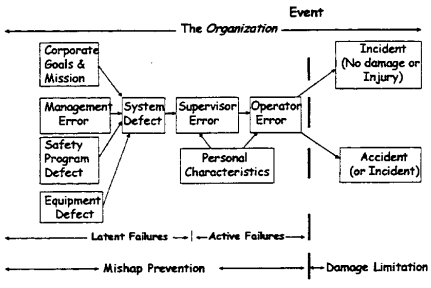
Theories

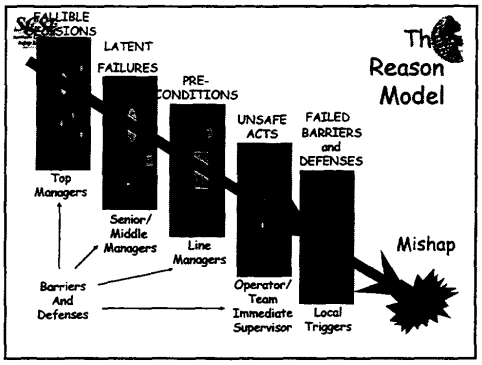
- Here are some of the theories used to explain safety issues.

The Domino Theory



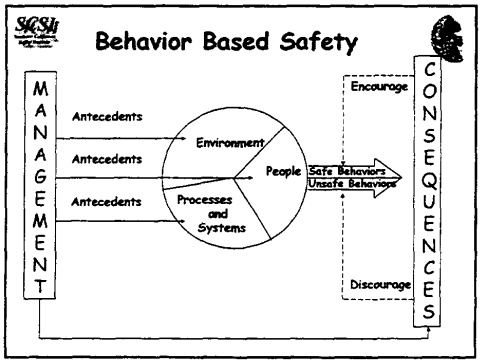
Accident Causation Model

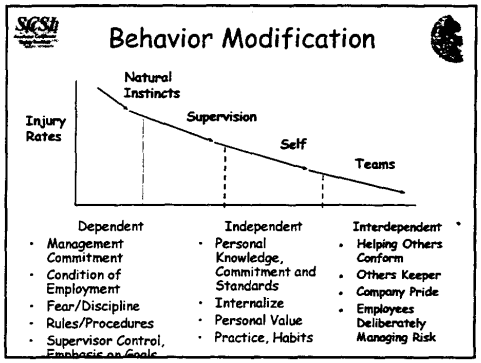


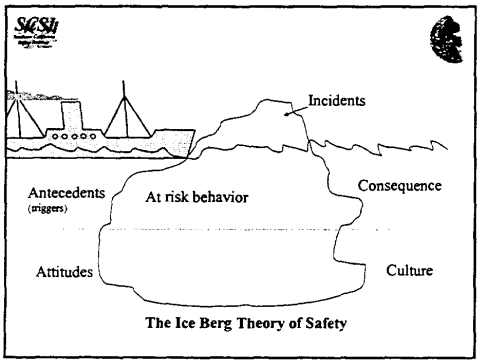


Behavior Based Safety

- Behavior based movement
- A tool for collecting data on the quality of a company's safety management system
  - A scientific way to understand why people behave the way they do when it comes to safety
  - Properly applied, an effective next step towards creating a truly pro-active safety culture where loss prevention is a core value
  - Conceptually easy to understand but often hard to implement and sustain

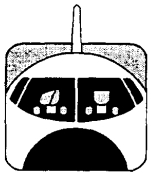






Traditional Theory

- Worker makes a choice
- Accidents are worker caused
- Rates are main measurement
- To improve: Appeal to workers!



Systems Theory

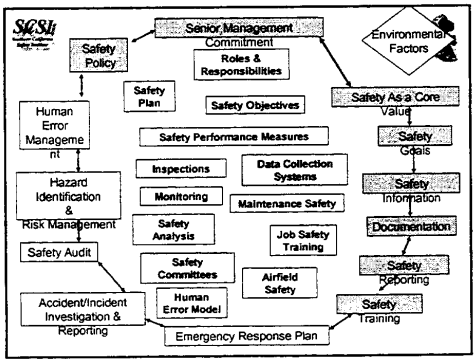
- Mishaps are defects in the total system
- There are multiple causes to accidents
- Measurement: Rates, near-accidents, investigations, training, perception surveys, etc
- To improve: Identify system improvements

Safety Management System

- Builds on the Systems Concept
- Involves Senior Management and the Total Organization
- Retains most of the traditional "tools"
- Focuses on Risk Identification and Control
  - (Risk Management)

- Questions
- Discussion

Accident Prevention Information



DISSEMINATED INFORMATION

- Company Policy
- CEO/President/Commander Correspondence
- Safety Goals and Objectives
- Safety Performance Data and Information

INCOMING INFORMATION

Definitions

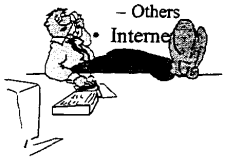
- Action Information
  - Critical Safety Information
  - Requires Rapid Action
  - Failure to Act Will Result in Damage or Injury
  - All Affected Personnel Need to Know
- Advisory
  - No Immediacy
  - Can Require Action
  - "Nice to Know"

Action Information

- Accident Reports
- Recommendations
  - Action Agencies
  - Follow-Up
  - Same Tasks/Conditions?
- Hazard Reports
  - Action Managers
  - Others
- Safety Alert Messages
  - Actions Required

Advisory Information

- Periodicals
  - FSF/FAA/NTSB, etc.
  - Manufacturer Magazines
  - Union Journals
  - Others
- Internet



Obtaining Information

- Accident Information
  - Current & Pertinent
  - Specific/General Equipment
- Local (Safety Theme Orientation)
  - Airport Bulletins
  - Employee Groups

Obtaining Information

- Periodicals
  - Current, Technical, Informative
  - General Applications
  - Specific Equipment/Occupation Oriented
- Internet Information
  - Multiple Aviation Websites
  - Current & pertinent
  - Specific / General Information

GETTING THE WORD OUT

- Sift through the junk
  - Four piles--critical, nice-to-know, future reference, and useless
  - Distribute the critical and nice-to know
  - File the Rest

Methods of Disseminating Safety Information

Critical Safety Information

- Aircrew Bulletins
  - Immediate Access to All
  - Positive Record of Review
  - No Feedback on Understanding
- All Employee Briefings
  - Controlled Presentation
  - Positive Record
  - Feedback Possible
  - Difficult to Schedule
    - Multiple Offerings
    - Action for Missing Presentation?

Non-Critical Information

- Characteristics of Dissemination
  - Timely
  - Pertinent
  - Tailor the Method
  - Plan Ahead
- Methods
  - Safety Meetings
  - Roll Call Items
  - Company/Location Orders
  - Company/Location Publications
  - Bulletin Boards

Safety Meetings & Bulletin Boards

Safety Meetings

PURPOSE

- Distribute Safety Information
  - Advisory or Action
- Training
  - Safety Program Elements
  - Operations Issues
- Feedback
- Where to have them
  - Neutral Territory
  - Threat-Free Environment

How to Have A GOOD Meeting

- **Preparation**
  - Plan Ahead
  - Use Interesting Topics & Speakers
    - Never show a film you haven't previewed!
  - Be Creative
  - Involve Senior Leaders
- **Agenda & Timing**
  - Publish Agenda - Stick To It
  - Start on Time - Finish on Time
- **Minutes**
  - Summarize Key Subjects
    - Action Item Status
    - New Taskings
  - Provides Review for Non-Attendees

GETTING THE WORD OUT

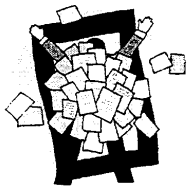
- Meetings
  - Meeting format
    - Welcome
    - Organizational Safety Issues
    - Mishap Experience
    - Guest speaker's presentation, if applicable
    - Film--if it fits
    - Training, when appropriate
    - Meeting Length

GETTING THE WORD OUT

- Meetings (continued)
  - Ideas for topics
    - Local problems--cold/hot climate
    - Survival--life support officer
    - Personnel equipment
    - Weather--local forecaster
    - Local civilian flying--FBO from nearby airport

Bulletin Boards

- Legal Requirements
- Strongly Recommended
- Use Only for "Nice -to-Know" Information
- Attractive & Creative
  - Uncluttered
  - Eye-Catching Formats
- Current
- "Politically Correct"



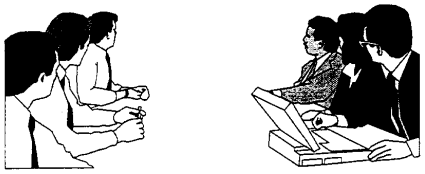
Newsletters & Internet

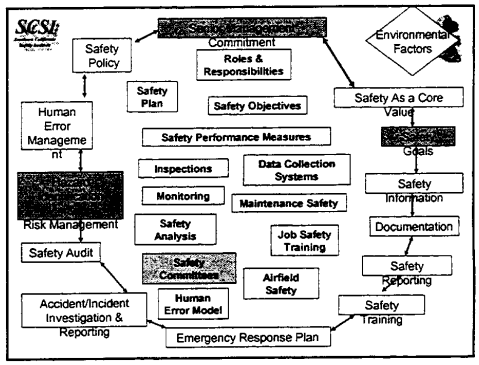
- Write Your Own
  - Desktop Publishing
  - Focus on Local Issues
- Company Newsletter
  - Safety Corner
  - Feature Stories
    - Successes; Highlight Individuals
    - Problems; Bring Out Policy
- Company Internet Site(s)
  - Safety Information Distribution
  - Exchange of Information

Discussion

- What methods does your company use for safety information?
- What would you change in that process?

SAFETY COUNCILS & COMMITTEES





SAFETY COUNCILS & COMMITTEES

Only the Occupational Safety & Health Committee is required (Public Law)

ALL OTHERS ARE Manager's OPTION

CSAFETY COUNCILS & COMMITTEES

- Flight Safety Committee
  - Completely separate from OSHA Committee
  - Forum for Problem Solving
  - Ops and Maintenance Focus
  - No more than 5-7 people who can take action.

SAFETY COUNCILS & COMMITTEES

- Have a Charter
  - Define Purpose, Authority
  - Establish Frequency of Meetings (Quarterly ?)
  - Appoint a Chairperson
  - Appoint an Administrator (FSO?)

SAFETY COUNCILS & COMMITTEES

- Committee Management
  - Get Meetings Scheduled
  - Develop An Agenda
  - Distribute The Agenda
  - Review the Agenda with Chair
  - Prepare Draft "Minutes"
  - Remind Members with "Action"

SAFETY COUNCILS & COMMITTEES

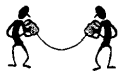
- Meeting Management
  - Start On Time!
  - Stick to the Agenda
  - Resolve All Agenda Items
    - Designate Action Agent & Suspense
  - Quit On Time!

SAFETY COUNCILS & COMMITTEES

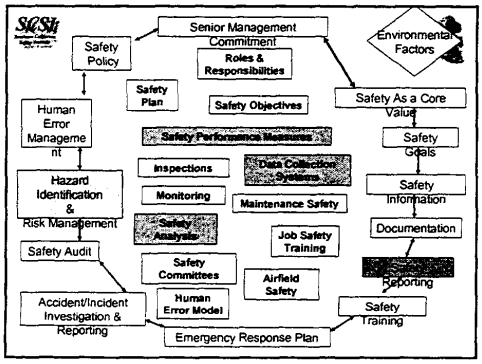
- After Meeting Actions
  - Prepare Final Minutes
  - Distribute Final Minutes (1-2 days)
  - Follow-up on Action Items
  - Start Planning for Next Meeting

Discussion

- What safety committees does your company have?
- How could you improve?



ESTABLISHING A SAFETY REPORTING SYSTEM



Why Establish a Safety Reporting System?

Mission 118, Where Are You?

SRS

- Provides the Information and Knowledge Linkage within the Safety Management System
- A Key Component of the Safety Management System
- SRS Must be a viable Network within the Organization

THE SRS NETWORK

- Follows the Organizational Chain of Command
- Must become a Key Element of the Organizational Communication Program
- Must be User Friendly and Easily Understood by the Entire Organization

SRS ELEMENTS

- Hazard Identification and Risk Assessment Projects within the Organization
- Hazard Reports
- Accident/Incident Investigation Reports
- Manufacturer's MDR's & SDR's
- Other User's Reports & Experience

ESTABLISHING A SRS

- Look at current/existing communications network
- Attempt to streamline the network for Safety/Risk Management Information
- Establish Focal Points for Safety Information Handling
- Don't overload the System

TESTING THE SRS

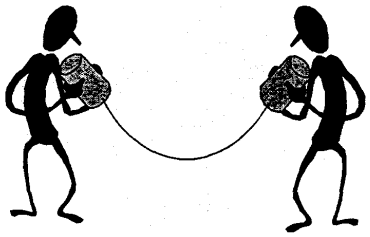
- Use Electronic Information transfer and dissemination whenever possible
- Develop a System to measure efficiency and effectiveness
- Who Looks at the Information?
- Is there Feedback and Action on the Information?

MANAGING THE SRS

- Screen Information
- Action Information vs. "Nice to Know"
- Look at Alternative Dissemination Methods

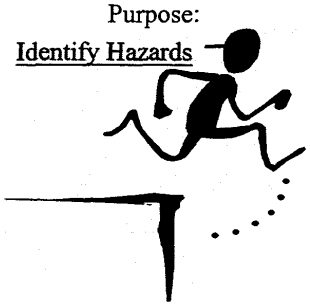
- Issue Packages
- Action Forms
- Coordination Forms

Internal Reporting Systems



Purpose:

Identify Hazards



Purpose

- Identify and Correct Hazards
  - In a Timely Manner
  - Fundamental Task in Accident Prevention
  - Responsibility of all Members of Organization
- Comply with OSHA General Duty Clause
- Provide an Effective Flow of Information
  - For Risk Management Decisions

Types of Internal Reports

- Equipment Deficiencies
- Operational Events
- Hazards To:
  - Employees
  - Aircraft
  - Passengers
  - etc.

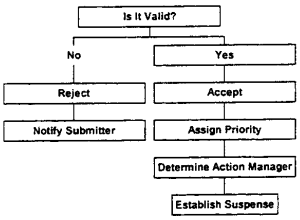
Successful Program Characteristics

- Simple - Convenient
  - Easy to Use Form
    - Readily Available
  - Tip Hotlines
- Non-Punitive
- Visible Response & Action
- Feedback Loop

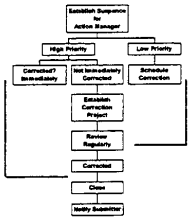
ICAO Principles

- Trust
- Independence
- Ease of Reporting
- Acknowledgment
- Motivation and Promotion
- Feedback

Processing the Hazard Report



Follow-Up and Closing



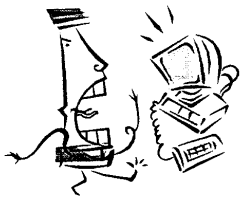
Hazard Reporting

- Additional Procedures
  - Transients
  - Tenants
- Promoting the Program
  - Communication

AIR SAFETY REPORTS

- Purpose - Accident Prevention
  - Non-punitive
  - Anonymous
- Who Reports
- What to Report
- Internal Liasion

External Reporting Systems



Why Report Externally?

- Legal Requirement
  - 49 CFR 830 (NTSB)
  - 29 CFR 1900 (OSHA)
  - Protect Investigations (Corporate Counsel)
- Moral Requirement

Similar Systems
+ Similar Practices
Similar Potential for Injury or Loss

Initial Notification and Reporting

- Immediate Notification Required for Accidents / Incidents
- Nearest NTSB Field Office
  - More Expeditious Means Available

NTSB Field Offices

Initial Reporting

- Information To Be Given
  - *"...shall contain the following information, if available"*
- Aircraft
  - Type
  - Nationality
  - Registration Markings
- Name of Owner and Operator
- Name of Pilot-in-Command
- Date and Time of Accident/Incident

Initial Reporting

- Last Point of Departure
- Point of Intended Landing
- Aircraft Location
  - Reference to Easily Identifiable Geographical Point
- Number of Persons
  - Aboard
  - Killed
  - Seriously Injured

Initial Reporting

- Nature of The Accident
- Weather
- Extent of Damage to Aircraft
- Description of Hazardous Cargo
  - Explosives
  - Radioactive Materials
  - Other Dangerous Materials

Follow-On Reports

- Operator Shall File:
  - Accident
    - Within 10 Days
  - Overdue Aircraft
    - Within 7 Days
  - Incident
    - "...only as requested by authorized representative of the Board..."
  - NTSB Form 6120.1 or NTSB Form 7120.7
    - *http://www.ntsb.gov/*

Crewmember Statements

- For Each Accident / Incident
- "Each crewmember ... shall attach a statement setting forth the facts, conditions and circumstances..."
- If Incapacitated, As Soon as Able

ICAO Annex 13

Accident and Incident Investigation

States Affected by the Annex

- State of Occurrence
- State of Registry
- State of Operator
- State of Design
- State of Manufacture

NTSB/ICAO Comparison

"Accident"

NTSB

- An Occurrence Associated With The Operation of an Aircraft
  - Starts: When First Person Boards
    - With Intention of Flight
  - Ends: Last Person Disembarks
- Person Suffers Death or Serious Injury, Or

ICAO

- First Person Boards to Last Person Exits, and:
  - Intent for Flight, and
  - Person is Fatally or Seriously Injured, and/or

"Accident"

NTSB

- Aircraft Receives Substantial Damage
  - Damage or Failure Which Affects
    - Structural Strength
    - Performance
    - Flight Characteristics
  - Would Normally Require Major Repair or Replacement
- Overdue Aircraft
  - And Believed to Be Involved in an Accident
  - Or, After 7 Days

ICAO

- Aircraft Damage or Structural Failure which:
  - Adversely affects
    - Structural strength, or
    - Performance, or
    - Flight Characteristics, and
  - Would Require Major Repair or Replacement
- Aircraft Missing or Completely Inaccessible

"Fatal Injury"

NTSB	ICAO
• Fatal Injury: – Any Injury Which Results in Death Within 30 Days of Accident	• Fatal (or Serious) Injury – Being in the Aircraft – Direct Contact with any Part of The Aircraft – Direct Exposure to Jet Blast – Exceptions: • Natural Causes • Self-Inflicted Injuries • Inflicted by Other Persons • Stowaways Not Normally Accessible

"Serious Injury"

NTSB	ICAO
• Hospitalization For More Than 48 Hours – Within 7 Days of Sustaining Injury • Fracture of Any Bone – Except Simple Fractures of Fingers, Toes or Nose • Severe Hemorrhages, Nerve, Muscle or Tendon Damage	• Hospitalization for more than 48 Hours – Commencing within 7 Days of Injury • Fracture of Any Bone – Except Simple Fractures of Fingers, Toes or Nose • Lacerations – Severe Hemorrhage – Nerve, Muscle or Tendon Damage

"Serious Injury"

NTSB	ICAO
• Involves Any Internal Organ • Burns – 2nd or 3rd Degree; or, – Covering 5% or More Body Surface	• Injury to Any Internal Organ • Burns – 2nd or 3rd Degree; or, – Covering 5% or More Body Surface • Verified Exposure to – Infectious Substances – Injurious Radiation

"Exceptions to Substantial Damage"

NTSB	ICAO
• Engine Failure • Damage Limited to Engine – If Only One Engine Fails or is Damaged – Engine Accessories • Bent Fairings or Cowling • Dented Skin • Small Puncture Holes in Skin or Fabric	• Engine Failure or Damage when Limited To: – Engine Itself, or its • Cowling, or • Accessories • Aircraft Damage Limited To: – Fairings – Small Dents, Punctures in Aircraft Skin

"Exceptions to Substantial Damage"

NTSB	ICAO
• Ground Damage to Rotor or Propeller Blades • Damage to Landing Gear, Wheels, Tires, Flaps, Brakes or Wingtips	• Aircraft Damage Limited To: – Propellers – Wing Tips – Antennas – Tires or Brakes

"Incident"

NTSB	ICAO
• "Serious Incident" – An Occurrence Other Than an Accident – Affects or Could Affect The Safety of Operations	• "Incident" – Circumstances Indicating an Accident Nearly Occurred – Difference Lies Only in the Result

Typical Serious Incidents

(not exhaustive)

- Near Collisions Requiring
  - Avoidance
  - Inability to Make Avoidance Action
- Controlled Flight into Terrain Marginally Avoided
- Operations involving Closed or Engaged Runway
  - Aborted Takeoffs
  - Takeoffs with Marginal Separation from Obstacles
  - Landings or Attempted Landings
- Gross Failure to Achieve Predicted Performance during Takeoff or Initial Climb

Typical Serious Incidents

(not exhaustive)

- Fires and Smoke in
  - Passenger Compartment
  - Cargo Compartment
  - Engines
  - Even if Extinguished by Extinguishing Agents
- Emergency Use of Oxygen by Crew
- Aircraft Structural Failures or Engine Disintegrations (Other than "Accident")
- Multiple Malfunctions of Systems Seriously Affecting Operation
- Flight Crew Incapacitation in Flight

Typical Serious Incidents

(not exhaustive)

- Fuel Quantity Requiring Declaration of Emergency
- Take-off or Landing
  - Undershoots/Overshoots
  - Off Side of Runway
- Difficulty Controlling Aircraft Due to
  - System Failures
  - Weather Phenomena
  - Operations Outside Aircraft Flight Envelope
- Failure of More than One System in a Mandatory Redundant System
  - Flight Guidance
  - Navigation

Aviation Safety Reporting System

(ASRS)

- Advisory Circular 00-46C
  - Purpose of Program
  - NASA Responsibilities
  - Use of Reports
- Reporting Procedures
  - NASA Form
  - Mail To: Aviation Safety Reporting System
    P.O. Box 189
    Moffett Field, CA 94035

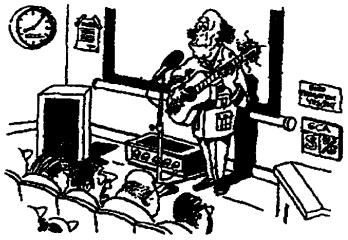
ASRS "Immunity" FAA Policy

- No Enforcement Action
- "No-Action" Violation in File
- One Use of ASRS Immunity per Five Years

Other External Reports

- Maintenance
  - Service Difficulty Reports
  - Failure Data to Maintenance
- OSHA Injury Reports of Employees
- EPA Reports of Spills, etc.
- Crosstells
  - Training Centers
  - Other Operating Locations
  - Other Operators

SAFETY ORIENTATION

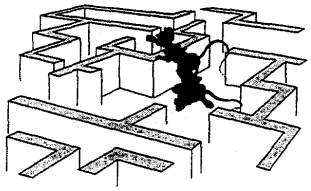


Our Flight Safety Officer is trying new methods to reach the young pilots.

SAFETY ORIENTATION

- Regulatory Requirement
- Company Requirement
- Senior Management Commitment
- Orientation Plan
- Supervisor Training
- Documentation
- Known Operational Hazards

Safety Training



Developing a Training Program

- Define Goals
- Establish Required Elements
  - Job Safety Analysis
  - Standards
  - HAZCOM
  - HAZMAT
  - Bloodborne Pathogens
- Recordkeeping Requirements

Training Requirements

- Safety Program Elements
- Additional Duty Safety Personnel
  - Shops
  - Stations/Operating Locations
- New Hires
- Crewmembers
- Mechanics
- Station Agents
- Management
- Contractors

Professional Safety Training

- Aircraft Accident Investigation
  - Participants in NTSB/ICAO/FAA Investigations
  - Company Investigations into Incidents
- Accident Response/Preparedness
  - Operating Locations
  - Company Headquarters
  - Compliance with Aircraft Disaster Family Assistance Act of 1996
- Personal Protective Equipment
- First Responders
  - Corporate and Personal Loss
  - Airport Plan Implementation

EMERGENCY PREPAREDNESS

WHAT IS AN EMERGENCY?

An unforeseen combination of circumstances that calls for immediate action

Types of Emergencies

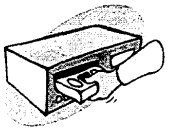
- Aircraft Accidents / Incidents
- Fires
- Weather-Related
- Sabotage
- Aircraft Emergencies
- Hazardous Materials
- Damage to Aircraft
  - Disabled Aircraft
- Explosions
- Power Interruptions
- Illegal Seizure
- Dangerous Goods
- Violence
  - Employee
  - Passenger
  - Other
- Workplace Injuries

WHY AN EMERGENCY ACTION PLAN?

- **IT MAKES GOOD BUSINESS SENSE.**
  - Prepare for the unusual and unexpected
  - Reduce Damage and Injury Losses
  - Get Back In Operation ASAP
- **IT'S REQUIRED BY LAW**
  - Annex 14, FAR 139.325, 49CFR Part 830
  - Aviation Disaster Family Assistance Act
  - HAZMAT

Emergency Action Plan

- Video



So What Must We Do?

Program Development

- Establish Company policy
- Produce Management Checklists
- Coordination With Others
  - Operating Locations
  - Certificated Airports
  - Regional Officials
- References Must Be Readily Available
- Response Kit
- Training of Company / Support Personnel
- Exercising the Plan

Company Preparation

- Notification
  - Alerting of Company Officials
  - Include The Director of Safety
  - Include Operating Locations
- Containment
  - Official Company Position
  - Reaction versus Preplanning
  - Established, Known Procedures
- Preserve Evidence

Community Preparation

- 14 CFR 139 Requirements
  - Certificated Airports
  - Regionals Not far Behind
- Response/Rescue
  - Capability
    - Fire, Rescue, Trauma Treatment
    - Mutual Aid / Timing
  - Availability
    - How Much, How Far, How long?
  - Bloodborne Pathogens

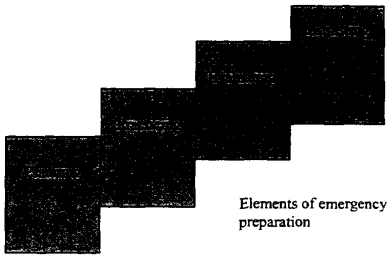
Community Preparation

- Local Official Liaisons
  - Airport Management
  - Local Government Disaster Preparedness
  - NTSB
  - FAA
  - FEMA
- Media Relations
- Does The Plan Include Off-Airport Response?

Identification of Response Personnel

- Family Support
- Media Relations
- Investigation Team
- Company Headquarters
- Outstations

Emergency Action Plan



Elements of emergency preparation

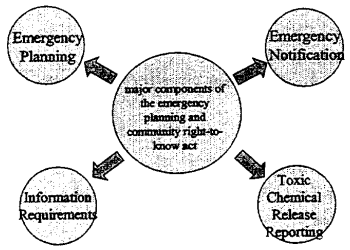
Emergency Action Plan

- What does an emergency action plan contain?
- This will vary with the operations at each individual site but must be location-specific.
  - map in the plan
  - chain of command
  - coordination information
  - local training

Emergency Action Plan

- The plan should have at least:
  - Procedures
  - Coordination
  - Assignment/responsibilities
  - Accident prevention strategies
  - Schedules

Emergency Action Plan



Emergency Action Plan

- Look at some examples.
- Take your own situation and determine what you would have as a minimum in your plan.
- Let's take a scenario and develop an outline of an emergency action plan.

Summary

- Understand what the airport and ARFF responsibilities are
- Understand what operator's responsibilities are in the event of an emergency
- Preparation

Assumptions on Use

Plan is useful for first 24 hours
Should be "User-Friendly"
- What should be done by whom
- When each action should be accomplished
  - Procedures first
  - Background information last

Provide logical note-taking and data records
- Becomes Part of Accident Record

Preparing For Emergency Response

- Some suggestions for preparation
- Base on availability and functionality
- Not inclusive

Emergency Supplies Assumption

- When aircraft accident occurs a company emergency command center will be established
- It will require:
  - Office furniture
  - File cabinets
  - Telephones
  - Typewriters
  - Computer terminals
  - Office supplies
  - File folders
  - FAX machine
  - Forms
  - Copier
- Obtain from other offices / pre-stocked?

Emergency Supplies Assumption

- Following an accident, a team will be dispatched to the scene
- They will need:
  - Organization identification
  - Severe weather clothing, boots, gloves
  - First aid kit
  - Camera(s)
  - Portable radios
  - Flashlights
  - Pencils, pens, etc
  - Tags for personal effects
  - Plastic bags/ties
  - forms
  - Expenditure authority
  - Copy of plan
- Member maintained / transportable kit?

Emergency Supplies Assumption

- Following an accident, A temporary office near the scene will be necessary
- It will require:
  - Office furniture
  - File cabinets
  - Telephones
  - Typewriters
  - Computer terminals
  - Office supplies
  - File folders
  - FAX machine
  - Forms
  - Copier
- Purchase or lease / pre-stocked?

Writing a Handbook

- Central Communications Center
  - Duties
  - Notification procedures
    - Normal telephonic
    - Emergency no telephone
- Facility shutdown procedures
- Handling customers, passengers or the public
- Locally related items

Format Suggestions

- Checklists
  - Short, simple
  - Reminder at the working level
- Response plans
  - Highly detailed
  - Function and response actions
- Emergency management plans
  - Comprehensive plan detailing actions
  - Before, during and after emergency

Format Suggestions

THE FAA DOESN'T MANDATE A PARTICULAR FORMAT - BUT THEY RECOMMEND THE ONE IN AC 150/5200-31A

This format is used by the local airport authorities

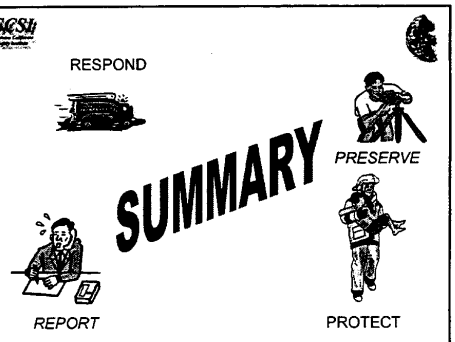
- Basic plan
- Functional annexes
- Hazard-specific sections
- SOPS and checklists

Responsibilities - Aircraft Operator

- **Provide pertinent information to Incident Commander to include:**
  - **Number of persons on board**
  - **The presence and location of any dangerous goods**
- **Provide EOC representation**
- **Make necessary notifications , to include the appropriate government agencies**
- **Arrange for appropriate passenger services to include**
  - **The transportation of uninjured passengers**
  - **Adequate holding facilities for uninjured passengers and crew members**
  - **Commissary items, telephones, clothing and additional medical services, as needed**

Responsibilities - Aircraft Operator

- Passenger services (continued)
  - Facilities for friends and families
  - Passenger/crew accountability and tracking
  - Hotel and /or other alternative travel arrangements for passengers
  - Critical Incident Stress Disorder Support.
  - Actions required by approved ADFAA plan.
  - Coordinate news releases with Airport Community/Public Relations personnel (later with NTSB)
  - Provide for the timely removal of wrecked or disabled aircraft as soon as authorized.



RESPOND

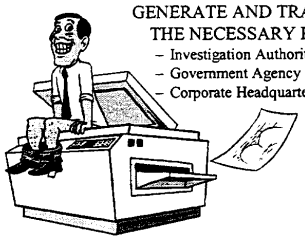
Get the appropriate personnel and equipment to the proper place in a timely manner.

- The accident scene
- Corporate Command Center
- Operations and Maintenance Facilities
- etc.

REPORT

GENERATE AND TRANSMIT THE NECESSARY REPORTS.

- Investigation Authority
- Government Agency
- Corporate Headquarters



PRESERVE

Preserve Lives of Victims

Prevent further Damage

Take action to preserve evidence
- wreckage
- records
- recordings

PROTECT

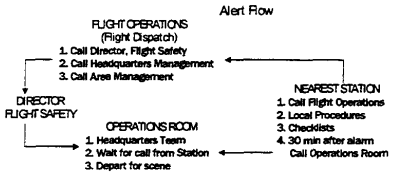
Accident Information

Survivors and Families of Victims

Crew Members and Employees

The Company Itself

ALERT & MOBILIZATION



Company Response

- Collect Data
  - Official Notification Data
  - Intrinsically Important Data
  - Aircraft and Crew Data
- Release of Information
  - Selected, Trained Representatives
  - Notification Data Without Embellishment
- Families and Survivor Support
- Post Accident Trauma Management

Civil Airfield Response

- 14 CFR 139.325 *Airport Emergency Plan*
- Areas Involved
  - Fire / Rescue
  - Survivor / Family Response
  - Vehicle Support
  - Removal of Disabled Aircraft
- Annual Review of Airport Plan
- Full Scale Emergency Exercise
  - Every 3 Years

EMERGENCY RESPONSE NECESSITIES

- Emergency Telephone Numbers
- Checklists
  - Notification
  - Reporting
    - Incident Commander
    - NTSB
  - EMERGENCY ACTION PLAN

NOTIFICATION AND RECALL LISTS

- ALL KEY PEOPLE
  - OTHER EMPLOYEES AS AUGMENTEES
- PRIMARY AND ALTERNATES FOR ALL KEY POSITIONS.
- PRYAMID RECALL
- *TEST & UPDATE LISTS REGULARLY!*

CHECKLISTS

- TWO TYPES
  - INSTRUCTIONAL
  - RECORD
- ONE FOR EVERY IMPORTANT FUNCTION OR ACTIVITY.
- COPIES OF ALL CHECKLISTS PART OF EAP (in every EAP binder)

TYPICAL RESPONSE ACTIONS

Company Official-in-Charge

Proceed to EOC
Review all available information on accident
Advise FAA and NTSB as required.
Hold pre departure meeting
Proceed to scene with headquarters team
Oversee and coordinate passenger, crew welfare handling and liaison with NTSB Investigator-in-Charge.
Arrange for removal of wreckage when authorized
Provide factual information to Public Affairs and Company President.

TYPICAL RESPONSE ACTIONS

Chief Pilot

Proceed to Flight Dispatch or nearest Ops Center
Assign a supervisory pilot qualified on the equipment to proceed to the accident scene (with HQ team)
Have Flight Dispatch obtain weather reports.
Ensure Flight Crew Records and flight records and planning materials have been secured.
Stand by to advise EOC on operational issues.

OTHER ISSUES

Mail, Cargo, Personal Effects

Passenger Welfare

PASSENGERS

- The first step for the Company is to develop an ***ACCURATE*** passenger list.
- The next is to determine passengers whereabouts and condition.
  - The first place to determine passenger (and crew member condition) is at the crash site.
  - At the outlet of the Triage Center, try to obtain medical tag numbers, names and hospital to which the patient is going. Condition of the passenger should only be noted in broad terms.

PASSENGERS

- Check on uninjured passengers at the passenger holding center. Here company representatives should conduct a passenger and crew count and obtain names while support and welfare activities are in progress.
- Information from Triage and Passenger Holding should be transmitted to the Station Operations Center as rapidly as possible, electronic means is recommended.
- A manager should also be stationed at each hospital in the area to obtain passenger information

  Note; This must be pre-planned and local authorities briefed on this activity.

Family Assistance

- Family Assistance Act
  - Toll-free telephone number
  - Provide secure facilities at departure, arrival and connecting airports
  - Provide timely notification If at all possible use personnel trained in crisis response and death notification. (Must be done at secure facility)
  - Provide logistical support

Cargo, Mail, Personal Effects

- The Plan must include arrangements for recovery and identification of cargo and personal effects of passengers. This should normally be handled by the company claims activity. There must be a secure facility to store all recovered material until it is identified and returned to the owners or NOK.
  - Mail is held "as-is" until arrival of US postal authorities
- Keep records of all recovered material, including identification, contents and condition and records of material known to have been on board.

Investigation

Mishap Investigation -- The Process

The need to take a system approach to investigation

VIDEO!

This program is for educational purposes only. Nothing herein is to be regarded as indicating approval or disapproval of any specific product or practice.

Investigator's Initial Site Assessment

- What are the terrain features in the vicinity?
- Any ground scars, skid marks associated with the mishap?
- Any Hazardous Materials involved?
- Which way was the mishap object or person moving?
- Do a quick inventory of parts and their distribution
- Look for things that belong/don't belong
- What is the configuration of the equipment, assembly, parts?
- Was there a fire?
- Was there an energy release?
- Did the emergency response change the scene?

Establish Priorities

- **Preservation of Perishable Evidence**
- **Ground Scars, Skid Marks, Grass**
- **Fluids – Oil, Fuel, Hydraulic Fluid, Chemicals**
- **Human Remains or Fluids – who decides when to remove?**
- **Photography**
- **Impound Records and Communications**
- **Documents/Personal Effects**
- **Wreckage Removal/Recovery**

Handling Evidence

The object is to preserve evidence for the investigation.

- Take Charge! You are the investigator.
- Be diplomatic in your dealings with people and organizations.
- Security Forces can help you with collection and preservation of evidence.
- Use photography and diagramming/sketches to provide proof of where you found key parts and pieces.
- Prioritize your work at gathering evidence.
- Damaged or fire involved evidence?
- On-site examination or send to lab?

Organize to Investigate

- Make a plan and a schedule
  - Determine support requirements
  - Get those assisting you to help
  - Assign duties
  - Work with "designated" representatives
  - Establish time line events
- Organize your information
  - Promote exchange of information and ideas
- Plan your daily activities
  - Establish priorities
- Be aware of the critical incident stress syndrome
- Use principles of basic investigation management

DOCUMENT CONTROL
KEEP TRACK OF *EVERYTHING*

- **Have a filing system**
  - Organize by system, utilities, organization
- **Make working copies**
  - Originals NEVER leave the file
- **Log evidence in and out**
  - Track where things go
  - Have a suspense for follow-up
- **Keep records of Report Section Status**
  - Working Draft Due
  - Corrections
  - Printing status, etc.

Investigative Procedures

- Depends on the nature, and results, of the mishap
- If a team (or single investigator) is to investigate:
  - Need to define the scope
  - If a team, need a preliminary briefing
  - Visit the site to get updated information
  - Inspect the site before any changes occur
  - Document location of people, parts, paper, position -- energy sources and hazardous material

As the Investigator Approaches the Scene

What you see depends on how you look at it

We all have our view point, our past experiences Be aware they may affect the outcome of your investigation

The ***organization*** needs to fix the problem(s) -- Don't focus in on what you initially think is the most apparent cause

Immediate First Steps

- Provide First Aid, Get Medical Help
- Eliminate or Control Hazards at the Scene
- Look at the "Big Picture" and Think About How to Approach This Investigation
- Start Documenting Accident Scene Information with Your First Impressions
- Contact Witnesses as Soon as Practical, if not Immediately

Gather Information

Stay calm
You are not there to find blame
Secure the site
Document everything
Take photographs, make sketches, measure
Note what you see and feel
Observe nearby activity
Look for anything unusual
Decide where to conduct interviews
Best approach is to investigate first
Locate records, training, history

Gather Information

Look for a combination of factors:
- Man – People directly and indirectly involved
- Machine – Equipment, materials
- Management – Policies, procedures, training, manning, resources, etc.
- Medium – Environment
- Mission – Taskings, operation, capability

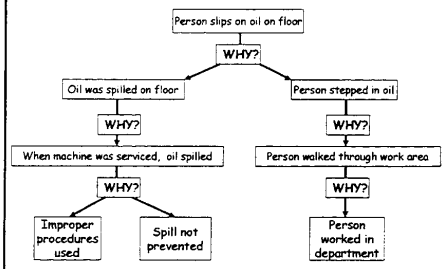
Collect evidence
- Photographs, diagrams
- Samples of chemicals
- Broken parts, pieces
- Witness statements, records review, etc.

Develop an Analysis Problem Solving Procedure

As you get into the analysis of facts you might want to consider using one of the most common procedures applied during mishap investigations:

Change Analysis
Hazard Analysis

Problem Solving -WHY?



Analysis

Work the facts
- **Review all information**
- **Clarify the facts**
- **Need to sort and analyze scenario minute by minute to trace events to source**
- **Use problem solving techniques**
- **Determine Cause(s) and effects**
  - **Look for hidden causes**
  - **List EVERY cause – don't just go for the easy ones – try to uncover them all**
  - **Look for latent failures: administrative and supervisory issues**

Analysis

Once you have causes, Look for Solutions
- **Watch for the "Can't"**
- **Look for creative options**

Recommend Corrective Measures
- **You may be asked for cost benefit analysis**
  - **Don't let the cost limit your analysis**
  - **Provide options**
  - **Let management determine economic realities**

Write the Report

Be Factual and non-judgmental
- **Provide basic information, don't embellish**
- **Sequence of events by minute/hour/day**
- **If necessary, provide an analysis of the facts**

Document findings identifying causal factors

Provide recommendations to take action to prevent the next mishap from happening

Filling out an accident report is like taking a test; if you are well prepared, then completing it won't be difficult

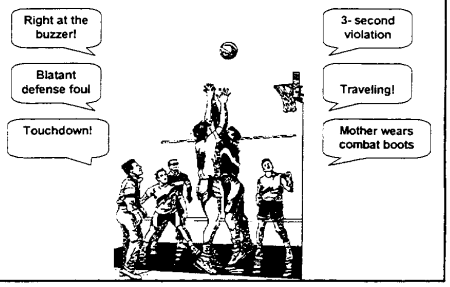
Follow-Up

The final activity of an accident investigation is to follow-up

Need to determine if the recommended corrective actions were properly implemented

Need to determine if the actions taken are accomplishing the goal of reducing or eliminating the level of risk

Witnesses



Fundamental Considerations

- **Legal Aspects**
- **Relative Importance**
- **Corroboration**

Objectives

- **Seek a preliminary suspect area to look at**
- **Complement other phases of the investigation**
- **Find out what the witness knows**

Possible Witnesses

- **Persons perceiving with their senses**
  - Eyewitness, Ear-witness, etc
- **Persons having knowledge of background to people involved**
- **Persons having knowledge of the equipment involved**
- **Persons participating in the investigation as experts**

Locating Witnesses

- **Police/Fire Department/Medical Response**
- **News Media**
- **Advertisement**
- **Records**
- **Other Witnesses - Referrals**

Make a list of potential witnesses

Preparing for the Interview

- **Get background information**
- **Go to the site – it gives you first hand knowledge**
- **Select an interview location**
- **Make a list of known facts and any missing facts that the witness might help with**
- **Don't intimidate – use the positive approach**
- **Be relaxed and informal**
- **Important that the witness feels at ease**

Interviewing

- **Qualify the witness**
- **Watch your question wording**
- **Note-taking**
- **Use of a tape recorder**
- **Don't try to be clever or trick/trap the witness**
- **Stay away from hearsay or speculation**
- **Do not assist with the terminology**
- **Important that the witnesses perceive they are playing a critical role in the success of the investigation**
- **Individual or Group interview?**

The Investigating Team Conducts an Interview

"Just Relax, Ms Smith and Tell Us What Happened."

Witness Problems

- **Fear of Reprisal**
- **Intimidation**
- **Embarrassment**
- **Witness Expectations**
- **Uncertainty**
- **Fleeting Glimpse**
- **Perceptions**
- **Memory**

Factors Affecting Witness Reporting

- **Background and experience**
  - **May have difficulty recalling details if they weren't familiar with the process or weren't interested**
- **Observer variations**
  - **Differences do matter! Such as, generally, adult females can relate color, size and shape while, generally, adult males will be better at observing speed, direction and distance.**

Factors Affecting Witness Reporting

- **Perception**
  - **We tend to report those events which we consider most vivid**
  - **Warning! Witnesses may become aware of gaps in their observations and add to their "observations" to make their statement more plausible**
  - **Emotion and excitement may distort**
  - **Exaggeration creeps in the more often the witness relates the observation**

Factors Affecting Witness Reporting

- **Transposition**
  - Facts may be out of sequence
- **Omissions**
  - Poor recall or did not consider the event important
  - Prepares the statement without the benefit of reminders of how fast it occurred, background noise, weather, etc.

Interviewer's Problems

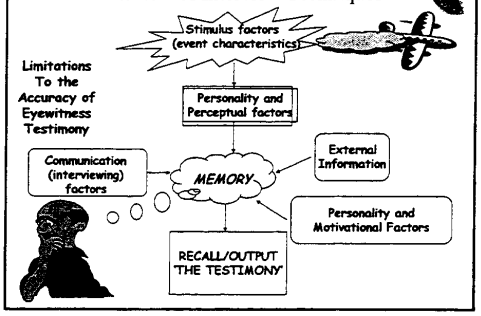
- **Prejudice**
- **Perceptions**
- **Fears**

Watch your communications skills!

Stages of Witness Interviewing

1. **Let the Witness Recount Event in Own Words**
2. **Allow the Witness to Reconsider, Read or Listen to Statement and Add Information**
3. **The Interviewer Asks Questions to Clear Up**

Review of Interview Techniques



WRITING THE REPORT

The Report (ICAO)

- Convenient and Uniform Manner
- Detailed Guidance in ICAO Manual of Aircraft Accident Investigation (Doc 6920)
- Working Language of ICAO
  (English, French, Spanish, Russian & Arabic)
- ICAO Lexicon (Doc 9110) Terminology

Report Addressees

- State Instituting the Investigation
- State of Registry
- State of Operator
- State of Design
- State of Manufacture
- States with Fatalities / Serious Injuries to Citizens
- States Providing
  - Relevant Information
  - Significant Facilities
  - Experts
- ICAO (Aircraft over 5,700 kg)

Report Format

- Title
  - Name of Operator
  - Aircraft
  - Nationality
  - Registration Marking
  - Location
  - Date of Accident/Incident

Report Format

- Synopsis
  - Notification
  - Identification of Investigation Authority
  - Accredited Representatives
  - Organization of Investigation
  - Authority Releasing the Report
  - Date of Publication
  - Brief Summary of Circumstances Leading to Accident

Report Format

- Body
  - Factual Information
  - Analysis
  - Conclusions
  - Safety Recommendations
- Appendices

Factual Information

- 1.1 History of Flight, Including
  - Flight Information
    - Number
    - Type of Operation
    - Last Point of Departure; Time of Departure
    - Point of Intended Landing
  - Flight Conduct
    - Flight Preparation
    - Description of Flight and Events Leading to Accident
    - Reconstruction of Significant Flight Path, if appropriate
  - Location of Accident/Incident
    - Latitude/Longitude
    - Elevation
    - Time (Day/Night)

Factual Information

- 1.2 Injuries to Persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal			
Serious			
Minor/None			

Complete Table with Numbers

Factual Information

- 1.3 Damage to Aircraft
  - Destroyed
  - Substantially Damaged
  - Slightly Damaged
  - No Damage
- 1.4 Other Damage
  - Damage to Property Other than Aircraft

Factual Information

- 1.5 Personnel Information
  - Each Flight Crew Member
    - Names and Ages
    - Validity of Licenses, Ratings
    - Mandatory and Periodic Checks
    - Flying Experience
      - Total and on Type
      - Recent Training
      - Route and Aerodrome
    - Relevant Information on Duty Time
    - Medical History and Checks

Factual Information

- 1.5 Personnel Information (Cont'd)
  - Statement of Qualifications and Experience of Other Crew
    - i.e., Evacuation Drills
  - Pertinent Information Regarding Other Personnel
    - Air Traffic Services
    - Maintenance
    - Management
    - Etc.

Factual Information

- 1.6 Aircraft Information
  - Airworthiness and Maintenance
    - Relevant Deficiencies
  - Performance and Bearing of:
    - Gross Weight and Limits
    - Center of Gravity and Limits
  - Type of Fuel Used

Factual Information

- 1.7 Meteorological Information
  - Forecast and Actual Conditions
  - Availability of Information to Crew
  - Natural Lighting Conditions
    - Sunlight
    - Moonlight
    - Twilight

Factual Information

- 1.8 Aids to Navigation
  - Information on Aids Available and Effectiveness
  - ILS, MLS, NDB, PAR, VOR, etc.
  - Visual Ground Aids
- 1.9 Communications
  - Mobile
  - Fixed Service

Factual Information

- 1.10 Aerodrome Information
  - Facilities and Condition
  - Takeoff or Landing Area
- 1.11 Flight Recorders
  - Location in the Aircraft
  - Condition on Recovery
  - Pertinent Data Available

Factual Information

- 1.12 Wreckage and Impact Information
  - Site of Accident
  - Distribution Pattern
  - Detected Material failures
  - Component Malfunctions
  - Location and State of Pieces for Break-up Prior to Impact
  - Diagrams, Charts and Photographs

Factual Information

- 1.13 Medical and Pathological Information
  - Investigation Taken
  - Pertinent Results
- 1.14 Fire (if Required)
  - Nature of the Occurrence
  - Fire Fighting/Suppression Equipment Used
  - Effectiveness of Equipment

Factual Information

- 1.15 Survival Aspects
  - Search and Rescue
  - Evacuation
  - Location of Crew and Passengers in Relation to Injuries
  - Failure of Seats or Seat-Belts, etc.
- 1.16 Testing and Research
  - Description and Results

Factual Information

- 1.17 Organizational and Management Information
  - Influencing the Operation of the Aircraft
  - Organizations
    - Operations
    - Air Traffic Services
    - Airway
    - Aerodrome
    - Weather Services
    - Regulatory Authorities

Factual Information

- 1.17 Organizational and Management Information (Cont'd)
  - Management
    - Organizational Structure
    - Functions
    - Resources
    - Economic Status
    - Management Policies and Practices
    - Regulatory Framework

Factual Information

- 1.18 Additional Information
- 1.19 Useful or Effective Investigative Techniques

Analysis

- What Happened and Why
- Only Portion Read By Everybody
- Narrative Portion, Backbone of the Story
- Analyze Information in Factual Part
- Accept and Reject Plausible Hypotheses
- Relevant to Conclusions and Causes

Conclusion
Findings

- Must Be Supported in Analysis Section
- Conclusions Based On:
  - Weight of Evidence
  - Professional Knowledge
  - Best Judgement of the Board
- Significant Events or Conditions Leading to the Mishap and Injuries

Conclusion
Findings

- Isolate Each Event or Condition
- Do Not Mix Cause and Effect in Same Finding
- Logical Connection with Other Findings
- Each Finding is Not Necessarily a Cause

Conclusion
Causes

- Those Findings That Led Directly to Conditions or Events Which Resulted in the Mishap
- Immediate Causes
- Deeper Systemic Causes

Recommendations

- Any Necessary Action to Prevent Accidents
- Any Corrective Actions Taken
- Action Agency

Appendices

- Any Document Adding to the Substance
- Clarification Publications
- Etc.

Validation Process

- Draft Final Report
  - To All Participative States
  - Invite Significant and Substantiated Comments
  - Non-editorial Specific Technical Aspects
- Comments within 60 days of Transmittal Letter
  - Amend Final Report Accordingly, or
  - Append Comments to Report
- Publish after 60 days, unless extension approved by States

GET ORGANIZED

- Checklist and Index
- Filing System
  - At least one folder per investigation area.
  - At least one folder for each participant in the mishap.
  - At least one folder for each witness' transcribed testimony.
  - File drawers & shelves

Findings

- **Are the conclusions of the SIB or investigator**
- **Are single statements, in chronological order, of each significant event or condition sustaining the sequence leading to the mishap**

Cause

- **An act, omission, condition, or circumstance**
- **Either starts or sustains a mishap sequence**
- **May be human or mechanical**
- **It is a cause if correcting, eliminating, or avoiding it would prevent the mishap, mitigate damage or injuries**

Recommendations

Those actions likely to prevent a similar mishap or reduce its effects

WRITING

- The Basic Steps
  1. Analyze Purpose and Audience
     - Mishap Prevention!
     - The People that can Act!
  2. Conduct Research
     - Facts from the investigation, analysis, conclusions
     - Other sources of information for recommendations

WRITING

- The Basic Steps
  3. Support Your Conclusions
     - Insufficient data!
     - Slanted Reasoning:
     - Asserted conclusion; Emotional Appeal – Reputation or precedent as sole support, Glittering Generality, Catch phrases, bandwagon appeal; Faulty analogy; Faulty dilemma; Hasty generalization; Loaded question; Non-expert opinion (assumed authority); Non sequitur; Poor compromise; Post hoc; Primacy-of-print; *Stacked Evidence*

WRITING

4. Get Organized
   - Executive Summary – Condensed version of the report that encapsulates the mishap sequence, analysis, and primary findings, causes and recommendations (2-3 pages)
   - Mishap Sequence
   - Investigation and Analysis
     - Must cover: Areas investigated, factors considered and rejected, with reasons, factors accepted, with reasons
     - Some conventions:
       - Don't Use Names, Reference Tabs, don't quote in narrative

WRITING

4. Get Organized
   - Mishap Factors
     - Any unusual, out-of-the ordinary, or deficient action or condition discovered that contributed to the eventual outcome or indicates a pattern of LTA decisions or conditions. Can be causal or non-causal.
   - Findings
     - Related to specific, brief event.
     - Correctable event in the sequence.
     - Single event or condition.
     - Specific enough without including supporting evidence.

WRITING

- CAUSES
  - Every cause is a finding – not every finding is a cause.
  - Correctable by managers, supervisors or individuals.
  - Clear and simple statement of a single condition or event.
  - Not an effect or expected result of a previous cause, even if it sustains the mishap sequence.

Writing

- Get Organized
  - Recommendations
    - Normally against causes but may be against normal findings.
    - No briefings
    - Clear action agencies
    - Definite closing action
    - Multiple actions-separate recommendations
    - Does the recommendation Make Sense?!

Writing

5. Draft and Edit
   - Build Effective Sentences
     - Write Actively, Doers before verbs.
     - Dump Acronyms, jargon and "buzz words"
       If you must use an acronym-Define it!
     - Set the Tone
       Polite, constructive not destructive, persuasive, nonjudgemental.
     - Eschew Obfuscation (Don't Be Wordy.)
     - Sentence length (K.I.S.S.)

   Don't Forget Effective Paragraphs

Writing

EDIT! EDIT! EDIT!

- Read what you have written out loud.
- Have someone else read it.
- Write as you speak.
- If it isn't right-REWRITE.
- Spelling and grammar DO matter.

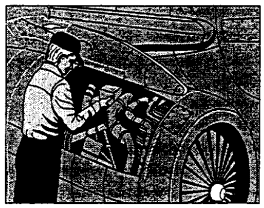
The Final Report
Review before Release

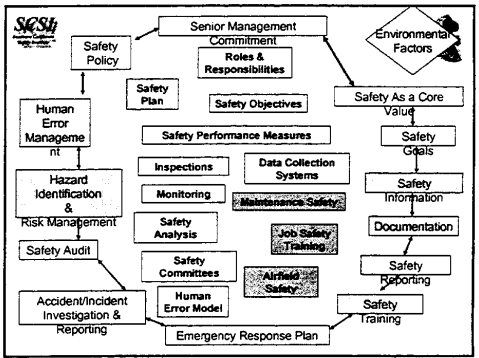
- Adequacy of content:
  - Did you include sufficient data from the investigation & analyses to support your conclusions?
- Findings:
  - Do they truly represent your conclusions?
  - Are they consistent with the analysis as presented in the message?
  - Are they presented chronologically and logically and continue to the logical end of the sequence?
  - Are they supported in the narrative section?

The Final Report
Review before Release

- Causes:
  - Do findings identified as Causes start or sustain the sequence or are they the *expected or logical result of the previous cause?*
- Recommendations:
  - Are they relevant to the accident?
  - Do they address identified deficiencies?
  - Are they specific, feasible and cost effective?
  - Are the action agencies appropriate

AIRCRAFT MAINTENANCE SAFETY





AIRCRAFT MAINTENANCE SAFETY

- The Purpose of a Maintenance Safety Program
  - Reliability
  - Teamwork and Cooperation
- Focus of Maintenance Safety Efforts
  - Industrial Safety
  - Airworthy Aircraft

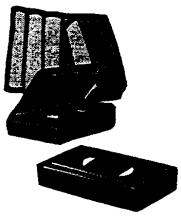
AIRCRAFT MAINTENANCE SAFETY
Safety Issues in Maintenance

- Aircraft Discrepancies
- Training
- Engine Runs
- Taxiing
- Maintenance Data
- Parts (Bogus Parts Are Real!)
- Tech Data
- Inspections
- Flight Line Practices
- Tool Control

THE "DIRTY DOZEN" OF MAINTENANCE

- Lack of Communication
- Complacency
- Lack of Knowledge
- Distraction
- Lack of Teamwork
- Fatigue
- Lack of Resources
- Pressure
- Lack of Assertiveness
- Stress
- Lack of Awareness
- "Destructive" Workplace Norms

Video



AIRCRAFT MAINTENACE SAFETY

- In-House vs. Customer
  - People vs. Product
- Maintenance Objectives
- Relationship to Flight Operations
  - Quality of Maintenance
  - Quality of Pilot Write-ups
  - Maintenance Test Flights

AIRCRAFT MAINTENACE SAFETY

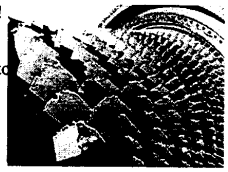
- Maintenance Evaluation
  - Who Evaluates?
  - Criteria
  - Records
  - QA
  - Parts and Spares
  - Support Equipment

AIRCRAFT MAINTENACE SAFETY

- Safety Evaluations
  - Housekeeping
  - Fire Prevention
  - Personnel Protection
  - Control of Chemicals
  - Reporting of Incidents/Hazards
- Where do You fit in This Program?

FOREIGN OBJECT DAMAGE (FOD)

- Who Manages the Program?
  - MAINTENANCE!
- Role of Safety
  - Advisor and Monito
- FOD Committee



The Hangar

- Industrial Setting
- Fragile Machinery Present (Aircraft)
- Multiple Hazards Combined; i.e.,
  - Confined Space (Fuel Cells)
  - Toxic Fumes (Fuels or Solvents)
  - Inadequate Protection (Unable to Team)
- Significant Fire Hazards
  - Open / Closed Fuel Cells
  - Electrical Systems Open / Active
  - Multiple Simultaneous Operations

Elements of a Good Program

- Personnel Awareness
- Documentation Complete
  - Training Records
  - Medical Records (for Exposed Personnel)
  - Material Safety Data Sheets (MSDS)
- Frequent Liaison with the Flying Operations

OCCUPATIONAL SAFETY

- Relationship to Aviation Safety
  - Focuses on Impact to the Mission
    - Ground Damage to Aircraft
    - Ramp/Flightline Accidents
    - Runway Incursions
    - Fuel Spills
    - Quality of Maintenance

OCCUPATIONAL SAFETY

- Who is Responsible for Managing and Monitoring Industrial Safety?
- Shared Responsibilities
  - Flight
  - Ground
  - Maintenance

OCCUPATIONAL SAFETY

- Focuses on Protection of Resources
  - People
  - Hardware
  - Real Estate

OCCUPATIONAL SAFETY

- Tire Maintenance
- Confined Space
- Electrical Safety
  - Control of Hazardous Energy
- Slips, Trips and Falls
- Personal Protective Equipment

ERGONOMICS

- Focuses on the worker's relationship to the working environment
- Tasks and Actions required to accomplish the mission
- Where do traumatic injuries occur?
- What can we do to eliminate the cause factors?

ERGONOMIC ISSUES

- Lifting
- Stretching
- Reaching
- Bending
- Repetitive Motion
- Cramped Spaces

INDUSTRIAL HYGIENE

- How does this differ from Occupational Safety?
  - Often, a fine line
  - The Key is Employee exposure to Environmental Hazards

INDUSTRIAL HYGIENE

- Hearing Conservation
- Exposure to Toxic Materials
- Radiation
- The Environment

INDUSTRIAL HYGIENE

- Hazardous Waste Management
- Bloodborne Pathogens

The Record

Non-Fatal Work Related Injury/Illness

- 1992
  - 2,162 Aircraft Mechanics
  - 4,348 Engine Mechanics
- 1993
  - 2,320 Aircraft Mechanics
  - 2,373 Engine Mechanics
- 1994
  - 1,673 Aircraft Mechanics
  - 2,967 Engine Mechanics

4,512 Air Transportation Citations (1995-6)

- Powered Industrial Trucks
- PPE
- Respiratory Protection
- Lockout/Tagout
- General Duty Clause
- Log & Summary
- Walking - Working Surfaces
- Portable Fire Extinguishers
- Machines, General
- Electrical Wiring
- Hazard Communication
- Asbestos

3,721 Aircraft Manufacturing Citations (1995-6)

- Electrical Power Distribution
- Asbestos
- PPE
- Electrical Protective Devices
- Portable Wooden Ladders
- Lockout/Tagout
- Log & Summary
- Hazard Communication
- Electrical Systems Design
- Use of Electrical Equipment
- Portable Fire Extinguishers

The Costs

- Injury and Illness Costs
- Worker Compensation Costs
- OSHA Penalties
  - Willful Violation: $70,000 / Count
  - Serious Violation: $7,000 / Count
  - Jail Time Possible
- Lawsuits

OSHA's Top 25
(Oct 1995 to Sept 1996)

1. Hazard Communication -- Written Program
2. Hazard Communication -- Employee Information and Training
3. Machine Guarding -- Types of Guarding
4. Hazard Communication -- Labeling Containers
5. Lockout/Tagout -- Written Energy Control Procedures
6. Abrasive Wheel Machinery -- Exposure of Adjustment/Safety Guards
7. Lockout/Tagout -- Establishment of an Energy Control Program

OSHA's Top 25
(Oct 1995 to Sept 1996)

8. First Aid -- Eye Wash/Emergency Shower Facilities not in Close Proximity to Employees
9. OSHA 200 Log and Summary
10. Mechanical Power Transmission -- Pulley Guarding
11. Wiring Methods -- Flexible Cords and Cables
12. Machine Guarding -- Point of Operation Guarding
13. Guarding Floor Openings, Platforms, and Runways
14. OSH Act -- General Duty Clause

OSHA's Top 25
(Oct 1995 to Sept 1996)

17. Hazard Communication -- MSDS Available for Each Chemical
18. Abrasive Wheel Machinery -- Work Rests
19. Lockout/Tagout -- Training and Communication
20. Electric -- Cabinet/Equipment/Box Covers
21. Personal Protective equipment -- Application/Type
22. Electric -- Wiring Methods/Identification
23. Hazard Communication -- Employee Information and Training
24. Electric -- Cabinet/Equipment/Box Conductors
25. Walking -- Working Surfaces -- Housekeeping

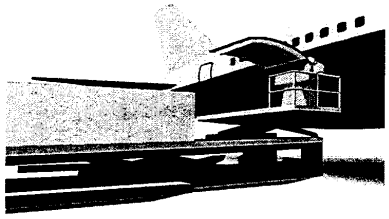
Typical OSHA Write-ups: Hangars/Aviation Related Shops

- Paint Booth
  - The air inlet to the breathable air compressor was not located in an area that would avoid contaminated air from entering the breathing air line (1910.134(d)(2)(ii))
  - Exits
  - Exits were locked or fastened, preventing free escape from inside of the building (1910.36(b)(4))
- Sprinkler System
  - Not operable (1910.133(a)(1))

Typical OSHA Write-ups: Hangars/Aviation Related Shops

- Employee PPE
  - Employee spraying trichlorethylene in a confined area adjacent to his face in bottom of aircraft. Not wearing face and eye protection. (1910.133(a)(1))
  - Hazard Communication
  - First line supervisors performance appraisal did not contain clear and concise statement that measured his or her obligation and dedication to ensure employees has a safe and healthful

Flightline & Hangar Safety



The Flight Line

- Busy
- Largely Uncontrolled
- Invisible Hazards
  - Propellers
  - Jet Blast
  - Noise

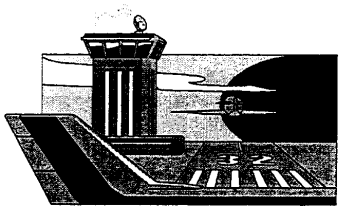
FLIGHTLINE SAFETY

- What Makes a Flightline/Ramp Safety Program Different from Industrial/Occupational Safety Programs?
- The Flightline/Ramp is a dynamic environment where ALL occupational safety and industrial hygiene programs apply!

FLIGHTLINE SAFETY

- Towing and Taxiing Aircraft
- Aircraft on Jacks
- Aircraft Cleaning
- Vehicles on the Flightline
- Refueling
- Maintenance
- Ground Damage

Airfield Safety



AIRFIELD SAFETY

- ISSUES
  - Construction
  - Contractors
  - Navaid Maintenance
  - Airfield Access and Transit
  - How many Agencies are Involved?
  - Inspection and Oversight
  - CONGESTION!

Concern for Airfield Safety

- Your Aircraft Operations
- Certificated/Non-Certificated Airports
- Response to Emergency Situations
- Site Surveys for New Locations
- Equipment Limitations

Airport Design

- Advisory Circular 150 Series
- Ramp
  - Loading Areas
  - Congestion
  - Movement Out of Parking
- Taxiways
  - Width
  - Intersections
  - Ground Control Systems
  - Other Traffic Considerations

Airport Design

- Runways
  - Width / Length
  - Parallel / Intersecting
  - Lighting
  - Distance Remaining Markers
  - High Speed Taxiway Exits
- Clear Zones
  - Sides
  - Ends

Airport Design

- Obstacles
  - Support Buildings
  - Drainage
  - Overpasses
  - Approach Lighting Structures
  - Military Arresting Cables
- "Grandfathering"

Approaches and Departures

- Commercial Approach/Departure Publications
- Visual Illusions
- TERPs versus Aircraft Capability
  - Minimums
  - Circling Approaches
  - Equipment Requirements
  - Climb Gradients
  - Missed Approach
- Noise Abatement

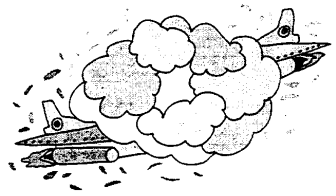
How to Find Out

- Site Surveys
- Pilot Squawks
- Hazard Reporting System

Reviews

- New Equipment Used
- Construction on Airfield
- Airport Board Meetings/Hearings
- Periodic Visits

MIDAIR COLLISION AVOIDANCE



THE THREAT

- CIVILIAN
  - Traffic Patterns
  - Uncontrolled Airfields and airspace

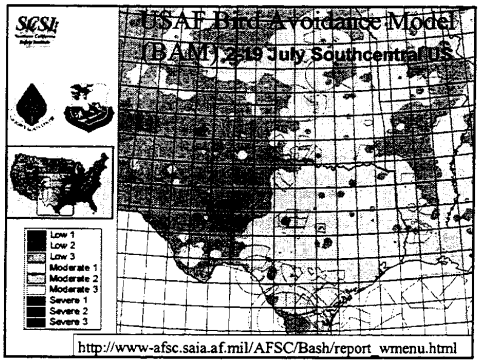
"See and Avoid"

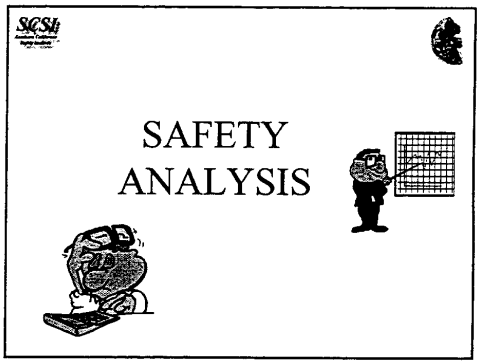
- MILITARY
  - Formation and Air Combat Training

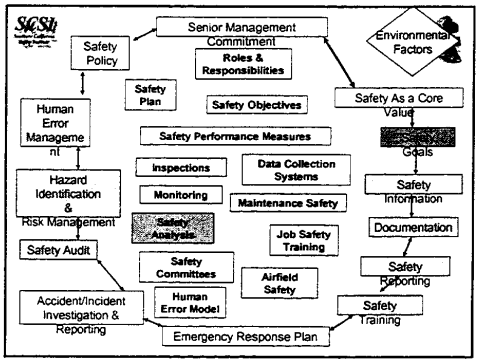
"We hit the ones we brief quiet"

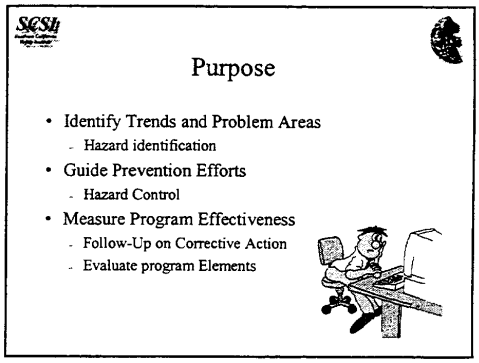
BIRDSTRIKE AVOIDANCE

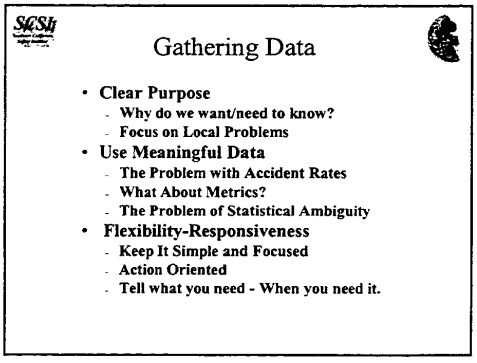
- Just as serious as Mid-Air Collision Avoidance
- Do You Have a Problem?
- Do You Have a Plan?

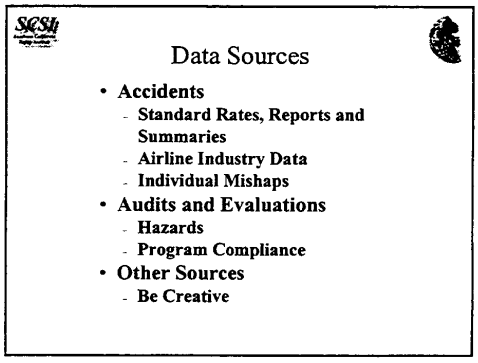

USAF Bird Avoidance Model (BAM) 2-19 July Southcentral US
Low 1
Low 2
Low 3
Moderate 1
Moderate 2
Moderate 3
Severe 1
Severe 2
Severe 3
http://www-afsc.saia.af.mil/AFSC/Bash/report_wmenu.html


SAFETY
ANALYSIS


Safety Policy
Senior Management Commitment
Environmental Factors
Roles & Responsibilities
Safety Plan
Safety Objectives
Safety As a Core Value
Human Error Management
Safety Performance Measures
Goals
Inspections
Data Collection Systems
Hazard Identification & Risk Management
Monitoring
Safety Information
Maintenance Safety
Safety Analysis
Documentation
Job Safety Training
Safety Audit
Safety Committees
Airfield Safety
Safety Reporting
Accident/Incident Investigation & Reporting
Human Error Model
Safety Training
Emergency Response Plan


Purpose
• Identify Trends and Problem Areas
- Hazard identification
• Guide Prevention Efforts
- Hazard Control
• Measure Program Effectiveness
- Follow-Up on Corrective Action
- Evaluate program Elements


Gathering Data
• Clear Purpose
- Why do we want/need to know?
- Focus on Local Problems
• Use Meaningful Data
- The Problem with Accident Rates
- What About Metrics?
- The Problem of Statistical Ambiguity
• Flexibility-Responsiveness
- Keep It Simple and Focused
- Action Oriented
- Tell what you need - When you need it.


Data Sources
• Accidents
- Standard Rates, Reports and Summaries
- Airline Industry Data
- Individual Mishaps
• Audits and Evaluations
- Hazards
- Program Compliance
• Other Sources
- Be Creative

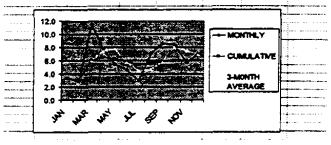
Data Portrayal

- **Aviation and Occupation Rate Calculations**
- **Standard Rates**
  - **Flight Events per 100,000 Flight Hours**
  - **Ground Accidents per 200,000 Man-Hours**
- **Use and Misuse of Rates**
- **Portraying Data as Reality**
- **Graphical Representations**

DATA PORTRAYAL

EVENTS, EXPOSURE AND RATES

MONTH	EVENTS		EXPOSURE		RATES		
	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	MONTHLY	CUMULATIVE	3-MONTH AVERAGE
JAN	2.0	2.0	600.0	600.0	3.3	3.3	
FEB	2.0	4.0	700.0	1300.0	2.8	3.1	
MAR	8.0	12.0	700.0	2000.0	11.4	6.0	6.0
APR	7.0	19.0	900.0	2900.0	7.8	6.6	7.1
MAY	6.0	25.0	1100.0	4000.0	5.5	6.3	7.3
JUN	6.0	31.0	1300.0	5300.0	4.6	5.8	5.8
JUL	3.0	34.0	1000.0	6300.0	3.0	5.4	4.4
AUG	5.0	39.0	700.0	7000.0	7.1	5.6	4.9
SEP	8.0	47.0	700.0	7700.0	11.4	6.1	5.8
OCT	5.0	52.0	800.0	8500.0	6.3	6.1	8.3
NOV	4.0	56.0	700.0	9200.0	5.7	6.1	7.3
DEC	7.0	63.0	1000.0	10200.0	7.0	6.1	7.0



Analysis Problems

- **Accuracy**
  - **Incomplete or Inadequate Data**
    - **Define Closely What You Are Looking For**
  - **Incorrect Data**
- **Focus**
  - **Problem Definition**
    - **Same As Above; Know What the Question Is**
  - **Data Selection**
    - **Accept The Answer The Data Gives You**

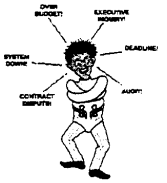
TYPES OF ANALYSIS

CAUSE AND EFFECT DIAGRAMMING

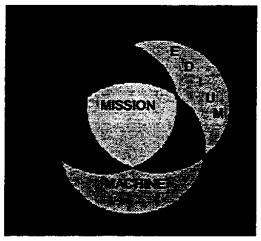
- What It Is:
  A graphic illustration of the relationship between a given out come and all the factors that influence this out come.
  Also called a "Fishbone" Diagram
- What It Does:
  Determine factors that cause a positive or negative effect.
  Focus on specific issues while avoiding irrelevant discussion.
  Identify areas where there is a lack of data.

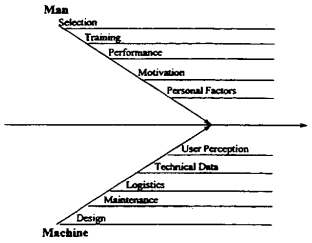
CAUSE & EFFECT DIAGRAMMING

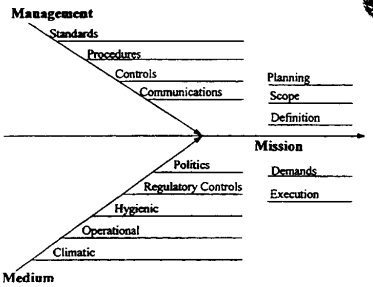
- How To Use It:
  - Specify the effect to be analyzed (positive or negative)
  - List major categories of factors that influence the effects being studied (The 5Ms for a start).
  - Use an idea-gathering technique to identify factors and subfactors.
  - Look for repeaters or root causes.
  - Prioritize the list of causes.

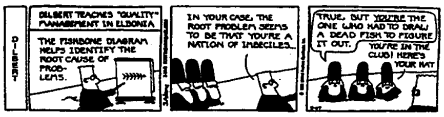


THE 5M MODEL









Hazard Analysis

- The Basic Tool of the Safety Analyst
  - List the elements of the system
  - Identify the hazards for each element
  - Assess the consequences of each hazard
  - Determine appropriate corrective action
- The Value of the Hazard Analysis is that it Drives Corrective Actions for Critical Safety Problems
- Its Weakness is That it is Not Comprehensive

Safety Sampling

- Identifies Hazards and Procedural Deficiencies
- Can be a Part of a Safety Audit System
  - Select Individuals and Jobs for Sampling
  - Ask Questions and/or Observe for Hazards and Deficiencies
  - Cross-Check with Other Similar Jobs for Validation

Job Safety Analysis

- List all the tasks in a job
- Observe a trained worker
- Identify hazards
- Develop controls
  - Improve procedures
  - Better training
  - New Equipment
- Job Hazard Analysis is another name for JSA

Critical Incidence Technique

- Makes use of Experts
- Focuses on Specific Problems
- Impacts Training and Operations
  - Identify a specific operation (Low visibility approach)
  - Ask experienced pilots to identify the key hazards.
  - Using a panel of experts develop specific procedures to cope with the hazards.
  - Train all crew members in these procedures.
  - Follow-up on effectiveness.

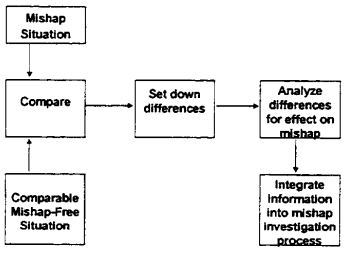
Change Analysis

- "What has (or will) change?"
- "What risks does the change introduce?"
- "What increase in risk will the transition create?"
- Mitigate the Change's Impact

CHANGE ANALYSIS

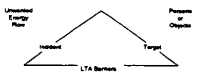
- What It Is:
  A method of identifying hazards resulting from changes.
  A tool for investigation as well as analysis of future events.
- What It Does:
  Identifies high risk areas introduced to an operation as a result of changes in environment, personnel, tasks, equipment, etc.

CHANGE ANALYSIS



ENERGY TRACE & BARRIER ANALYSIS (ETBA)

- Derived from MORT
- Defines incident as "Unwanted Flow of Energy"
- Mishap occurs when energy flow strikes targets and causes injuries



ENERGY TRACE & BARRIER ANALYSIS

- How To Do It
  - Identify Types of Energy Present (Chemical, Electrical, Kinetic, etc.)
  - Locate point(s) at which energy enters or originates
  - Trace energy flow or path.
  - Identify and evaluate barriers and potential targets

FAULT TREE & LOGIC DIAGRAMS

- What It Is:
  - A graphical depiction of the relationship between various elements of a system.
  - Similar to Cause and Effect Diagram but can be quantified using Boolean Logic.
  - Can combine hardware and human elements.
- What It Does:
  - Shows combinations of failures
  - Identifies the "weak link" (Critical Path).

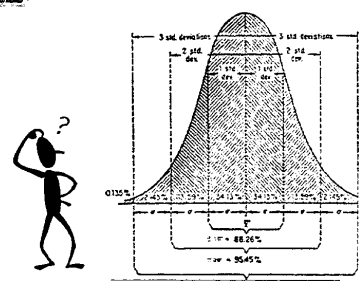
Root Cause Analysis

- **A subset of fault tree analysis**
  - **Keep breaking down the precipitating factors into smaller and smaller units until you reach the basic cause factor.**
  - **Like a child does, keep asking why?**

Example: Pilot Error is a common cause for accidents. Pilots don't deliberately make mistakes. Find the underlying reason for the mistake and you prevent future accidents.

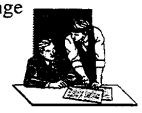
ANALYSIS FOR MINOR EVENTS

- Not Cost-effective to analyze each occurrence.
- Need a method to determine if there is a problem
- The Process is:
  - Monitor: Use Statistical Methods to alert
  - Study: Use Change Analysis or other techniques to identify problem



Statistical Process Control

- Select a Category to Monitor
  - Meaningful for Your Operation
- Determine Average Experience
  - Look at Historical Data
- Establish an Acceptable Range
  - Plus or Minus from Average
- Draw Graph and Plot Data
- Monitor
- Action for Deviation

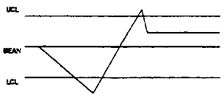


Statistical Control for Safety

- Based on concepts of Statistical Process Control
- Establish "average" number of events
- Define Upper and Lower Control Limits
- Monitor and Plot actual experience
- Take action if significant deviation occurs

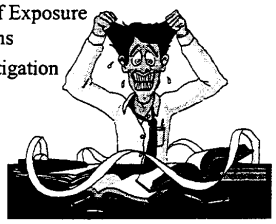
Statistical Analysis

- When deviations occur, shift from monitor to analyze.
- Use any analysis tool.
- Most useful is probably Change Analysis



Cost-Benefit Analysis

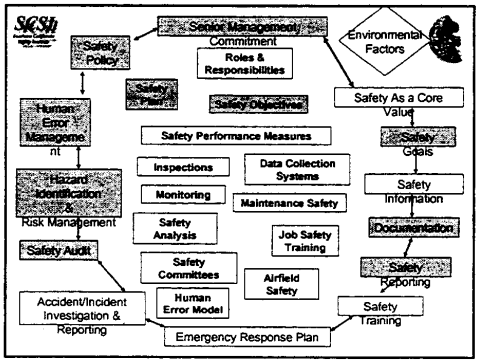
- Cost of Loss versus Cost of Fix
- Lifetime of Exposure Calculations
- Include Litigation



COST-BENEFIT ANALYSIS

ACCIDENT COSTS (est.)		COST TO FIX HAZARD	
DIRECT COSTS		Design	$ 50,000.00
Material/Equipment	$ 155,000.00	Material/Equipment	$ 450,000.00
Injury	$ 250,000.00	Labor	$ 125,000.00
Property Damage	$ 100,000.00	Training	$ 75,000.00
INDIRECT COSTS		Loss of Productivity (short-term)	$ 750,000.00
Loss of Revenue	$ 850,000.00		
Liability	$ 1,000,000.00		
TOTAL ACCIDENT COST	$ 2,455,000.00	TOTAL ACCIDENT COST	$ 2,455,000.00
		TOTAL CORRECTION COST	$ 1,750,000.00
		DIFFERENCE	$705,000.00

MAKING THE SAFETY CASE



What Is a Safety Case?

A method to systematically demonstrate to management that the major hazards to an operation have been identified and are being controlled.

What is a Safety Case?

- Originally developed for the petroleum and chemical industries
- Designed to present a report on safety of a system to regulators
- Now required in Great Britain, Australia and other countries.
- Also now being used in other fields, including transportation

What is a Safety Case?

- Aviation Use
  - Australia, by law
  - EEC as an aid to analysis of the new air traffic system
  - Royal Dutch/Shell Group, as a method to assure the safety of contract aviation operations.
  - Manufacturers of advanced avionics
- It is very similar in content and purpose to the Safety Assessment Report common in system safety practice

What is a Safety Case?

A Safety Case should be a subset of an effective

Safety Management System (SMS)

Safety Case

- **The Safety Case is a line of argumentation, not just a collection of facts!**
- The Safety Case contents
  - **–Definition of System**
  - **–Quality Management Report**
  - **–Safety Management Report**
  - **–Technical Safety Report**
  - **–Related Safety Cases**
  - **–The Conclusion**

Safety Management System
An aviation definition

- A systematic, explicit and comprehensive process for the management of safety risks, that integrates operations and technical systems with financial and resource management for all activities related to an air operator or an approved maintenance organization's certificate

SMS vs. The Safety Case

- Safety Management System
  - Comprehensive program to identify and control ALL risks in a company's operations.
  - Defines how management of air safety is integrated into the overall corporate management program
- A Safety Case
  - Shows that the major risks in a specific business activity (operation) have been adequately identified and controlled.
  - The safety management of the operation is being conducted in accordance with the corporate SMS.

Safety Case vs. Safety Plan

- The Safety Case is a description of what will be done in an operation to ensure adequate safety.
- The Safety Plan describes the steps necessary to meet the requirements of the Safety Case.

How Does This Relate to Safety Decision Making?

- The safety case is a organized report that depicts the decision-making process leading to a decision to continue or stop an operation based on safety considerations.

How to Build a Safety Case

The Royal Dutch/Shell Group Model
Designed for a contract operator

The Parts of a Safety Case

- Management Summary and Introduction
- Safety Management System relationship to the Safety Case
- Activities covered by the Safety Case
- Operation description
- Hazard Analysis and Hazard Resister
- Remedial Action Plan
- Conclusions.

Management Summary

- Overall Objectives
- Name, description, location and function of managers for each operation
- Description of historical safety performance (How SMS is really working)
- Key performance indictors that the safety case meets objectives
- Summary of main findings
- Endorsement by senior management
- Safety Case Review Criteria and Timing

Safety Management System

- Describe the safety management system as it is applied to the specific operation.
- If the SMS is not complete, the Safety Case must be extended to cover the essential elements of an SMS

Policy and Objectives

- State safety policy and objectives for the operation
- Identify regulatory requirements
- Define means of communicating these requirements within the operation.
- Where possible refer to other documents that cover these items (Policy statements, safety plans, etc.)

Organization, Accountabilities and Resources

- Describe the management structure and safety accountabilities for safety-critical functions.
  - The organizational structure for the operation.
  - The safety responsibilities for senior managers, line supervisors, employees and contractors.
  - The structure for planning, monitoring, review, discussion and communication of safety issues in the operation.
  - How all personnel are involved in safety – communication methods, meetings, committees, etc.

Organization, Accountabilities and Resources

- Describe the management structure and safety accountabilities for safety-critical functions (continued).
  - The role and responsibilities of safety committee members, including qualifications and training required.
  - The methods for measuring employee knowledge and understanding of safety requirements for their tasks
  - The policy on performance standards related to safety-critical tasks, including safety training and exercises.
  - The methods for monitoring of work in progress.

Standards and Procedures

- Describe how the corporate standards are to be applied.
  - Identify any waivers, deviations or modifications with justification.
- Include
  - Codes and Standards, Operational Planning
  - Change Control, Risk Management Procedures
  - Permitted Operations, Emergency Planning
  - Contractor Safety Management
  - The Operations Safety Plan

Performance Monitoring

- Safety Targets
- Performance Criteria
- Performance Monitoring Procedures
- Data Analysis Methods
- Communication

Auditing

- Description of the audit program
- Reporting, corrective action and follow-up
- Investigation and reporting of near-misses, incidents and accidents
- Lessons Learned

Management Review and Improvement

- Describe the methods and process for periodic review of the safety management process for the operation.
  - Establish timing for formal reviews
  - Describe methods for making changes between formal reviews

Activities Catalog

- A description of safety-critical activities, the task breakdown and specific controls for the described hazards.

Operational Description

- A description of the operation with emphasis on:
  - Essential features
  - Non-standard or unusual aspects
  - Special controls for hazards

Hazard Management

- Process for Hazard Identification and Control
  - Systems approach
  - ORM
  - Other
- The Hazard Register
- Special Procedures
  - Safety-Critical Procedures
  - Operating Limits

Corrective Actions

- All hazards identified must be controlled
- Any shortfalls must have a corrective action identified and approved
- The corrective action must identify
  - Interim controls
  - Accountable manager
  - Timing for completion of actions

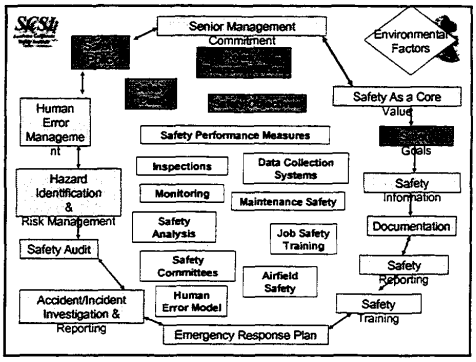
Summary & Conclusions

- Summary Statement
  - Conclusions of the Safety Case
  - Statement that Operation meets safety criteria to continue operations

Lessons Learned

- The standards don't cover all aspects of a real development
  - suppliers, operators and assessors should agree on how to proceed at the start of the project
- Modifications during the process are expensive
  - get your system safe first, then upgrade it
  - delta safety case for the upgrade
- Start adapting procedures to the standards NOW
  - the standards are here to stay
  - the sooner you're compliant, the easier life will become
- Document history
  - keep CVs of key personnel
  - keep development records
  - keep descriptions of old procedures
- Understand the standards
  - learning by doing is expensive
  - know what to do at the start, then you'll avoid expensive blunders

PREPARING THE SAFETY PLAN



Safety Policy vs. Safety Plan

- The Safety Policy is a description of what will be done in an operation to ensure adequate safety.
- The Safety Plan describes the steps necessary to meet the requirements of the Safety Policy.

Safety Case vs. Safety Plan

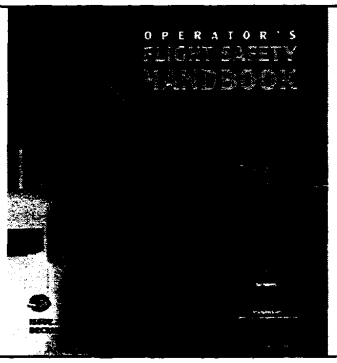
- The Safety Case is a description of what will be done in an operation to ensure adequate safety.
- The Safety Plan describes the steps necessary to meet the requirements of the Safety Case.

The Safety Plan

- A definition of the fundamental approach a company will adopt for managing safety within their organization
- Clearly defined safety roles and responsibilities.
- A description of the safety management system components.

How Do We Get Started? (Dick Wood)

- Establish policy, goals and objectives
- Assign Responsibility
  - Somebody have to be in charge.
- Pick the elements of our program.
  - Describe how they will work.
- Establish measurement procedures and indicators (Look at our goals and objectives)
- Write it all down



We have not succeeded in answering all your questions.
Indeed, we sometimes feel we have not completely answered any of them.
The answers we have given only serve to raise a whole set of new questions.
In some ways we feel that you are as confused as ever; but we believe that you are now confused on a

MUCH HIGHER LEVEL
GOOD luck!
MORE IMPORTANT THINGS

EXERCISES

HAZARD IDENTIFICATION AND RISK MANAGEMENT

SMS ELEMENT LINKAGES

- Safety Information
- Establishing a Safety Reporting System
- Safety Audit/Assessment
- Accident and Incident Reporting and Investigation
- Safety Orientation and Recurrent Training
- Emergency Response Plan
- Documentation

HAZARD IDENTIFICATION

- The Most Difficult of all Safety Tasks
- The Required First Step in Risk Management
- The Key Element in Abatement Programs

HAZARD IDENTIFICATION

- What is a Hazard?
- A Hazard is a condition with the potential of causing injury to personnel, damage to equipment or structures, loss of material, or reduction of the ability to perform a prescribed function
- A Hazard may impair or prevent successful accomplishment of the Mission

HAZARD IDENTIFICATION

- How do we recognize hazards?
- Do we have tools that can assist us?
- Previously Documented Hazards
- Safety Information Systems
- Safety Reporting Systems
- Safety Audits and Assessments
- Emergency Response Plans

HAZARD IDENTIFICATION

- Identification Tools
- Trend Analysis
- Accident/Incident Investigation and Reporting
- Safety Training Programs
- Regulatory Compliance Programs
- International Standards
- Reporting Systems

HAZARD IDENTIFICATION

EXAMPLES OF KNOWN HAZARDS IN THE AVIATION INDUSTRY

OVERWING OPERATIONS

OVERWING OPERATIONS

- Jet Bridge Operations
- De-icing Operations
- Cabin Service
- Catering Service
- Ticket Counters

UNDERWING OPERATIONS

UNDERWING OPERATIONS

- Vehicle Operations
- Baggage Handling
- Aircraft Fueling
- Lavatory Service and Potable Water Service
- Baggage, Freight and Cargo Runners
- Line Maintenance

MAINTENANCE OPERATIONS

FLIGHTLINE

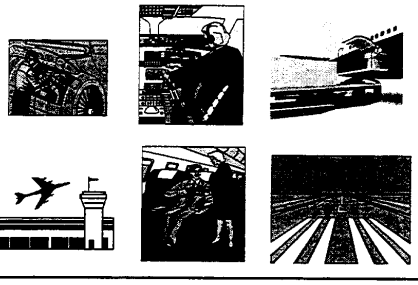
EXAMPLES

MAINTENANCE OPERATIONS

HANGER

EXAMPLES

FLIGHT SAFETY OVERSIGHT



FLIGHT SAFETY PROGRAM ELEMENTS

- Airfield Safety
- Vehicle Operations
- FOD
- Taxi Routing
- Aircraft Parking
- Jetway Congestion

FLIGHT SAFETY PROGRAM ELEMENTS

- Aircrew Standardization Programs
- Simulator Programs
- Check Rides

FLIGHT SAFETY PROGRAM ELEMENTS

- Birdstrike Avoidance
- Mid-Air Collision Avoidance
- Air Traffic Control
- Weather Forecasting
- Life Support
- Heliports and Landing Zones
- Obstruction Clearances

RISK MANAGEMENT

RELATIONSHIPS

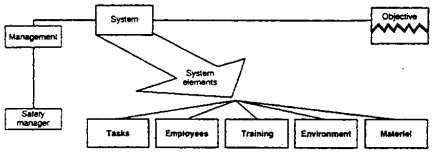
- RISK MANAGEMENT IS A SYSTEMS-BASED APPROACH
- THE SYSTEM CONCEPT CAN BE UNDERSTOOD AND APPLIED WITHIN ALL LEVELS OF THE ORGANIZATION

THE SYSTEM CONCEPT

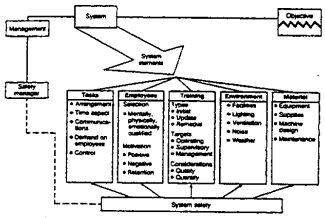
DEFINING THE SYSTEM:

- Elements of the System
- Responsibilities within the System
- Utilizing and Managing the System

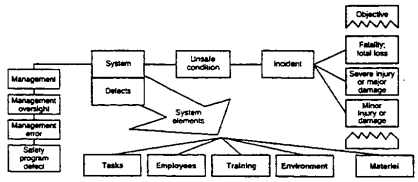
A System Is Comprised of Elements



System Safety Model



Results If Defects Are Not Corrected



BASIC CONCEPTS OF RISK MANAGEMENT

WHAT IS RISK?

- PROBABILITY VS. SEVERITY
- RESULTS IN RELATIVE RISK RANKINGS
- RESULTS IN ACCURATE ALLOCATION OF RESOURCES

RISK MANAGEMENT

THE PROCESS:

- Define the Job Process and Identify Hazards

RISK MANAGEMENT

THE PROCESS:

- Assess the Risk

RISK MANAGEMENT

THE PROCESS:

- Analyze Risk Control Measures

RISK MANAGEMENT

THE PROCESS:

- Make Control Decisions

RISK MANAGEMENT

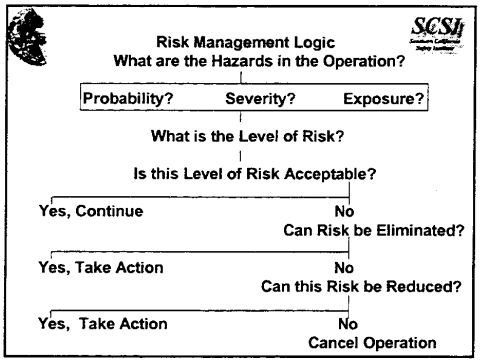
THE PROCESS:

- Implement Risk Control Measures

RISK MANAGEMENT

THE PROCESS:

- Feedback--Supervise and Review Effectiveness of Risk Control Measures



RISK MANAGEMENT TOOLS AND TECHNIQUES

PRELIMINARY HAZARD ANALYSIS:

- THE PAST

- Statistics
- Inspections
- Accident/Incident Investigations
- Insurance Reports

RISK MANAGEMENT TOOLS AND TECHNIQUES

THE PRESENT...DATA DRIVEN

- Reporting Systems
- Statistics
- Employee Feedback

RISK MANAGEMENT TOOLS AND TECHNIQUES

THE FUTURE...DATA DRIVEN

- Trend Analysis
- Next Mishap Projections
- Planning Cycles

ANALYSIS TOOLS AND TECHNIQUES

TREND ANALYSIS...DATA DRIVEN

- Your Statistics
- Manufacturer's Statistics
- Airline Statistics
- Regulatory Agency Statistics

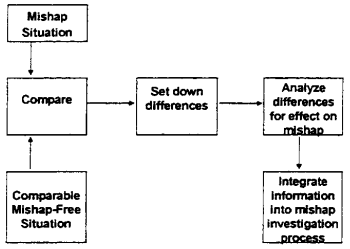
RISK MANAGEMENT TOOLS AND TECHNIQUES

JOB SAFETY ANALYSIS

RISK MANAGEMENT TOOLS AND TECHNIQUES

CHANGE ANALYSIS

CHANGE ANALYSIS



RISK MANAGEMENT TOOLS AND TECHNIQUES

ZONAL ANALYSIS

RISK MANAGEMENT TOOLS AND TECHNIQUES

FAILURE MODES AND EFFECTS ANALYSIS

RISK MANAGEMENT TOOLS AND TECHNIQUES

FAULT TREE ANALYSIS

FAULT TREE ANALYSIS

- Defines the "System" in Detail
- Provides a "Roadmap" for Analysis
- Readily Identifies both Strong Points and Deficiencies in Programs, Processes and Investigations

HOW DO WE APPLY ALL THIS?

- The Risk Assessment Matrix
- Probability vs. Severity
- Ranks System Deficiencies
- Allows prioritization of Control Measures
- Examples

THE RISK ASSESSMENT CODE

- A Basic Matrix
  - Plots Probability against Severity
  - Graphic Portrayal of Mishap Results
  - Assists in Prioritization of Resources
  - Easily Understood by Senior Leadership
  - Facilitates Risk Communication

RISK MANAGEMENT

THE MATRIX

DEFINITIONS

- PROBABILITY
- SEVERITY
- EXPOSURE
- HAZARD ELIMINATION vs. HAZARD REDUCTION

THE RISK ASSESSMENT CODE

- Probability Categories
  - A--Frequent
  - B--Probable
  - C--Occasional
  - D--Remote
  - E--Improbable

THE RISK ASSESSMENT CODE

- Severity Categories
  - I---Catastrophic
  - II--Critical
  - III-Marginal
  - IV-Negligible

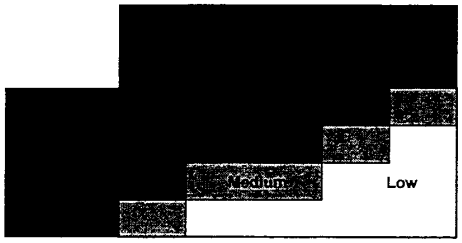
THE RISK ASSESSMENT CODE

- Matrix has More Than One Version
  - USAF---Numbers 1 through 5
  - NSC-----Numbers 1 through 4
  - No Numbers--Only Risk Levels
- Strong/Weak Points of All Three

THE NUMBERED MATRIX

NSC MATRIX

US ARMY MATRIX



MATRIX APPLICATION

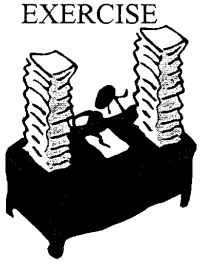
- Relative Levels of Risk
- Prioritization
- Analysis of Options
- Choosing the Correct Option

CHOOSING THE CORRECT ANALYTICAL TOOLS

- What Kind of an Answer are You Looking For?
- Accurate Definition of the Problem
- Capability to Assemble the Right Data
- Analysis MUST Lead to a Solution

PRESENTING RISK ASSESSMENTS TO SENIOR MANAGERS

RISK MANAGEMENT EXERCISE



QUESTIONS?

Financial Management

Financial Planning and Control

Key indicator, MOE, objective, etc.

is money

Where does money come from?

Taxpayers

Banks

Shareholders

Bondholders

Friends/Relatives

Sales

Different Sources

Different Stakeholders

Different Concerns

Planning Process

Produces Budgets

Budgets are established to carry out plans

Every dollar/euro in a budget is allocated to something

PPBS – planning, programming, budget system

Zero Based Budgeting

Financial Things Managers Worry About

- Interest Rates
- Uncertainty in Economy
- Currency fluctuations (Prague Example € vs $)
- Demand for Capital (by others)
- Bond prices
- Tax Rates and Voter Reaction
- Inflation
- Change

- All planning is based on uncertainty
- Managers plan and then ask "what if?"
- Do answers change the decision?
- All (good) managers have a plan "B"
- Best case, worst case, most likely case

What drives commercial UM?

- Profits and balance sheets
- Cash flow
- Earnings per share
- Risk
- Change
- Taxes (rates and rules)

What drives Government UM?

- Stay within Budget
- Budget Share (adequacy)
- Taxpayers (and their reps)
- Risk (budget cuts, freezes)
- Changes in Priorities

Basic Financial Statements

Financial Statements

Profit and Loss (Earnings)

Balance Sheet

Profit and Loss For FY

Net Sales	3,000,000	100%

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%
Gross Profit	420,000	

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%
Gross Profit	420,000	
G&A (Overhead)	90,000	3%
Gross Operating Income	330,000	

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%
Gross Profit	420,000	
G&A (Overhead)	90,000	3%
Gross Operating Income	330,000	
Depreciation	100,000	
Net Operating Income	230,000	

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%
Gross Profit	420,000	
G&A (Overhead)	90,000	3%
Gross Operating Income	330,000	10%
Depreciation	100,000	
Net Operating Income	230,000	7.67%
Interest	30,000	
Net income before taxes	200,000	6.67%

Profit and Loss For FY

Net Sales	3,000,000	100%
Cost of Goods Sold	2,580,000	86%
Gross Profit	420,000	
G&A (Overhead)	90,000	3%
Gross Operating Income	330,000	
Depreciation	100,000	
Net Operating Income	230,000	
Interest	30,000	
Net income before taxes	200,000	
Income Tax	80,000	
Net Income after taxes (Net Profit)	120,000	4%
Earnings Per share	0.20	

Some important terms/concepts

- **Net Sales (from product/service)**
- **Cost of Goods Sold (COGS) (Direct)**
- **G&A (overhead – indirect costs - support)**
- **P&L show results for one year**

Balance Sheet

Assets

Liabilities
(claims on assets by others)

Shareholder "share"
(what shareholders would get if they liquidated company now)
(Shareholder claims on assets)

Balance Sheet

Assets (as of 31 Dec xx)	
Current Assets	
Cash	52
Receivables	425
Inventory	355
Total Current Assets	832
Fixed Assets	
Plant & Equip	1,610
Less Depreciation	400
Net Plant/Equip	1,210
Total Assets	**2,042**

Balance Sheet

Assets (as of 31 Dec xx)		**Liabilities** (as of 31 Dec xx)	
Current Assets		Current Liabilities	
Cash	52	Accounts Payable	87
Receivables	425	Notes payable	110
Inventory	355	Provisions for tax	145
Total Current Assets	832	Total Current Liabilities	342
Fixed Assets		Long Term Liabilities	
Plant & Equip	1,610	Debt	720
Less Depreciation	400		
Net Plant/Equip	1,210		
Total Assets	**2,042**		

Balance Sheet

Assets (as of 31 Dec xx)		**Liabilities** (as of 31 Dec xx)	
Current Assets		Current Liabilities	
Cash	52	Accounts Payable	87
Receivables	425	Notes payable	110
Inventory	355	Provisions for tax	145
Total Current Assets	832	Total Current Liabilities	342
Fixed Assets		Long Term Liabilities	
Plant & Equip	1,610	Debt	720
Less Depreciation	400	Common Shares (600K)	600
Net Plant/Equip	1,210	Retained Earnings	380
Total Assets	**2,042**	Total Net Worth	980
		Total Liabilities and Equity	**2,042**

Balance Sheet

Assets (as of 31 Dec xx)		**Liabilities** (as of 31 Dec xx)	
Current Assets		Current Liabilities	
Cash	52	Accounts Payable	87
Receivables	425	Notes payable	110
Inventory	355	Provisions for tax	145
Total Current Assets	832	Total Current Liabilities	342

Some important terms/concepts

- Current – receive or spend in current year
- Long Term – more than one year
- Balance Sheet – a snapshot in time

Ratio Analysis

Key Financial Ratios

Used to determine financial health of company

Types of Financial Ratios

- Liquidity Ratios
- Leverage Ratios
- Activity Ratios
- Profitability Ratios

Liquidity Ratios

First Concern – can the company pay its bills?

Quick and easy-to-use

Liquidity Ratios

Current Ratio: current assets divided by current liabilities

Ratio for company compared with same ratio for like companies in industry

Liquidity Ratios

Quick Ratio: current assets less inventory divided by current liabilities (only cash or close to cash – no inventory)

Called the "acid test"

Should be greater than 1

Ratio for company compared with same ratio for like companies in industry

Liquidity Ratios

Current Ratio for Example

Quick Ratio for Example

Liquidity Ratios

Current Ratio for Example = 2.43

Quick Ratio for Example = 1.39

Types of Ratios

- Liquidity Ratios
- Leverage Ratios
- Activity Ratios
- Profitability Ratios

Leverage Ratios

Used to show whose money has been invested in the company – owners or someone else (bank).

Creditors look at this (existing and new)

Owners want more of someone else's

Others want more of owner's

Leverage Ratios

Debt Ratio: Total Debt to Total Assets

In our example: 1,000/2,042 = .4897

Others have provided almost half the company's financing

Types of Ratios

- Liquidity Ratios
- Leverage Ratios
- Activity Ratios
- Profitability Ratios

Activity Ratios

Measure how effectively the firm employ its resources such as

- Average Collection Period

Types of Ratios

- Liquidity Ratios
- Leverage Ratios
- Activity Ratios
- Profitability Ratios

Profitability Ratios

Profit Margin

net profit after taxes/ sales

Return on total assets

net profit after taxes/total assets

Profitability Ratios

Profit Margin

net profit after taxes/ sales = 4%

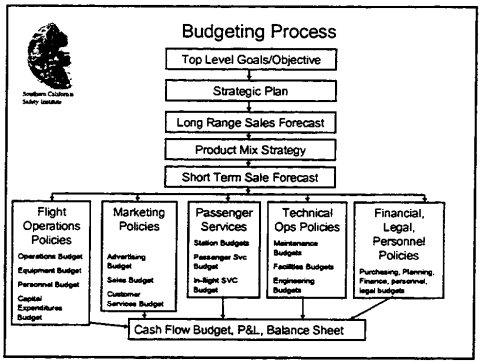
Return on total assets

net profit after taxes/total assets = 6%

Financial Ratios

Manager Looks at them over time

Takes action to correct them in improve financial performance



Correcting Financial Ratios

Things have changed!

The Business Class Customer 30% of revenue – is going away

Fuel Costs Going Up

Security Costs Going Up

Correcting Financial Ratios

The DuPont Model

Correcting Financial Ratios

How managers plan strategically to intervene to improve ratios

DuPont Model

See handout

Exercise with DuPont Model

Cash vs. Accrual

Cash Flow

Contribution Analysis

Contribution Analysis

Area A
Rev: 900
Exp: 500
HQ OH: 400
Profit: 0

Area B
Rev: 1100
Exp: 600
HQ OH: 400
Profit: 100

Corporate HQ Need: 1600

Area C
Rev: 1100
Exp: 500
HQ OH: 400
Profit: 200

Area C
Rev: 1500
Exp: 500
HQ OH: 400
Profit: 600

Contribution Analysis

Area B
Rev: 1100
Exp: 600
HQ OH: 533
Profit: -33

Corporate HQ Need: 1600

Area D
Rev: 1100
Exp: 500
HQ OH: 533
Profit: 67

Area C
Rev: 1500
Exp: 500
HQ OH: 533
Profit: 467

Contribution Analysis

Corporate HQ Need: 1600

Area D
Rev: 1100
Exp: 500
HQ OH: 800
Profit: -200

Area C
Rev: 1500
Exp: 500
HQ OH: 800
Profit: 200

Contribution Analysis

Corporate HQ Need: 1600

Area C
Rev: 1500
Exp: 500
HQ OH: 1600
Profit: -600

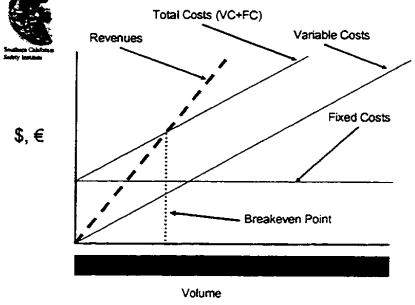
Contribution Analysis

Some Bad Decisions Are Made to Cut "non profitable activities

Contribution Analysis

It may not be profitable but it does help pay overhead

Volume and Breakeven Analysis



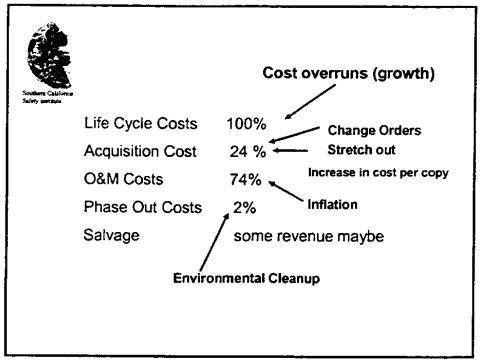
A Decrease in Revenue per unit means it takes higher volume to get to breakeven point

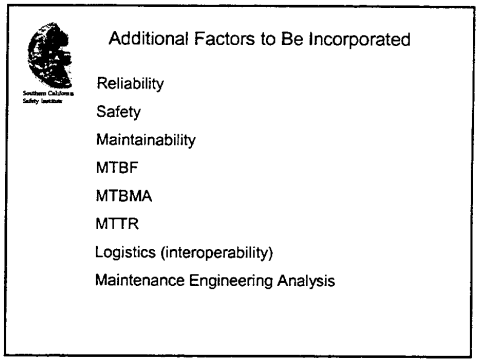
An increase in costs per unit means it takes higher volume to get to breakeven point

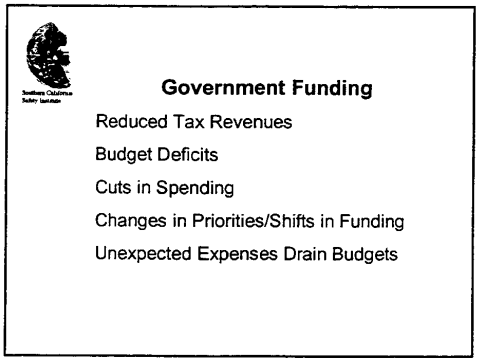
An increase in fixed costs means it takes higher volume to get to breakeven point

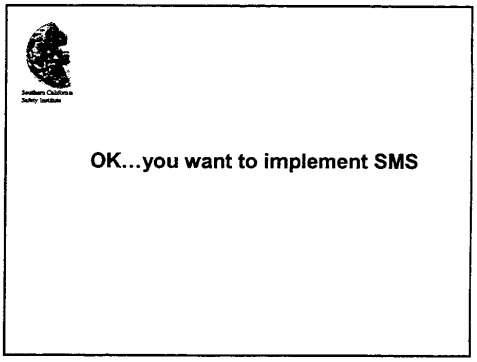
Government and Military Financial Planning and Control

Life Cycle Costs	100%
Acquisition Cost	24 %
O&M Costs	74%
Phase Out Costs	2%
Salvage	some revenue maybe

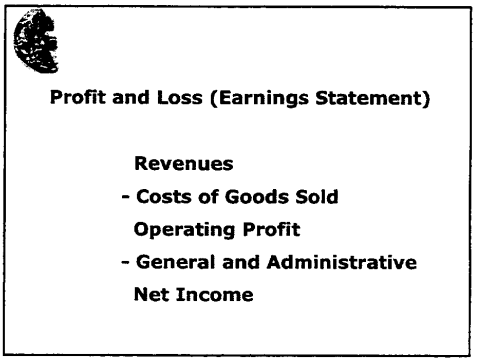

Cost overruns (growth)
Life Cycle Costs 100%
Acquisition Cost 24 %
O&M Costs 74%
Phase Out Costs 2%
Salvage some revenue maybe
Change Orders
Stretch out
Increase in cost per copy
Inflation
Environmental Cleanup


Additional Factors to Be Incorporated
Reliability
Safety
Maintainability
MTBF
MTBMA
MTTR
Logistics (interoperability)
Maintenance Engineering Analysis


Government Funding
Reduced Tax Revenues
Budget Deficits
Cuts in Spending
Changes in Priorities/Shifts in Funding
Unexpected Expenses Drain Budgets


OK...you want to implement SMS

Who do you see?
What kind of a proposal do you put together to make your case?


Profit and Loss (Earnings Statement)
Revenues
- Costs of Goods Sold
Operating Profit
- General and Administrative
Net Income

Profit and Loss (Earnings Statement)

Revenues
- Direct Costs

Operating Profit
- Indirect Costs

Net Income

Authorized Budget (Gov't/Military)

- Direct Costs
- Indirect Costs

Profit and Loss (Earnings Statement)

What is the impact of poor safety practices?

Revenues ↓
- Costs of Goods Sold ↑

Operating Profit ↓↓
- General and Administrative ↑

Net Income ↓↓↓

Authorized Budget

What is the impact of poor safety practices?

- Direct Costs ↑
- Indirect Costs ↑

Deficit ↑

Profit and Loss (Earnings Statement)

Where do the costs of safety programs show up?

Revenues
- Costs of Goods Sold ↑

Operating Profit ↓
- General and Administrative ↑

Net Income ↓↓

Authorized Budget

Where do the costs of safety programs show up?

- Direct Costs ↑
- Indirect Costs ↑

Deficit ↑

Profit and Loss (Earnings Statement)

Where do the benefits of safety programs show up?

Revenues ↑
- Costs of Goods Sold ↓
Operating Profit ↑
- General and Administrative ↓
Net Income ↑↑↑

Authorized Budget

Where do the benefits of safety programs show up?

- Direct Costs ↓
- Indirect Costs ↓
Surplus ↑

Financial Decision Making

Bottom Line: Does your safety program (proposal) generate more benefits measured in dollars/euros than costs?

Talk Dollars/euros! Not apple pie and motherhood. No hand waving!

To Introduce SMS

Get to UM level of management

Get the commitment of UM (define it)

Weave SMS into the Strategic Planning

Create Budgets (Plan and Control)

Project costs and benefits

Show benefits exceed costs

Monitor to verify benefits exceed costs

To Introduce SMS

Use the tools and vocabulary that UM uses and understands

Put Safety into the UM framework

Show how to implement SMS through the UM's process of strategic planning and control

Use operational definitions, measures of effectiveness that are quantitative when possible

Use proper problem definitions

To Introduce SMS

Use the tools and vocabulary that UM uses and understands

Put Safety into the UM framework

Show how to implement SMS through the UM's process of strategic planning and control

Use operational definitions, measures of effectiveness that are quantitative when possible

Use proper problem definitions

To Introduce SMS

Let's sketch out your approach to introducing SMS into your Organization

Management

Pete Gardiner

Pete Gardiner

- 27 Years University Professor
- 8 Years Department Chair, 3 years Chief Academic Officer of Academic Unit
- BS EE, MS Systems Management, Ph.D.
- Areas of Expertise
  - Management of Large, Complex, Socio-Technical Systems
  - Decision Making, Policy Analysis, Cost Benefit Analysis, Cost-Effectiveness, and Systems Analysis
  - Telecommunications Management and Information Security

Pete Gardiner

- Author of over 50 papers, book chapters, and presentations
- Six year researcher in Quantitative Social Sciences
- Consultant to Government and Industry
- Expert in Distance Learning
- President and CEO, SCSI (since 1997)

Pete Gardiner
A variety of Management Settings

- Managed in University Setting (Dept Chair and Deputy Division Manager Level
- Managed in Government Setting as one of five elected members of School Board and currently one of five elected members of City Council of Rancho Palos Verdes (42,000 residents)
- US Navy Officer and DOD Experience
- President and CEO, SCSI (since 1997)

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Goal of this Management Module

Understanding Managers
Insights into Management

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Why bother?

Management and Safety

Early in the aviation safety business, we spent about a third of our time exhorting and cajoling people to be safe; another third wandering around with a clipboard trying to catch them not being safe, and the other third investigating accidents. That kept us busy, but we didn't seem to be making a lot of progress.

Management and Safety

Eventually, we realized that safety was very much a function of management and it was time to start treating it that way. Current thinking holds that accidents are indications of a failure on the part of management.

Management and Safety

If you agree that accident prevention requires change, then you must agree that the key player is not the aviation safety manager. It is some other manage with the power and authority to direct change. This is absolutely true and it puts the burden of accident prevention right where it belongs: in the line manager's office. Once we get by that hurdle, it is easy to see that safety programs can be managed just like any other program. Basic management principles work just fine.

Richard H. Wood
Aviation Safety Programs:
A Management Handbook, 1991

Management and Safety

If you agree that accident prevention requires change, then you must agree that the key player is not the aviation safety manager _____. It is _____ with the power and authority to direct change. This is absolutely true and it puts the burden of accident prevention right where it belongs: in the line manager's office. Once we get by that hurdle, it is easy to see that safety programs can be managed just like any other program. Basic management principles work just fine.

Management and Safety

If you agree that accident prevention requires change, then you must agree that the key player is not the aviation safety manager who is staff. It is with the power and authority to direct change. This is absolutely true and it puts the burden of accident prevention right where it belongs: in the line manager's office. Once we get by that hurdle, it is easy to see that safety programs can be managed just like any other program. Basic management principles work just fine.

Management and Safety

If you agree that accident prevention requires change, then you must agree that the key player is not the aviation safety manager who is staff. It is line management with the power and authority to direct change. This is absolutely true and it puts the burden of accident prevention right where it belongs: in the line manager's office. Once we get by that hurdle, it is easy to see that safety programs can be managed just like any other program. Basic management principles work just fine.

Management

This is especially true in the Safety Management Systems approach which basically takes the view that accidents are organizational accidents and moves the responsibility for Safety to all line managers top to bottom

Management

Safety Managers Need to Understand Line Managers

Management

There is no obligation for Line Managers

- to understand Safety
- to learn Safety Terms
- to learn Safety Methods and Techniques
- to understand Safety Programs

Management

To close any gap, Safety Managers will have to learn about and understand line managers and principles of management

Management

This four hour segment is to give you a glimpse into management so you can

- Understand line management
- Be effective in getting a line manager's attention
- Talk line management language
- Get action from line managers at all levels – **maybe**

Management

Let's Get Started

Management

Line Management = ?
Staff Management = ?

Management

- **Line Managers**
  - Make decisions about people, money, and things directly related to goal/mission
  - Invent goals/mission statements
  - Have responsibility, authority, and accountability to achieve goal/mission
- **Staff Managers**
  - Advise and recommend to line managers
  - Indirectly related to goal/mission

Management Setting

Start-up, Brand new
Existing Slot in Existing Organization

Management Setting

Commercial, Industry
Government, Military

Different?

Management Level

Upper Management
Middle Management
Lower Management

Different?

What is being Managed?

Big Company/Agency
Small Company/Agency

Different?

Management

What do managers do?
How do they spend their time?
What gets the attention of managers?

Management Exercise

List the three most important things line managers have to know/worry about

Management – did you say

Keep the place running
Don't make any big mistakes
Stay within your budget
Try not to get sued
Know the regulations and procedures
Don't make the 6 o'clock news

Management – did you say

Push for Continuous Improvement
Be Creative and Innovative
Set Clear goals and repeat them often everywhere
Find and train good managers to work for you
Think "outside the box"

Management

Let's look at some Management Course Outlines

Management

What a mess

Management

6 schools of management
11 schools of management

Management

Where did your manager go to school?

How Management Got Started

- Everyone worked for himself – made and sold their own stuff
- Everyone worked for himself – made and sold stuff to a middle man who sold it to others
- Everyone worked for someone else who had a factory and made and sold stuff – paid a wage – was called the "boss"
- Boss was often biggest and strongest – not much known about getting people to work – i.e., not much known about management

Management

In the early 1900's Fredrick W. Taylor and Henri Fayol wrote two books on management

This started the writing of books on management

Management

Now there are hundreds of books on management
All saying something different

Management

So who gets the attention of LM?

Management

MM

Management

Who gets the attention of MM?

Management

UM

Management

Who gets the attention of UM?

Management

Let's see if we can sort this out.

Management

Who do you need to get the attention of?

Management

Please write down the following:

The title of the "Boss" in your system?

Write down the chain of command to the ultimate Boss

Management

Let's look at some of the things Upper Managers do

Then we can talk about how Safety "fits in"

Management

Planning
Organizing
Staffing
Leading
Controlling

Management

Planning
Organizing
Staffing
Leading
Controlling

Management

Focus on Planning and Control Goes Against a Long Standing Tradition –

When in Doubt, Reorganize!

Management

Planning
And
Controlling
And
Adjusting Plans

Management

Financial Planning

Organizing
Staffing
Leading

Financial Controlling

Strategic Management (UM)

Strategic Planning
- External Environment

Organization Structure
- Organizational Culture

Strategic Control
- Internal Environment

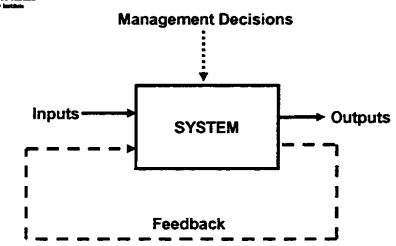
Resource Requirements
- Availability

Strategic Management (UM)

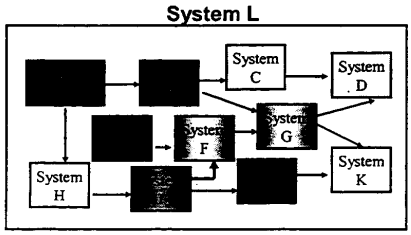
Can't talk management without talking about what is being managed

Inputs-Outputs System Model

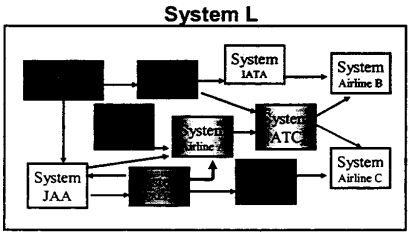
Inputs are transformed to Outputs by System being "Managed"

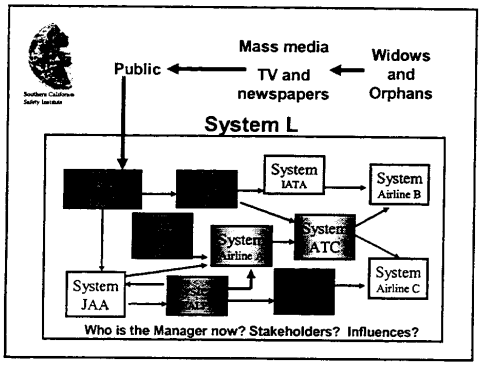


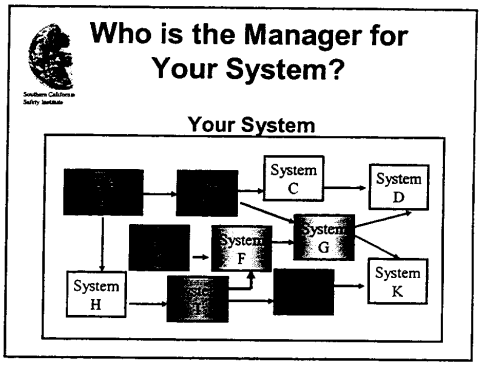
Who is the Manager for System L?

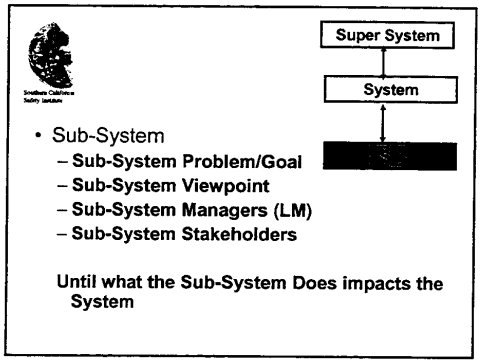


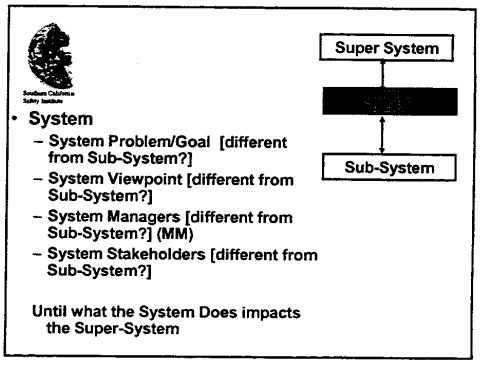
There may or may not be "a" Manager for System L

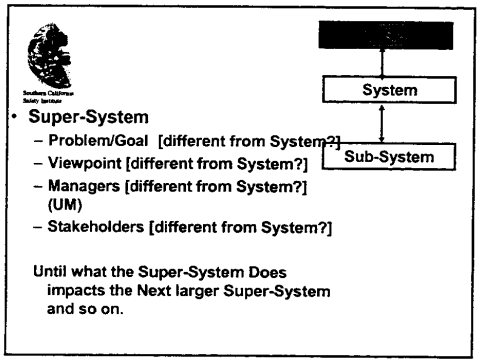


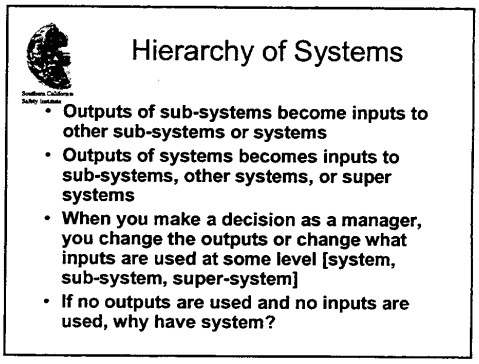

Mass media
Public
TV and newspapers
Widows and Orphans
System L
System IATA
System Airline B
System Airline A
System ATC
System Airline C
System JAA
Who is the Manager now? Stakeholders? Influences?


Who is the Manager for Your System?
Your System
System C
System D
System F
System G
System H
System K


Super System
System
• Sub-System
– Sub-System Problem/Goal
– Sub-System Viewpoint
– Sub-System Managers (LM)
– Sub-System Stakeholders
Until what the Sub-System Does impacts the System


Super System
Sub-System
• System
– System Problem/Goal [different from Sub-System?]
– System Viewpoint [different from Sub-System?]
– System Managers [different from Sub-System?] (MM)
– System Stakeholders [different from Sub-System?]
Until what the System Does impacts the Super-System


System
Sub-System
• Super-System
– Problem/Goal [different from System?]
– Viewpoint [different from System?]
– Managers [different from System?] (UM)
– Stakeholders [different from System?]
Until what the Super-System Does impacts the Next larger Super-System and so on.


Hierarchy of Systems
• Outputs of sub-systems become inputs to other sub-systems or systems
• Outputs of systems becomes inputs to sub-systems, other systems, or super systems
• When you make a decision as a manager, you change the outputs or change what inputs are used at some level [system, sub-system, super-system]
• If no outputs are used and no inputs are used, why have system?

This is why we have Organization Theory: How do we Organize?

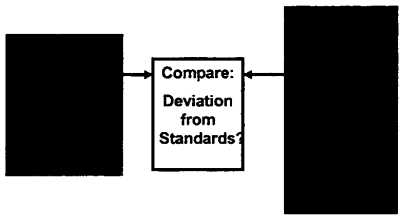
- Functionally: operations, maintenance, marketing, inspections, engineering, legal, safety, etc.
- Geographically: Brussels, Berlin, New York, Los Angeles, Sidney, Taipei
- By product: regional, long distance, cargo, passengers, etc.
- By "Customer": Military, civilian, other government use, commercial, business traveler, vacationers, etc.
- Matrix Organization

Why and When do Managers Make Decisions?

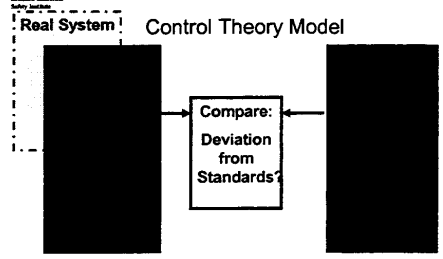
- Something went wrong
- Something is going to go wrong if we don't do something
- New opportunity presents itself – what we have been doing doesn't look so good now

Why and When are Decisions Made?

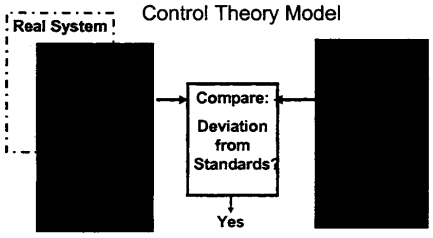
Control Theory Model



Why and When are Decisions Made?

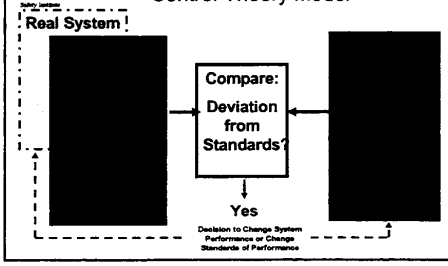


Why and When are Decisions Made?



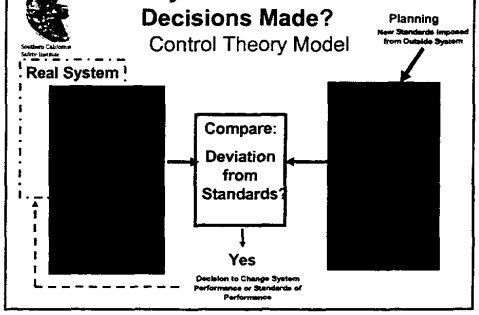
Why and When are Decisions Made?

Control Theory Model



Why and When are Decisions Made?

Control Theory Model



Why and When are Decisions Made by Managers?

Control Theory Model

1. When there is a deviation from a standard or standards. System performance deviates from desired system performance.
2. When there is a projected deviation from a standard or standards. Deviation has not yet occurred but is projected to occur.
3. When setting new standards of performance. To achieve new goals and objectives. (could arise from new opportunities)

Why and When are Decisions Made by Managers?

Control Theory Model

To Solve Problems or solve Anticipated Problems

- What is a problem?
- List Some Illustrative Problem Statements?

Why and When are Decisions Made by Managers?

Control Theory Model

Problem Statements?

1. It takes six months to train a new Director of Safety.
2. The Ground Approach Radar is not adequate.
3. Our office does not have a large enough budget.
4. The airport security is not good enough.
5. Your example?

Why and When are Decisions Made by Managers?

Control Theory Model

Let's make these Problem Statements

1. It takes six months to train a new Director of Safety.
2. The Ground Approach Radar is not adequate.
3. Our office does not have a large enough budget.
4. The airport security is not good enough.
5. Your example?

Why and When are Decisions Made by Managers?

Control Theory Model

Let's make these Problem Statements

1. It takes six months to train a new Director of Safety and it should only take four.
2. The Ground Approach Radar is not adequate as measured by comparing xxx to the standard which is yyy which shows a deviation of zzz.
3. Our office budget is xxx which will fund yyy man hours of work. The projects we have been asked to do total zzz man hours of work. Therefore there is a budget shortfall of QQQ.
4. The airport security had 50 type I errors last month and 75 type II errors. The standard is 5 type I errors and zero type II errors.

Why and When are Decisions Made by Managers?

Control Theory Model

To Solve Problems or solve Anticipated Problems

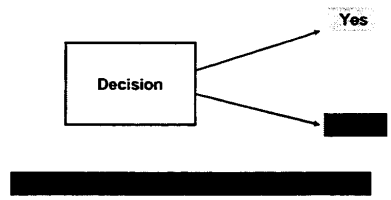
- A problem occurs when a system's performance deviates from desired performance
- A problem is projected when a system's performance is projected to deviate from its desired performance

Why and When are Decisions Made by Managers?

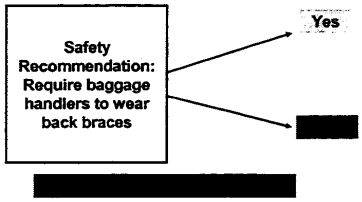
Control Theory Model

A correctly formulated problem statement allows managerial decision making. It can often suggest the types of alternatives to be considered when making a decision.

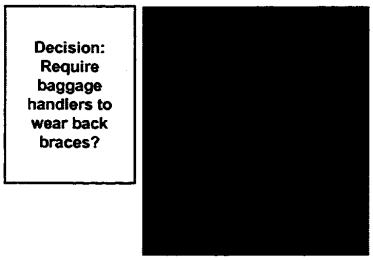
Example Problem Definition



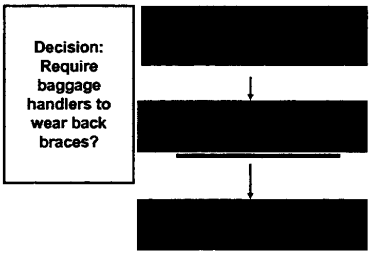
Example Problem Definition



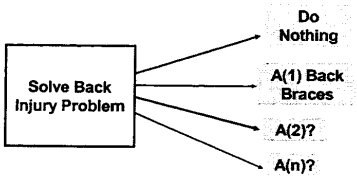
Example Problem Definition



Example Problem Definition



From a Management view



How many alternatives do you need to consider, analyze, and present to the Manager?

Management Measures of Effectiveness

What is it you want to achieve?

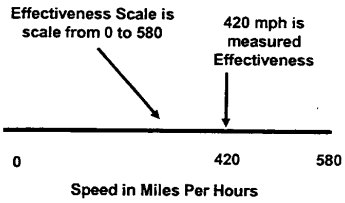
How do you want to measure it?

Management Measures of Effectiveness

Effectiveness Scale. Scale selected to indicate the degree of achievement of objective (Measure of Effectiveness – **MOE**)

Effectiveness. The position on an effectiveness scale established by measurement, prediction, or estimation

Example of MOE



Fuzzy, Foggy Hand Waving Definitions

Leave us unclear on how to take measurements and collect data

- e.g. 1: measure "Incidents"
- e.g. 2: We want a "safe system"

What are they talking about??? What do they mean???

Operational Definitions

Operational definitions tell us what to measure and how. Gets rid of ambiguity. Answer the question "as measured how?"

- Effectiveness is measured by "number of required incident reports filed per year"
- Effectiveness is measured by "average number of consecutive days between reportable incidents"

Other Examples?

Data Types

When talking with Managers, numbers are better than words

Data Types

We have a "good" safety record

We are "not likely" to have any major accidents in the next ten years

Data Types

"good" means what?

"not likely" means what probability?

Words or numbers? Quantifying the Unquantifiable?

- An accident is likely. P= ?
- An accident will seldom happen. P = ?
- There is a significant chance this hazard will cause an incident. P = ?

Data Types

Three different types of data

- Objective Measurements on Objective Scales
- Subjective Measurements on Objective Scales
- Subjective (subjective scales, open ended comments,etc.)

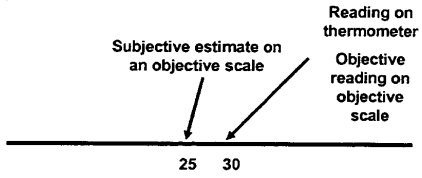
Examples?

Data Types

What kind of Data?

- 30 degrees C measured by thermometer
- Estimated 25 degrees C by human expert
- Rated "Very Hot" on a five point scale ranging from Very Cold to Very Hot indicated by a participant.

Data Types



Data Types

1. Very hot
2. Hot
3. Neutral
4. Cold
5. Very Cold

Please circle the answer that most closely reflects you views about temperature

5 point Subjective Scale with instruction

Measurement Issues

1. Are we looking in the right places for data?
2. Do the data have unintentional errors?
3. Do the data have intentional errors?

Caution: Just because it is a number, does not mean it's correct or useful!

Establish the Figure of Merit (FOM) what Managers use to base the decision upon

Figure of merit (Criterion)

Rule or standard used for ranking any alternatives under consideration in order of desirability

Best alternative has best FOM

Some Typical Figures of Merit (FOM)

- Cost – Benefit FOMs ($, € only)
- Return on Investment ($, € only)
- Earnings Per Share Impact
- Will I get Sued? Fired? Demoted?
- Cost – Effectiveness FOMs ($,€ +1 non $,€)
- Multiple Objectives FOMs ($,€ + many non $,€)

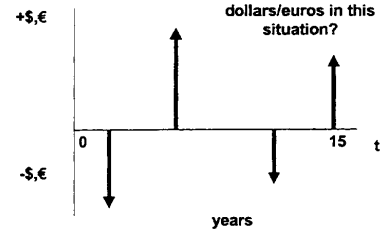
Cost-Benefit FOMs

All Consequences measured in Dollars or "Dollar Proxies"

- Time Value of Money
- Various Engineering Economy and Economic models (e.g., Net Present Value, internal rate of return, incremental cost-benefit)
- Cost-Benefit ratio is incorrect use of this method
- Not a realistic approach in most settings
- Exceptions: Return on Investment, Payback Period
  - Technically incorrect unless take into account time value of money
  - Frequently Used

Time Value of Money

Is there one number to describe "net" dollars/euros in this situation?



Cost-Benefit FOMs

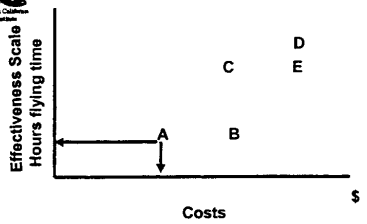
All Consequences measured in money or "money Proxies" or arrived at by use of money proxies

- Net Present Value (B-C) ($,€ 55,000,000)
- Internal rate of return 8.5%
- Incremental cost-benefit) ΔB / ΔC
- Cost-Benefit ratio B/C (incorrect!)
- Return on Investment ROI
- Payback Period x Months

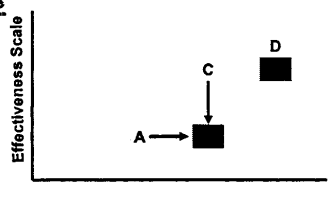
Cost-Effectiveness FOMs

- All cost consequences are computed taking into account time value of money
- One objective (measure of effectiveness) is used
- Goal (Pivot Rule)
  - **Maximize effectiveness for a given cost**
  - **Minimize cost for a given effectiveness**

Cost-Effectiveness FOMs

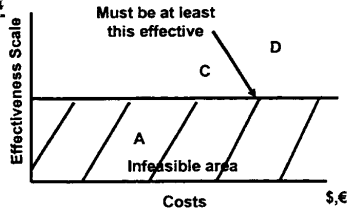


Cost-Effectiveness FOMs



Which Alternative is the best?

Cost-Effectiveness FOMs



Select the lest expensive alternative that meets the minimum required effectiveness

Multiple Objective FOMs

- Many different objectives each with own scales of effectiveness (e.g., mpg, braking distance, number of passengers, and purchase price for a car)
- How do we find an overall value when there are many measures of performance – all different?

Multiple Objective FOMs

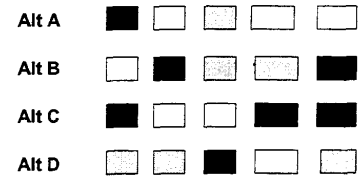
- Stoplight Charts (color scorecards)
- Multi-Attribute Utility Measurement
- Decision Analysis

Color Scorecards (stoplight chart)

Alt A	12	56	1.4	1232	Good
Alt B	25	45	1.6	1400	Poor
~~Alt C~~	~~11~~	~~55~~	~~1.0~~	~~850~~	~~Poor~~
Alt D	37	60	.78	1200	Excellent

Which one is best? (larger number is better)

Color Scorecards (stoplight chart)



Which Alt is best?

Setting Objectives

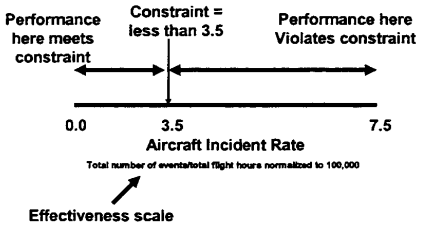
Setting Objectives (using MOEs)

- Whose objectives? Which Manager's?
- How many objectives? (See FOM)
- Operationally Define all Objectives
- Set Constraints

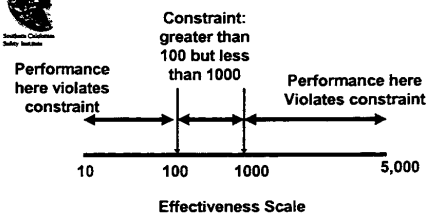
Constraints

Restrictions or requirements put on system performance which must be met.
A Position on the effectiveness scale.
Also called Standards.

Constraint Example



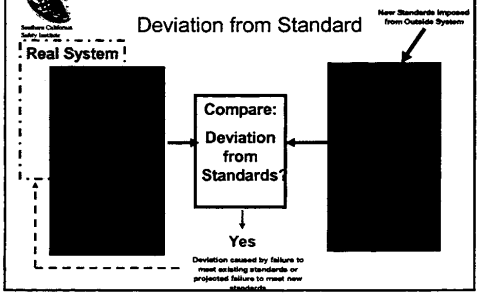
Constraint Example



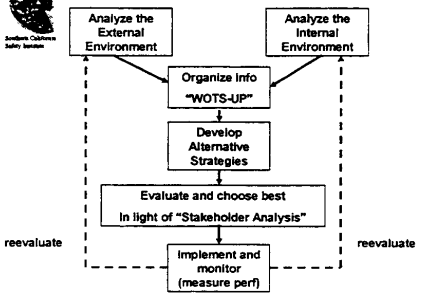
Constraints

- Internal Constraints. Restrictions placed on system performance but manager has authority to change them.
- External Constraints. Restrictions placed on system performance that cannot be changed by manager.
- Hard Constraints. Must be met (e.g. G Force, laws of physics)
- "Soft" Constraints. Nice to have. "Whims of someone, somewhere."

Problem Definition



UM Strategic Planning Process



Strategic Planning (UM)

Illustrative Tools Used

WOTS-UP Analysis
ETOP (Environmental Threat and Opportunity Profile)
Environmental Scan
Vulnerability Analysis
Growth Vector Analysis
Product Life Cycle
Product Portfolio Analysis
Strategic Position and Action Evaluation

Strategic Planning (UM)

Illustrative Tools Used Continued

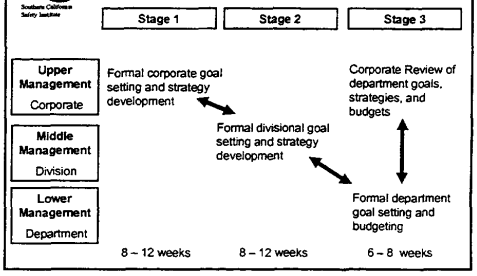
Value Chain Analysis
Country Risk Assessment
Financial Analysis
Strategic Funds Programming
Company Capability Profile
Key Result Objectives

Strategic Planning (UM)

Illustrative Tools Used Continued

Cost/Benefit Analysis
Reactive Four Force Analysis
Decision Style Inventory
Social Change Model
Assessment of Cultural Elements
Stakeholder Analysis

Strategic Planning Cycle



Class Exercises

WOTS-UP
Key Results Objectives
Stakeholder Analysis

We will focus on financial matters on Tuesday Morning

Manager Perspectives

TOP Profile Test

Manager Perspectives

TOP Approach

- **Recognize Different Approaches used by managers to make decisions**
  - **Technical (T)**
  - **Organizational (O)**
  - **Personal (P)**
- **Examine impact of approaches**

Manager Perspectives

Have you ever done a "perfect" technical study, recommended the correct action, and had your recommendations and study rejected?

Manager Perspectives

Managerial decision making involves organizations and individuals, whose perspectives are very different from those who use formal, "rational" decision processes.

Different Perspectives Occur when

- Problems are hard to structure (typically in large, complex systems)
- Significant human (societal or individual) aspects are present
- Formal studies and analysis methods are used (quantitative)

The Rational approach and its assumptions

- problems can be "solved"
- there is a "best" solution or decision
- A model of a system -- although limited -- approximates the real system well enough
- Rational people are objective

The Rational approach and its assumptions

- **Required information can be quantified**
- **Individuals can be ignored**
- **Movement of time (pace of events) is universally accepted by physical measurement. Passage of time is perceived the same by all**
- **Methods that work in science and technology will work in society and its socio-technical systems.**

Some famous quotes

- Systems analysis is a "celebration of human rationality" -- Herbert Simon, Nobel Laureate
- The challenge is to enlarge this celebration to include the rational management of all of society's systems and their problems -- Hugh Miser

The Problem-Solution Assumption

- Every problem has a solution, an optimal solution – but:
  - **"solutions" often create new problems**
  - **We often shift problems rather than solve them**
  - **There may be no solution**
  - **It may be a "mess" and we must do "mess management"**

The Optimization Assumption

Search for "the optimal solution" -- but:

- **Many simply seek to avoid failure**
- **Many seek to maximize options (leave options open)**
- **Seek to survive (have resilience)**
- **Many simply accept the first solution that works. They don't look for a better solution.**

Reductionism Assumption

- **Simplify the complex by dividing. If still too complex, keep on dividing until we get to a problem we can "solve" – but:**
  - **Use averages and probabilities work with large numbers but can be troubling with small numbers or individuals**
  - **Does a probability of .12 make it the most likely if it is the largest probability?**
  - **Events with very low probability can cause terrible damage.**

Reductionism Assumption

- Vast simplifications cause problems.
  - A system with three elements has 49 possible interactions. A system with ten elements has over one million possible interactions $(2^n - 1)^2$
  - Reducing a system from 10 elements to 3 to make an analysis more manageable, removes over one million possibly significant interactions!
- Simplifications that seem harmless, may turn out to be vast.
- Solutions chosen that work on models of the real world system may not work in the real system

Reliance on Data and Models Assumption

- Models can provide insights – but:
  - We can overreach when we claim a model mimics the real world system
  - Models can lead to group think
  - Model assumptions are often ignored
  - A computer model may simulate a social system but it does not duplicate it
  - Pygmalion complex (fall in love with our model)

Reliance on Data and Models Assumption

- None of the goals in using large scale models have been achieved

Quantification Assumption

- Quantitative analyses tend to drive out qualitative analyses – but:
  - People's worth is measured in dollars and Societies are measured by Gross National Product [does not set well]
  - Measure whatever can be easily measured and then disregard what can't be measured or give it an arbitrary value [misleading]

Quantification Assumption

- Assume what can't be measured is not very important [blindness]
- Assume what can't be measured doesn't really exist. [suicide]
- Quantification engenders self-delusion
- People tend to underestimate the probabilities of failure in complex systems

Objectivity Assumption

- The professional is "objective" – but:
  - It is impossible to eliminate all bias
  - Objectivity cannot occur. The claim that the bias of an observer must not enter into the description of his/her observation is nonsense, because without the observer there are no descriptions.
  - The choice of model and data, problem definition and boundaries, is always subjective.

Ignoring the Individual

- **Models have to aggregate – but:**
  - **There is a danger in ignoring the individual**
  - **Tools and models that work at the global level do not work very well at the individual level**
  - **Individuals can be crucial in socio-technical systems**
  - **A person alone is different from a person in groups of 3, 11, 40, 4,000, 60,000 and so on. [James Thurber letter to E.B. White, 20 Jan 1938]**

Perception of Time Assumption

- **Time moves linearly, to a universally accepted pace determined by precise physical measurements – but:**
- **There are relative time horizons**
  - **Technological time [longest time horizon]**
  - **Social time [next longest time horizon]**
  - **Personal time [shortest time horizon]**

Difficulty with Rational Approach

- Rational decision making
  - **Performed for other rational decision makers**
  - **Not performed for audience that needs it**
  - **Does not work for people with another approach**

Understanding Perspectives

- Focuses on how we look at a problem or system not on what we are looking at.
- Like a pair of magic glasses that filter out everything except our own perspective.

Multiple Perspectives for Decision Making

- Technical Perspective: a rational perspective.
- Organizational Perspective
- Personal Perspective

Organizational actors

- Cohesion – formal or informal leadership
- Structure and power
- Communication patterns, programmed responses, decision rules, nonroutine decision processes

Organizational actors

- Incentive reward system – motivational assumptions
- The Crowd, warring crowds, rent-a-crowd
- Bureaucracies

Individual Actors

- Entrepreneur
- Charismatic Politician
- Terrorist
- Visionaries and realists
- Promoters and obstructionists
- Operators and theoreticians
- Bold and Dynamic
- Conservative and cautious

Perspectives:
the "filters" we use to see the world

Technical Perspective

- How we see things
  - **Rational**
  - **See the system as a structure**
  - **Model it**
  - **Apply decision analysis**

Organizational Perspective

- How we see things
  - **see the system as powerful or weak**
  - **a collection of fighting competitors**
  - **cohesive or divided**
  - **a collection of strong divisions and department under a weak chief executive officer, or a strong CEO with loyal lieutenants running sub units**
  - **powerful staff and weak line or vice versa etc.**

Personal Perspective

- How we see things
  - **See system as job security**
  - **Opportunity to exert power**
  - **Step to gain prestige**

Perspectives Defined

- **Technical Perspective**:
  - Dominant perspective in the systems, risk analysis, and decision making literature
  - World is seen in quantitative terms and computer models
  - Analytical in nature [e.g., cost-benefit analysis]
  - Use of matrices, charts and graphs
  - Start with a problem and develop a solution

Perspectives Defined

- Organizational Perspective:
  - **Seen from the point of view of those being impacted by decisions**
  - **Concern whether a decision will threaten the organization's rights, standing or stability.**
  - **Will decision fit the current standard operating procedures and parochial priorities**

Perspectives Defined

- Organizational Perspective:
  - **We deal with power**
  - **Where is the real leverage in a system**
  - **How can conflicts among units be turned to constructive use**
  - **No interest in analytic tools**
  - **Mistrust of "academic" techniques. They are unrealistic, unpredictable, and uncontrollable**

Perspectives Defined

- **Organizational Perspective**:
  - Short range consequences are given priority over long term
  - Each organizational actor knows the priorities and interests in his/her system. They are distinctive to his/her system.
  - Fear of making errors
  - Break down and allocate problems along lines of organizational responsibilities

Perspectives Defined

- **Personal Perspective**:
  - Most subtle and elusive perspective
  - World is seen through filter of the individual's eyes and brain
  - These people are the "movers and shakers" in a system.
  - Use of intuition, leadership and self interest
  - Strong system of beliefs, emotions, ethics

Perspectives in practice

- Predominant perspective?
- Perspectives can shift over time
- Integration of Perspectives?

	Technical Perspective	Organizational Perspective	Personal Perspective
Goal	• Problem Solving • focus on the product (a study, a recommendation)	• Stability and continuity • focus on process, action and implementation	• Power, influence, prestige, • maintaining status, improve status
Modes of Inquiry	Models, data, analysis	Discussion, negotiated reality, consensus	Intuition, individual experience, individual "reality"
Time Concept	Technological time	Social time	Personal time
Planning Horizon	Far, but often little breadth, narrow focus	Intermediate, intermediate breadth	Short, variable breadth
Discount Rate	Small	Medium	High
Constraints	• Simplify problem by limiting variables • Cause and effect • Need to validate, replicate • Objectivity emphasized	• Divide problem up • Delegate to others to avoid problem • Agenda (what's important at the moment) • "Political" sensitivity • Expediency • Loyalty; credentials • Restricted access	• Individual needs (Maslow's hierarchy) • Challenge and Response • Each person imagines the attributes of others • Inner world subjectivity

	Technical Perspective	Organizational Perspective	Personal Perspective
Characteristics	• Prediction • Optimization (best) • Feedback loops • Quantification • Use of averages, probabilities, trade offs • Uncertainties noted • Many Caveats ("on the one hand ...")	• Recognition of partial unpredictability • Long range planning often ritualized • Satisficing (first acceptable rather than optimal solution • Incremental change, Slow adaptation, • Standard Operating Procedures • Parochial priorities • Compromise and bargaining • Monitoring and correction •Uncertainties avoided •Fear of error,	• Need for certainty • beliefs • Creativity and vision of the few • Limited number of alternatives • Limited number of variables • Filter out images and info inconsistent with past experience • Game playing • Focus on simplistic • Leaders and followers • Fear of change and unknown
Method of Communication	Technical Report and Briefing	Directive, Conference Private language with insiders, Encouraging words with public	Narrative (story) Discussion,

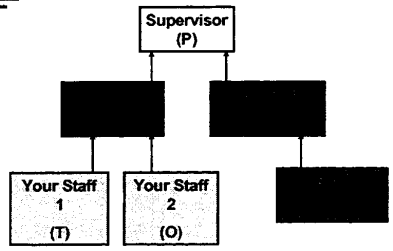
Examples of Perspectives in Managerial Decision Making

- Commercial Aircraft: The Wide-Body Trijets
- The DC-10 Cargo Door

Examples of Perspectives in Managerial Decision Making

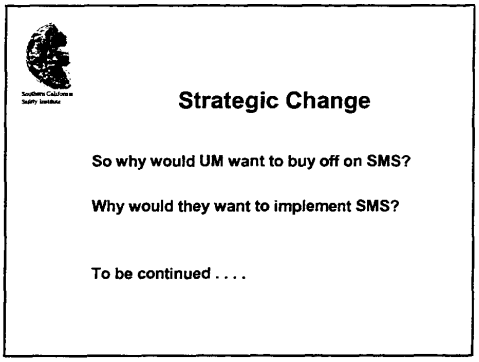
- **Your Results of TOP Profile Test**

Who listens to whom? How to succeed or fail

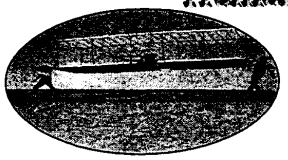


Strategic Change

- SMS is a strategic change
- Absolutely Involves UM
- Starts with UM
- Must be supported by UM
- Enters entire organization through strategic planning process at all levels
- Must have measurable indicators showing success


Strategic Change
So why would UM want to buy off on SMS?
Why would they want to implement SMS?
To be continued . . . .

Introduction to Human Factors



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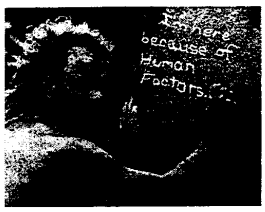

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Flight of Icarus

Exxon Valdez

Human Factors

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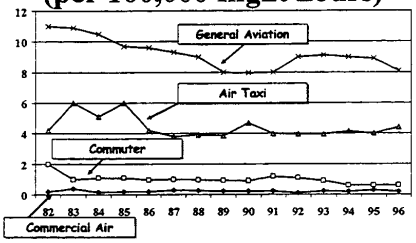
World Wide Accidents (per 100,000 flight hours)



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Human Factors

SCSI Southern California Safety Institute 5

Human Factors Principles

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Outline

1. Human error defined
2. What do we mean "Human Factors"?
3. Basic model of human performance
4. Performance Biases
5. Organizational Perspective

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Human Error

"The failure of planned actions to achieve their desired results.... Without the intervention of some unforeseeable event."
James Reason

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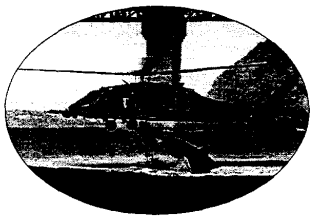
Unforeseeable event?



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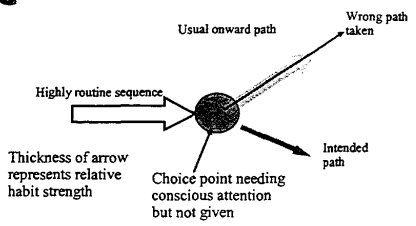

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Or.....

"When there is general agreement that the individual should have done other than what they did, and in the course of that conduct inadvertently causes or could cause and undesirable outcome."
David Marx, JD

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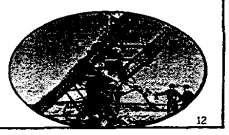
Human Error

- ✗ The plan was good but something went wrong that we did not intend
- ✗ Our actions went according to plan, BUT it was not a good plan
- ✗ The actions were intended and they were not sound



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Human Error

As an organization, how must we view error?

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Human Error

- A window on a problem
- A marker of everyday behaviours
- An opportunity to learn more about the:
  - Organizational opportunities
  - Operational opportunities
  - Technological opportunities

that create error potential!

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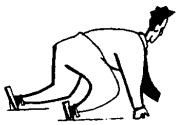
Human Error

It is the starting point of an investigation,
NOT the end!



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So what are Human Factors?

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Human Factors & Technology?

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Basic Model of Human Performance

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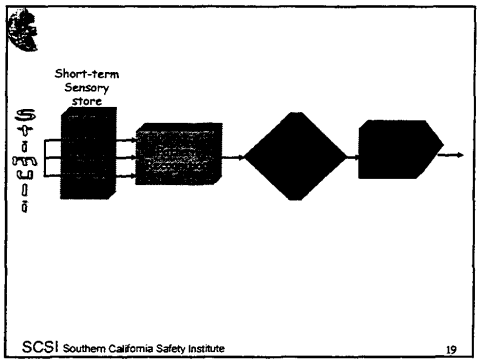
Short-term Sensory store
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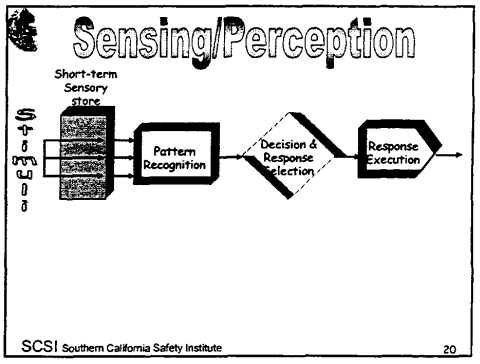
19


Sensing/Perception
Short-term Sensory store
Pattern Recognition
Decision & Response selection
Response Execution
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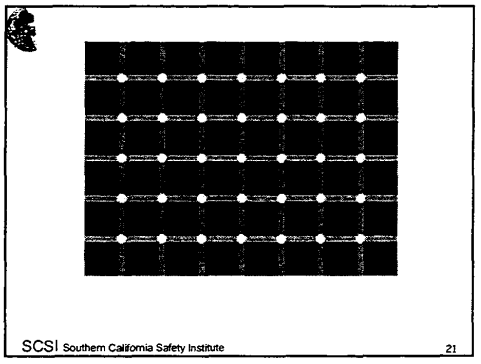
20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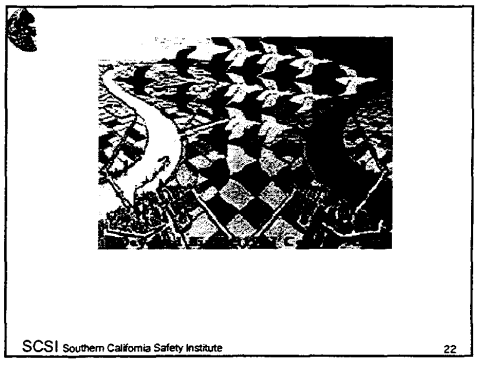
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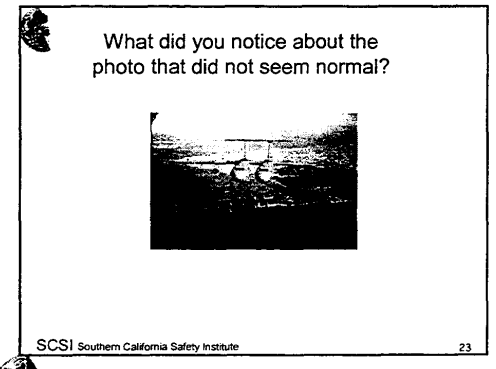
What did you notice about the photo that did not seem normal?
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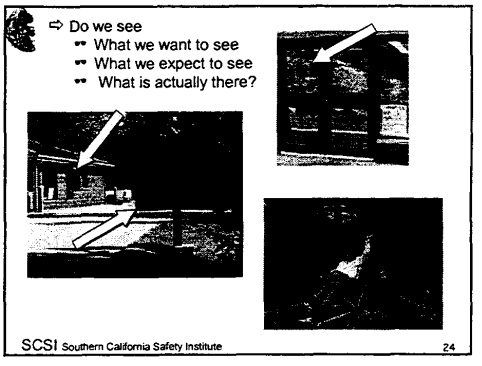
23


Do we see
What we want to see
What we expect to see
What is actually there?
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24

Case Study

Sensing and Perception

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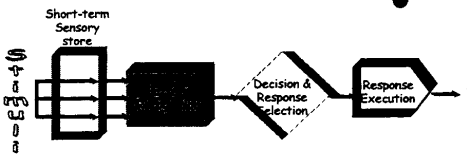
Information Processing



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What do you See?

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Case Study

Information Processing

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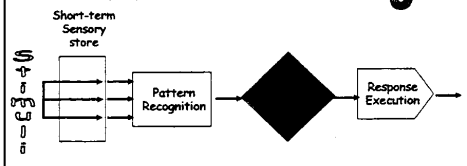
Decision Making



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Decision Making = Risk Management

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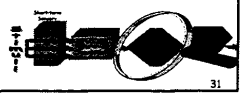
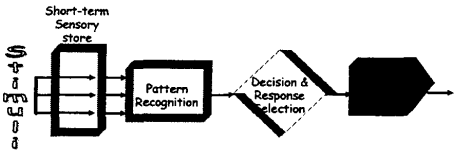
Case Study

Decision Making



Action



Case Study

Errors of Response/Action

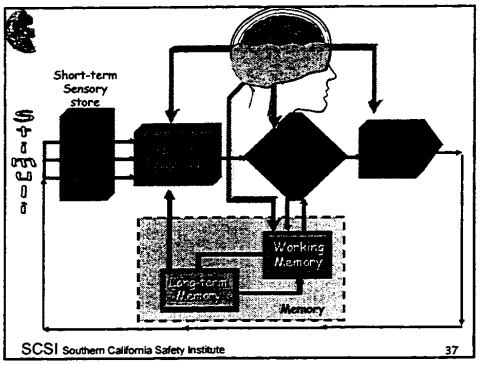
Action error or Decision Error or...?

Action Errors (Active Failures)

- Moving the wrong switch, lever, knob
- Putting in the wrong control input
- Pressing the wrong pedal while driving a tug
- Difficult to assess without consideration of the other 3 steps
- The environment we work in is time critical
- The result of pressures, real or perceived, always results in the speed accuracy trade-off

How much time does it take?

Action	Time (Seconds)



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Human Factors Spectrum

Physical Factors Sociological Factors Management and Training

Psychological Factors Engineering Factors

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Physical Factors

- Temperature
- Acceleration
- Altitude
- Fatigue
  - jet lag
  - sleep
- Vision/Illusions
- Physiology

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Physical Factors

- Acceleration

Example: CF188714 1995, Cold Lake

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Psychological Factors

- Illusions
- Stress
- Workload
- Information Processing
- Decision Making
- Attitude and Motivation
- Complacency, Expectancy, Habit Patterns etc.

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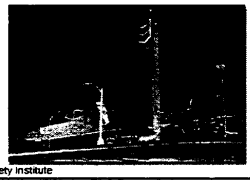
Psychological Factors

- Decision Making
- Attitude and Motivation



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Sociological Factors

- Communication
- Mental model overlaps
- Personality
- Leadership
- Culture

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Sociological Factors

- Leadership
- Culture

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Engineering Factors

- Anthropometrics
- Man-machine interface
- Biomechanics
- Workspace design
- Controls,Instruments and Displays

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Engineering Factors

- Workspace design

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Management and Training

- Organizational factors
- Policy
- Leadership/Supervision
- Standards
- Training
- Documentation

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Management and Training

- Policy
- Leadership/Supervision
- Training

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Your Decision Making...

- "sub-optimal"
- built-in biases
  - representative heuristic
  - hindsight bias
  - confirmation bias
  - overconfidence in judgements
  - availability heuristic
  - framing bias

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A Bad decision - but whose?

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Coin Toss

1) TTTHHH

2) THHTHT

T = Tails
H = Heads

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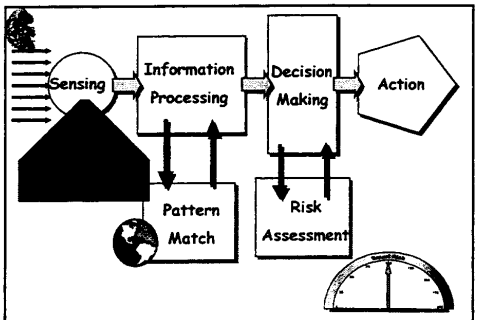

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Hindsight bias

- biased judgements of past events after the outcomes are known

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Confirmation Bias

- The tendency to only accept facts that confirm a theory and reject those facts that do not fit the theory

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Pay attention to the list of names

Q: Were there more men or women in the previous list?

A: There were an equal number of women and men.

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Availability Heuristic

- Tendency to judge events that are more noticeable or that have happened before as more likely to happen again

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Expectation bias

- Events in the past can modify ideas in the present.

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Framing bias

- Decisions can be influenced by how the information is presented
  - Car accident study
    - 2 Groups
    - Smashed vs. Contacted
    - Speed difference
    - Broken Glass

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Case Study

Framing Bias

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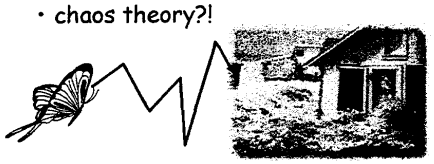
System Perspective

- systems: no part isolated from the system, all parts influenced (eco system)
- chaos theory?!



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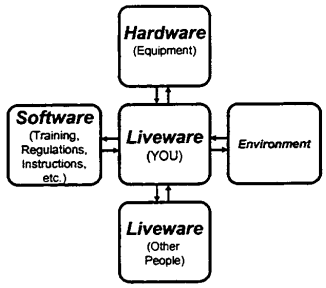
SHEL(L) Model



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You know something is wrong with the system when...

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Conclusion

- Human Factors impacts all facets of aviation
- Accepting this fact is essential to:
  - understanding incidents and accidents
  - Fostering a Learning Culture
- Human performance and decision making can be influenced.

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Culture and Aviation Safety Systems

This Afternoon's Flight Plan

- ☆ A Generic View of Culture
- ☆ Three Perspectives of Culture
- ☆ Components of a 'Safety Culture'
- ☆ Video Case Studies
  - ☆ Reaction to a major accident
  - ☆ Value Jet 592
  - ☆ JAL Flight 123

Why Include *'Culture'* in SMS?

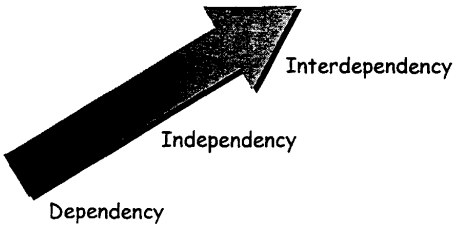
"Culture fashions a complex framework of national, organizational and professional attitudes and values within which groups and individuals function. The power of culture often goes unrecognized since it represents 'the way we do things here' - the natural and unquestioned mode of viewing the world."

Helmreich & Merritt, Culture at Work in Aviation and Medicine, 1998

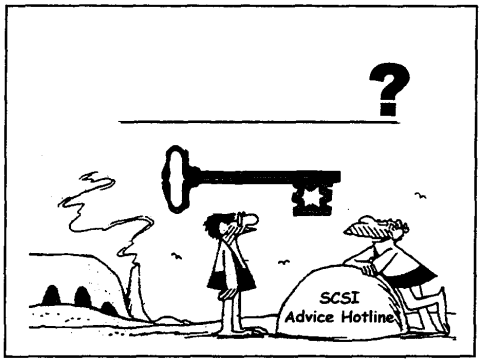
The Import of Culture

- No one operates alone
- Teams require high levels of collaboration to be effective:
  - *Organizationally*
  - *Interpersonally*
  - *Communications*
  - *Co-ordination*

Maturity Continuum©



A key component in achieving "Interdependency"?



Key Elements to Nurture Interdependency

- Shared values
- Shared purpose (mission)
- Shared beliefs
- Shared language
- Common Vision

The Issues to Address

- The functions of culture
- The strength & health of a culture
- Cultural elements, their nature and roles:
  - Above the surface (visible) elements
  - Below the surface (hidden) elements

What constitutes 'Culture'

- Defn: The set of values, guiding beliefs, understandings, ways of thinking, and norms shared by members of a community
- Functions of culture
  - Internal integration
  - External adaptation

Culture: Internal Integration

- ✓Constitutes a collective perspective of community (values, beliefs, norms)
- ✓Shared by most members
- ✓Systematically "passed along" to new members
- ✓Determines how people relate to one another

Culture: Internal Integration

- ✓Shapes members' views of the community and its purpose
- ✓Shapes members' views of their role and their purpose
- ✓Provides sense of identity for members
- ✓Guides and controls behavior
- ✓Enhances internal cooperation

Culture: Internal Integration (Cont.)

- Guides decision making & justice
- Enhances commitment/loyalty
- Provides justification for behavior
- Allows anticipation of actions of others

Culture: External Adaptation

- Influences how collective meets goals and deals with outsiders
- Influences perceptions of the 'collective' by outsiders
- Guides and controls behavior with/of outsiders
- Shapes expectations of outsiders

Metrics of A Culture

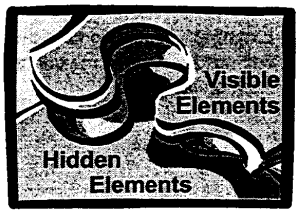
- Depth: The degree of agreement among members about the importance of specific cultural values, beliefs, norms (i.e., how many people agree & how strongly)
- Breadth: The number of cultural elements (values, beliefs, norms) on which there is agreement

The Health of a Culture

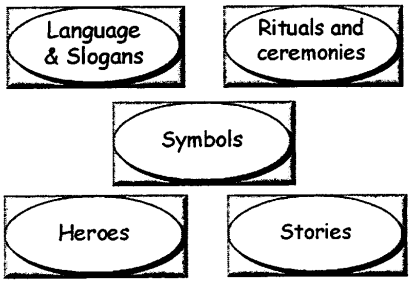
- A healthy culture helps to adapt to the external environment (reality)
- The unhealthy culture can drive the collective in the wrong direction and thus be dysfunctional

Cultural Elements

Culture can be broken down into two distinct elements



Visible Elements



Language and Slogans

- Intended to convey:
  - Identity
  - Meaning
  - A sense of purpose
  - A sense of belonging
- Easy to pick up, remember, & repeat

Symbols

- Things that stand for something else
- Material objects that hold cultural meaning

KOREAN AIR

onze luchtmacht

Civil Aeronautics Administration Ministry of Transportation and Communications

Can Symbols be Dysfunctional

- Can you think of an example where a symbol backfired
- How was the symbol actually received?
- What should the have done differently?

Rituals and Ceremonies

- Celebrations of an organization's values
- Provide dramatic examples of culture

Types of Rituals & Ceremonies

- Passage
- Enhancement
- Renewal
- Integration

Types of Rituals & Ceremonies

- *Passage:* Facilitates transition into new role or status.

  Example: Promotional tie-cutting, bar mitzvah, note in your mail slot, rank or insignias

Types of Rituals & Ceremonies

- *Enhancement:* Increases social status.

  Example: Award night, uniform or distinguishing symbols, titles

Types of Rituals & Ceremonies

- *Renewal:* Refurbishes and improves.

  Example: Development activities, certificates, official papers, green card

Types of Rituals & Ceremonies

- *Integration:* Encourages common feelings.

  Example: Party, citizenship ceremony, graduation from training

Heroes & Legends

Role models whose ideals, character, and support of the culture highlight the values and norms a community wishes to reinforce

Mother Theresa

WWI Fighter Pilots

Nelson Mandela

Stories, Legends, & Myths

- Narrative examples repeated among members to inform the young and the new
- Stories: based on fact
- Legends: based on facts but embellished
- Myths: consistent with culture but not based on fact

The Unspoken Elements (Hidden/Below the Surface)

- Values about what is important
- Assumptions & beliefs about what is true
- Attitudes toward others and issues
- Norms about appropriate & inappropriate behavior

Norms:

"Norms - cultural beliefs and conventions originating in the environment - create unreflective, routine, taken-for-granted scripts that become part of individual worldview."

Diane Vaughan, The Challenger Launch Decision, 1996

Video Case Study

- Video will be done in two parts
- *Part I (today)*
  - What can we deduce about the culture of this organization?
- *Part II (tomorrow)*
  - A human factors approach to understanding what went wrong and how organizationally we should approach remediation

How to Guarantee Failure:

- ✕ Structure the SMS like a financial spreadsheet
- ✕ Use the tick box managerial approach
- ✕ Ignore cultural issues because 'we are highly professional and highly regulated and do not need all this 'soft, group hug stuff"
- ✕ Management without leadership!

Mission Recap

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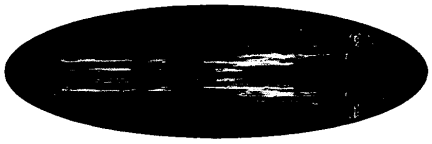
Culture and Aviation Safety Systems



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Three Faces of Culture

- Professional

- National

- Organizational

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Professional Culture

- How would you define a professional culture, specifically to aviation?
  - Is aviation a profession?
  - Or is it a vocation?

SCSI Southern California Safety Institute 3

Professional Culture

- Professional attributes:
  - Special expertise
  - Governing values
  - Self-governing
  - Selectively competitive
  - Rigorous training

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Professional Culture

- The Rewards of a Professional Culture
  - Prestige
  - Recognition
    - Stripes
    - Wings
    - Maint? ATC?

  - Public acknowledges and trusts

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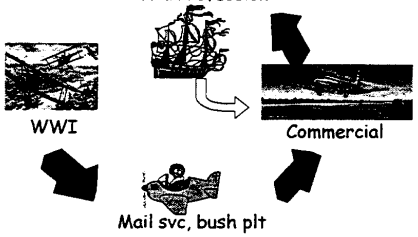
Professional Culture

The Evolution of Aviation as a Profession



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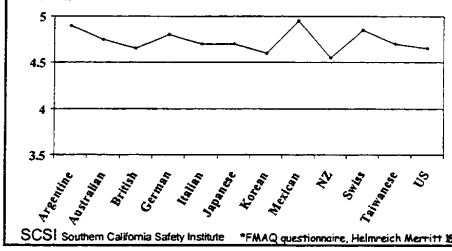
Professional Culture

- The Characteristics of Professional Cultures
  - Performance?
  - Meeting Organizational Objectives?
  - Job Satisfaction?

Is job satisfaction linked to performance?

Professional Commitment

"Pilots - Do you like your job?"



 *FMAQ questionnaire, Helmreich Merritt 1998

Professional Culture

"Culture is manifested in its [illegible] of communi[illegible]onds of [illegible]"

Goode 1957

- In a professional culture the norms and values are exemplified by senior members
- they passed those on to 'recruits'

Professional Culture

- The impact of the 'stereotype' in aviation culture
  - Imperturbable confidence
  - Air of knowing
  - Influence on the socialization of new members

Is this a positive or a negative?

Professional Culture

- Self-concept's role in a professional culture
  - "Internalized values of a professional culture are likely to be important components of the self-concept" Helmreich-Merritt
  - Is there a negative side to this assertion?
    - Studies* suggest that maintenance of self-concept overrules even if it is negative in nature
    - What then is the impact on culture/performance within?

*Josephs et al 1992, Swann 1996, Swann & Read 1981

Professional Culture

- The impact of the 'stereotype' in aviation culture
  - Imperturbable confidence
  - Air of knowing
  - Influence on the socialization of new members

Is this a positive or a negative?

Professional Culture

- Is the profession is happy with their job does that facilitate 'buy-in' to a culture of safety?
  - Is this an indicator or an answer?
  - In USA, 9 airlines surveyed - 77-98% pilots were happy with their jobs*
  - Air of knowing
  - Influence on the socialization of new members

Is this a positive or a negative?

*FMAQ questionnaire, Helmreich Merritt 1998

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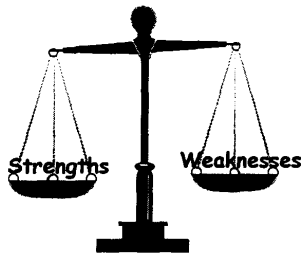
Professional Culture



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Professional Culture

Strengths

- Dedication to competence
- Self-concept can be a powerful and positive influence (UA232)
- Perpetuate the 'traditions'
- Enhance the 'immune' system to viruses such as:
  - Change
  - Technology
  - Mergers

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Professional Culture

- Pride can be blind to....
- Confidence can lead to....
- Can also weaken the immune system
- Distorted perspective of limitations
- Sense of personal confidence & denial

Drawbacks

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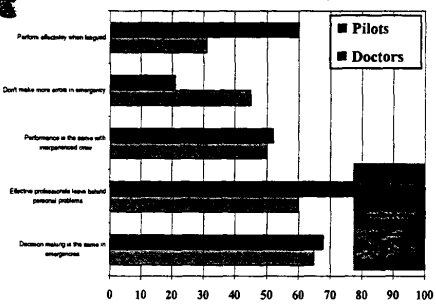
Unrealistic Attitudes in Professions



SCSI Southern California Safety Institute *FMAQ questionnaire, Helmreich Merritt 1998

Professional Culture

Additional Influencing Factors:

- The import of professional subcultures
  - Different vocations
  - Aircraft types
  - Size of company
- Gender issues
  - % of men vs women in the aviation industry
  - Helmreich's FMAQ startling revelation
  - Is it professional culture or personality?

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Professional Culture

Additional Influencing Factors:

- Personality
  - Attitude
  - Behaviour
- Is personality a performance predictor
- Is this a consideration/factor in an SMS?

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Do we need to consider factors such as national culture, in a profession that is highly regulated, and in a sense controlled by centrally developed SOPs?

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National Culture

- CRM led the way raising national culture as a consideration
- Study by Helmreich & Merritt, 1996, revealed significant differences between US and Asian pilots..... Why?

"This was our first clue that behaviour in the cockpit could be influenced by things other than professional standards"

Helmreich & Merritt, Culture at Work in Aviation and Medicine

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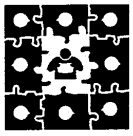
National Culture

- Cultural Variables
  - The many pieces of the puzzle
  - Emerging discipline in aviation (~ 1990s)
  - Performance issues for consideration:
    - Communication
    - Leadership
    - Perceptions of risk
    - Stress
    - Decision Making
    - Teamwork/relationships



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National Culture

Helmreich and Merritt focused on 3 areas:

1. To what extent are pilot's work-related attitudes and values universal/different
2. Can the differences be categorized
3. If national differences are apparent, can pilots be "clustered" from different countries by their "attitudes"?

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National Culture

- Geert Hofstede , Landmark studies on Cultural Impact
- Formulated "four dimensions" of culture
  - Power distance
  - Individualism-Collectivism
  - Uncertainty Avoidance
  - Masculinity - Femininity

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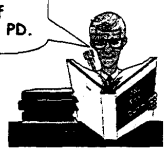
National Culture

Power Distance

"The extent to which the less powerful expect and accept that power is distributed unequally."

Now let's review the reference sheet of Hofstede's findings on PD.



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National Culture

Individualism-Collectivism

"Individualists consider the implications of their behaviour with their own goals and values. Collectivists come from strong, cohesive groups with self concept coming from the social network"

Now let's review the reference sheet of Hofstede's findings on Individualism & Collectivism.

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National Culture

Uncertainty Avoidance

"The extent to which people feel threatened by ambiguous circumstances and have created beliefs and institutions to avoid such conditions."

Now let's review the reference sheet of Hofstede's findings on UA.

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National Culture

Masculinity - Femininity

"T dominant values in society are material success (money and things) versus caring for others and the quality of life. Distinct gender roles versus an overlapping and a greater concern for life."

Now let's review the reference sheet of Hofstede's findings on MAS.

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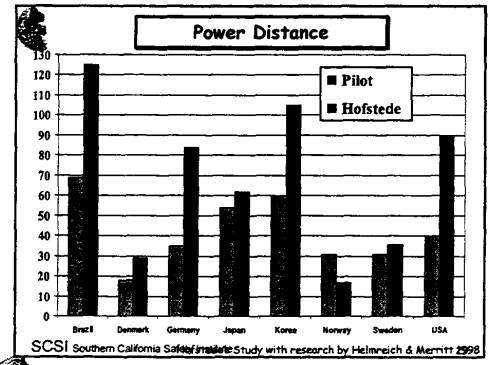
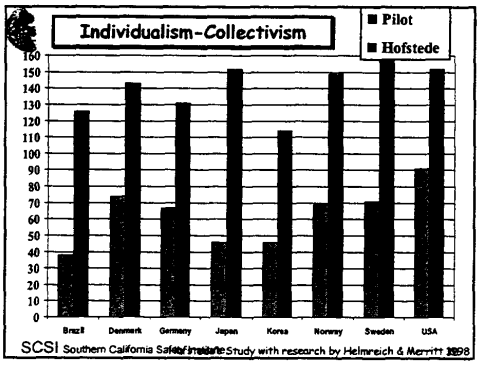


SCSI Southern California Safety Institute Study with research by Helmreich & Merritt 1998



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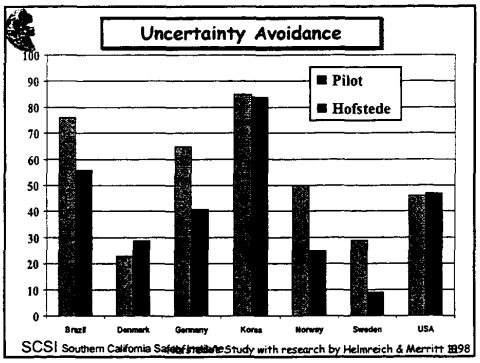

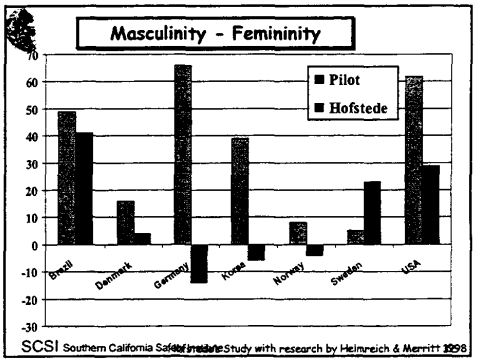

Video Case Study

- JAL Flight 123, 12 August 1985
- 747SR
- Four survived, 520 perished
- Observe both the human factors issues and the impact culture has on the investigation (PD, IND, UA)
- Be prepared to discuss

National Culture Recap

- CRM raised our awareness to the fact that human factor issues indeed affect performance
- Human performance is powerfully influenced by a variety of factors, including national culture
- An effective safety management system must both include and address these issues, I.e. we must not put on the blinders in the belief that with regulations and enforcement, 'cultural' issues will not be a factor

Organizational Culture

In her research, Diane Vaughan identified three factors traditionally associated with organizational misconduct:

1. Competitive pressures and resource scarcity
2. Regulatory ineffectiveness
3. Organizational characteristics

Organizational Culture

- If 'organizational characteristics' can be a major contributor to errors, then:
  - Does the member's perceptions of the organization influence performance?
  - Do the perceptions manifest themselves in one's commitment?
  - Are commitment and compliance mutually exclusive

What then is organizational culture?

Organizational Culture

Our definition will depend on which glasses we are wearing!

- Business school perspective
- Sociological/anthropological perspective
- Organizational psychologists

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Organizational Culture

"Organizational culture is the values, beliefs, assumptions, rituals, symbols and behaviours that define a group"

Helmreich & Merritt, 1998

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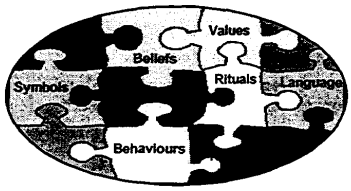
Organizational Culture



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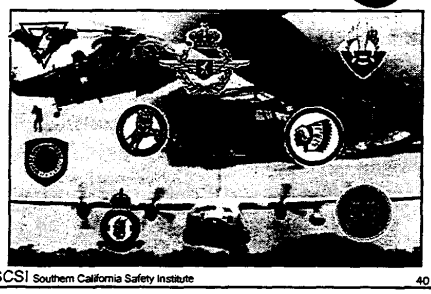
Organizational Culture



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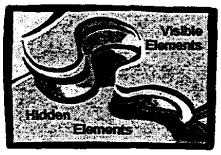
Organizational Culture

Recall from our initial discussions on culture, I mentioned there were 'two elements'...



Question: Does the hidden manifest in the visible?
Question: Does the visible inform the hidden?

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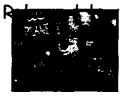
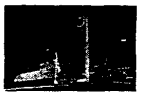
Organizational Culture

Visible	Hidden
• Logos	• Values
• Uniforms	• Beliefs
• Symbols	• Attitudes
• Reward programs	• Norms
• Written SOPs	• Assumptions
• Rules	





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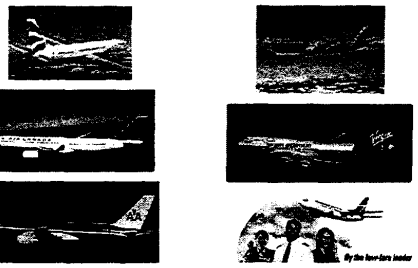
Does the difference in culture translate into a difference in performance?



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Organizational Culture

Helmreich's research on organizational attitudes in two US Airlines.

Item	Airline A	Airline B
I like my job.	98	79
I'm proud to work for this organization.	97	26
Pilot moral is high	87	3
Management never compromises safety for profit.	82	35
My safety suggestions would be acted upon.	68	19

Helmreich & Merritt 1998, page 116

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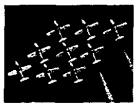
Organizational Culture

Strengths	Cautions
• Commitment	• Lack of alignment
• Synergy	• Normalized Deviancy
• Enthusiasm	• "Groupthink"
• Empowerment	• Compliance issues:
	- Grudging
	- Non-compliance



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Video Case Study

- Value Jet, 11 May 1996
- DC-9, Everglades, FL
- 110 perished (all on board)
- Was the negative influence of a 'bad' organizational culture accountable?
- Be prepared to discuss

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Recap of where we have come:

- Culture comes in several forms
- It is essential to understand the impact of the hidden and visible elements of culture
- Effectiveness, I.e. safety, is powerfully influenced through culture
- We must strive towards engineering a culture that fosters effectiveness balanced with efficiency

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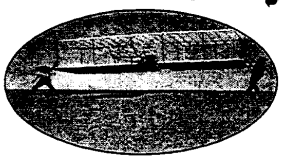
Engineering & Safety Culture



" The purpose of bureaucracy is to compensate for incompetence and lack of discipline."

Jim Collins, Good to Great

Culture:

"Organizational culture is the values, beliefs, assumptions, rituals, symbols and behaviours that define a group, especially in relation to other groups organizations."

Safety Culture?

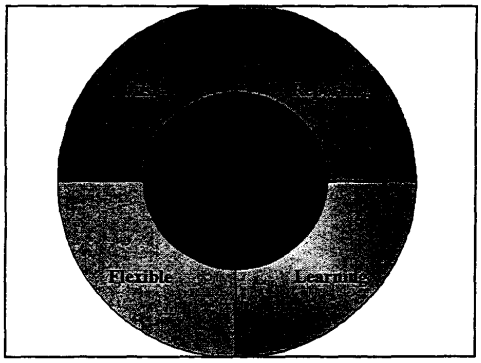
What constitutes a sound safety culture?

中華民國交通部民用航空局

6 Key Components towards fostering a 'Safety Culture'

- ✓ The 'engine' that drives the organization is run by the 'accountable executive'
- ✓ A "wary culture" that has a "collective mindfulness" that things can go wrong
- ✓ Informed culture!
- ✓ Trust
- ✓ Just culture to foster a reporting culture
- ✓ A learning culture

Adapted from James Reason, Managing Maintenance Error, 2003



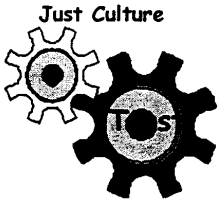
A Just Culture

"Culture defines the values and predisposed attitudes, exerting a final influence on the behaviour of a particular group. Norms are enforced by expressing disapproval of wrongdoers; how strongly a culture sanctions those who violate norms is an indication of the importance attached to those norms."

ICAO Human Factors Digest

Gearing Towards an Informed Culture

Just Culture



Organizational Cultures

Pathological	Bureaucratic	Generative
× Don't want to know	➢ May not find out	✓ Actively seek it
× Messengers are shot	➢ Messengers are listened to if they arrive	✓ Messengers are trained and rewarded
× Failure is punished or concealed	➢ Failures lead to local repairs	✓ Failures lead to far reaching reforms
× New ideas are actively discouraged	➢ New ideas often present problems	✓ New ideas are welcomed

Adapted from Ron Westrum

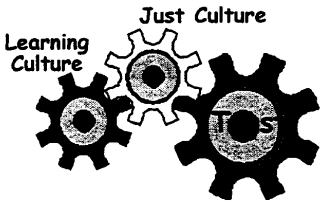
Leiden's Safety Culture Continuum

- Pathological
- Reactive
- Calculative
- Proactive
- Generative

Leiden's Safety Culture Continuum

- Pathological
  - "who cares as long as we don't get caught"
- Reactive
  - "safety is important; we do a lot every time we have an accident"
- Calculative
  - "we have systems in place to manage all hazards"
- Proactive
  - "we work hard on the problems we still find"
- Generative
  - "we know that achieving safety is difficult and it is an ongoing process of brainstorming new means of prevention"

Gearing Towards an Informed Culture



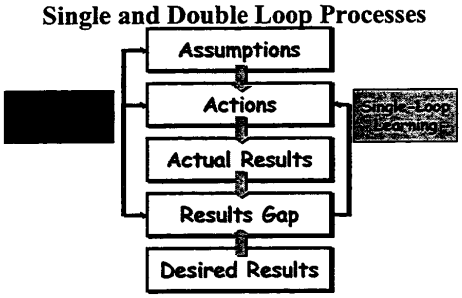
Punishment vs. Learning

Beliefs in tact	Changing beliefs
Culprits are unique part of the failure	Failure is part of the system
Stifling flow of info	Increases flow of info
All about NOT getting caught	Removing the conditions that caused the error
Closure	**Continuity**

Sidney Dekker, Field Guide to Human Error

Organizational Learning

Single and Double Loop Processes

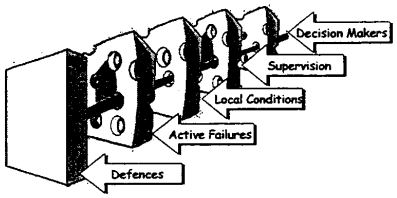


Fostering a Learning Culture

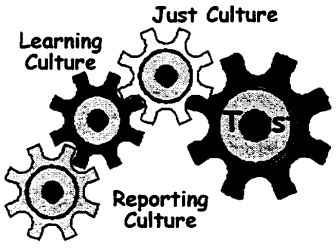
- ✓ Local stage which is primarily single-loop focused on specific skills and actions
- ✓ Control Stage is a focus on compliance
- ✓ Open Stage challenges assumptions and is more adaptive to new ways
- ✓ Deep Learning Stage constantly reviews assumptions, "intelligent wariness", errors and accidents are expected and planned for

John Carroll, MIT Sloan School of Management

How an Learning Organization Views Error



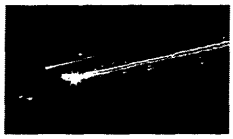
Gearing Towards an Informed Culture



"An organization without a reporting culture is not only unaware of the risks, but also lacks a memory"

James Reason, Managing Maintenance Error, 2003

STS 51-L, Challenger
28 January 1986



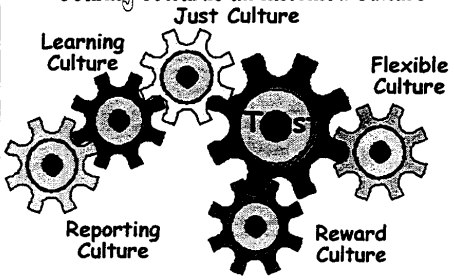
STS 107, Columbia
01 February 2003

The Reporting Continuum

Creating a Reporting Culture

- ✓ Ability to report anonymously
- ✓ Are the reports used for learning of some other agenda
- ✓ Clear lines of separation between safety and compliance
- ✓ A process that fosters feedback
- ✓ A process that is easy and limits forced questions

Gearing Towards an Informed Culture



Case Study

Event: Aircraft engine comes off mount due to a cracked bolt. It was determined that the cracked bolt was missed on a recent maintenance inspection.

- Scenario A
  - Maintainer collects work stand and lights...
- Scenario B
  - Maintainer decides not to bother...
- Scenario C
  - Maintainer goes to the store to fetch the work stand and the lights....

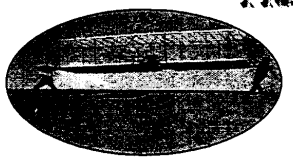
To summarize...

- ✓ Safety cultures can be engineered
- ✓ It takes a consistent and dedicated process
- ✓ The foundational principle is trust
  - trustworthiness will foster a just culture
  - a just culture will foster a reporting culture
  - a reporting culture must be based on fostering a learning culture

Tomorrow's Flight Plan

- Introduction to human factors
- Integration of human factors into an SMS
- Case studies
- Preparation

Turning Theory into Practice



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Today's Flight Plan

- Defining our Program Needs
- Developing the Six essentials
- Fostering a Safety Culture

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"People ~~forget that most~~ worthwhile innovations and improvements are hard, ~~not easy, that most bets~~ are big, not little; and that most things require time and patience - they don't happen overnight."

Steve Ballmer, CEO Microsoft

Process!

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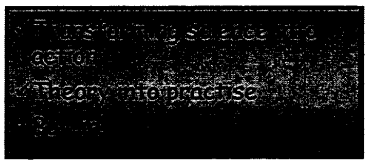
Nature of the Challenge



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Must occur on three levels:

1. Organizational
2. Workplace
3. Task

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Principles of Safety in Complex Systems

Principles

- **Safety is never the only goal in systems that people operate**
- **Trade-offs between safety and other goals often have to be made under uncertainty and ambiguity**
- **Systems are NOT inherently safe**

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What is:

- Human Factors?
- Risk?
- Culture?
- Safety?

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What is Safety?

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Communicating through a *"common language"*

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Safety

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Safety Definitions:

? The condition of being safe
? Activity in which precautions are taken to reduce the risk
? Operate in a risk free environment

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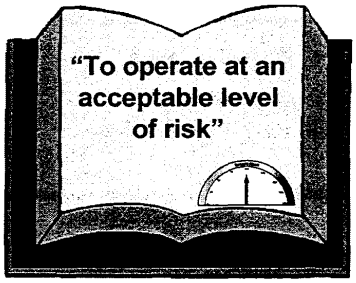
The book answer is:



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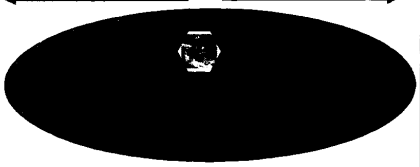
The Safety Space

Increasing Resistance ← → Increasing Vulnerability



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"A safety management system is a systematic, explicit and comprehensive process for the management of safety risks..."

Transport Canada 2002

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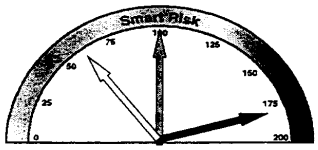
What determines the success of a safety management system (SMS)?



No Risk = Risk Aversive

High Risk = High Opportunity

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Having the *right* 'Sensors' in the *right* places

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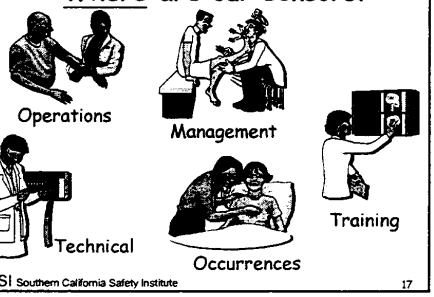
What do we measure?

Where are our sensors?



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Operating at an acceptable level of risk.

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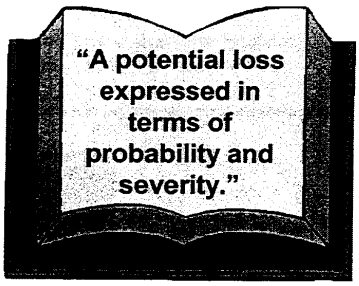
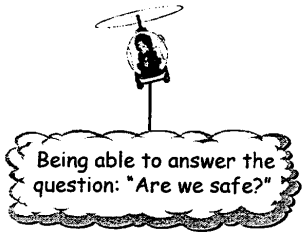
Risk:





Traditional Safety Metrics

- People
- Engineering
- Organizational

People

- ✓ Traditional occupational safety approach (like early CRM)
- ✓ Emphasis is upon individual unsafe acts and personal injury accidents
- ✓ *Errors* are shaped by psychological factors
- ✓ People are free agents capable of choosing between safe and unsafe behaviour
- ✓ Most widely used counter measures are fear appeal campaign posters, rewards, punishments, more SOPs, training

James Reason, 1995

Traditional Safety Metrics

- People
- Engineering
- Organizational

Engineering

- ✓ Reliability engineering, traditional ergonomics
- ✓ Risk management
- ✓ Human reliability assessment
- ✓ Focus is upon engineered system reliability, often expressed in probabilistic terms
- ✓ *Error* is not regarded as what goes on between a person's ears, rather human-machine miscues
- ✓ Nuclear power industry, NASA, military designers, oil and gas designers

James Reason, 1995

Traditional Safety Metrics

- People
- Engineering
- Organizational

Organizational

- ✓ Latest of the three and has a disciplinary link
- ✓ Landmark studies that brought it about:
  - ➢ Man-Made Disaster Barry Turner
  - ➢ Peter Mahon on the Mt Erebus Tragedy in 1979
  - ➢ Justice Moshansky's report on Dryden 1989
- ✓ View error as a consequence not a cause
- ✓ *Errors* are symptoms
- ✓ Organizational model blurs the lines between quality management and safety
- ✓ Extension of the engineering model

James Reason, 1995

Three Key Questions?

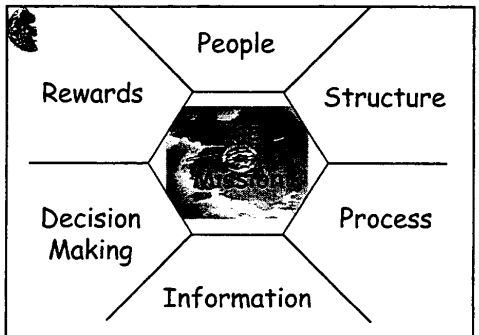
- **What do you want your SMS to do?**
- **How important is it?**
- **Are you willing to invest what is required?**

Commitment vs Compliance

- ➢ **Commitment**
- ➢ **Endorsement**
- ➢ **Compliance**
  - ➢ Formal Compliance
  - ➢ Compliance
  - ➢ Grudging Compliance
- ➢ **Non-Compliance**
- ➢ **Apathy**

"Most airlines would not be in business if they did not have a cursory understanding of how to adopt to environmental demands and harness human performance."

Vince Mancuso, PhD. Delta Corporate HF Manager



People

Rewards

Structure

Mission

Decision Making

Process

Information

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"People are not your most important asset. The right people are!"

Jim Collins, Good to Great

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The #1 job of a Flight Safety Department?

- Advisors

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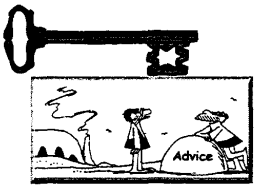
Advice:

What is the key to success in getting people to listen?



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How does one develop trust?

Trust

Trustworthiness

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The #1 job(s)
of a Flight Safety Department?

- Advisors

- **Problem solvers**
- **Leadership**

Key Attributes and Roles:

- ✓ Have a vision
- ✓ Character
- ✓ Competency
- ✓ Congruency
- ✓ Courage
- ✓ Motivator
- ✓ Coach
- ✓ Educator
- ✓ Mentor

People

Rewards

Structure

Decision Making

Process

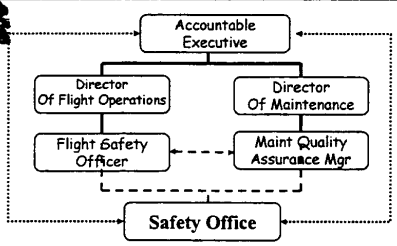
Information

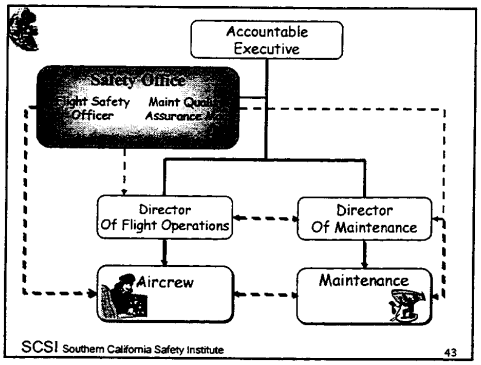
"Every organization is perfectly aligned to get the results it is getting."

Stephen R. Covey

The 'Right' Structures

- **Organizational structure**
- **Safety Management System**
- **Emergency Response Plan**




Accountable Executive
Safety Office
Flight Safety Officer
Maint Qual Assurance
Director Of Flight Operations
Director Of Maintenance
Aircrew
Maintenance
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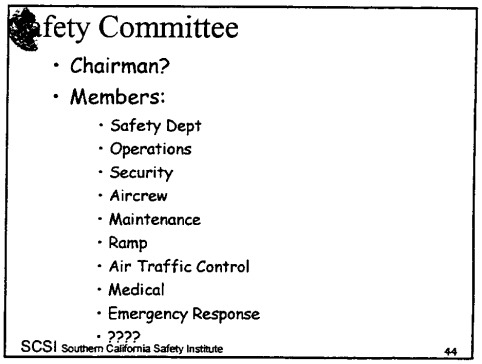
43


fety Committee
• Chairman?
• Members:
• Safety Dept
• Operations
• Security
• Aircrew
• Maintenance
• Ramp
• Air Traffic Control
• Medical
• Emergency Response
• ????
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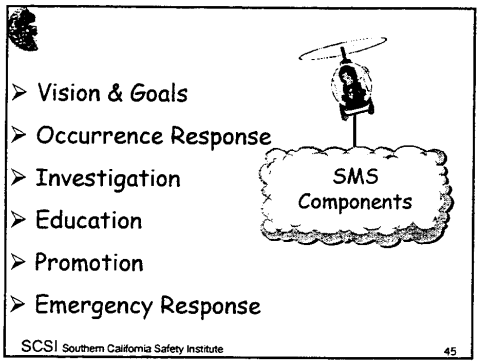
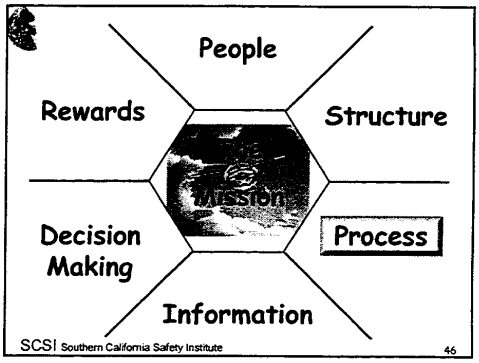
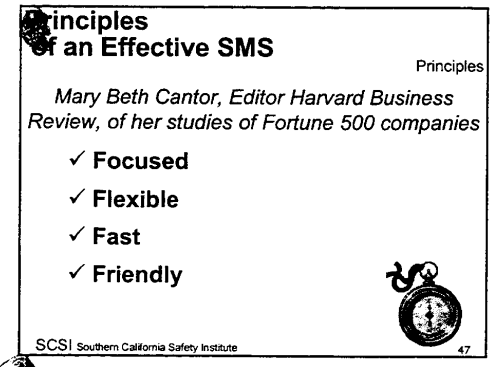
44


➢ Vision & Goals
➢ Occurrence Response
➢ Investigation
➢ Education
➢ Promotion
➢ Emergency Response
SMS Components
SCSI Southern California Safety Institute
45


People
Rewards
Structure
Mission
Decision Making
Process
Information
SCSI Southern California Safety Institute
46


rinciples
f an Effective SMS
Principles
Mary Beth Cantor, Editor Harvard Business Review, of her studies of Fortune 500 companies
✓ Focused
✓ Flexible
✓ Fast
✓ Friendly
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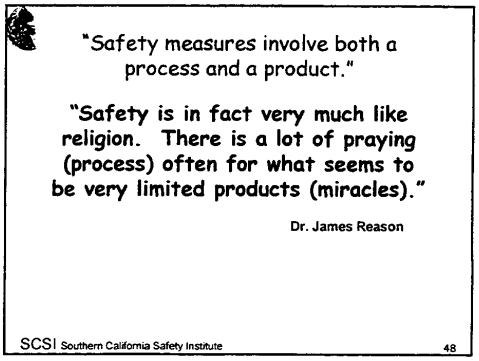
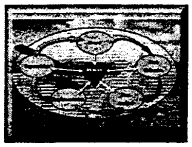
47


"Safety measures involve both a process and a product."
"Safety is in fact very much like religion. There is a lot of praying (process) often for what seems to be very limited products (miracles)."
Dr. James Reason
SCSI Southern California Safety Institute
48

Kinds of Processes...

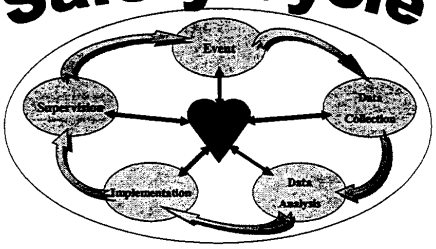
Processes to Consider

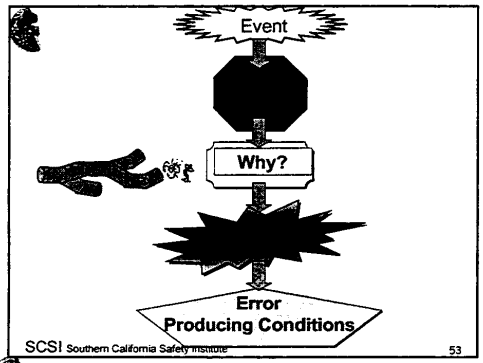
- ✓ Occurrence Reporting
- ✓ Investigation
- ✓ Hazard Reporting
- ✓ Education
- ✓ Promotion
- ✓ Rewards & Recognition
- ✓ Feedback
- ✓ ?????

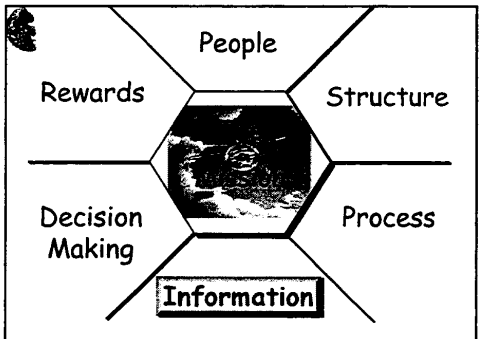


Safety Space

Safety Cycle







" If you look across the rise and fall of organizations, however, you will rarely find companies stumbling because they lacked information."

Jim Collins, Good to Great

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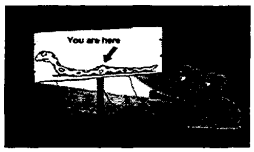
Types of Information

- ✓ Occurrences
- ✓ Training Files
- ✓ Hazard Reports
- ✓ FOQA
- ✓ LOSA



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Types of Information

- ✓ Audits/Surveys
- ✓ Complaints?
- ✓ Discussions at the:
  - ✓ In the cockpit
  - ✓ On the 'line'
  - ✓ Operations Desk
  - ✓ Snags Desk
  - ✓ Meetings
  - ✓ Socially
- ✓ ????

What do we do with the information?

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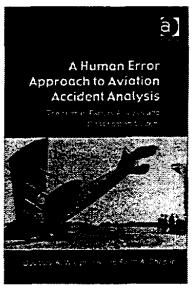
An example of an Information System



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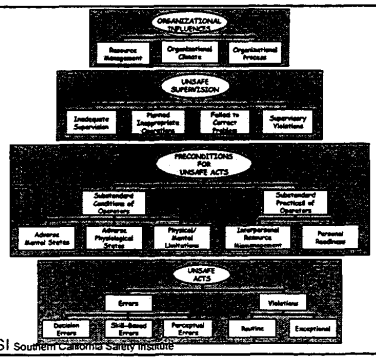

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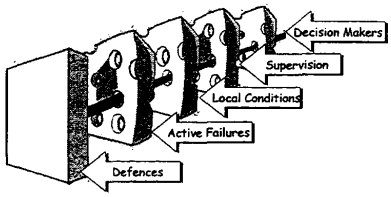
The Organizational Perspective of HF



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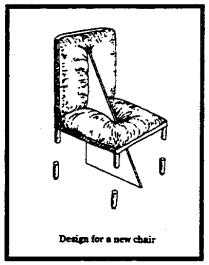
What do you think of my new chair design?



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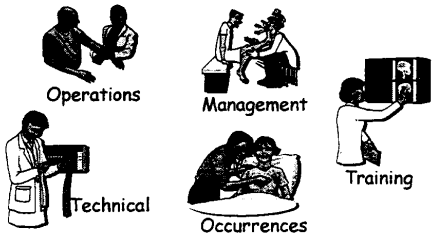
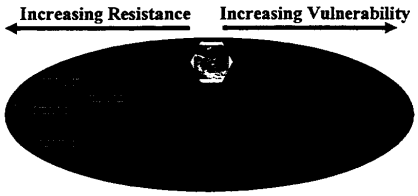
Is the info we are getting answering the right questions?



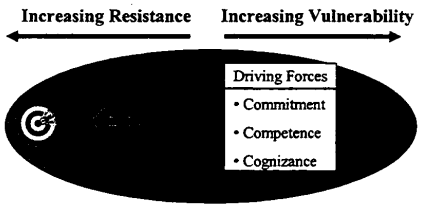
SCSI Southern California Safety Institute 62

What question should our information answer?

SCSI Southern California Safety Institute 63



SCSI Southern California Safety Institute 64



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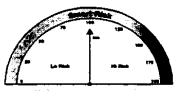
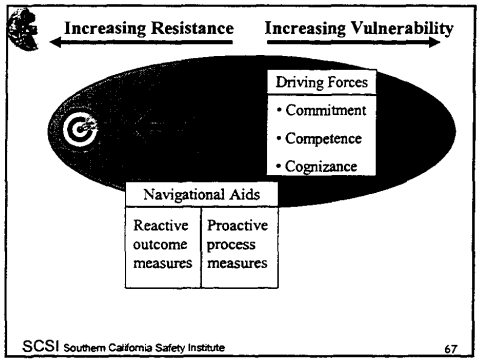
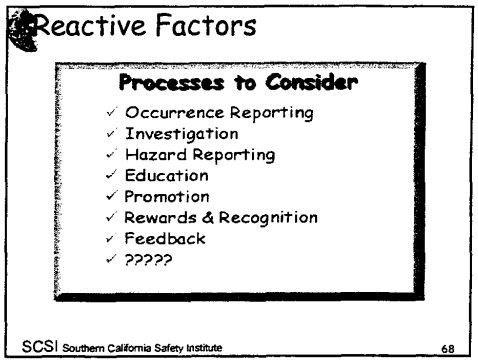
Driving Forces for Intrinsic Safety

- Commitment
  - ✓ Motivation
  - ✓ Resources
- Competence
  - ✓ Investment
  - ✓ Leadership vs. Management
- Cognizance
  - ✓ Process



SCSI Southern California Safety Institute 66


Increasing Resistance
Increasing Vulnerability
Driving Forces
• Commitment
• Competence
• Cognizance
Navigational Aids
Reactive outcome measures
Proactive process measures
SCSI Southern California Safety Institute
67


Reactive Factors
Processes to Consider
✓ Occurrence Reporting
✓ Investigation
✓ Hazard Reporting
✓ Education
✓ Promotion
✓ Rewards & Recognition
✓ Feedback
✓ ?????
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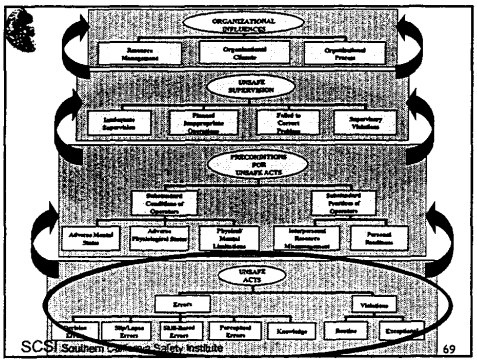
68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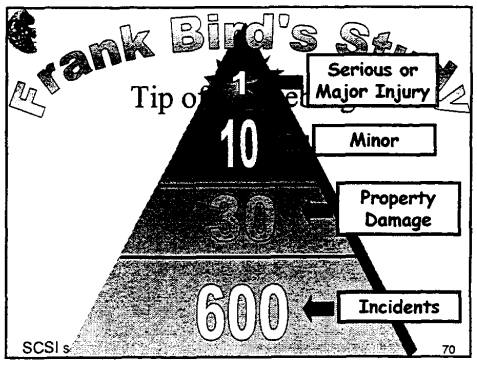
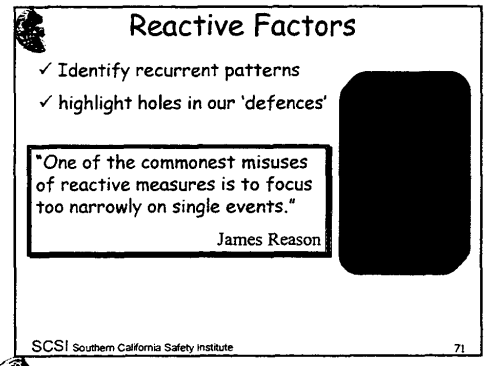
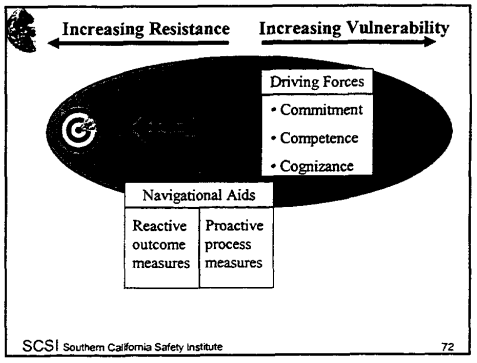
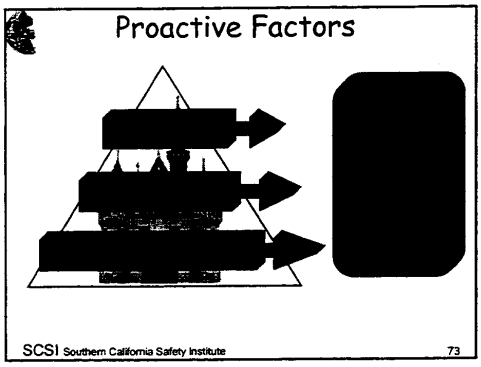
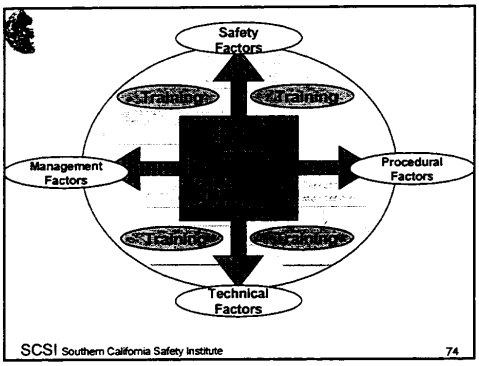
69

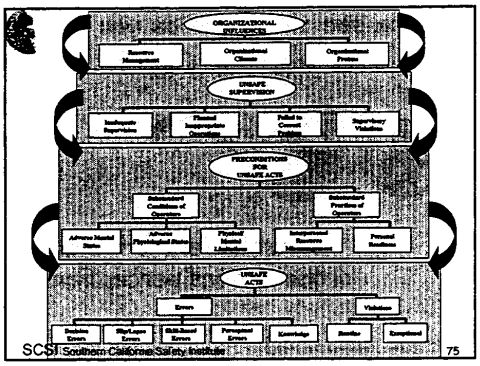

Frank Bird's
Tip of
Serious or Major Injury
10
Minor
30
Property Damage
600
Incidents
SCSI
70

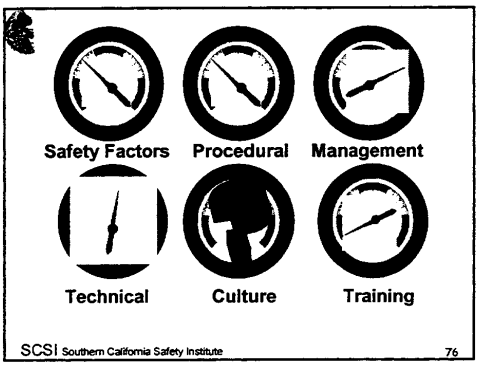

Reactive Factors
✓ Identify recurrent patterns
✓ highlight holes in our 'defences'
"One of the commonest misuses of reactive measures is to focus too narrowly on single events."
James Reason
SCSI Southern California Safety Institute
71

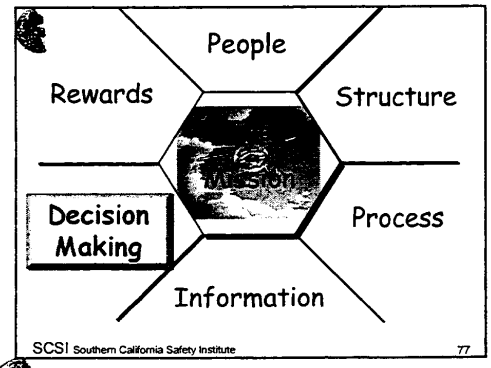

Increasing Resistance
Increasing Vulnerability
Driving Forces
• Commitment
• Competence
• Cognizance
Navigational Aids
Reactive outcome measures
Proactive process measures
SCSI Southern California Safety Institute
72

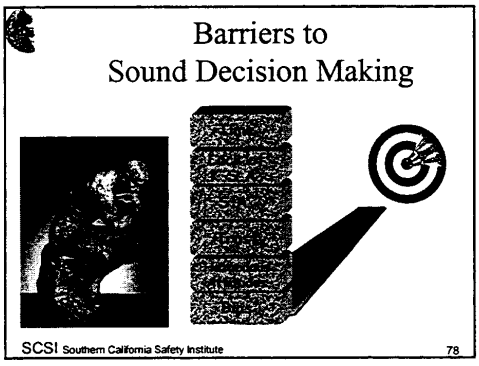

Proactive Factors
SCSI Southern California Safety Institute
73


Safety Factors
Management Factors
Procedural Factors
Technical Factors
SCSI Southern California Safety Institute
74


SCSI Southern California Safety Institute
75


Safety Factors
Procedural
Management
Technical
Culture
Training
SCSI Southern California Safety Institute
76


People
Rewards
Structure
Decision Making
Process
Information
SCSI Southern California Safety Institute
77


Barriers to
Sound Decision Making
SCSI Southern California Safety Institute
78

Decisions Focus Upon:

- ✓ Having the right information (sensors)
  - ✓ How
  - ✓ What
- ✓ Processes
  - ✓ Risk Management
  - ✓ Best Practices
- ✓ Our priorities
  - ✓ Organizational
  - ✓ Personal

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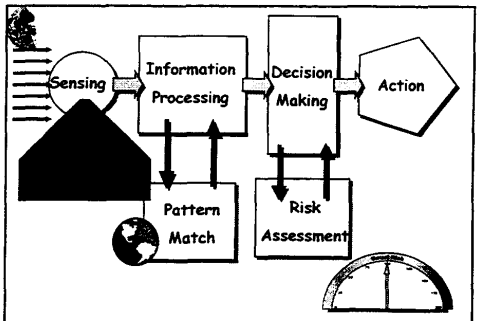

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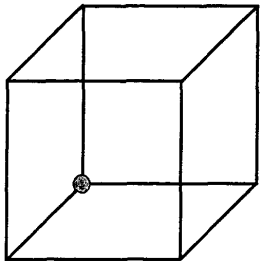
Necker Cube



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You see the world as you are, Not as it is!

What 'filters' drive an organizations perceptions?

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SCSI Southern California Safety Institute 83

The consequences a hazard presents to accomplishing the mission cannot be assessed until that hazard is converted to RISK

SCSI Southern California Safety Institute 84

Why do we take Risk?

- ☑ Expected *advantages* of comparatively *risky* behaviour
- ☑ Expected *costs* of comparatively *risky* behaviour
- ☑ Expected *benefits* of comparatively *safe* behaviour
- ☑ Expected *costs of*....

Target Risk II, Gerald J.S. Wilde

SCSI Southern California Safety Institute 85

Organizational Perspective

SCSI Southern California Safety Institute 86

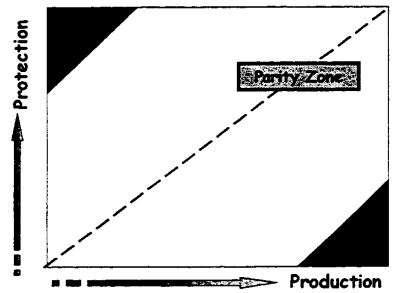
"Accidents by themselves are not necessarily a reliable indicator of an organization's intrinsic safety; however they succeed temporarily in concentrating the minds of top management upon protection rather than production."

Dr. James Reason

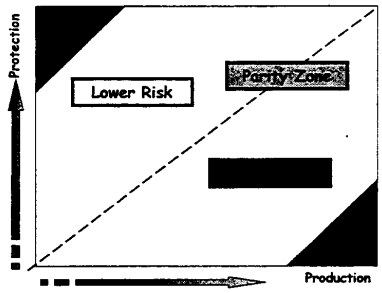
SCSI Southern California Safety Institute 87

Impact of limited resources

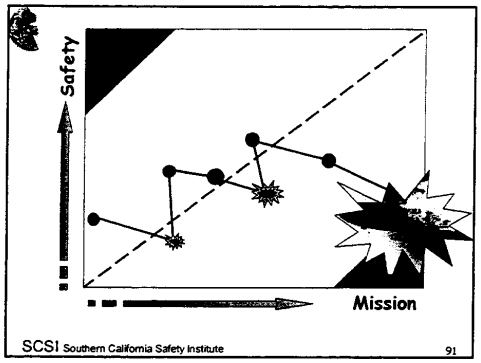
SCSI Southern California Safety Institute 88

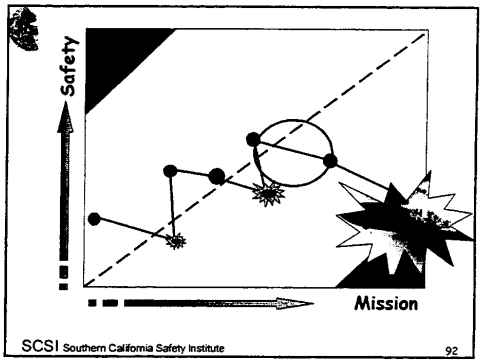


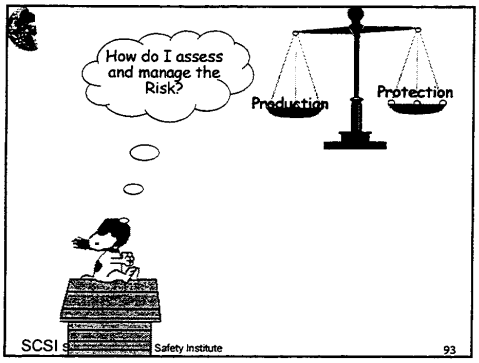
SCSI Southern California Safety Institute 89

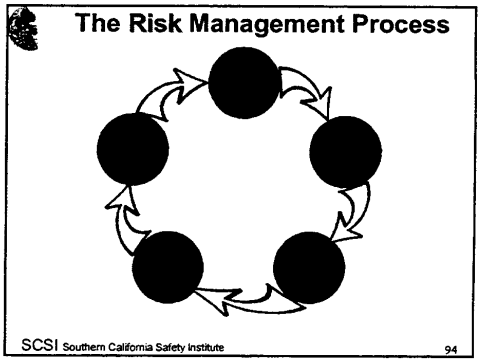


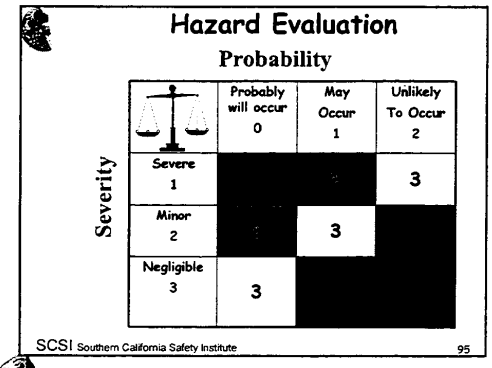
SCSI Southern California Safety Institute 90

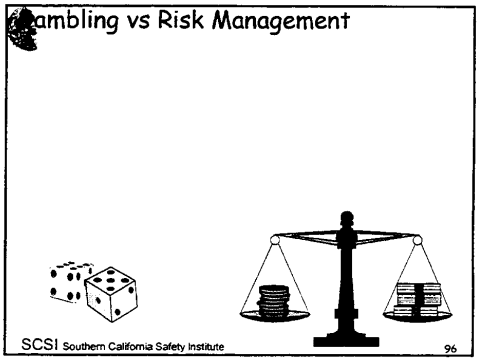

Safety
Mission
SCSI Southern California Safety Institute
91


Safety
Mission
SCSI Southern California Safety Institute
92


How do I assess and manage the Risk?
Production
Protection
Safety Institute
93

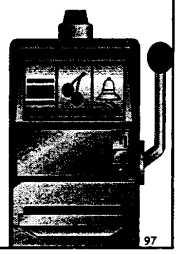

The Risk Management Process
SCSI Southern California Safety Institute
94


Hazard Evaluation
Probability
Probably will occur 0
May Occur 1
Unlikely To Occur 2
Severity
Severe 1
Minor 2
Negligible 3
3
3
3
SCSI Southern California Safety Institute
95

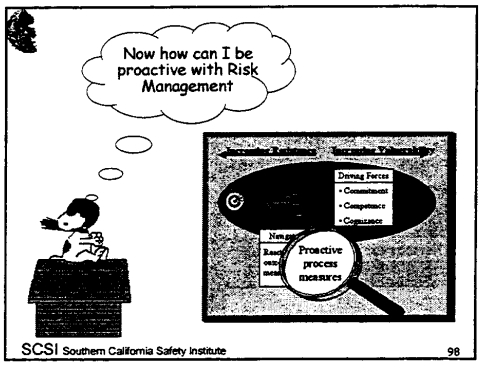

ambling vs Risk Management
SCSI Southern California Safety Institute
96

The key difference between the gambler and the risk managing leader is that the latter can reasonably predict the outcome

The gambler is only guessing!



SCSI Southern California Safety Institute 97



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Hazard Reports

- Have simple forms easily accessible to all
- Advertise and educate on the program (no involvement, no commitment)
- Keep the definitions simple (hazard, severity, probability, etc)
- Acknowledge all submissions
- Clean resolution process
  - Submission
  - Prioritization
  - Feedback
- ~~Anonymous?~~

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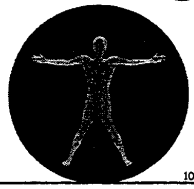
Human Factors in Decision Making



SCSI Southern California Safety Institute 100

Perceptual Control Theory

Decision Making

Theoretical Metaphor
Individual
Organizational

Adapted from work by Keith Hendy, DRDC & Dr Gerald Wilde, Target Risk II

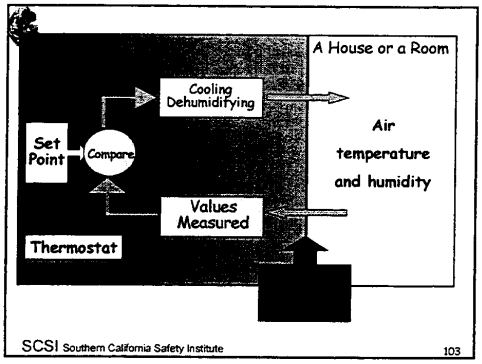
SCSI Southern California Safety Institute 101

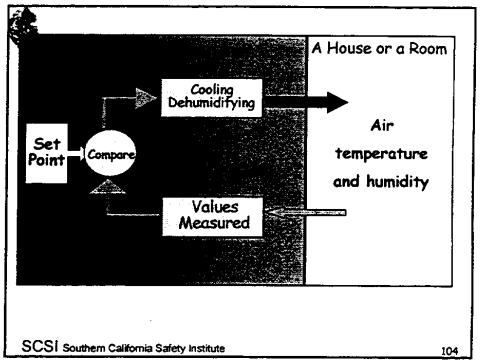
Perceptual Control Theory

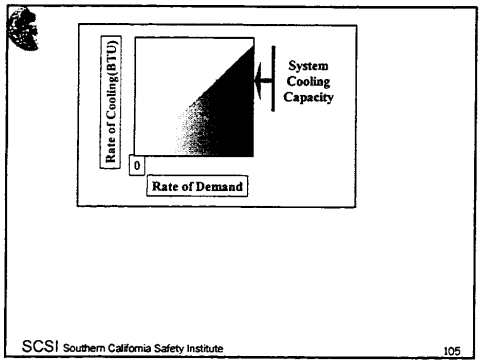
Decision Making

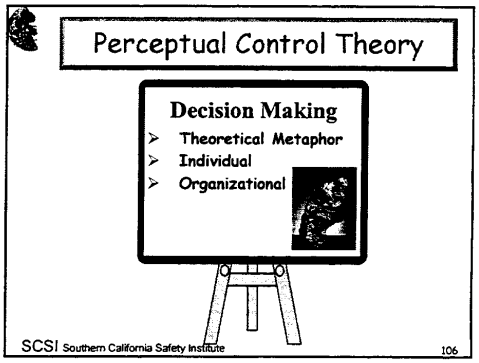
- **Theoretical Metaphor**
- **Individual**
- **Organizational**

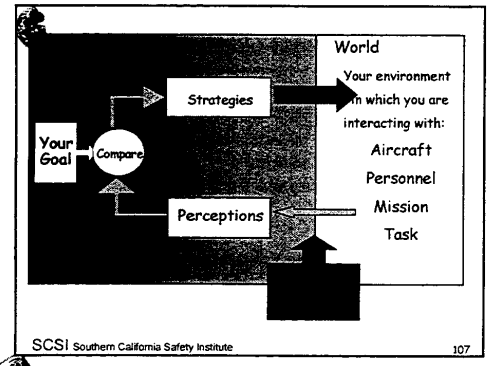
SCSI Southern California Safety Institute 102

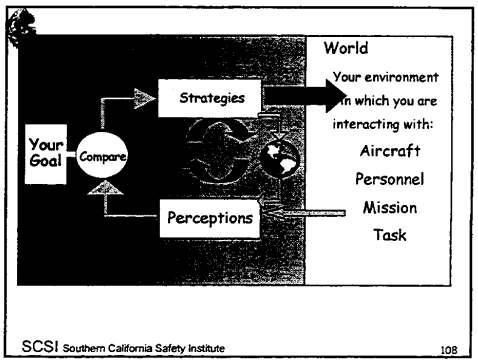

A House or a Room
Cooling Dehumidifying
Set Point
Compare
Air temperature and humidity
Values Measured
Thermostat
SCSI Southern California Safety Institute
103

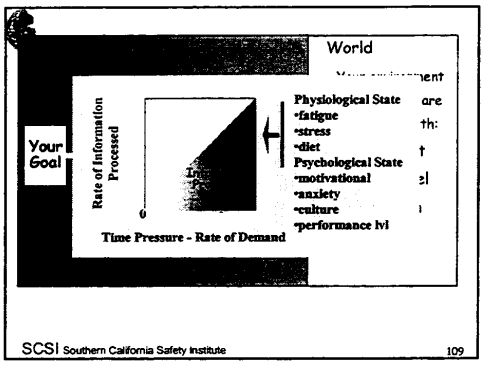

A House or a Room
Cooling Dehumidifying
Set Point
Compare
Air temperature and humidity
Values Measured
SCSI Southern California Safety Institute
104

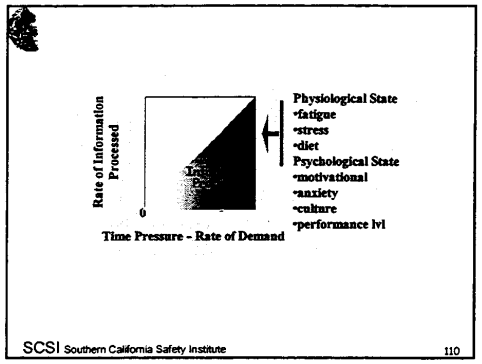

Rate of Cooling(BTU)
System Cooling Capacity
0
Rate of Demand
SCSI Southern California Safety Institute
105

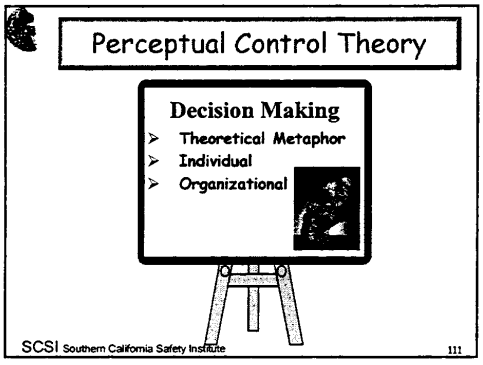

Perceptual Control Theory
Decision Making
Theoretical Metaphor
Individual
Organizational
SCSI Southern California Safety Institute
106

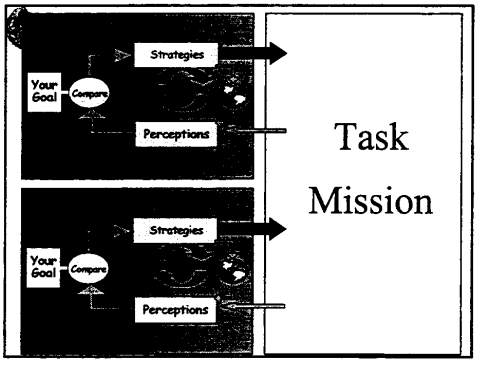

World
Your environment in which you are interacting with:
Aircraft
Personnel
Mission
Task
Strategies
Your Goal
Compare
Perceptions
SCSI Southern California Safety Institute
107

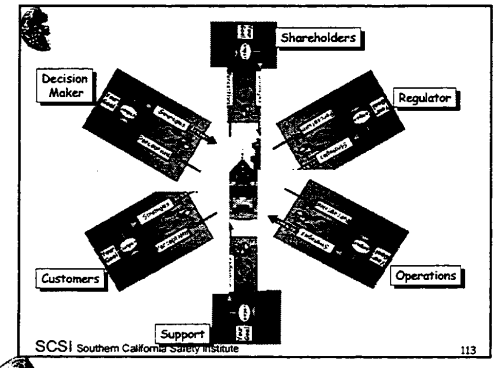

World
Your environment in which you are interacting with:
Aircraft
Personnel
Mission
Task
Strategies
Your Goal
Compare
Perceptions
SCSI Southern California Safety Institute
108

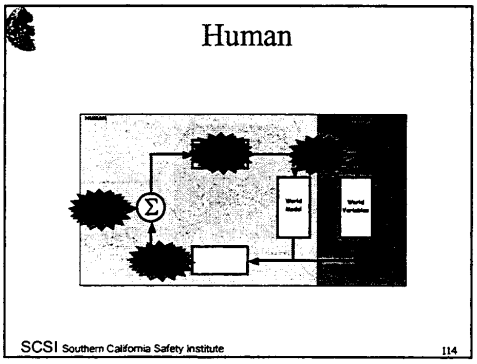

World
Your Goal
Rate of Information Processed
Physiological State
•fatigue
•stress
•diet
Psychological State
•motivational
•anxiety
•culture
•performance lvl
Time Pressure - Rate of Demand
SCSI Southern California Safety Institute
109


Rate of Information Processed
Physiological State
•fatigue
•stress
•diet
Psychological State
•motivational
•anxiety
•culture
•performance lvl
Time Pressure - Rate of Demand
SCSI Southern California Safety Institute
110

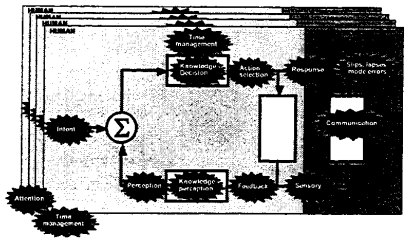

Perceptual Control Theory
Decision Making
Theoretical Metaphor
Individual
Organizational
SCSI Southern California Safety Institute
111


Your Goal
Compare
Strategies
Perceptions
Task
Mission

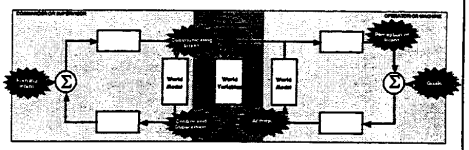

Shareholders
Decision Maker
Regulator
Customers
Operations
Support
SCSI Southern California Safety Institute
113


Human
SCSI Southern California Safety Institute
114

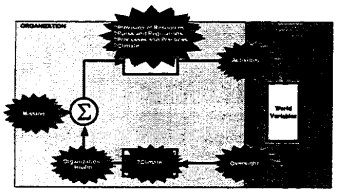
Crew



Supervisor

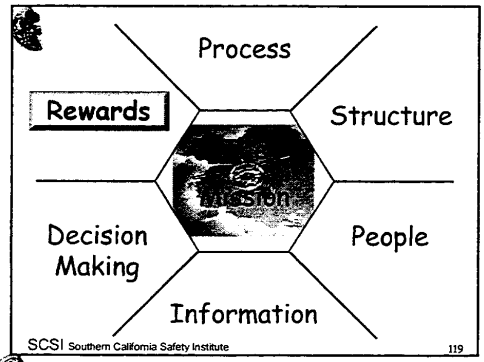


Organization



IP/PCT Edicts

1. Time pressure
2. Speed and accuracy trade-off
3. Reducing time pressure
4. Error management
5. Resource management
6. Ignorance is NOT bliss

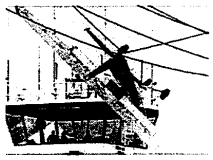


Reward Systems

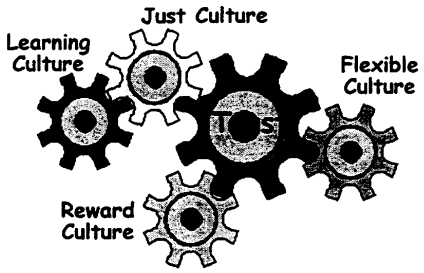
- Manifest themselves in many forms
- Not just "technician of the month" or a mug
- Must be built on a foundation of trust
- The motivations must be in alignment with the 'visible' value system

"Keep on doing what you're doing and you'll keep on getting what you are getting."

E. Scott Geller



Gearing Towards an Informed Culture



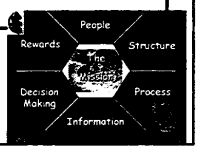
Flight Plan to Integrate Theory into Practice

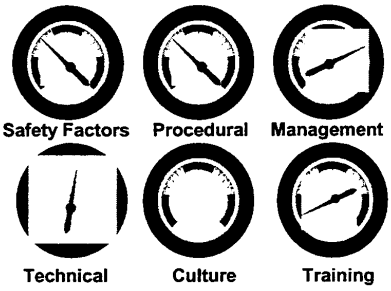
- Proactively develop a structure rather than letting one emerge
- Establish trust in relationship with both management and workers
  - Identify, assess and report error producing conditions, human performance problems
  - Bring Solutions
- Processes to work on problems and challenges
  - Ability to prioritize so as to maximize the uses of limited company resources
- Facilitate the integration of the risk management process
  - Management
  - Workers
- Continually educate and promote using all three mediums (tactile, auditory, visual)
- Foster commitment through involvement

To summarize...

Flight Safety - the real force multiplier!

- ✓Do we know what 'safety' means to us?
- ✓Do we have the sensors to answer the question: "Are we safe?"
- ✓ Are we working towards a Learning culture?





Safety:

- You accomplished your production goals
- You finish the day with the same number of people you started with
- They want to come back tomorrow and do it again
- Your people left work feeling:
  - They learned something and are better prepared for tomorrow
  - They made a difference
  - They had fun

SCSI Southern California Safety Institute 127

SCSI Southern California Safety Institute 128

AVIATION SAFETY AUDITING

Tommy McFall
McFall & Associates

Aviation Safety Auditing

- Auditor training class typically a full week
- This 4 hour presentation will be an overview of the concept and process
- Philosophy internationally based comparing FAR, JAR, IATA, and U.S. DOD

Presentation Will Cover

- Corporate Support for Auditing
- Why Audit
- Audit Types and Orientation
- Auditor Qualification
- Auditor Training
- Documentation
- Risk of Auditing
- Associated Websites

Corporate Support for Auditing

- GAIN Flight Safety Handbook CEO statement calls for:

1. Regular safety audits with full participation
2. Audits focused on people and working conditions
3. Leading and trailing performance indicators to evaluate safety

- But, manual contains no guidance on how

Why Audit

- Company safety awareness and monitoring of ongoing safety programs
- Regulatory compliance
- Concern for legal liability

Why Audit (continued)

- Regulator or public expectations

1. JAR OPS 1.035, compliance monitoring with feedback
2. FAA AC 120-59, "voluntary" internal evaluation program
3. HBAT 99-19, director of safety – "safety audits and inspections"
4. U.S. Department of Defense (DOD) requirement for IEP

Types of Audits

- Internal Evaluation Program (IEP)
- External audits
- Focused audits
- Abbreviated audits
- All require independence

IEP – Compare Guidance From:

- DOD Model Program
- IOSA Internal Evaluation Program
- JAR-OPS Quality Assurance Program
- FAA Advisory Circular AC 120-59

Audit Orientation

- Compliance
- Quality/system safety
- International (codeshare/alliance/IOSA)

Auditor Qualification

- Varies with type and orientation of audit
- quality is a combination of operational/audit experience and audit training
- Internal audits – less visibility
- Focused audits - focused capability
- Abbreviated audits, external/internal – broader background

Auditor Qualification (continued)

- Compliance audit - less "auditor skills"
- External audits – far more visibility/liability
- Quality/System approach –more "auditor skills"
- International – more cultural awareness

Auditor Training Requirements

- Vary based on audit type and orientation
- Quality of training - factor in credibility
- Standardization
- Don't confuse with skill training
- Can experience offset formal training?

Documentation, Types of Audit Reports

- Executive summary only
- Executive summary with checklists
- Checklists only, with or without comments
- Verbal
- Coordinate with legal department
- Document retention policy – formal and consistent
- Types of Checklists, Comparison of DOD & IOSA

Risk of Auditing

- Awareness without corrective action
- Future mishaps or other situations could resurrect an old audit
- Risk of not auditing
- Risk of unqualified auditors
- Risk of inadequate standards

Website Resources

- JAR: http://www1.jaa.nl/
- FAA: http://www1.faa.gov/
- DOD: http://public.scott.amc.af.mil/
- IOSA: http://www.iata.org/Whip/Public/frmMain_Public.aspx?WgId=200