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# Methods to Optimizing Human Error in Aviation Safety

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## Abstract

In aviation safety system "Human error" has been documented as a primary contributor to more than 70 percent of commercial airplane hull-loss accidents. In aviation, human factors is dedicated to better understanding how humans can most safely and efficiently be integrated with the technology. Surprising if you consider all the effort and expense put into management, research, training and the development of new technologies such as automation. But still human error related accidents occur. If interpreted narrowly, human factors are often considered synonymous with crew resource management (CRM) or maintenance resource management (MRM). However, it is much broader in both its knowledge base and scope. That understanding is then translated into design, training, policies, or procedures to help humans perform better. Despite rapid gains in technology, humans are ultimately responsible for ensuring the success and safety of the aviation industry. They must continue to be knowledgeable, flexible, dedicated, and efficient while exercising good judgment. Meanwhile, the industry continues to make major investments in training, equipment, and systems that have long-term implications. Because technology continues to evolve faster than the ability to predict how humans will interact with it. In Olden days there are many concepts are used to predict human error like "Swiss cheese", "Shell model", "HTA", "HEART", But still there are many reasons to air crash. So the author introduces ADS-B system. Nowadays mostly this system is employed in all commercial aircrafts and avoids the collision of air crash due to ATC & human mistakes.

**Keywords**: Safety, Aviation, Human error, ADS-B.

# 1. Introduction

Humanerrorinaviationissomewhatofasensitive topicduetotherecenttragicevents. Thegoalofthisresearchistounderstandhumanerrorinaviation,inordertounderstandhowde signing better computersystemscanassistinmakingtheaviationindustrysaferforpilots andpassengers, byreducing human error. Thispaperdoesnotattempttoaddressaccidentscausedbycowardlyactsofterrorism. Itisafactoflife.Peoplearenotprecisionmachinery designedforaccuracy.Infact,wehumans areadifferentkindofdeviceentirely.Creativity,adaptability,and flexibilityareourstrengths.Continualalertnessandprecisioninactionormemoryareourwea knesses.Weare amazinglyerrortolerant.Weareextremelyflexible,robust,andcreative,superbatfindingex planationsand meaningsfrompartialandnoisyevidence.Thesameproperties thatleadtosuchrobustness andcreativityalso produceerrors.Thenaturaltendencytointerpretpartialinformation althoughoftenourprimevirtuecancause operatorstomisinterpretsystembehaviorinsuchaplausiblewaythatthemisinterpretationca nbedifficultto discover.

Errorsare aninevitablepartofflying.Nomatterhowgoodapilot’s trainingis,wecanneverhopeto eliminate allerrors.Nowhere inlifecanweevermusterenoughbrainpoweranddiligence tomake mistakes impossible.Evenatourverybest,weseeashadow castbyourownbrilliance.Thispaperwilldiscusshumanerror inageneralsense,humanerrorspecifictoaviation,maintainingsituationalawarenessinaviati onandhumanerror reductiontechniques. And comparing the reduction techniques & to give more preferable method. Thegoalis tobecomeeducatedinhumanerrorinordertodeterminehowtoreduce,ifnot eliminate, humanerrorinaviation.

# 2. Methods to Predict Human Error

## 2.1. Swiss cheese

The Swiss cheese model of accident causation is a model used in the risk analysis and risk management of human systems. It’s like human systems to multiple slices of Swiss cheese, stacked together, side by side.

- Organizational failure
- Unsafe supervision
- Preconditions for unsafe acts
- Unsafe acts themselves

This method also poses some disadvantages, like Swiss cheese model to the engineering of human systems in the field of firefighting, with the aim of reducing human errors by "inserting additional layers of cheese into the system", namely the techniques of Crew Resource Management.

In the Swiss cheese model, individual weaknesses are modeled as holes in slices of Swiss cheese, such as this Emmental. They represent the imperfections in individual safeguards or defences, which in the real world rarely approach the ideal of being completely proof against failure

### 2.2. SHELL MODEL

- Software- The rules, regulations that govern operations
- Hardware- equipment, material and other physical resources
- Environmental conditions
- Live ware- the human

According to Edwards theorists system failures occur when there is mismatch between these components or when other environmental tasks occurred. The following factors are affecting the human performance in SHELL MODEL .Physical Size and Shape, Fuel Requirements, Input Characteristics, Environmental Tolerances.

### 2.3 HEART Technique

"The aspect for dealing with the errors which may have a gross effect on the system to be analyzed in order to reduce the resources usage when applying the technique". HEART method is based upon the principle that every time a task is performed there is a possibility of failure and that the probability of this is affected by one or more Error Producing Conditions (EPCs) – for instance: distraction, tiredness, cramped conditions etc. – to varying degrees. His main criticism of the HEART technique is that the EPC data has never been fully released and it is therefore not possible to fully review the validity of Williams EPC data base. Kirwan has done some empirical validationon HEART and found that it had "a reasonable level of accuracy" but was not necessarily better or worse than the other techniques in the study. Further theoretical validation is thus required. HEART relies to a high extent on expert opinion, first in the point probabilities of human error, and also in the assessed proportion of EPC effect. The final HEPs are therefore sensitive to both optimistic and pessimistic assessors. The interdependence of EPCs is not modelled in this methodology, with the HEPs being multiplied directly. This assumption of independence does not necessarily hold in a real situation.

### 2.4. HTA Technique

The HTA (Hierarchical Task Analysis) starts with then top and full goal of the task, which can be decomposed into sub-goals. Meanwhile a series of plans should be involved to indicate the sequence of the human activities. The plans are determined according to system design and operation guidance. When the analyst approves of the task analysis of this level, the development of next level may be undertaken.

## 3. Proposed Method

ADS-B CreatesaNew Standard of Aviation Safety:

What isADS-B?
ADS-Bistheacronym for Automatic DependentSurveillance-Broadcast—anew technology thatallowspilotsinthecockpitandairtrafficcontrollersonthegroundto "see"aircrafttrafficwithmuchmoreprecisionthanhasbeenpossible before.ADS-B can makeflyingsaferandcanallowmoreefficientuse ofourairspace.

ADS-B-equippedaircraftbroadcasttheirprecise position,speed, andaltitudeviaa digitaldatalink.ADS-Breceiversthatareintegratedintotheairtrafficcontrolsystem orinstalledaboardotheraircraftprovideuserswithanaccuratedepictionofreal-timeaviationtraffic,bothintheairandontheground. Unlikeconventional radar,ADS-Bworksatlowaltitudesandonthegroundsothatit can beusedtomonitortrafficonthetaxiwaysand runways of anairport. It's also effectivein remoteareasorinmountainousterrainwherethereisno radar coverage,orwhere radarcoverageislimited.One ofthegreatestbenefitsof ADS-Bisitsabilitytoprovidethesame real-time information tobothpilotsinaircraftcockpitsandgroundcontrollers, so thatforthe first time,they canboth"see"the samedata.

Howdoes itwork?

ADS-Breliesonthesatellite-basedGPSsystemtodetermineanaircraft'sprecise location.Thepositiondataiscombinedwithotherinformation suchas thetypeof aircraft, speed, altitude,andflightnumber.The informationisconvertedintoa digitalmessageandbroadcastviaaradiotransmitter.Otheraircraftandgroundstationswithi nabout150milesreceivethe radio broadcasts anddisplaytheinformationinuser-friendlyformatonacomputerscreen. Pilotsinthecockpit see thetrafficonaCockpitDisplayof Traffic Information(CDTI). Controllersontheground canseetheADS-Btargets ontheirregulartrafficdisplay screen,alongwithother radartargets.

**Advantagesof ADS-B**

- ADS-Btechnologyisthe cornerstone of future airtrafficcontrolsystems. It will improveaviation safetyby givingpilotsinthecockpitandcontrolleron thegroundreliable,accurate, real-timeinformationaboutaviationtraffic.
- Byusing existing,proven,digitalcommunicationstechnology, ADS-Bcanbe implemented rapidlyforarelativelylow cost.
- ADS-Bprovidestrafficinformationtopilotsthatiscurrentlyunavailableto them.Becausethesystemhasaneffectiverangeofmorethan100miles, ADS-B providesamuchgreatermargininwhichtoimplementconflict detectionandresolutionthanisavailablewithanyothersystem.
- PilotsandcontrollersusingADS-Bdatawillbeabletodeterminenotonlythe osition of conflictingtraffic, but willclearly seethetraffic'sdirection, speed, And relativealtitude. As theconflictingtrafficturns,accelerates, climbs,or descends, ADS-Bwillindicatethechangesclearlyandimmediately.

- ADS-B systemscanfurther enhanceaviation safetythroughfeatures suchas automatictrafficcall-outsorwarningsofimminentrunwayincursion.
- ADS-Btechnologycanbeusedinbothaircraftandingroundvehicles. This Will provideaffordable, effective surveillanceof allairandgroundtraffic,even on airporttaxiwaysandrunways, andinairspacewhere radarisineffectiveor unavailable.
- ADS-Bcanimproveairportcapacity,byallowingmore efficient operationsat airportsthatdonothave radar service.
- General aviationaircraftcanuseADS-Bto receive flightinformation services such as graphical weatherdepictionandtextualflightadvisories.Inthepast, theseserviceshavebeenunavailableortoo expensivefor widespreadusein generalaviation.

## 4. Results and Conclusion

Human errors are not fully predictable, but preventable. So the researchshows that humanerroridentificationmethodologiessuchas SHERPAand HEARTare suitable fora flightcrew's mistakesanalysisandquantificationinthe aviationdomain but they have disadvantages. The author proposed ADS-B is more preferable to avoid collision.ADS-Btechnologyisthe cornerstone of future airtrafficcontrolsystems. It will improveaviation safetyby givingpilotsinthecockpitandcontrollerson thegroundreliable,accurate, real-timeinformationaboutaviationtraffic.The processes in the project,employed fromHEItechniques,are actually comprehensible andconvenient toconduct.

Everycoinhastwosidesonitssurface.Thecurrenthumanerrorpredictionapproachescomefrom theirdevelopmentbackground,wheremostlytheirgenerationcomesfromthenuclearindustry.The humanmodelandworkingenvironmentusedintheseHEItechniques are different from those of an aircrew.Therefore,the humanerrormodelsandHEPcalculationmethodsarestillunderdiscussion. However,the validationincludedinthese projectsshowsthe failure rate of "prevent human error" isveryclose tothefrequencycomputedusing operational record data.That meansifa flight crewerror databaselikeCORE-DATAistotallyavailable,the piloterror predictioncanbe performed accurately. In ADS-B also having some disadvantages. It will be corrected for further ongoing project.

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