

International Cross-Industry Safety Conference (ICSC) and International Symposium on Aircraft Technology, MRO and Operations (ISATECH) 2019

Editorial of Proceedings

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The Amsterdam University of Applied Sciences (AUAS) and the Sustainable Aviation Research Society (SARES) organised in Amsterdam (9-11 October 2019) the 4th edition of the International Cross-industry Safety Conference (ICSC) and the 2nd edition of the International Symposium on Aircraft Technology, MRO and Operations (ISATECH) dedicated to the interface between research and practice.

The AUAS Aviation Academy performs research into real-life cases and problems in the aviation sector, focusing on safety and human factors, MRO process improvement, composites & advanced maintenance technologies and aviation capacity. The overarching concept of the AA research is the Sustainable Operational Readiness; the development of sustainable processes & operations in Aviation. Our goal is to improve and innovate professional practice. We perform all of our research projects in close cooperation with industry, governmental agencies and scientific institutions and universities. This ensures a solid connection with state-of-the-art scientific knowledge, as well as a focus on the most current and urgent problems. The aim of this gathering is dual; to act as a forum, where innovative ideas and technologies are presented and to form the hub for the dissemination of multi-disciplinary knowledge and expertise between industry and academia.

ICSC addressed a variety of topics that center safety and human factors across industries, such as aviation and rail. Specifically, safety and risk management, systems thinking and safety culture, neuroergonomics, peer pilot support, safety investigations, and safety performance were discussed. The interdisciplinary thematic forms a commotional context in safety and human factors, calling industries and academia to an open dialogue. ISATECH served as a platform for the dissemination of multidisciplinary knowledge, innovative ideas and experience between industry and academia. ISATECH addressed a variety of topics such as advanced maintenance technologies, air transport operations, aerospace advanced materials, airport capacity, advances in composites, maintenance planning & scheduling, predictive maintenance, electric flight, propulsion technologies for aerospace vehicles, structural health monitoring systems, and sustainable aviation.

Maarten Koopmans (Vice President, Component Services, KLM) opened the conferences in a joined plenary session. Robert Jan de Boer (Director of Northumbria University in Amsterdam, NL), Stathis Malakis (Air Traffic Controller, Hellenic Civil Aviation Authority, GR), Colin Dennis

(Retired Technical Director of RSSB, UK), Tamara Pejovic (Safety Performance Expert, Eurocontrol, BE), David Lindley (Head of Aviation Safety and Quality Assurance at Hybrid Air Vehicles, UK), Umit Kus (Training Manager at myTechnik, TR), Arnold Gad-Briggs (Director of EGB Engineering, UK), Birol Kilkis (ASHRAE Fellow, Polar Technology Hacettepe University & European Technology and Innovation Platform, TR), Ravi Rajamani (Visiting Professor Cranfield University, UK & SAE Fellow, USA), and Kateryna Synylo (Assoc. Professor, Faculty of Environmental Safety, UA) addressed the conferences as keynote speakers. Besides the keynote speakers, 46 delegates from various industry, academia and (inter)governmental organisations delivered their presentations and discussed with the attendants a wide range of practical applications and research results.

We would like to thank the organising committee members, Rianne Boute, Renée Groen and Shen van Dijk under the leadership of Sanne van Dorp and Viktoria Balla-Kamper. We also express our deep appreciation to the programme committee members for their contribution in the review process (in alphabetical order of the last name):

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Finally, we would like to thank our partners:

- The Safety and Reliability Society (SaRS), UK
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- GMI Aero, FR
- Women in Aviation, The Netherlands Chapter (WAI), NL
- WSP Consulting, UK

In this editorial, we append the abstracts of the contributions that were not submitted as full papers. We hope that the abstracts and the full papers will trigger the readers to reflect on their practice and initiatives and contact the contributors for any inquiries and possible collaborations.

Dr. Konstantinos Stamoulis, ICSC-ISATECH 2019 Conference chair

Dr Maria Papanikou, Co-chair ICSC 2019

Dr. Asteris Apostolidis, Co-chair ISATECH 2019

Anastastios Plioutsias, Co-chair ICSC 2019

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Introducing a system theoretic framework for safety in the rail sector: supplementing CSM-RA with STPA.

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ABSTRACT

To meet the ever-growing challenge to improve the capacity and performance of the UK's rail network, the industry continues to deliver technical, operational and organisational change projects. The safety risk associated with such change is controlled through a risk management framework known as the Common Safety Method for Risk Evaluation and Assessment (CSM-RA). But as we continue to deliver extremely complex mega-projects, with the use of new and novel technology and systems to support safety-critical functions, new modes of both machine failures and human errors arise. This work discusses how System-Theoretic Process Analysis (STPA), a relatively new hazard analysis technique based on systems theory, can be used in the application of CSM-RA. It presents how to apply STPA to supplement our current 'toolbox', promoting a 'systems-thinking' approach to safety in the rail sector to help us to answer that crucial question: How can we be confident that we understand what our safety requirements should be, and are we really sure that all reasonably foreseeable hazards have been identified?

So far in the rail sector, there have been some attempts to switch attention to more system and less component-oriented approaches to safety. STPA is one of those new approaches that started being applied in cases such as the Chinese railways, Beijing metro, US and Chinese high-speed rail, and European Railway Traffic Management System (ERTMS). More recently, a study involved the development of a control structure model of rail transport in Australia, using the safety control structure of STPA to identify the actors involved in managing safety, and show the control and feedback mechanisms that comprise the adaptive feedback function to maintain safety.

To explain how STPA can be used in the UK rail sector and embedded into the CSM-RA process, in our presentation to ICSC2019 we will elaborate on the activities described in the CSM-RA Risk Management Process, discussing a 'typical' practice for a project applying CSM-RA. We believe that with the implementation of STPA we have opportunities to improve current practice, but of course along with those opportunities for improvement, there are also challenges which will need to be addressed.

The next steps to be taken is the application of STPA to real case studies from the rail projects we lead. This will help us draw conclusions about the sensitivity of STPA in

comparison with traditional safety approaches and within the CSM-RA framework. Future work and experiments may also shed light to further challenges and opportunities that accompany both new and traditional tools. Moreover, we may be able to determine whether the effectiveness of STPA is limited if we are forced to operate within the bounds of the CSM-RA framework, and if so, propose areas for improving CSM-RA to allow the industry to realise the full potential of STPA. With these results we seek to increase the availability and acceptability of new systems-theoretic tools by rail organisations and companies who are faced with mega-projects of unprecedented complexity.

Keywords: CSM-RA, Hazard Analysis, Safety, Reliability, STPA, Systems Theory

Ensuring that human error, does not become fatal human error

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ABSTRACT

Why fresh thinking and disruptive breakthrough technology can mitigate against the fatal consequences of human error in mass transportation. It is no secret: humans make mistakes. Humans are prone to error. That fact is a reality. What is surprising then, is that following any public transportation mass fatality, where a verdict of human error is returned, such a verdict generates both shock and surprise. All humans make mistakes: every human; every day. That includes all train drivers, airline pilots, underground rail drivers, and tram operators. Therefore, the challenge is not just to recognise and acknowledge the presence of human frailty—nor to accept that error cannot be mitigated—but to deploy solutions which ensure that all such human error does not become fatal human error. We are not removing the human from the process, we are removing human error from the process. However, there is a problem with such a strategy. The enemy of new thinking—and what is proposed here is disruptive, breakthrough, totally new thinking—is the rigid adherence to legacy technologies, processes, and practices. Any technology is only as strong as its weakest part, and old technologies and processes cannot deliver new solutions. This paper argues that in advancing human factors focused public transport safety, what is needed is revolution, not evolution; that robust and mature technologies which have proven their viability and worth in completely unrelated industries, now have the potential to deliver absolute operator safety and protocol adherence in the key areas of air and rail mass public transport. But in deploying such technological lead, the art is integrating new practices, protocols and systems in a way which does not require operator re-training. This paper introduces these new approaches, technologies, practices, and protocols into the arena of passenger safety in mass transportation operations.

Keywords: CFIT, Fatality, Artificial Intelligence, Aviation, Rail, Human Error, Safety Monitoring, Safety Compliance

'Famous' Barriers, a novel approach to improving management understanding of critical functions.

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Hudson Global Consulting

ABSTRACT

This paper further develops Bow-Tie methodological concepts such as the Levels analysis (SPE 127180), Sparseness, Completeness and Complexity (Hudson & Hudson, 2015). These concepts, taken together, are developed here to provide simple ways of providing managers with both strategic and tactical information about how well their risks are being controlled. The introduction of frequency and effectiveness measures combined with greater understanding of the management functions as described allows improved control. The disconnect between the knowledge and understanding residing within the risk management function of an organisation and its senior management has been the cause of numerous incidents within the Oil and Gas industry. The immediacy of personal safety incidents, together with the personal history of senior managers, can create situations where the actual organisational needs are deprioritised in favour of immediate, hands-on actions. The FAME method, by looking at all the management functions controlling barriers, allows risk managers to communicate the highest priority safety critical management functions to the senior managers in a clear and concise manner. The emphasis is moved from immediate causes to factors that are within the span of control of managers. This allows the conversation to change from “why wasn’t he wearing his gloves?”, a purely reactive question about events that the manager has very little control over; to “how did we not have a start-up audit on this contract?”, a subject that is closely related to the actual activities of the manager concerned. This paper introduces a method for clearly communicating to senior management what their own critical management functions are and what they can be held accountable for.

Keywords: Bowtie, Barriers, Criticality, FAME

Moving up the culture ladder: creation and application of management methods to guide organisations towards generative, a case study

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ABSTRACT

The paper discusses the novel understanding of the difference between the steps in the IOGP HSSE culture ladder and the methods used in a high hazard operation to effect the change required to move up those steps. The organisation involved has been de-identified.

In the expert report to the U.S. 5th Federal Court Deepwater Horizon case (Hudson 2011), the transitions ascending the cultural steps are described by the sequence “In place – In operation – Effective – Permanent”. The authors applied this understanding in a high hazard aircraft engineering operation and discuss the challenges, roadblocks and adaptations required to effect the desired organisational changes. It includes the methods used to gain senior management involvement for the process and the general processes developed to create the understanding within the organisation.

A frequently stated organisational goal is the development of the organisational culture using the HSSE Culture ladder. While the ladder can provide a road map that allows for realistic incremental improvements of the safety culture the actual detailed definition of the measures to be taken can still be challenging. Using the cultural sequence as set out in the report to the court a more understandable path can be forged that allows improvements to be mapped onto current operations, by identifying processes and activities associated with higher steps on the ladder. This enables a clearer definition of the desired goals and assessment of whether those goals have been achieved leading to cultural change. This includes changing or moving on from performance indicators as and when they are fulfilled. In this case study the organisation achieved advanced cultural behaviours through application of standard management techniques. This includes topics that distinguish more from less advanced cultures such as: Managing Non-compliance, Operational Discipline, Using Standards and Best practises. Improvements in the major lagging Process Safety indicators were gained through the application of this method, demonstrating a marked reduction of major incidents, as would be predicted by a more advanced safety culture. This paper introduces a number of measures that can be used to effect lasting cultural change within organisations. Use of these methods allows more granular control over the cultural development, which allows more effective and efficient change programs.

Keywords: Culture, Development, Quality

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Safety and security implications of HRM austerity measures implemented on European airports during the economic crisis

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ABSTRACT

The issues of safety and security is of fundamental importance for the air transport industry since any aircraft accident or terrorist attack triggers multiple implications for airlines and travel destinations altogether. Given the rapid technological advancements and the increased number of security threats major investments are required to address current challenges and maintain high safety and security standards. However, economic recession that sweeps Europe for over a decade joined with air transport deregulation and liberalization has caused a cost-reduction frenzy in the aviation industry. Labor costs are among the first targets of cost reducing policies and austerity HRM practices are often implemented in all aviation sectors. Similar measures in other industries are known to have a deteriorating effect on the working conditions and possible implications in further organizational dimensions but a wide research gap exists regarding the impact of neoliberal labor measures on the airports' workforce. This study investigates the austerity HRM practices implemented in the European airports' workplace during the economic crisis, the subsequent work deterioration and additional associations with airports' safety and security dimensions.

The survey took place in 2016 in 40 European airports of various sizes, both public and private, located in 22 countries. To quantify the economic crisis magnitude, a single Economic Crisis Index (ECI) per country was constructed using the four most common macroeconomic indicators (GDP per capita, unemployment rate, inflation and public debt) and the 22 countries of the sample were separated in three ECI categories (low-moderate-severe). The ECI classification was used in statistical comparisons and as an independent variable in regression analysis.

Study results reveal that the most common HRM practices implementing on the airports' workforce during the economic recession include increased workload, retirement age lengthening, staff and wages reduction, restriction of rights and longer working hours. Subsequent work deterioration is expressed with increased stress levels, job uncertainty, reduced job satisfaction, work-life imbalance and in-work poverty. Safety incidents are mostly related to ground handling operations, airport infrastructure, bird and wildlife hazard, dangerous goods and fuelling operations, whereas security incidents connect to inadequacy of security staff, unruly passengers, illegal migration, unauthorized access to restricted areas and failure of security equipment.

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One-way ANOVA affirms that crisis impact is not homogeneous across airports, since public airports and those located in South European regions and in countries displaying a high ECI have widely applied most of the austerity HRM practices, display severe work deterioration and report the highest frequencies in safety and security incidents.

Multivariate statistical analysis located statistically significant positive bivariate correlations among the four survey variables (Austerity HRM practices, Work Deterioration, Safety and Security). The two latter variables were also used as dependent variables in multiple regression analysis with the results suggesting that both safety and security are affected by work deterioration but not by other characteristics like airport size, region, management type and job position, whereas ECI affects safety but not security.

Finally, regression analysis was used to investigate the hypothesis that work deterioration mediates the effect of austerity HRM practices on airport safety and security. Results indicated that, in both cases, austerity HRM practices was a significant predictor of airport safety and security when ignoring the mediator (work deterioration), but austerity HRM practices was no longer a significant predictor of airport safety and security after controlling for the mediator, providing evidence for full mediation effect of work deterioration on the eroding impact that austerity HRM practices have on airports' safety and security.

Keywords: Safety, Security, Airports, Economic crisis, Austerity HRM practices, Work deterioration

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CAA support to the development of pilot peer assistance and a national pilot peer assistance network (P PAN)

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ABSTRACT

The physical and psychological wellbeing and health of pilots is something the UK Civil Aviation Authority (CAA) takes seriously. Like all safety-critical roles, it is important that pilots who are experiencing any issues feel safe to seek appropriate support free from judgment at the earliest opportunity. We want the UK pilot community to understand that it is supported and to know where it can go to seek advice on wellbeing and health.

To this end, the CAA is facilitating the concept of pilot peer assistance and a National Pilot Peer Assistance Network (P PAN). The National P PAN will be an industry-wide programme, which will positively promote and support the whole health and wellbeing of commercial pilots. The network will provide confidential and independent peer-based support and assistance. Trained peer volunteers – who understand the different pressures that commercial pilots can face – will work alongside qualified health professionals to enhance the wellbeing of the UK's pilot community. Pilots will be able to have safe conversations with peer volunteers who will be specially trained to listen, support and empower. Ideally there will be several ways pilots can access this support. This could be initially via a website or telephone line, depending on the needs of the pilot. If a pilot feels that they require further support to help with longer term or more complex health and wellbeing needs, then that would be enabled through the peer assistant and engagement with the relevant bodies. Ultimately, the P PAN aims to improve whole health and wellbeing for pilots, to be at their best and so to enhance aviation safety.

The P PAN will be based on three fundamental principles. Firstly, it should be supported by all stakeholders and be available to all pilots working in commercial air transport. Secondly, it should be independent from the regulator and the operators, so pilots feel they can communicate openly and frankly about their wellbeing and finally, it should be trusted and confidential.

To do this, we will be identifying 'pathway organisations' that can provide such services via a 'Request for Information'. These organisations would ultimately work with operators, pilots and healthcare professionals to create the services ready for implementation by August 2020. Organisations that are part of the network will provide services that benefit all pilots working in UK commercial aviation.

While some operators may already have – or choose to create – their own internal peer assistance programmes, a National P PAN will enable other operators to benefit from

collaborating together and with the service providers to ensure that all their pilots have access to peer assistance.

The development of the national P PAN also fits into a broader European initiative to provide more wellbeing and health support to pilots. The UK CAA has worked closely with EASA and fellow authorities to develop the regulation which is the basis for peer assistance and support programmes across the continent, which need to be implemented by August 2020.

UK aviation has an exemplary safety record. It's our role at the CAA to look at how we can continue to build on this strong foundation, making aviation even safer in the future.

LTT

A UK Civil Aviation Spokesperson said: "Health and wellbeing is as important for pilots as it is for any other profession. The Civil Aviation Authority wants the UK pilot community to understand that it is supported and to know where it can go to seek advice on wellbeing and health.

The creation of a national pilot peer assistance network will be an important tool in achieving this, and we look forward to working with operators on its development." You should leave 8 mm (22,7 pt) of space above the abstract and 10 mm (28,35 pt) after the abstract. The heading Abstract should be typed in bold 9-point Arial. The body of the abstract should be typed in normal 9-point Times in a single paragraph, immediately following the heading. The text should be set to 1 line spacing. The abstract should be centred across the page, indented 17 mm from the left and right page margins and justified. It should not normally exceed 200 words.

Keywords: Pilots, Mental Health, Peer Assistance Network

Is a symbiosis of systems thinking with systematic management feasible in occupational health & safety?

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ABSTRACT

A systems approach to Occupational Health & Safety Management (OHSM) can arguably address the emergent complexity of organisations within the modern industrial age. This approach acknowledges that entities are comprised of people, equipment, tools, processes and policies that are all interconnected and interrelated and affect process outcomes of any business. An effective systems approach also requires the inclusion of budgetary, regulatory, internal and external emerging issues and behavioural aspects, and must be tailored to the size and risk profile of each enterprise.

Although the core systems approach to occupational health and safety is based on the complex sociotechnical view, systematic analysis to allow manageability of systems traditionally breaks down an organisation into its constituents such as workers, technology/processes and organisational and environmental components. However, due to their dynamic behaviour, complex sociotechnical systems are impossible to measure; thus, when a system is decomposed into interrelated elements and phenomena, only the aspect of the complexity that is captured momentarily is being measured. Internationally recognised standards for OHSM systems attempt to address this issue as they draw on both management theory, the quality paradigm and the complex sociotechnical view.

In our work, we reviewed prevalent approaches, and studies relevant to systematic and systems approaches to OHSM as a means to explore their boundaries and overlaps and suggest whether and how their symbiosis could be advisable and feasible. Overall, our study showed that even when organisations have adopted what appears to be a well-designed, compliant, implemented and monitored OHSM system, they may not consider all internal and external (sub)systems, elements and connections necessary for a truly effective management system. On the other hand, a system approach alone is not a guarantee for success if not accompanied by an agreed, transparent systematic management framework that acknowledges its limitations and is open to evolve and consider that work occurs in a context where the various risks exist concurrently, and their emergence is influenced by interdependent components and (sub)systems.

Although OHSM systems in themselves do not prevent accident and incidents and are necessary but not sufficient to meet intended business outcomes, they can still function as a framework for instilling an overall systems approach within and across organisations. Our premise is that systems and systematic methods, tools and techniques must be combined with caution and an understanding of the inherent limitations of each approach.

Keywords: Health and safety management, Systems thinking, Systematic approach

Root causes for non-compliant behaviour on airside

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ABSTRACT

Non-compliance in airside operation – a case study

The paper discusses the results of a study, conducted airside at Amsterdam Airport Schiphol (AAS), looking at the root causes and contributing factors that create situations where non-compliance is more likely to occur. It discusses the challenge posed by the agency problem and unclear accountabilities in multi party operations (multiple ground handling companies, fueling, maintenance, catering, airline, Authority, etc.). Situations where non-compliance was more likely to occur were identified using a triangulation between four investigation methods: A meta-analysis of all airside incidents over the previous year, a procedures and practices questionnaire based upon the “Hearts and Minds” safety culture approach, a series of workforce interviews and focus groups, and observations of all ground handling processes. This data was then collected.

The results from the triangulation were then used for two further lines of inquiry: a human factors analysis of the locations and processes identified, and a series of supervisor and management interviews into quality and safety management.

Our analyses point to two root causes at the two immediate organisational levels (work site and supervision): physical working environment and work force operations. There are two main contributing factors that create, shape, and define the two root causes (environment and workforce). The first factor can be defined as how the airside organisations manage their operations. The second factor is how AAS manages the airside organisations.

Physical work environment.

Although available space and time for ground handling comply with regulations and planning does have a sense for realism, this is not experienced by airside workers. It seems that complex interactions between all parties involved in ground handling and being present in offices and on service roads nearby are not adequately managed. The design of stands, roads, and vehicles certainly contributes to non-compliant behaviour in many cases: these encourage a problem solving (‘can do’) attitude taking shortcuts on safety.

Work force operations

The goal of On Time Performance is present in all organisational layers in aviation. In situations where compromises have to be made between performance and protection there is a strong preference for performance. This then motivates non-compliant behaviour on airside.

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Airside organisations

Airside organisations face a challenge in effectively managing the compliance of their workforce. There are airside issues in the exchange and sharing of information both internal to organisations and between airside parties. Their incident and accident reporting and safety management systems in place are still developing and maturing. There is constant pressure on production targets.

AAS management

There are a number of issues for AAS management. These include insufficient enforcement, toleration of deviation, and the poor assignment of airside spaces and offices. AAS currently does not ensure effective cooperation between airside organisations in their interactions.

These findings of the main root causes of incidents and non-compliances indicate the need for a change in approach to how these issues are addressed and mitigated. The complexity of the problem precludes a purely prescriptive approach. A performance based approach that allows for context dependent interventions can be a highly effective solution. This is the underlying approach of the European Aviation Safety Programme (EASP).

Our integrated approach with a both a bottom-up human factors analysis and a top-down organisational analysis was appreciated by all stakeholders. The next phase is to implement solutions targeted at Equipment, Infrastructure, Regulations, Workforce, and Management issues.

Keywords: Non-Compliance, Aviation, Driving, Airside, Accountability, Agency Problem, Root causes, Contributing factors, Hearts and Minds, Regulation

Safety investigations: lessons learned, lessons forgotten?

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ABSTRACT

Safety is a prime mover in the aviation industry, which is among the best of the world, labelling the industry as a Non-Plus Ultra-Safe system. Air disasters and safety concerns are investigated on an institutional basis, while their findings are formulated as lessons learned to prevent similar occurrences. This safety achievement is the result of a community, capable of dynamic learning, sharing knowledge and feeding back operational experiences into design, certification and training processes.

However, due to new technologies, organisational and commercial changes, optimization of production processes have also created a phenomenon of ‘emergent’ properties. Such properties are assumed to be unprecedented. Recently major concerns were raised across the aviation industry due to a series of air disasters with modern aircraft with highly qualified and experienced crews. Air disasters such as with the B737 MAX 8 raise questions about the role of automation, training of pilots, allocation of responsibilities for certification to either inspectorates or manufacturers and optimization of designs and operations to weight and fuel economy criteria. Such questions are not unique for the B737 MAX 8 case. In the past, similar questions have been raised about the validity of design choices, operational procedures and optimization processes. Iconic examples safety investigations are provided by the thrust reverser of the B767, the engine pylon design of the B747 and the rudder actuator certification of the B737. Each revealed specific knowledge deficiencies and safety assessment assumptions. In hindsight, each of these lessons revealed inherent but unnoticed safety consequences of decisions made earlier and higher up in the process of aircraft design and operations. Could such deficiencies have been foreseen or are they inevitable as ‘emergent’ properties?

In this paper, we elaborate on the question: are recent air disasters the consequence of emergent properties or are they lessons forgotten from safety investigations? Do we need a new frame of reference for learning lessons from air disasters? In elaborating on this question, we focus on properties of the various generations of the B737, whether they can be considered derivative or disruptive designs and adaptations. Did these generation shifts require specific adaptation in training and familiarization, supported by feedback of pilots on emergent differences between generations? But foremost, do we have to reconsider the lessons learned from investigations into mishaps as introductions of disruptive technologies and procedures? Are these lessons learned obsolete legacies and are we bound to drift into failure or should

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we look for inherent properties rather than waiting for emergent properties to manifest themselves as unanticipated, catastrophic events?

It is doubtful whether a conventional strategy of further investment in existing concepts of either man or machine safety performance is successful for the future. Is a fallback on manual control and maintaining a focus on stall prevention rather than stall recovery still a valid strategy? Or should we move to a systemic understanding of the more complicated man-machine-interface dynamics? Is it an exclusive responsibility of an independent and qualified inspectorate or safety board to assess the safety consequences of disruptive changes or can such an assessment be left to a delegated responsibility of a manufacturer and carrier? How do we define the difference between derivative and disruptive changes? Our primary recommendation in this paper is to recognize and operationalize transitions from derivatives to disruptives. Is it recommendable that new devices and adaptations should not be accepted with respect to their safety properties without substantive proof of concept by an independent and qualified assessment?

Conclusions

Lessons learned from investigations in the past provide a very valuable body of knowledge as a repository for safety considerations, assumptions, properties and expertise in the evolutionary adaptation of aviation to new times. Such lessons should be basic training material for all future aviation safety specialists, designers, inspectors, trainers, managers and investigators alike. Eventually, safety investigations are the problem providers for knowledge development. This body of investigative knowledge should be stored in a repository of a training institute that contains lessons learned on systemic properties, deficiencies and their remedies in both the design and operational phase of the aviation industry.

Keywords: Safety investigations, Lessons learned, Emergent properties

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Ground Handling Service Providers safety training: safety contributors and sociotechnical gaps for continuous development

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ABSTRACT

Safety Management Systems are data-driven decision systems aiming to continuously improve safety in an aviation organisation. Although several aviation organisations have long implemented SMS, there is a significant data gap on ground safety training needs to inform further developments. Our research hence explores whether the training practices under SMS addresses the needs of the industry and satisfy the aspirations to evolve best practices, and specifically for Ground Handling Service Providers. Our research aims to aid formulating a training agenda for ground handling organisations. This research was done by using effective and accessible guidelines/legislations of regulatory and advisory aviation organisations concerning the Safety Management System training. Archival data was used to define the current situation (minimum legal requirements / compliance) and compare it to a continuous development scenario in order to identify gaps. In addition, key safety findings at Ground Handling Service providers were used to complement the definition of the current situation. Following a gap analysis, we identified the gaps in the current situation, and we make the suggestions required for improvement. This analysis was aided by the introduction of what we call, safety contributors, meaning the factors that work well and contribute to safe ground operations. We report the benefits of the latter approach in viewing gaps in training, and in light of lack of data sharing, reporting and other challenges. We conclude with the proposition of the development of safety contributors for ground handling service provider organisations. Our contribution to knowledge focuses on the understanding of sociotechnical gaps for ground safety training and continuous improvement, revealing the imbalance of investments. We propose that future studies should include a broader employee sample for certified training, including safety training and assessment categories, classification of occupational groups and the Training Needs Analysis.

Keywords: SMS, Training, Ground Handling Service Provider, Aviation

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Benefits of relational database architecture of CMMS: configuration practices of enormous number of assets in airports

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ABSTRACT

Maintenance of the working parts for an operational asset was an operational and financial decision in mid- 20th century. However, it has developed itself and included environmental decisions as a factor. Maintenance has turned into more economical decision than ever. Besides of the rules of the maintenance activities, did the roots of these rules changed? Many of the maintenance configurations and the migration projects are being unusable in months. Kindly but not wisely efforts to maintain newly set up computerised maintenance management systems (CMMS) creates more and more desperate technicians and planning departments, which bogs down in visionless and dragged by the urgent needs of the operational requests, day by day.

Maintenance Management practices on enormous numbers of assets must need some methods to change as the requests and the factors changes. This paper has focused the practical approaches and basis of the computerised side of Airport CMMS systems. Basically, trying guide projects to follow more efficient solutions to using indexing functions of the relational databases.

Keywords: Maintenance Tag Design, Location Tag, Maintenance History, Precise Maintenance Planning

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Assessment of external risk factors and identification of precursors of veer-off event by means of statistical analysis

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ABSTRACT

According to ICAO viewpoint, the runway excursion problem is one of the priority task for aviation community because hard landings and runway excursion events are the most frequent aviation incidents. The presented report is dedicated to statistical analysis application for the purpose to assess some factors provoking such runway excursion as veer-off and identify precursors of such incidents.

The factors under consideration are the follows: year season, contamination type and crosswind speed. Precursors under consideration are some flight parameters at checkpoints on glide slope trajectory. The subject of research is some sample of raw flight data from on-board recorder of civil airplane and METAR archives with information about weather and runway contamination. There was developed special software for METAR archives processing and synchronization meteo data with terminal stage of specific flights.

In accordance with proposed approach, the risks of veer-off event are evaluated by analysis of successful landings (with no vee-roff). For this objective some “post-landing run metric” (TrackIndex – TI) was introduced, its value represents deviation of considered landing from “ideal” one. It is assumed that higher value of this metric shows higher risk of veer-off.

There were investigated various metrics based on such flight parameters as lateral deviation from runway axis (TI_Y), lateral acceleration (TI_{ny}), heading angle (TI_ψ), rudder pedal position (TI_{xr}). Equation for TI_Y metric looks as follows:

$$TI_Y = \frac{\int_{X_{touch}}^{X_{turn}} |Y - \bar{Y}| dx}{L_{run}}, \text{ where}$$

Y – deviation of the aircraft from runway axis during landing run;

\bar{Y} – mean value of Y ;

L_{run} – length of run;

X_{touch}, X_{turn} – points of touchdown and end of run.

Graphical illustration of TI_Y metric is shown in Figure 1.

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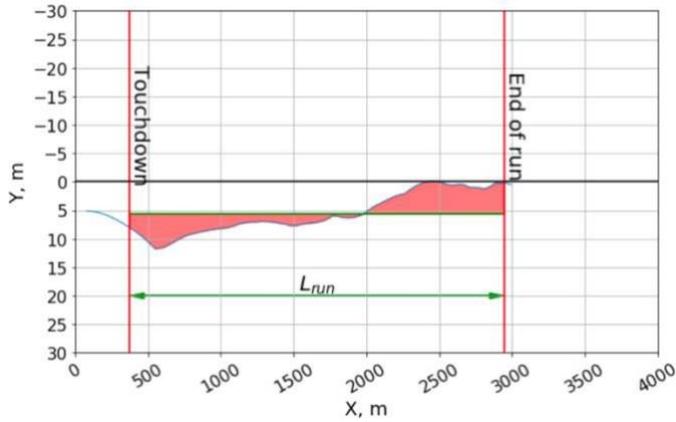


Figure. 1. TIY graphical illustration.

Additional metrics were also considered. These are lateral acceleration metric (TI_{ny}) and rudder pedal control intensity metric (TI_{Xr}):

$$TI_{ny} = \sigma_{n_y} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (n_{yi} - \bar{n}_y)^2}, \quad TI_{Xr} = \sigma_{X_r} = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (X_{ri} - \bar{X}_r)^2},$$

where n_{yi} and X_{ri} are the values of lateral acceleration and rudder pedal positions during run.

The results of impact assessment of year season, crosswind speed, runway contamination and flight parameters on some checkpoints (figure 2) on selected metrics are given. Mann-Whitney test is used for categorical parameters (year season, runway contamination) impact assessment; Spearman correlation coefficient is used for impact assessment of continuous parameters (crosswind speed, flight parameters at checkpoints on glide slope).

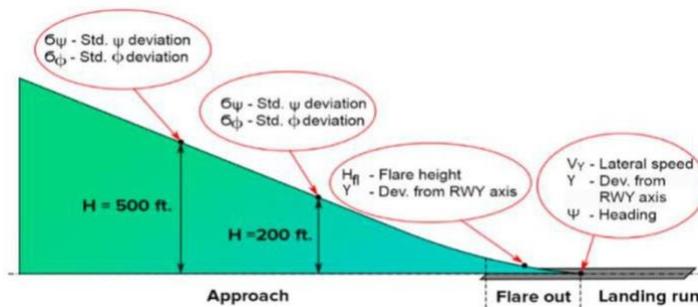


Figure. 2. Checkpoint on final landing phase.

Mann-Whitney test has showed significant increase of TIY in the presence of dry snow on runway (figure 3) and significant increase of TI_{ny} in a case of wet runway. Spearman test showed significant dependency of TI_{ny} and TI_{Xr} on crosswind speed (figure 4), dynamics of

bank angle and heading on 500ft and 200ft during final approach phase. Obtained results does not contradict to observations in practice.

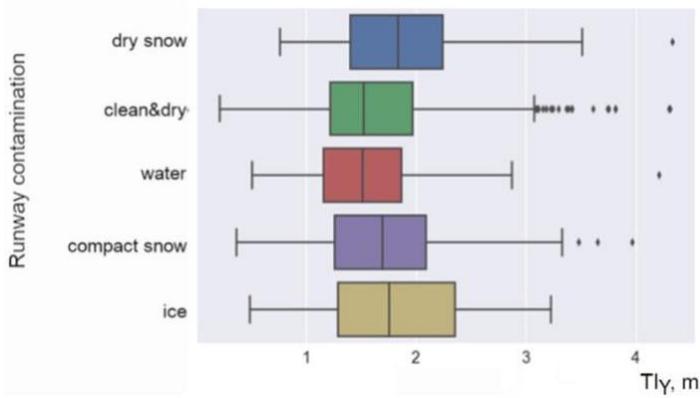


Figure. 3. Boxplot of TI γ grouped by contamination at RWY.

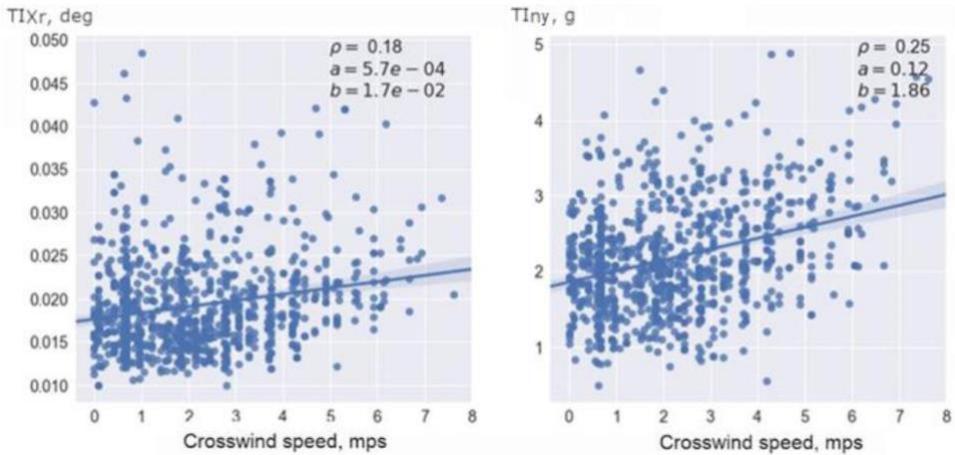


Figure. 4. Scatterplots of TI x_r , TI γ – Crosswind speed.

Presented work was performed within the framework of the project “P3-Solutions for runway excursions” of Future Sky Safety programme and financed by Ministry of Industry and Trade of the Russian Federation.

Keywords: Flight safety, Data mining, Statistics

Aircraft noise management model for airports

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ABSTRACT

In parallel with the increasing air traffic and the number of passengers in air transport in recent years, the number of people exposed to aircraft-induced noise has shown a significant increase. From past to present, aircraft- based noise emissions have become one of the most important research topics in environmental management in aviation. Especially in the areas close to the airports, measures have been taken in the construction of the airport in order to prevent noise emission from aircraft (during landing, take-off, taxi and ground operations), and it is seen that the engine manufacturers have made significant improvements in noise production in the production of new generation aircraft engines. It is seen that most of the existing airports in Turkey and in the world are mostly located near city centers and densely populated areas.

With the growth of cities, the location of the airport locations within the city resulted in an increase in the population exposed to noise. Negative effects of the noise impact on and around the airports and settlements, such as sleep disturbance, lack of concentration, anxiety and heart disease due to high blood pressure, have been identified. For this reason, it is important to examine the impact of aircraft-induced noise and to determine the necessary measures to be taken in terms of sustainable development of aviation. In this study, a sustainable noise management model is proposed for airports.

For this purpose, sustainability requires an effective management strategy for all processes. As a matter of fact, environmental impacts such as energy, waste and noise are important for the development of aviation in multi- faceted sustainability criteria.

Keywords: Aircraft Noise, Aircraft Noise Management Model, Sustainable Aviation, Aircraft Acoustics, Aviation Management

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Global warming responsibility of airport terminals: an exergetic study about their environmental safety

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ABSTRACT

This paper presents new metrics for rating airport terminals in terms of passenger energy cost and exergy-levelized passenger cost on terminal grounds in order to compare them with the passenger flight cost on air, again levelized with exergy. These figures were related then to total CO₂ responsibilities of civil aviation per passenger on the ground and in the air. Total CO₂ responsibilities are claimed to establish a new metric for environmental safety, S or to say the inverse of their CO₂ footprints, namely ΣCO₂. On a global average, inefficient airport terminal complexes spend up to 12 kW-h/passenger of installed-energy capacity in different forms, like heat, cold, and electricity [1]. When this so-called EP value is levelized with the average rational exergy management efficiency, ψ_R of such terminals, which is about 0.15 [1] regarding primary fuel use, it becomes 80 kW-h/passenger.

$$E_{XP} = \frac{E_p}{\psi_R} = \frac{12}{0.15} = 80 \text{ kW-h/passenger} \quad \{\text{Metric 1}\} \quad (1)$$

This metric leads to a second metric about CO₂ emissions responsibility:

$$S = \frac{1}{\sum CO_2} = [E_p \{a(2 - \psi_R) + b\}]^{-1} \quad \{\text{Metric 2}\} \quad (2)$$

For an inefficient airport like the IGA airport terminal complex, the coefficients a and b were found to be 0.07 and 0.67, respectively. Therefore, for IGA airport S metric is only about 0.1 passenger/kg CO₂. This means that for every kg of CO₂ released to the atmosphere, only 0.1 passenger is accommodated in the airport terminal during their average stay. Conversely speaking, such an airport emits 10 kg of CO₂ per passenger. For the 90-million annual passenger design capacity of the same airport in its first phase, this emission totals to about 1 million-ton CO₂/annum, excluding parasitic energy consumptions. On the other hand, if an average of 1.22 kW-h/passenger/km, namely EF of flight operation [2] for an equal mix of scheduled and chartered flights over a 600 km route, R is considered, then based on the jet fuel spent in aircraft turbines with an approximate ψ_R of about 0.40 [1], exergy-levelized form of this value, EXF becomes 1830 kW-h/passenger. This means that for each

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passenger, about 4.4% of exergy-levelized energy for air travel is spent on the ground, i.e. mainly in airport terminals:

$$\frac{E_{XP}}{E_{XF}} = \frac{80}{1830} = 4.4\% \quad \{\text{Metric 3}\} \quad (3)$$

GAR

This new exergy-levelized ratio, so-called ground to air energy ratio per passenger, GAR may be below 1% for truly sustainable airport terminals, which may involve trigeneration systems, bio-gas on-site, heat pumps, energy storage, low-exergy heating and cooling systems and equipment, waste heat utilization, and water management. In this study, an earlier proposal about Amsterdam Schiphol Airport [3] of such a green sophistication is compared with the new Istanbul Grand Airport (IGA), which does not involve such green components. Figures 1 and 2 show the rational exergy management efficiencies of them. Solar and wind energy utilization are excluded in this comparison because there are strict FAA rules, which limit their application on-site. Blank sections in Figures 1 and 2 represent exergy destructions and in Figure 2 they add up to substantial amounts.

Comparisons revealed that ground to air energy ratio per passenger, GAR for the proposed systems for Amsterdam Schiphol is only 0.85%. These ratios also indicate that total CO2 emission responsibility of IGA airport terminal is about five times more than the Schiphol Airport. This paper provides environmental, economic and energy use rationality comparisons in detail.

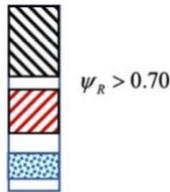


Figure 1. Amsterdam Schiphol Airport
All-in-one Concept: Trigeneration

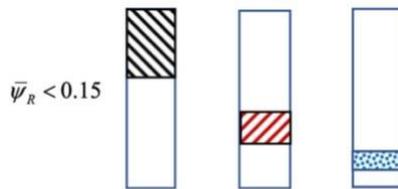


Figure 2. Current Operational Phase of IGA Airport.
All separate: Grid Power, Boiler, Chiller

Keywords:

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Investigation of aircraft maintenance according to the environmental impact

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ABSTRACT

Maintenance planning is an important process for airlines. A major cause of this process is “maintenance cost”. The aim of this study was to investigate the maintenance of the sample aircraft under 500 maintenance hours with the environmental impact approach. With this research, maintenance of both aircraft types is divided into related subsystems and total process hours are determined in man-hours. Thus, it is aimed to show that environmental impacts should be taken into consideration in maintenance planning.

Keywords: Aircraft Maintenance, Environmental Impact Assessment, Ecosystem Quality, Human Health, Resources

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Energy and exergy analysis of a turboshaft helicopter engine

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ABSTRACT

Global warming and environmental pollution have become a common problem all over the world. The use of fossil fuels is the basis of these problems. Exergy analysis are also applied in order to use the resources more efficiently in addition to energy analysis. Thus, the extent to which efficiency can be improved is determined. Sustainability assessments based on energy and exergy analysis are used widely nowadays and it's also plays an important role in aviation. In this study, energy and exergy analysis of a turboshaft helicopter engine were made. Evaluations are carried out in three different power ranges to less than 600 SHP, between 600 SHP and 1000 SHP and higher than 1000 SHP. Energy efficiencies are found to be between 6.04% and 21.99%, exergy efficiencies are found to be between 4.36% and 15.87% at less than 600 SHP. These values are calculated as 22.07% - 24.39 and 15.93% - 17.60 for between 600 SHP and 1000 SHP. Energy and exergy efficiencies are obtained as 24.12% - 27.44% and 17.41% - 19.80%, respectively for the higher than 1000 SHP.

Keywords: Energy, Exergy, Aviation, Helicopter, Turboshaft

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Adaptive heating solutions to face contemporary challenges in aircraft composite repair

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ABSTRACT

As newly constructed aircraft have a structure made of up to 80 % of composites, including Class I (i.e. safety critical) parts of the structure like A350 & B787, the need for bonded composite repair continuously increases. GMI, being the leading EU SME in composite repair solutions, has developed since 30 years composite repair equipment and methodologies, establishing its portable hot bonder “ANITA EZ” as the worldwide state-of-the-art in such operations. Adaptive Heating (AdaptHEAT) is the innovative solution for heating stiffened all-composite structures of new commercial aircraft, as well as complex structures (like reversers, nacelles etc.) of legacy aircraft. The solution has been developed by GMI Aero and was validated in cooperation with major aeronautical manufacturers (Airbus, ATR), Tier 1 suppliers (Safran, Aircelle etc.) and operators (LHT, AFI-KLM etc.), with excellent results. It comprises of a range of appropriately designed and controlled heating elements, “tailored” to the “thermal signature” of the part to be repaired, and gives excellent temperature homogeneity results, thus enabling repair of complex primary aircraft structures. The adaptive heating concept is also extended to the so-called Repair Enhanced Autoclaves, i.e. autoclaves using thermal blankets for heating of large parts to be extensively repaired, in order to enable local adapted heating and avoid thermal distortion (e.g. GE90 nacelle repair developed in cooperation with AFI-KLM E&M). Combined with the so-called “ANITA 4.0” architecture, the use of remote control tablets and associated peripherals is also enabled, in order to continue monitor heating profiles of repairs performed at difficult to access aircraft locations (e.g. vertical stabilizer) or simply for saving Man-Hours, by allowing technicians to leave the repair area and perform in parallel administrative activities, while being permanently informed of the repair evolution. This is also in line with the need for integrating such “autonomous” repair operations in a “net-centric” Quality Assurance and Surveillance network, so that critical repairs performed on an aircraft overseas could be real-time monitored by the manufacturer’s engineering department or MRO headquarters. Through applying these innovative features, the MRO will be now able to extend the range and quality of repairs, increase automation & data exchange or, in other words, make steps towards the so-called Industry 4.0, thus strengthening QA procedures and increasing productivity and process monitoring.