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"The goal of a scientist is to uncover new ideas, concepts and tools, practical or theoretical, that extend our understanding of the world around us and enable us to do new things. One must believe in what one is doing and stay the course. Now of course, in science one can ultimately prove the correctness of one's work by appeal to experiment and established theory. But even with this buttressing of one's ideas, acceptance can be a long and difficult road."

Richard F.W. Bader (1931 – 2012)
Grand Fellow of the MIRCE Akademy

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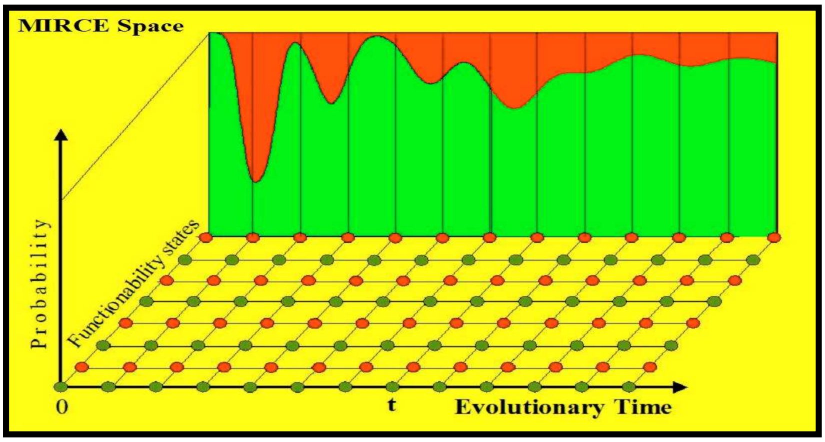
Content

MIRCE Science

The philosophy of MIRCE Science is based on the premise that the purpose of existence of any functionable system[1] is to do functionability work, which is considered to be done when the expected measurable function is performed through time, like miles travelled, units produced, energy supplied and similar. However, experience teaches us that at any instant of in-service life there is a probability of work being interrupted by occurrences of negative functionability events, resulting from failures of consisting components, natural causes, human actions or their interactions. For the work to be continued, humans undertake appropriate positive functionability actions, like: maintenance tasks, change of the mode of operation and similar must be performed. Thus, the life of functionable systems is a sequence of transitions through functionability states. Typically, functionability performance (the amount of work done and resources consumed to support operation and maintenance) becomes known through the end of the life statistics[2], which c ertainly could be change at that stage..

After five decades of systematic studies (practical and observational) of in-service behaviour of functionability systems and their performance Knezevic [1] has generated a body of knowledge, named MIRCE Science, which describes the motion of functionable systems through MIRCE Space[3]. Its axioms, equations and computational methods enable predictions of expected performance to be done, well before the design has been finalised, for each of physically feasible alternative. It is based on the scientific understanding of the physical mechanisms that generates the occurrences of functionability events, considered within a physical scale between 10^{-10} m (atomic scale) and 10^{10} m (solar system scale). These mechanisms, together with the human imposed rules, quantitatively define the expected functionability performance.



Reference: [1] Knezevic, J., The Origin of MIRCE Science, pp. 232, MIRCE Science, Exeter, UK, 2017, ISBN 978-1-904848-06-6

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[1] Functionable system is a set of the constituent things from natural and human worlds arranged to deliver at least one measurable function. [1]

[2] Pan Am's Boeing 747, registration number N747PA, during the 22 years of in-service life, has delivered 80,000 hours of positive work (transported 4,000,000 passengers, burned 271,000,000 gallons of fuel) while receiving 806,000 man-hours of maintenance work (consuming: 2,100 tyres, 350 brake systems, 125 engines, among other parts.

[3] MIRCE Space**:** a conceptual 3-dimentional space containing MIRCE Functionability Field, which is an infinite but countable set of all possible functionability states that a functionable system could be found in at any instance of calendar time and the corresponding probability of being in those states. [1]

Emergency Oxygen Provision as a Mechanism of the Motion of an Aircraft through MIRCE Space

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The paper addresses the provisioning of emergency oxygen as a physical mechanism of the motion of an aircraft through MIRCE Space. [1] Although the malfunctioning of this process is not frequently observed event, their occurrences could cause significant consequences to airline and flying pubic, impacting the functionability performance of commercial aircraft in the air and on the ground [2]. A full understanding of the mechanisms of these actions is essential for the accurate predictions of the functionability performance of functionable system using MIRCE Functionability Equation. Thus, this paper focuses on the observed physical phenomena or human activities related to the aviation industry and some of them are briefly described and analysed in the paper. Based on the evidence available recommendations for the reduction of the probability of occurrence of negative functionability events of the emergency oxygen provision are presented.

0. Preface

"Oh, we humans, never content to remain on the earth that holds us down with its gravity and sustains us with oxygen-laden atmosphere to breathe. No, as soon as we figured out how to ascend into that atmosphere, cheating gravity with hydrogen-filled balloons or artificial wings, we were compelled to claw our way ever higher into the thin, cold air of the stratosphere. But alas, fragile mammals that we are, we could not survive for long – let alone maintain consciousness to control our fabricated aerial conveyances. So we learned to take containers of our precious gravity-thickened atmosphere aloft with us to inhale through rubber hoses or to encase our bodies in suits and helmets pumped full of that life-fortifying gas." David Esler [3]

1. Introduction

For thousands of years humans believed that air is an element[4]. Today we know that air is a composition of gases that include nitrogen, oxygen, argon, carbon dioxide and water vapour, together with solid particles such as dust, sand and carbon, with a traces of other gases such as helium, hydrogen and neon. Oxygen makes up approximately 21% of the dry atmosphere, by volume, and is essential for life. As any other tangible material substance the universal force known as gravity influences air. Gravitational force of Earth shapes and influences all atmospheric processes and causes the density and pressure of air to decrease exponentially with a distance from its surface. As the

[4] "We live submerged at the bottom of an ocean of the element air, which by unquestioned experiments is known to have weight, and so much, indeed, that near the surface of the Earth where it is most dense, it weighs (volume for volume) about the four-hundredth part of the weight of water, whereas on the tops of high mountains it begins to be distinctly rare and of much less weight." E. Torricelli (1608-47)

altitude increases, the consequent decrease in pressure reduces the amount of oxygen the human body can absorb when breathing. At higher altitudes, flight crews and passengers would quickly be overcome by hypoxia, oxygen starvation, followed rapidly by unconsciousness and soon ending with a death.

2. MIRCE Science Fundamentals

3. Description and Certification of Aircraft Emergency Oxygen System

3.1 Regulations

3.2 Equipment

3.2.1 Flight Deck

3.2.2 Passenger Compartment

3.3 Oxygen Mask

3.3.1 Flight Deck

3.3.2. Passenger Compartment

3.4 Types of Oxygen Generating Systems

4. Malfunctions of Emergency Oxygen Provisioning Systems

Case 1:
Case 2:
Case 3:
Case 4:
Case 5:
Case 6:

5. Oxygen Masks Related Negative Functionability Actions

6. Functionability Improving Actions for Emergency Oxygen Provisioning

7. Impact of the Descent on Human Body

8. Conclusions

The main objective of this paper was to address the emergency oxygen provisioning as a physical mechanism of the motion of an aircraft through MIRCE Space. [1] Although the malfunctioning of this process is not frequently observed negative functionability event, their occurrences could cause significant consequences to airline and flying pubic, impacting the functionability performance of commercial aircraft in the air and on the ground [5].

Emergency oxygen provisioning systems have been briefly described in the paper considering their main characteristics and potencial negative impact on crew and flying passengers. Timely response by a flight crew to a loss of cabin pressurisation or to smoke or fumes is critical for the safe operation of an aircraft and certainly not the time to discover that emergency oxygen provisioning system is in a negative functionability state (NFS).

It has been pointed out in the paper that in many instances the accident report concluded that the deterioration of the condition of emergency oxygen provisioning systems were intensified by inadequately maintained oxygen masks, their attachments to the rest of the system and frequent inspections by flight deck crew.

This paper clearly confirms that malfunctions of emergency oxygen provisioning system have caused considerable contributions to the transition of an aircraft from positive to negative functionability state, resulting in the reduction of the functionability work done and occasional destruction of the aircraft or human fatalities.

Recommendations provided in the paper, based on the observed in-service functionability events, should be used for the design of the future emergency oxygen provisioning systems as well as the planning of their maintenance programmes and a corresponding cabin crew training.

9. References

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[2] Knezevic, J., Aerotoxic Syndrome as a MIRCE Mechanics Phenomenon, International Journal of Applied Engineering Science, Paper number: 14(2016), pp. 451 – 456, Belgrade, Serbia, 2016.
[3] Elser, D., Under Pressure: What To Do When You Lose It, Aviation Weekly, https://aviationweek.com/business-aviation/under-pressure-what-do-when-you-lose-it?utm_rid=CPEN1000001174516&utm_campaign=24318&utm_medium=email&elq2=7f1865b582244d209f3a999aa4981d73 (accessed 10 June 2020)
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Reliability + Maintenance = Work Done

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Abstract

The main objective of any business is to stay in business. The best way to achieve that is to increase the revenue generating work done by an asset, while reducing the resources consumed for it. One way towards that target is to improve the reliability of the asset by using appropriate engineering and production methods. Another way is to reduce the time asset spends in maintenance by applying appropriate condition monitoring and management technologies. Hence, the work done by an asset is driven by the combined impact of inherent reliability and maintenance policies chosen. Although, reliability and maintenance are well-recognised disciplines in their own rights, there is no a body of knowledge for predicting their combined impact on the work done and resources consumed, in a quantitative and comparative manner.

The main objective of this presentation is to introduce reliability and maintenance professionals to MIRCE Science [1], a body of knowledge that enables quantitative prediction of the complex interactions between reliability and maintenance issues on the work done by an asset and resources required. Hence, by making use of MIRCE Functionability Equation it is possible to perform quantitative trade-off between feasible reliability and maintenance options to select the compromising solution that would yield greatest benefit measured through the work done.

A numerical example, where the trade off between reliability improvements by increasing the expected time to failure by 50% or decreasing maintenance time by 50%, is provided to illustrate the applicability of MIRCE Science to assets management process.

***Key words**: Reliability, Maintenance, Work Done, Profit, MIRCE Science*

1. Introduction

2. Brief overview of MIRCE Science

3. Mathematical Principles of MIRCE Science

3.1 Positive Work in MIRCE Science

4. Application of MIRCE Science

5. Conclusion

Thus, the main objective of this paper was to introduce reliability and maintenance professionals to MIRCE Science, a body of knowledge that enables quantitative prediction of the complex interactions between reliability and maintenance issues on in-service performance of assets to be done.

By making use of MIRCE Functionability Equation it is possible to perform analytical trade-off between feasible reliability methods and maintenance policies to select the compromising solution that will maximise “up time” for a given budget. A numerical example provided clearly illustrates the applicability of MIRCE Science to asset’s planning and management processes that are the essential part for any business’s main objective to stay in businesses.

6. References

[1] Knezevic, J., The Origin of MIRCE Science, pp. 232, MIRCE Science, Exeter, UK, 2017, ISBN 978-1-904848-06-6

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Appendix A: Costs of Work Done

Cost of Positive work

Cost of Negative work

MIRCE Profitability Equation

Microbial Contamination of Fuel Tanks as a Mechanism of the Motion of an Aircraft through MIRCE Space

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Abstract

The paper addresses the microbial contamination of fuel tanks as a physical mechanism of the motion of an aircraft through MIRCE Space. [1] Although this phenomena is not frequently manifested its occurrences could cause undesirable consequences like: clogging of fuel filters, corroding tanks and performance degrading build up of deposits caused by the acids the microbes excrete which cause the fuel to break apart and lose combustion quality, as well as damaging the rubber system components specific to the fuel tank, impacting the functionability performance of an aircraft. A full understanding of this mechanism is essential for the accurate predictions of the functionability performance of a functionable system using MIRCE Functionability Equation. Thus, this paper focuses on the observed physical phenomena or human activities related to the microbial contamination in the aviation industry and some of them are briefly described and analysed in the paper. Based on the evidence available recommendations for the reduction of the probability of occurrence of microbial contamination of fuel tanks are presented.

1. Introduction

On 13 April 2010 a Cathay Pacific Flight 780 was on route from Surabaya Juanda International Airport in Indonesia to Hong Kong International Airport with 309 passengers and a crew of 13 on board. As the Airbus A330 (B-HLL) approached Hong Kong the crew were unable to change the thrust output of the engines. As the engine became unusable a PAN and then a MAYDAY were declared. The aircraft landed at almost twice the normal speed, as the control of trust from the remaining engine became impossible. Five main tyres were deflated after the aircraft came to a complete stop. After confirming that there was a fire and smoke on the wheels, an emergency evacuation of passengers was performed. The 57 passengers sustained injuries while ensuing slide evacuation; one of them received serious injuries. The cause of the accident was the contamination of the fuel uploaded at Surabaya, which gradually damaged both engines of the aircraft.[5] The contaminated fuel contained particles of a super-absorbent polymer (SAP), which caused the main metering valves of the fuel-metering unit to seize. The valves were found to be stuck in positions corresponding to the recorded thrust output of each engine as the aircraft approached Hong Kong. [2]

Experience teaches us that the storage and distribution of aviation fuel has “challenges” with controlling and preventing the growth of microbes (bacteria and fungi) in fuel tanks. Presence of water enables microbes to grow and multiply in the tank, and it is

[5] "Pilots reveal death-defying ordeal as engines failed on approach to Chek Lap Kok". South China Morning Post. 20 April 2014. (Accessed 21 July 2020)

very easy for them to get transferred between fuel tanks and continue propagating. Hence, the contaminated fuel causes undesirable consequences like: clogging of fuel filters, corroding tanks and performance degrading build up of deposits caused by the acids the microbes excrete which cause fuel to break apart and lose combustion quality. The main objective of this paper is to address microbial contamination of fuel tanks as a potential mechanism of the motion of an aircraft though MIRCE Space, which could impact its physically measurable functionability performance, namely work done and resources consumed. Also, based on the industry best practices available recommendations for the reduction of the probability of occurrence of microbial contamination of fuel tanks are presented.

2. MIRCE Science Fundamentals

3. Types of aviation fuel contamination

3.1 Water
3.2 Particulates
3.3 Microbial growth

4. **Mechanisms of attack by microorganisms**

5. Impact of Microbial Growth of Aircraft fuel system

5.1 Microbially Influenced Corrosion of Alloys used in Aircraft Fuel Tanks
5.2 Impact of microbial contamination on filters in the aviation fuel supply chain
5.3 Impact of microbiological contaminants on the quality of aviation fuel

6. Microbial Contamination Treatment and Prevention

6.1 Fuel sampling
6.2 Topping off fuel tanks
6.3 Inspection of fuel system screens and filters
6.4 Cap fuel lines during maintenance
6.5 Fuel Tank Design

7. COVID-19 disruption creates perfect conditions for microbial contamination

8. Conclusions

Aviation fuel, whose primary function is to power the aircraft, is a complex mixture of thousands of organic compounds known as hydrocarbons. Although at the end of the refining process the fuel is sterile, the journey from refinery to the aircraft fuel tank provides many opportunities for it to become contaminated. One of the major contaminants of aviation fuel is a microbe, as bacteria and fungi find it to be highly favourable media for multiplication.

Microbiological contamination of fuels can cause operational problems, such as corrosion of metallic structures, fuel quantity indication problems, and blocking of the scavenge systems and fuel filters during flight. There are a number of signs that will indicate that fuel tanks are contaminated such as evidence of contamination of fuel filters, discoloration of sump sample, blocking of fuel injectors, erratic/inaccurate fuel level readings. For example erratic behaviour of the fuel quantity gauging system can be a sign of microbiological contamination, as most gauging systems are capacitance based and the microorganisms have a different capacitance than fuel.

In summary the potential consequences of engines transitions to a NFS, caused by microbial contamination, may be simply economical, but in some cases may have serious consequences on the natural environment and humans. Thus, better understanding of the physical mechanism that govern this process provides better opportunities for designing a fuel systems for aircraft that are less susceptible to the microbial contamination or developing more robust maintenance tasks for their management and control.

9. References

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Microbial Decontamination of Fuel Tanks as a Mechanism of the Motion of an Aircraft through MIRCE Space

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Abstract

The paper addresses the microbial decontamination of fuel tanks as a physical mechanism of the motion of an aircraft through MIRCE Space, in accordance to MIRCE Science[6]. In cases where microbiological contamination is detected and decontamination needs to be done with biocides, up-to-date instructions in the Aircraft Maintenance Manuals should be followed to ensure that the correct method and dosage is applied. Although in-service problems with this maintenance task are not frequent, the consequences of its incorrect execution could lead to the occurrence of "a serious incident". The case study analysed in this paper is related to the event of this type that took place at London Gatwick Airport on 26 February 2020. A full understanding of the sequence of actions that led to the occurrence of this negative functionability event is essential for drawing recommendations for the reduction of the probability of human errors during the microbial decontamination process of fuel tanks of an aircraft, some on which are presented in this paper.

1. Introduction

Millions of gallons of aviation turbine fuel are used daily to power thousands of the aircraft to facilitate thousands of flights all over the world. It is complex mixture of thousands of organic compounds known as hydrocarbons, which is sterile when produced. However, during the transport, storage and in the aircraft fuel tank, it may become contaminated. One of the major contaminants of aviation fuel are microbes, like bacteria and fungi. Contaminated fuel can cause significant damage to the aircraft and engine, which can range from fuel system corrosion, clogging of fuel filtration components, failure of aircraft fuel system instrumentation, and even stopping the fuel supply to the engines during flight and in some cases may even be fatal. In the past several aeroplane crashes have been attributed to the deterioration of aviation fuel caused by microbial contamination. [2]

Microbial contamination is not specific to any one fuel type, diesel, petrol, bio-diesel, kerosene, gasoline, and other fuels used in marine, aviation, automotive and home heating applications are all susceptible. Similarly there is no single specific organism that can be identified as being responsible for degradation and spoilage. As a general rule, wherever fuel and water come into contact in storage or distribution system microbial contamination is likely to occur.

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[6] MIRCE Science is a body of knowledge that studies the motion of functionable systems through MIRCE Space resulting from any functionability actions whatsoever and predicts work done and resources needed.[1]

In the initial stages of contamination the organisms present are predominantly aerobic, using the dissolved oxygen in the water for respiration. As this supply of oxygen is depleted, anaerobic organisms, known as sulphate reducing bacteria, develop. These organisms do not require oxygen for respiration and form corrosive waste products such as hydrogen sulphide.

Once a microbial population becomes established fuel quality rapidly deteriorates. Problems such as haziness, failure to meet specifications, corrosion, filter plugging and additive degradation can occur. All of these problems are related directly to the presence of microorganisms or their associated by-products.

Several factors that affect the presence of microbial contaminants in jet fuel and thus determine to a large extent the quality of aviation fuel, have been determined. Among them, as indicated by numerous studies, the presence of free water is the most important one. However, for various reasons it is almost impossible to prevent the presence of at least minimal amounts of water in jet fuel. Therefore, microbial contamination of turbine fuel is almost inevitable, which requires decontamination actions to take place in order to restore the functionability of the aircraft affected.

The main objective of this paper is to address microbial decontamination of fuel tanks as a potential mechanism of the motion of an aircraft though MIRCE Space, which could have a huge impact on its physically measurable functionability performance, namely work done and resources consumed. Also, based on the real life case study analysed in the paper possible recommendations for the reduction of the probability of human error during the microbial decontamination of fuel tanks are presented, based on the philosophy of MIRCE Science.

2. MIRCE Science Fundamentals

3. Microbial Contamination Treatment and Prevention

4. Microbial decontamination

5. The biocides

5.1 Biobor JF
5.2 Kathon FP1.5

6. MIRCE Science Analysis of "a serious incident" of G-POWN aircraft

6.1 The Aircraft (G-POWN)
6.2 The scheduled positive functionability action
6.3 The negative functionability event on 26 February 2020
6.4 Sequence of functionability events preceding the incident flight
6.5 Post incident functionability analysis
6.5.1 Fuel Analysis
6.5.2 Engines Analysis
6.5.3 Kathon FP1.5 quantity analysis
6.5.4 Aircraft Maintenance Organisation Analysis
6.5.5 Aircraft Maintenance Manual Analysis

6.5.6 Troubleshooting task

7. Safety actions taken after the incident event

7.1 Actions by regulators
7.2 Actions by the manufacturers of the biocide and engines
7.3 Actions by the AMO at London Gatwick Airport
7.4 Action by the Operator

8. Conclusions

The main objective of this paper is to address microbial decontamination of fuel tanks as a potential mechanism of the motion of an aircraft though MIRCE Space, in accordance to MIRCE Science.

Although in-service problems with this functionability action are not frequent, the consequences of its incorrect execution could lead to the occurrence of " serious incidents", which could have a huge impact on functionability performances, namely work done and resources consumed.

The case study analysed in this paper is related to the microbial decontamination of fuel tanks of Airbus G-POWN that took place at London Gatwick Airport on 26 February 2020. A full analysis of the sequence of functionability actions that led to the occurrence of "a serious incident" presented in this paper is essential for the understanding of the actions that should be taken regarding the reduction of the probability of human errors during the execution of this maintenance task, starting with the design of maintenance task and its description in Aircraft Maintenance Manual to the safety practices within Approved Maintenance Organisations, regarding: training of maintenance personnel, creation of technical engineer and usage limits in stores.

9. References

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COVID-19 Pandemic as a Mechanism of the Motion
of an Aircraft through MIRCE Space

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Abstract

The COVID-19 outbreak has shown that pandemics, like other rarely occurring natural catastrophes, have happened in the past and will happen in the future. Although humans cannot prevent dangerous viruses from emerging, they should be prepared to dampen their consequences for the economy and all of society. The main objective of this paper is to address the COVID-19 pandemic as a novel mechanism of the motion of an aircraft in MIRCE Mechanics, as only then the most effective technological, social and economical actions can be taken by humans to deal with it. Examples of devastating impacts on aviation world-wide are given in the paper, as well as, some of the human and technological solutions taken to cushion their consequences. To assist airlines in the selection process of aircraft types that should be returned to the post pandemic service MIRCE Functionability and Profitability Equations are presented in the paper. They embrace the impact of COVID-19 on the expected positive and negative work, as well as the cost of associated resources, which determine their business existence.

1. Introduction

The philosophy of MIRCE Science is based on the premise that the purpose of existence of any industrial system is to be industrial[7], which means doing the expected work. The work is considered to be done when measurable functionality (function, performance and attributes) is delivered through time, like annual miles travelled, monthly units produced, daily energy supplied and similar. [1]

According to MIRCE Science, at any instant of calendar time, any industrial system could be in one of the following two industrial states:

- Positive Industrial State (PIS), a generic name for a state in which an industrial system is doing work,

- Negative Industrial State (NIS), a generic name for a state in which an industrial system is not doing work.

In MIRCE Science a work done by an industrial system is uniquely defined by the trajectory it traces thorough MIRCE Space. Mathematically, it is a continuous three-dimensional space containing discrete points, each representing an industrial state that

[7] Industrial, adj - from Medieval Latin *industrialis*, in relation to Latin *industria* meaning "engaged in, for use in, serving the needs of industries".

an industrial system could be found in at any instant of time and the corresponding probabilities.

The motion of an industrial system through industrial states is governed by the following two types of actions:

- Negative Industrial Action (NIA) that causes occurrences of negative industrial events (NIE) at which industrial systems are compelled to move to NIS.

- Positive Industrial Action (PIA) that causes occurrences of positive industrial events (PIE) at which industrial systems are compelled to move to PIS.

MIRCE Mechanics is a part of MIRCE Science that focuses on the scientific understanding of the mechanisms that generate positive and negative industrial actions, which uniquely define a time evolution of industrial systems though MIRCE Space [1]. The minimum sufficient "physical scale" that enables scientific understanding of the mechanisms that govern positive and negative actions is between 10^{-10} of a metre (the level of the atoms) and 10^{+10} of a metre (at the level of the solar system). A full understanding of these mechanisms is essential for the predictions of expected performance of industrial systems using MIRCE Science Equations, like works done and resources consumed.

2. COVID-19 Pandemic

3. Impact of COVID-19 on Aviation

4. COVID-19 pandemic generated negative industrial events in aviation

4.1 Impact of the Covid-19 Pandemic on flight safety
4.2 Impact of the COVID-19 pandemic on existing aircraft cleaning procedures
4.3 Impact of the COVID-19 pandemic on usage of toilets on commercial flights
4.4 Impact of the COVID-19 pandemic on personal protection equipment for Chinese cabin crew
4.5 Impact of the COVID-19 pandemic on the decisions of where to ground aircraft
4.6 Impact of the COVID-19 pandemic on the contamination of fuel and fuel tanks in grounded aircraft

5. Impact of the COVID-19 pandemic on the aircraft type retirement

5.1 Impact of the COVID-19 pandemic on the retirement of A380
5.2 Impact of COVID-19 pandemic on the retirement of B747

6. Use of MIRCE Science Equations for the post the COVID-19 fleet selection

6.1 MIRCE Functionability Equation
6.2 MIRCE Profitability Equation

7. Conclusions

The main objective of this paper is to address the impact of the COVID-19 pandemic as a mechanism of the motion of an aircraft though MIRCE Space, which is a mathematical reality of the observed physical realities, experienced in aviation world during 2020.

The COVID-19 outbreak has shown that pandemics, like other rarely occurring natural catastrophes, have happened in the past and will happen in the future. Although humans cannot prevent dangerous viruses from emerging, they should be prepared to dampen their consequences for the economy and all of society.

Examples of devastating impacts on aviation world-wide are given in the paper, as well as, some of the human and technological solutions taken to cushion their consequences.

To assist airlines in the selection process of aircraft types that should be returned to the post pandemic service MIRCE Functionability and Profitability Equations are presented in the paper. They embrace the impact of COVID-19 on the expected positive and negative work, as well as the cost of associated resources, which determine their business existence. However, the above-presented equations are applicable only when the mechanisms of the motion of an industrial system through MIRCE Space are known. As COVID-19 pandemic was not known until the beginning of 2020 business plans of airlines world-wide are for several orders of magnitude off the target, measured in flying hours delivered, revenue generated, number of aircraft grounded and those retired from active service.

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MIRCE Science Question: Digital or Analogue Visual Displays of Dynamic Information for Humans?

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Abstract

Visual Displays of Dynamic Information (VDDI) represent the interface that machines use to communicate their dynamic functionability state to humans. This paper tries to address the question of the selection between the two main types of VDDI available, digital or analogue, and identify what are some of the most important factors that may affect this selection. In that aid the paper briefly covers how the displays and VDDI are classified, their uses and objectives, the factors that could affect the selection process and finally a comparison between digital and analogue VDDI. The quantitative assessment of the impact of VDDI on the human elements of functionable systems could be determined by making use of MIRCE Functionability Equation. It enables to predict the impact of each feasible options of VDDI on the expected work to be delivered by the system.

8. Conclusions

The main objective of this paper was to address the question of the selection between the two main type of VDDI available, digital or analogue, and identify what are some of the most important factors that may affect this selection. In that aid the paper briefly covered how the displays and VDDI are classified, their uses and objectives, the factors that could affect the selection process and finally a comparison between digital and analogue VDDI are made. As no definite answer was found in existing literature, the author introduced MIRCE Functionability Equation [15] as a method for quantitative assessment of the impact of VDDI on the human elements of functionable systems. Thus, the main conclusion of the paper is that for each feasible application of VDDI a quantitative assessment of the expected work and resources demanded has to be performed and the most compromising option selected, in accordance to the given criteria.

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