

**The Correlation between Human Physiology with Adv  
The correlation between Human Physiology and  
Advancement of Technology in Aviation ancement of  
Technology in Aviation.**

FINAL YEAR PROJECT

PRESENTED BY: Numra Mir (14006001004)

UNIVERSITY OF MANAGEMENT AND TECHNOLOGY | LAHORE

## **Statement of Submission:**

This is to certify that I 'Numra Mir (ID: 14006001004)' has successfully submitted the final year disquisition on January 09, 2018 highlighting "The correlation between Human Physiology and Advancement of Technology in Aviation" at University of Management and Technology as a part of partial requirement of the Bachelor's degree in Aviation Management (BS.AM)

Capt. Imran Saeed

**Director Institute of Aviation Studies (IAS).**

## **Resource Person:**

The project has been completed under the continual support, motivation and assertion of **Air Commodore Mr. Khalid Chisti (Retd.)**. I extend my heartiest regards to him as his visionary perspective of doing things has helped me to work with sheer dedication and flexibility while focusing on quality output.

## **Achievements:**

Sitara -e- Imtiaz (Military), Sitara -e- Basalat.

## **Profile:**

With the experience and learning from the PAF, he has served in various squadrons as a leader after joining PAF as fighter pilot in 1977. With more than 3000 flying hours, he has also determinedly served as an Instructor Pilot for Mirage, F-6 and FT- 5 fighter jets. The role of Assistant to Air Force Chief on Training and Education at Air Headquarters and Base Commander of a training base are just the few highlights of his life achievements.

After being retired from PAF as an Air Commodore in 2012, his role in commercial aviation has also been significant. He has been the part of 'Shaheen Airport Services' as a General Manager for four years. Also a successful entrepreneur in food industry and motivational and educational leader in different universities and platforms.

**Signature Supervisor.**

## **Dedication:**

*In the name of Allah, The most Merciful and The most Benevolent.*

I would like to extend the acknowledgement of all my work and achievements in these years to all those praying hands whose blessings had made me grow and achieve the things with honor.

This would have been incomplete without the support of Allah - Al -Mighty, my parents, teachers and all those friends whose continuous assurance about my work has developed a sense of motivation in me to achieve my goals.

## Table of Contents:

<b>1. Abstract.....</b>	<b>8</b>
1.1 Purpose of Study.....	8
1.2 Problem Identification.....	8
1.3 Project Goal.....	9
<b>2. Executive Summary.....</b>	<b>10</b>
<b>3. Introduction.....</b>	<b>10</b>
3.1 SHELL MODEL.....	10
<b>4. Human Physiology.....</b>	<b>13</b>
4.1 History of Human Physiology.....	13
4.2 Safety Evolution in the field of Aviation.....	13
<b>5. Aerospace Physiology.....</b>	<b>14</b>
5.1 Atmosphere composition at higher altitudes.....	14
5.2 Gas Laws Application.....	15
5.3 Functioning of body's circulatory system.....	16
<b>6. Limitations at high altitude in general Human Physiology.....</b>	<b>17</b>
6.1 Hypoxia.....	18
6.2 Hyperventillation.....	19
6.3 Time of Useful Consciousness (TUC).....	20
6.4 Motion Induced Sickness.....	20
1.2 Sleep Inertia.....	21
1.3 Circadian Rhythm.....	21
<b>7. Limitations due to the Effect of Gravity on Human Physiology.....</b>	<b>22</b>
7.1 Spatial Disorientation.....	22
7.2 Loss of control.....	23
7.3 Controlled Flight into terrain.....	23
7.4 Hand-Eye-Head Coordination.....	23
<b>8. Automation.....</b>	<b>24</b>
8.1 Information Processing.....	25
<b>9. Evolution of Automation in Aviation.....</b>	<b>26</b>
9.1 Initial Era.....	26
9.2 Second Era.....	27
9.3 Third Era.....	27
<b>10. Early Advancement benefits in correlation with Human Physiology.....</b>	<b>29</b>
10.1 Economic Impact.....	29
10.2 Fuel Cost.....	30
<b>11. Potential Advancement Problems due to non-correlation.....</b>	<b>31</b>
11.1 Situational Awareness.....	31
11.2 Complacency Factor.....	31
11.3 Increasing intimidation in Technological Advancement.....	32
11.4 Cockpit Interface Design.....	33
11.5 Training and Selection Procedures for crew.....	34
11.6 Distribution of work related activities.....	34
11.7 Cognitive and Physical requirements.....	35
<b>12. Safety Risks related to non-correlation due to dependency on Advancement.....</b>	<b>36</b>
12.1 Information Blackouts.....	36
12.2 Difficulty in decoding the message.....	36
12.3 Lack of Mode Realization.....	37

<b>13. Design considerations of Aircrafts in correlation with Human Physiology .....</b>	<b>38</b>
13.1 Cockpit Design .....	38
13.2 DERP .....	39
13.3 Workspace Limitations.....	39
13.4 Control Displays and Layouts .....	39
<b>14. Accidents due to non-correation of Advancement with Human Physiology .....</b>	<b>40</b>
14.1 Accident 1 .....	40
14.2 Accident 2.....	41
<b>15. Recommendations .....</b>	<b>42</b>
<b>16. Conclusion .....</b>	<b>43</b>
<b>17. Reference .....</b>	<b>44</b>

## List of Abbreviations:

Below given is the list of abbreviations that will be used throughout the research and its significance with the entitled page numbers.

<b>ABBREVIATIONS</b>	<b>MEANING</b>	<b>PAGE NUMBER</b>
<b>CFIT</b>	Controlled Flight into Terrain	21
<b>CRT</b>	Cathode Ray Tube	25
<b>CNS</b>	Central nervous system	23
<b>CVR</b>	Cockpit Voice Recorder	39
<b>CRM</b>	Crew Resource Management	39
<b>DERP</b>	Design Eye Reference Point	36
<b>FARS</b>	Federal Aviation Regulations	17
<b>FMS</b>	Flight Management System	25
<b>GPWS</b>	Ground Proximity Warning System	31
<b>G FS</b>	Gravitational Forces	20
<b>IFR</b>	Instrument Flight Rules	25
<b>ILS</b>	Instrument Landing System	25
<b>IMC</b>	Instrument Meteorological Conditions	38
<b>ILS CAT 3</b>	Instrument Landing System Category 3	38
<b>IATA</b>	International Air Transport Association	27
<b>ICAO</b>	International Civil Aviation Organization	27
<b>LOC</b>	Loss of Control	20
<b>LVP</b>	Low Visibility Procedure	38

***Continuation on the next  
page***

<b>LNAV</b>	Lateral Path Navigation	34
<b>LCD</b>	Liquid Crystal Displays	25
<b>MAC</b>	Mean Aerodynamic Cord	
<b>PH</b>	Power of Hydrogen	17
<b>RCBS</b>	Red blood cells	15
<b>SID</b>	Standard Instrument Departure	25
<b>STAR</b>	Standard Terminal Arrival Route	25
<b>TUC</b>	Time of Useful Consciousness	15
<b>TCAS</b>	Traffic Collision Avoiding System	25
<b>VFR</b>	Virtual Flying Rules	11
<b>VOR</b>	Very High Frequency Omni Directional Range	25
<b>VNAV</b>	Vertical Path Navigation	34

## **1. Abstract**

Aviation has always been a focus especially after the establishment of the importance of air transport within the people. Analysts have been always in the pursuit to seek knowledge of aviation and implement the latest research. One such focus has been the technology that is always changing within the field. Initial research in the field of aviation in advancement discovered new avenues and changed the whole concept of flying from visual to instrumental and then glass cockpit variations.

### **1.1. Purpose of Study:**

The purpose of this study is to analyze the human cognitive and physiological limitations and its correlation with advancement in commercial aviation.

#### **Will majorly emphasize on:**

- What to automate and to what level because the final input depend on human cognition and physiology.
- How much the current automation allows the operator to remain engaged at higher altitudes as technology is going faster than a human to predict?

### **1.2. Problem Identification:**

Increasing the technology in aviation after a certain level is not a source of increased productivity and compromise safety as there is a limit to human physiology at high altitude whereas high altitude can be defined as anything which is 5000ft above mean sea level. This man- machinery interaction still needs human input to carry out activities so their limitations have direct impact on advancement and operating the technology.

Although technology has been evolutionary in aviation but the active role of human has been changed to supervisory flux on automation due to advancement making operator reluctant to use their own abilities.

### **1.3. Project Goal:**

- To determine a fit between technological advancements, human cognition and physiological limits in aviation.
- Establishing the need of human centered automation approach rather than technology centered.

## **2. Executive Summary**

As we all know the growth of advance in technology helped aviation to flourish in the world transporting people from one place to other with the efficient and safest means in the early 1970 to late 90s. It helped pilots to maintain a more precise and accurate view of flight dynamics onboard lowering the risks of human error that contributed to major accidents in aviation resulting the loss of lives but this explains one side of the story.

The purpose of me to undertake this study is to highlight the unanticipated issues that arises due the non-correlation of human physiology because of the fast pace advancement of technology in aviation. The latter half of the study will discuss the details of human physiology and its limitations that were taken into consideration initially before designing and implementing the new parameters that proved to be successful in the evolutionary era up to a certain level of technology changes.

However, the next half of the project will highlight the important preview of automation phases and the unanticipated issue establishing the fact that increasing automation up to a certain level in aviation industry doesn't contribute to any significant growth in safety and efficiency and doesn't relate with the human philology as it has failed to create a fit between man and machinery interaction.

The conclusion will discuss the relatable cockpit interface and training and safety solutions to prevent these issue and promoting the active status of humans rather than supervisory role.

### **3. Introduction**

The advancement in automation in commercial aviation on a higher level is just a myth about the technology that it contributes to productivity and efficiency. The incorporation of technology with human reasoning lead to huge changes in the field of aviation. That do resulted in reduced human error at certain level but gave rise to unanticipated problems because it fails to create a fit between human cognition and physiological limitations with technology.