

# THE FUTURE OF PASSENGER AIR TRANSPORT – VERY LARGE AIRCRAFT AND OUT KEY HUMAN FACTORS AFFECTING THE OPERATION AND SAFETY OF PASSENGER AIR TRANSPORT

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**ABSTRACT.** The article outlines some human factors affecting the operation and safety of passenger air transport given the massive increase in the use of the VLA.

Decrease of the impact of the CO<sup>2</sup> world emissions is one of the key goals for the new aircraft design. The main wave is going to reduce the burned fuel. Therefore, the eco-efficiency engines combined with reasonable economic operation of the aircraft are very important from an aviation perspective. The prediction for the year 2030 says that about 90% of people, which will use long-haul flights to fly between big cities. So, the A380 was designed exactly for this time period, with a focus on the right capacity, right operating cost and right fuel burn per seat. There is no aircraft today with better fuel burn combined with eco-efficiency per seat, than the A380. The very large aircrafts (VLAs) are the future of the commercial passenger aviation. Operating cost versus safety or CO<sup>2</sup> emissions versus increasing automation inside the new generation aircraft. Almost 80% of the world aircraft accidents are caused by human error based on wrong action, reaction or final decision of pilots, the catastrophic failures of aircraft systems, or air traffic control errors are not so frequent. So, we are at the beginning of a new age in passenger aviation and the role of the human factor is more important than ever.

**KEYWORDS:** VLA, human factors, air transport, air traffic, security.

## 1. INTRODUCTION

The study of human factors deals with people's interaction with their environments. In the case of general aviation, this is the study of pilot performance with influence on the emotions, stress, fatigue or design of cockpits or interaction with crewmembers, air traffic control personnel and others. Fatigue is an expected aspect of life and there is a very thin border between normal daily fatigue (for example fatigue from lack of sleep) and the tough fatigue from continuous stress. Typically, there are no significant marks or consequences. But the aftermath in general aviation environment can be disastrous[1].

### 1.1. INTRODUCTION OF THE AIR TRAFFIC MARKETS SITUATION

Aviation Mega-cities (AMCs) are the new phenomenon for the long-haul market. For long-haul flights we are rating the traffic over 2,000 nautical miles. More than 40% of all long-haul passengers are beginning or ending, at AMCs and another 20% are between these 40 AMCs. More than another 40 cities have a potential to grow to AMCs. By the GMF of Airbus, the A380 is the choice number one for these markets. The current markets situation is represented Figure 1.

The Wide-Body Aircraft is a very important aspect of the aircraft market as well. These aircraft types are more focused on the routes for AMCs than to the secondary cities. This is the right market opportunity for the highly efficient new A350XWB as well as the A330neo by the Airbus.

### 1.2. VERY LARGE AIRCRAFT

According to Airbus statistics before the VLAs age, one million passengers per month were served by 200 aircrafts per day. But today, it is only 100 VLA aircrafts connecting the world's major hub. The passengers prefer to fly on a VLA due to the high travel comfort which only the VLA aircraft can provide.

One of the most comfortable seating configurations is the 407 pax (passengers) on board configuration. But also, the maximum capacity of 853 seats are a highly desired option for airlines, which means they have the flexibility to mix comfort with revenue and cost per seat. But today, a typical configuration of an A380 is between 500-520 seats in three or four traveling class configurations. The capacity flexibility is one of the best airline tools how to optimize the right capacity at the right time between mature and expanding markets and their reaction you can read from Figure 2[2].

We can find three key reasons why the VLAs aircraft are the future of aviation:

- a) Solution to sky congestion: reducing the number of aircrafts needed for transport of the ever-growing air passenger volume;
- b) Solution to the changing demand at different times of the day;
- c) Solution to overcrowded slots at the megacities airports.

The standard solution, which is often implemented

**CONCENTRATION OF FLIGHTS IN LONG-HAUL MARKETS**

August 2012 Schedules - Source: OAG, Airbus

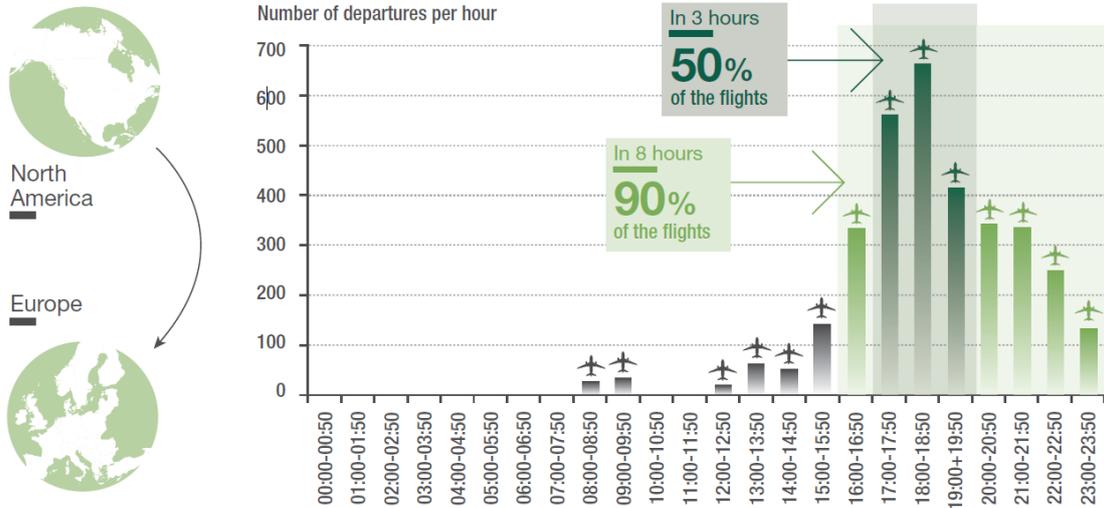


FIGURE 1. Concentration of Flights in Long-Haul Markets [source: OAG, Airbus].

**NEW DELIVERIES OF VERY LARGE AIRCRAFT BY REGION**

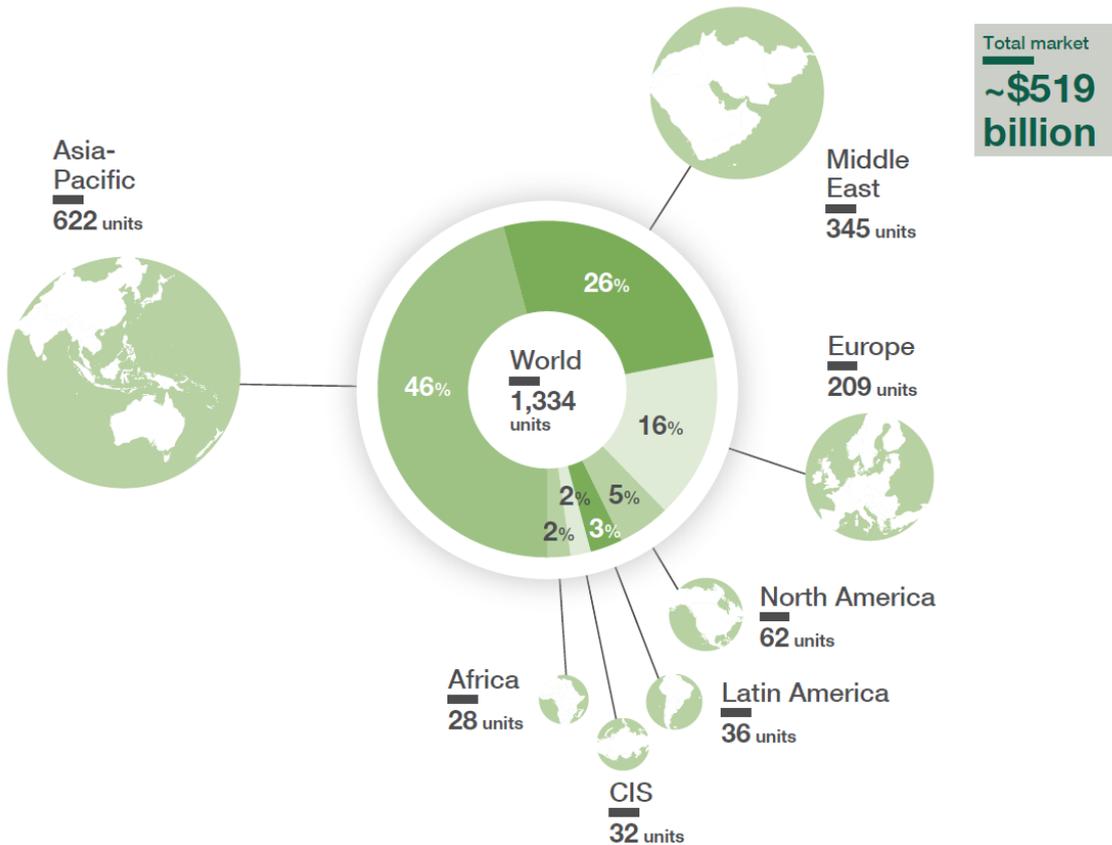


FIGURE 2. New Deliveries of VLA by Region [source: OAG, Airbus].

on routes via the A380, is operating the A380 during peak hours and other aircraft types at non-peak hours during the day on the same routes. In fact, 50% of airports-pairs served by the A380 have another aircraft type in operation also. For the airlines it means to target the right capacity at the right time during the day, for example a combination of the A380 and A350XWB aircraft. The main markets for the VLA are the long-haul markets between AMCs. In these days they are mainly on the Asia/Pacific area, where more than 25% flights are served by the A380[2-4].

"From today until 2033, we forecast the demand for nearly 1,230 VLA globally. The two largest markets are Asia-Pacific and the Middle East. Asia-Pacific will represent 47% of the demand for VLA over the next 20 years which can be clearly seen by the large number of VLA today flying to from and within Asia-Pacific followed by the Middle East which today has the largest fleet and largest backlog"[2].

By the GMF prediction we can await an annual growth of the passenger air traffic around 4.7% and it will assist approximately 30,555 passengers' aircraft during next 20 years. "This demand represents \$4.4 trillion at book value over the next 20 years. Of this demand for passenger aircraft, 40% will be for the replacement of ageing, less fuel efficient aircraft and 60% of the demand will be for growth"[3].

## 2. HUMAN FACTORS TRAINING IN AVIATION

Safety means different things to different people. To the traveling public, the term 'safety' means, at its most fundamental level, that we want to reach our destinations without getting hurt. Since people do get hurt on occasion, it is logical to conclude that we are willing to accept some risk in traveling. Whether consciously or subconsciously, we know that there is some chance, albeit a minute one, that we could be hurt or killed while traveling. Today we average about 50 accidents in commercial airlines each year, but it means that the odds of any one flight being your last one are remote ( 1 to 4,9 million ) and given that more people are killed or injured in automobile accidents (approximately 44,000 deaths per year), 'safe' is a reasonable word to apply to commercial aviation[5].

One of the first airlines to accept the Human Factors training was Continental Airlines. They accepted the existing format and settled the special training called Cockpit Resource Management, evolved into their original training initially titled "Crew Coordination Concepts", and later changed to "Maintenance Resource Management"[6]. It covers communications with pilots, pilots with cabin crewmembers, labor with management, and companies with the government.

The ICAO (International Civil Aviation Organization) is a specialized agency of the United Nations, which codifies the principles and techniques that aviation has developed and implemented a special human

factors training called SMS program: Safety Management System. The definition of SMS: "A dynamic risk management system based on quality management system (QMS) principles in a structure scaled appropriately to the operational risk, applied in a safety culture environment."

### 2.1. HUMAN RELIABILITY ANALYSIS (HRA)

It is well-established that the largest contribution to the probability of system failure in complex systems is human error. A risk assessment method of any value in aviation must consider human interactions and errors on system reliability. HRA models human behavior to better understand human interactions with the rest of the system. A popular method used for human performance reliability prediction is the Technique for Human Error Rate Prediction (THERP).

THERP are model with five steps:

- (1.) Define the system or process.
- (2.) Identify and enumerate all human operations performed and their relationships to the system.
- (3.) Predict error rates for each human operation.
- (4.) Determine the effect of human error on the system.
- (5.) Make changes that will reduce the system failure rate.

PRA has been used in chemical, transport, energy, aerospace and military. The first step in an HRA is a study to identify the hazards and their impact on the scale. The scale is uses fault trees (FT). The hazards are assigned probabilities, which are propagated up the tree to establish the probability of the undesired top hazards.

In practice, it means that the phase of mapping the hazards and human failures is followed by a practical modeling scenario with deductive logic and probabilistic tools called Fault Trees (FT). The FT are composed of three levels: the top level called type of accident which defines the accident scenario, the middle level are the intermediate failures causing the top level and the basic level are the failures that cause the top level to occur. Developing the scenario is a highly sophisticated method with extreme dependency on source data of the model and good subject knowledge. It could be supported by probabilistic software tools.

## 3. CONCLUSION

In these days, more than 300 Airbus A-380 are in service operating under the flags of 13 carriers: Singapore Airlines, Emirates, Qantas, Air France, Lufthansa, Korean Air, China Southern Airlines, Malaysia Airlines, Thai Airways International, British Airways, Asiana Airlines, Qatar Airways and Etihad Airways using airports all over the world. One part of responsibility for passengers' security is on airport management, how to manage the airports runways, taxiways, gate areas

and terminals to accommodate this large and heavy aircraft and more than 700 pax per flight. What has resulted has been a relatively seamless, trouble-free adaptation on the part of airports, which reflects the results of thoughtful planning and analysis.

The other part is the human factor. Commercial air carriers continue to restructure. The world's economic downturn beginning in 2008 forced many air carriers out of business and other to consolidate. As a result, air traffic management has had to, and will continue to, become more flexible in its contractual obligations with air carriers, their aeronautical revenue structures, and increasingly the use of their facilities.

In the past, aviation safety improvements were characterized by a fly-crash-fix-fly approach. Sometimes the causes would be weather-related or a mechanical failure, but more often the causes would be determined to be human factor error – usually the pilot. Today we realize that it is much more productive to engineer a system in which causes of failure have been prevented. As one might imagine, there are many elements to this engineering effort. The understanding of hazard identification, risk management, system theory, human factors engineering, organizational culture, quality engineering and management, quantitative methods and decision theory must have a pillar in aviation development.

The requirement for VLAs will grow with the world's network and as more people have the ability to fly. By 2032, this demand will result in a need for more than 1,300 VLAs. Given the projected growth in Asia-Pacific, both economic and air passenger traffic growth, the region's demographics and urbanization trends, it is unsurprising that the region's airlines will take 47% of these aircraft over the next 20 years. The Middle East will be the second largest region in terms of demand for VLAs, at 26%. This can be seen today in the size of the backlog of A380s within Middle Eastern carriers[3].

## REFERENCES

- [1] S. Young. *Airport: Planning & Management 6th Edition*. McGraw-Hill Companies, Inc., 2011.
- [2] A. 2015. *AIRBUS*. [Online], Přístup získán MAY 2015.
- [3] IATA. *The International Air Transport Association*. [Online]. Available: <http://www.iata.org/about/Pages/index.aspx>. Accessed MAR 2015.
- [4] WTTC. *World Travel & Tourism Council*. [Online]. Available: [www.wttc.org](http://www.wttc.org). Přístup získán MAR 2015.
- [5] *The Economist Group*. [Online]. Available: <http://www.eiu.com/home.aspx>. Přístup získán APR 2015.
- [6] R. Stanley, R. Trollip. *Human Factors for General Aviation*. Jeppesen Sanderson, 2011.