Artificial Intelligence in Aircraft Docking: The Fear of Reducing Ground Marshalling Jobs to Robots and Way-Out

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Abstract

This study gaudily examines the impact of Artificial Intelligence on aircraft docking, and technophobia that may arise on the part of ground marshallers. Ground marshallers are ground personnel that signal or communicate visually to pilots when docking the aircraft in an airport. Artificial Intelligence is an expert system which can be incorporated in different areas, such as finance, transportation, aviation, and tele-communications. Attitude theory and Technology Acceptance Model (TAM) were used to establish the acceptance of Artificial Intelligence. It should be noted that expert systems make decisions which requires human level of expertise. In order to reduce the fear that technology will replace the jobs of human in the field of air transportation particularly with aircraft docking, it is crucial for airport personnel to embrace the upcoming revolution by developing themselves as regard Artificial Intelligence; Universities should prepare the transport students to face the upcoming reality. Also various organizations should put in place necessary resources needed to be part of this revolution which will be fully achieved in the fourth indus-trial revolution and the fifth industrial revolution.

Keywords: Artificial İntelligence, Ground Marshalling, Air Transportation.

1. Introduction

Digital devices are becoming increasingly ubiquitous and interconnected. Their evolution to intelligent parts of a digital ecosystem creates novel applications with so far unresolved security and safety issues (Leandros, Ali, Ying, Isabel, & Helge, 2016). A particular example is an aircraft. As aircraft evolve from a simple-complex means of transportation to smart entities with new sensing and communication capabilities, they become active members of a smart air transport system. The Internet of Aircrafts (IoA) which is a term borrowed from Internet of Things (IoT) for this study consists of aircrafts that communicate with each other and with installations that allow ease of landing and takeoff through V_2V (vehicle-to-vehicle), vehicle-to-infrastructure and installations and vehicle-to-airmen interactions, which enables both the collection and the real-time sharing of critical information about the condition of aircraft, air route, weather, ground movement, and others. In the era of digitization, the importance of Artificial Intelligence (AI) cannot be over emphasized.

According to Andrei & Andrew (2013), Artificial Intelligence is the science concerned with the creation of machine intelligence which is able to perform tasks heretofore only performed by people. It refers to machines that respond to stimulation consistent with traditional responses from human capacity for contemplation, judgment and intention. Much of this machine intelligence is symbolic. Artificial Intelligence deviated from the juggernaut of computer research in the early 50s by exploring how computers can be used for more than just numeric processing. It incorporates critical reasoning and judgment into response decisions. They also noted that artificial intelligence is

being incorporated in a variety of different areas, such as finance, transportation, aviation, and telecommunications. It should be noted that expert systems make decisions which normally require human level of expertise. A very good example of digital device that has some form of artificial intelligence used in the airport is aircraft docking system.

A docking system (Visual Docking Guidance System (VDGS)) is a computerized device developed with the aid of Information Communication Technology (ICT), which guides the aircraft from taxiway to the gate position and vice versa. It enables wide-body aircraft to park at the correct position on the parking bays without the assistance of a ground marshaller. Ground crews (ground marshaller) are trained personnel employed to aid the pilot in guiding the aircraft into the dock (Adeniran, 2014).

There is a growing notion that our society is entering a "robot society" which seems to be an unstoppable and fundamental shift in advanced economies that will transform the nature of work and opportunity within society (Van & Kool, 2015). There is also an impression that the advent of robot is an apparition threatening the economic security not just of the working poor but also the middle class across mature societies (Kelly, 2016). There has been revelation of the variety of robot applications in our daily life, but at the same time underlined the potentials, limits and problems that require further understanding (New York Times). In addition to the public interest, an increasing number of policy reports and scientific articles are being issued on these topics, indicating the rise of robots at work and in daily life of modern societies in the nearest future.

Over the next 15 years, 2 to 3 million Americans who drive truckers, bus drivers and cabbies will be replaced by self-driving vehicles, according to a December 2016 White House report on the ascent of artificial intelligence (AI). Also, an estimate by the University of Oxford and Citi bank, predicts that 77 percent of Chinese jobs are at risk of automation over roughly the same period. In the same vein, millions of people around the world would lose their jobs under these scenarios, potentially sparking mass social unrest and upheaval (David, 2017). It is important to relate these happenings to air transportation particularly aircraft docking. Will this change be applicable to ground marshallers?

With the increasing volume of passenger enplanement worldwide coupled with high safety consciousness in air transportation, it is therefore needed to increase the level of technological development. It has become essential to develop and code artificial intelligence systems in air transportation that will work side-by-side human and ensure efficient air transportation with emphasis on efficient aircraft management on the apron during landing and takeoff in the airport.

Furthermore, firms have discovered that machine learning, and artificial intelligence will improve accuracy, productivity, and efficiency of operations but a disadvantage by replacing human. During the global recession, many businesses were forced to downsize their workforce for budgetary reasons. They had to find ways to maintain operations through leaner workforces. The United States Bureau of Labor Statistics (BLS) compiles future employment projections; the agency predicts that 15.6 million new positions will be created between 2012 and 2022. This amounts to the growth of about 0.5 percent per year in the labor force. Hence, technology can be seen to boost productivity and improve efficiency, but do so by reducing the number of employees needed to generate the same or even higher levels of production and efficiency.

This study gaudily examines the impact of artificial intelligence on aircraft docking and technophobia that may arise on the part of ground marshallers and other related fields.

2. Literature Review

2.1. Overview of Robots in the World

Predictions that automation will make humans redundant have been made before now, however, going back to the Industrial Revolution, when textile workers, most famously the Luddites, protested that machines and steam engines would destroy their livelihoods. As computers began to appear in offices and robots on factory floors, former President of the United States, John F. Kennedy declared that the major domestic challenge of the 1960s was to maintain full employment at a time when automation is replacing men.

In the year 1964, a group of Nobel prizewinners, known as the Ad Hoc Committee on the Triple Revolution, sent President Lyndon Johnson a memo alerting him to the danger of a revolution triggered by the combination of the

computer and the automated self-regulating machine. This, they said, was leading to a new era of production which requires progressively less human labour and threatened to divide society into a skilled elite and an unskilled underclass. The advent of personal computers in the 1980s provoked further hand-wringing over potential job losses (Economist Newspaper, 2016).

The dissemination of robots worldwide shows high relevance of this technology in manufacturing. The introduction rate of advanced robots in manufacturing is still much higher than that of service robots in other branches. However, the expected trend is towards a significant increase in these markets. Most industrial robots (IR) are introduced in the automotive industry, which is the sector with the highest density of robots worldwide. The average global robot density is about 66 industrial robots installed per 10,000 employees in the manufacturing industry (International Federation of Robotics (IFR), 2015).

Yet mechanization has always been a feature of modern economies. For example, while American steel output remained roughly even between 1962 and 2005, the industry shed about 75 percent of its workforce, or 400,000 employees, according to a 2015 paper in the American Economic Review. Since 1990, the United States has lost 30 percent (5.5 million) of its manufacturing jobs while manufacturing output has grown 148 percent, according to data from the Federal Reserve Bank of St. Louis.

The high rate of automation in the automotive industry compared to all other sectors is demonstrated by comparison of the number of industrial robots in operation per 10,000 employees in the automotive industry and in all other industries. In international comparison, Japan has the highest robot density in the automotive industry. In 2013, more than 1.5 thousand industrial robots were installed per 10,000 employees in the Japanese automotive industry, while in the other manufacturing sectors the density was 214 robots per 10,000 employees. Considering the automotive sector, this rate is followed by Germany with 1.2 thousand robots, the United States and the Republic of Korea with 1.1 thousand units each (IFR, 2015).

The International Federation of Robotics (IFR) states that from 2015 to 2017, robot installations are estimated to increase by 12% on average per year (CAGR): about 6% in the Americas as well as in Europe, and about 16% in Asia/Australia. The trend towards automation continues to increase the volume of robot installations. Also, the strong increase in the number of robots is expected to continue, especially in the Asian market, as shown in Figures 1 and 2 respectively:
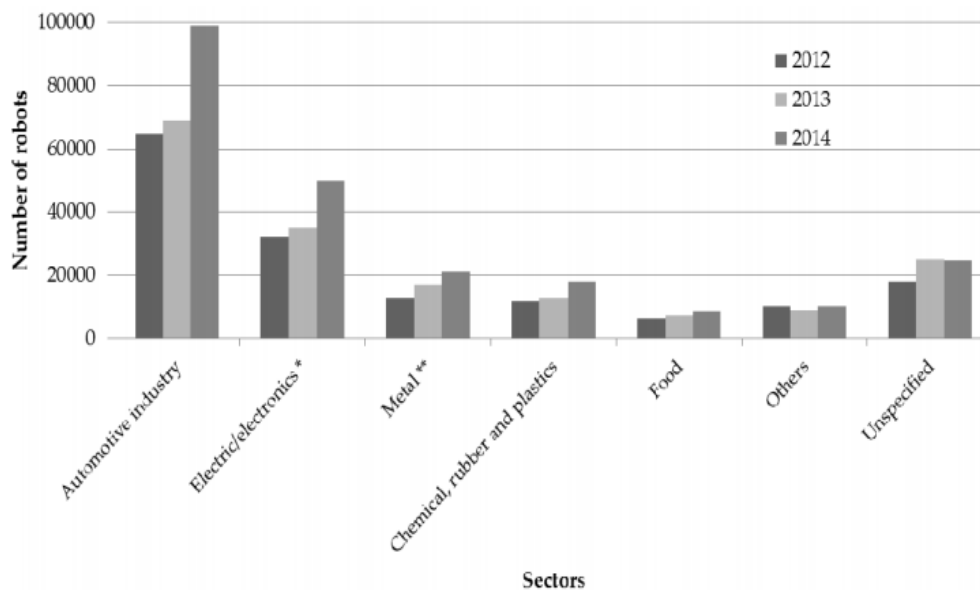

Figure 1. Estimated worldwide annual supply of industrial robots by industries (2012–2014).
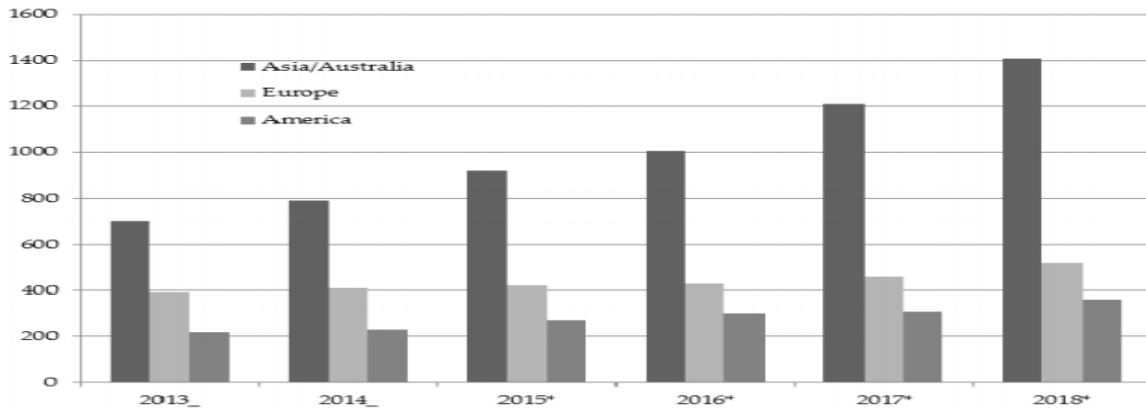Source: (IFR, 2015)

Figure 2. Estimated operation stock of industrial robots 2013–2014 and forecast for 2015–2018

Source: (IFR, 2015)

2.2. Theoretical Framework

2.2.1. Attitude theory

Attitude is a mental and neutral state of readiness organized through experience exerting a directive or dynamic influences upon individual's response to all objects or situations with which it is associated (Allport, 1935). Attitudes are inclinations and feelings, prejudices or bias, preconceived notions, ideas, fears and convictions about any specific topic (Spacey & Attwell, 1998).

This study theoretically focused on establishing the conception of Ground Marshallers to Artificial Intelligence. Attitudes represent the conceptual value of these technologies in the minds of the Ground Marshallers, not the values of the technologies themselves. Positive attitudes are fundamental in implementing new technologies (Spacey, Goulding & Murry, 2004; Fine, 1994; Fine, 1986). It was discovered that there is a correlation between attitude toward technology and number of hours spent using a computer (Matheison, 1991; Taylor & Todd, 1995).

2.2.2. Technology acceptance model (TAM)

Technology Acceptance Model (TAM) has gained attention and confirmation in a wide array of areas and applications to understand end-user's intention to use new technology and systems (Venkatesh, Morris, Davis, & Davis, 2003). Although TAM has not been widely applied to examine adoption and acceptance of Information Technology (IT), TAM has been found to provide consistently superior explanations or predictions of behavior (Taylor & Todd, 1995; Morris *et al*., 2003). This may be as a result of various factors that influence technology adoption, type of technology and users and the context (Chan & Auster, 2003).

Many existing studies in the context of technology acceptance have shown that individual's attitude directly and significantly influences behavioral intention to use a particular technological application (Gribbins, Shaw, & Gebauer, 2003; George, 2002). Studies conducted are not directly related to Artificial Intelligence but they are indirectly linked to Artificial Intelligence because of the term technology involved. TAM has received much attention from researchers and practitioners as a parsimonious yet powerful model for explaining and predicting usage intention and acceptance behavior. This can be a useful model to assessing the acceptance of Artificial Intelligence.

2.2.3. Related issues and solution

The introduction of robots in manufacturing has been identified as a major trend in the modernization of industry (EUROP; Moniz, 2016; OECD, 2015). However, the training and skills requirements for operating these machines are much higher compared to conventional tasks. This can lead to shifts in employment. Thus, the percentage of jobs at risk of being replaced by machines is difficult to estimate and other criteria have to be taken into account. The Organization for Economic Cooperation and Development (OECD) report on the future of productivity by McGowan et al. states that, labor productivity initially grew rapidly following 1950, reflecting significant scope for catch-up and the rebuilding of war-ravaged capital stocks. Productivity growth decelerated from the early 1970s, but convergence continued in many economies.

From the mid-1990s, productivity growth accelerated in the United States, largely reflecting the large productivity gains associated with rapid diffusion in ICT (OECD, 2015). After that, growth slowed down because of the financial crisis in many economies after 2008. Labor productivity in a number of OECD countries had already slowed down before (during the 2000–2007 period). According to the OECD report, the productivity slowdown may partly reflect the pull-back in the pace of KBC (knowledge-based capital) accumulation observed in many OECD economies during the early 2000s. One factor pointed out is the decline in business start-up rates, as observed in many OECD countries even before the crisis. Another important factor is the increasing competition, which impedes the access of small businesses to more advanced technologies. Emphasis is also laid on the fact that increases in the complexity of technologies over time may have also increased the amount and sophistication of complementary investments required for technological adoption.

In the year 2016, OECD conducted another study through a policy think tank run by thirty-five (35) rich countries, they took a different approach that looks at all the tasks that workers do; taking account of the heterogeneity of workplace tasks within occupations already strongly reduces the predicted share of jobs that are at a high risk of automation. They found that only 9 percent of jobs face high risk of automation in the U.S. Across all thirty-five (35) OECD member states, they found a range of 6 to 12 percent facing this high risk of automation. Based on this, it can therefore be said that air transport industry will be faced with high risk because of the complexity and global nature of the system.

David (2017) noted that the technical revolution in the late 20thcentury moved workers from factories to new service-industry jobs. Frey and Osborne argued that this time is different. New advances in artificial intelligence and mobile robotics mean machines are increasingly able to learn and perform non-routine tasks, such as driving a truck and docking an aircraft. Job losses will outpace the so called capitalization effect, whereby new technologies that save time actually create jobs and speed up development. Without the capitalization effect, unemployment rates will reach never before seen levels. The only jobs that remain will require workers to address challenges that cannot be addressed by algorithms.

A good and common example in most developed and developing countries in the world is ATMs. Instead of killing jobs, the number of banking jobs in the world has increased advantageously since they were introduced. This is so and realistic because the ATM allowed banks to operate branch offices at lower cost; this prompted them to open many more branches.

Machines are besting humans in more and more tasks through technology; fewer Americans make more stuff in less time. But today economists debate not whether machines are changing the workplace and making us more efficient they certainly are but whether the result is a net loss of jobs. As we look ahead to a world populated by smart machines that can learn ever more complex tasks, economists agree that retraining people will be required and as the case may be with global free trade any big economic shift creates both winners and losers.

2.2.4 Advantages of robots over human

Hardee's CEO in the White House listed the advantages of robots as:

- They are easier to manage than people;

- They are always polite;

- They always up-sell;

- They never take a vacation;

- They never show up late;

- There never a slip-and-fall; and

- There is no age, sex, or race discrimination case.

3. Conclusion and Recommendation

3.1. Future Perspectives Regarding Robots in Aircraft Marshalling

Robots is presumed in air transportation to be the most common transportation mode which embraces the use of automated systems with emphasis on aircraft ground marshalling technical applications. Due to some unforeseen technical issues, robot is expected to be a machine that is capable of providing technical or skilled help to the ground marshallers. This will enhance human-robot interaction in aircraft ground marshalling. Based on this, the airport organization and ground marshallers must seek for new qualification needed, technical competences, and organizational competences which will facilitate human-robot interaction with regard to competences in communication and decision processes in aircraft ground marshalling and overall airport organization.

In the future, the development of robotics will be autonomous in nature such that their roles will be highly significant in the society. It is expected that the technical challenges associated with robots will be resolved based on continual development of artificial intelligence technology. Issues associated with full acceptance of robots by human will be solved through human-robots collaboration such that human will be the driver of robots.

3.2. Conclusion

Technophobia in air transportation particularly in aircraft docking can be reduced when there is proper orientation regarding the application of technology and the roles of human in air transportation. As stated in the (Economist Newspaper, 2016), it should be noted that new jobs will be created in the field of AI itself whereby robots may need remote operators to cope with emergencies, and manhandle packages. This is highly necessary in air transportation because of the huge risk involved, hence the lives of human cannot be solely left in the control of robot. It is also connected to the fact that no matter how advanced artificial intelligence becomes, some tasks in the air transportation industry will be better done by humans, because of the social nature of human.

The major lesson to be deduced is that technology increases productivity output and efficiency of service delivery which in turn creates a greater demand for workers to perform more complex tasks that computers cannot handle. It should be noted that workers who may have been replaced by machines may not have had suitable training to take the more complicated jobs. It is therefore crucial for human to embrace the upcoming change by developing themselves as regard Artificial Intelligence so as not to be displaced. Universities should prepare the students to face the upcoming reality. Also various organizations should put in place necessary resources needed to train their staff.

3.3. Recommendation

In order to be economically relevant, one must be conscious of work rapid transformation in the global economy which is attributed to scientific and technological knowledge. The airport organization should train and retrain airport employees on Information Technology (IT) in disseminating various tasks given.

Airport organization should developed and adopt automation processes to improve their operational efficiency such that they will be better placed to focus on human involvement in technology processes with trending. The more robots are introduced in work environments, the more human interaction with those systems becomes crucial. Thus, a management strategy for human involvement in the aircraft ground marshalling becomes vital for developing and implementing the air transport policy. The policy context and content regarding aircraft docking will result to the policy consequences of efficiency, safety, reliability of aircraft docking and reduce turn-around time of aircraft on air-side.

Robots helps human anticipate problems or deal with difficulties as they come up, as there is growing applicability of artificial intelligence in many industries. It is being used to take the place of humans in such difficult areas and resolving complex tasks. In air transportation, aircraft ground marshallers should be involved in decision making, programming, applying standard procedures and practices, and developing basic maintenance tasks, or carrying out standard procedures of surveillance and basic operations. They should therefore have fundamental and higher training on artificial intelligence. Universities should prepare the students to face the upcoming reality. Also various organizations should put in place necessary resources needed to train their staff.

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