

AI IN AVIATION

EXPLORING THE FUNDAMENTALS, THREATS AND OPPORTUNITIES OF ARTIFICIAL INTELLIGENCE (AI) IN THE AVIATION INDUSTRY.

WHITE PAPER | JUNE 2018



Foreword

The commercial aviation industry is no stranger to Artificial Intelligence (AI) technology and has been using it effectively in various parts of the business and across the value chain for decades. However, we are entering an era in which AI capabilities are reaching new heights and will have a major impact on how we conduct business. There are various schools of thought as to the socio-economic long-term impact of AI. Historical trends show a positive impact of emerging technologies, i.e. while some jobs are made redundant due to new technologies, other new jobs are created at the same time.

The AI adoption barrier to entry has become much lower due to an intense competitive environment with many technology providers offering AI solutions. Adopting such solutions has a lower risk exposure, in particular from a financial perspective. The long-term future of AI is difficult to predict; however, over the short- and medium-term, the aviation industry has the potential to extract significant benefits from this technology.

IATA is eager to raise awareness and support airlines and the wider value chain to reap the benefits of new technologies such as AI. Through applied research and development, proof of concepts, pilots and engagement with the academic and start-up sectors, we aim to accelerate innovation. To learn by doing, IATA has already adopted AI solutions to improve the performance of its own Settlement Systems and Customer Services, and will keep testing new solutions.

We trust this white paper on AI will help the aviation industry to address pain points, opportunities and threats. We look forward to hearing your feedback.

A special thank you to the team of authors and contributors that created this document and continue to lead innovation in our industry.

Sincerely yours,

A handwritten signature in blue ink, appearing to read 'E. Léopold', with a horizontal line underneath the name.

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Executive Summary

AI is an overarching technology that enhances existing, and new business capabilities possible for airlines and other entities across the aviation value chain. The following illustrations are a mapping of different AI capabilities against the business capabilities and needs of airlines in 3 clusters (Customer touch-points, Operational, and, Support and management). The intelligent bot technology has the highest potential in the customer touch-point capabilities of airlines with the potential of making customer service operations more efficient and effective; and there is also a paradigm shift towards unique treatment of customers by having the capability of auto processing what airlines already know about their customers. In many cases, there is already a lot known, upon which personalized offerings and services can be built.

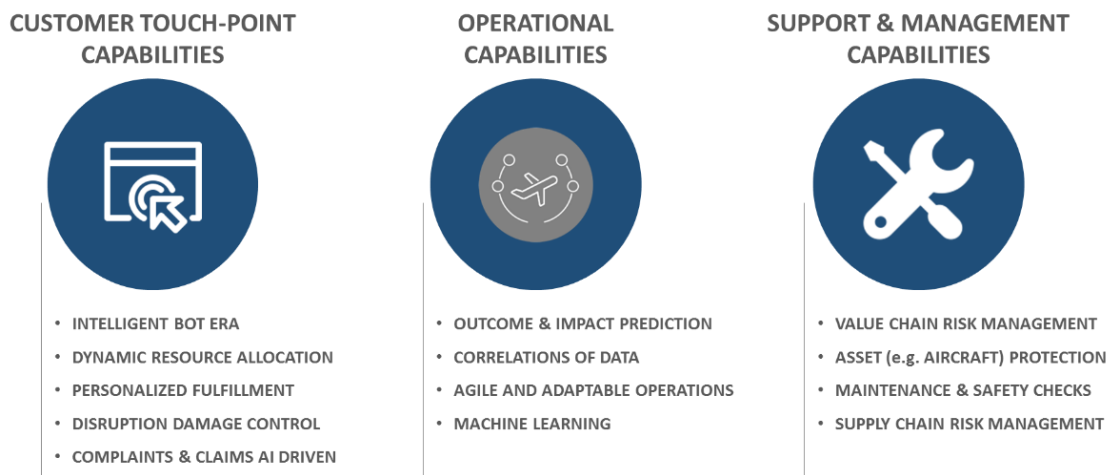


Figure 1: Airline Business Capabilities impacted by AI

AI capabilities are becoming more accessible as there are many providers with off-the-shelf AI solutions. These solutions make it relatively easy for companies to quickly start leveraging the benefits of AI. However, in competitive markets; it's more about who has it first before it becomes a commodity and stops being a differentiating factor.



Figure 2: Recommended approaches to AI

A strong dependency on vendors for AI does have advantages in terms of fast implementation of solutions, however, in particular for companies that act as an intermediary it's important to identify where AI is a strategic asset and to ensure these assets are kept within, or brought into the company. Digital assets are more prone to cyber theft and abuse as AI makes it very easy to browse the digital world; it's therefore imperative to have a strong strategy on how to protect digital assets.

IATA has already started research and development and a number of concrete projects that are leveraging bot technology and machine learning to enhance customer services and to protect the moneys of its members.

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3 Acknowledgement

This white paper is the result of a multidisciplinary research with collaboration across different areas and functions within commercial aviation.

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4 Purpose of this document

This document is intended to:

- Raise awareness of AI across the aviation industry;
- Expand on the rationale of why AI is worth considering;
- Present the threats and opportunities that are expected to come from AI;
- Recommend areas of potential to start with;
- Cover areas of concern.

5 Introduction

What makes AI unique is that it is a generic umbrella technology that is an enabler of many different disruptive technologies and solutions; it has the power to add great value and be a force for good in aviation and beyond. The airline industry Open Innovation community is well positioned to lead the transformation that is on the horizon and enable airlines and the wider entities across the value chain to reap the benefits of AI and support them to cope with the impact of this technology. The aviation industry has already started adopting some limited AI capabilities in business; however there is now the opportunity to start with a wider adoption of AI capabilities to support achieving business objectives.

While this technology has been around since the 1960s, it's only recently that the necessary computing power¹ has become accessible and has given traction to AI developments- manifesting itself in value-added products and services. This trend is expected to accelerate even more when new emerging computing technologies such as neural processors and quantum computing² reach sufficient maturity.

5.1 Art of the Possible

AI has the potential to help humans with the running of an airline; Some of the potential future characteristics, capabilities and use cases of AI systems in the aviation context include:

24/7 AI Services: AI never gets tired and has a multi-layer parallel redundant architecture, i.e. unlikely to fail and if failure does occur there are many backups.

100% up-to-date: AI system can be loaded with a complete competence packages for all the systems, tools and equipment used in an airline; with updates as and when there are changes.

More comfortable flight experience: While IATA and airlines are already working on a real-time turbulence database, AI could enhance this, for example with a real-time multidimensional pressure data feed of the airspace within a radius of certain value, which can be used for optimization purposes as well as avoidance of turbulence.

Safety & Real-time Monitoring: AI could make it possible to have an Aircraft Real-time Health Monitoring System (ARHMS), driven by sensors at the atomic level on every part of the aircraft, its content, and surroundings. Any anomalies (e.g. stress, pressure, magnetic, temperature, humidity fluctuations) can be measured and acted upon. Upon landing, AI could conduct a physical safety check, inspecting the entire aircraft through the ARHMS and using an autonomous multi-drone system.

Baggage Delivery: AI could deliver the bags in partnership with a Drone Service Provider that flies bags from the aircraft straight to the location indicated by the passengers.

¹ "The ability of a computer to perform work, often considered in terms of the number of instructions that can be carried out in a given time, or with reference to the amount of random access memory present." (oxforddictionaries.com)

² <http://www.mckinsey.com/industries/high-tech/our-insights/the-growing-potential-of-quantum-computing>

Commercial Decision Making: AI can also fulfill central duties (e.g. aiding commercial decision making, revenue management, Service Level Agreement monitoring, management of all Smart Contracts with value chain partners, invoicing and settlement, and procurement).

Technically most of the above is already possible; some are not yet commercially viable, and some have regulatory obstacles.

5.2 Ever Enhancing Value Proposition

Future visions often have an enhanced value proposition; i.e. it's not only about more efficient ways of doing the same thing, but also radical change in how we achieve our end-goal. Airbus' Pop.Up concept is a good illustration of this; a 2 passenger autonomous pod that can drive on normal roads, integrate with trains, and even zip through Hyperloop tubes.



Video 1: Airbus Pop.Up (Click to watch)

5.3 Aviation Skills Mismatch

An optimistic future view would argue that the number of newly created jobs will always exceed, or at least, be equal to the ones that are made redundant. While that may be true; there will be a significant skills shortage and gap.

"If the next generation is to use AI and big data effectively – if they're to understand their inherent limitations, and build even better platforms and intelligent systems — we need to prepare them now. That will mean some adjustments in elementary education and some major, long-overdue upgrades in computer science instruction at the secondary level." (Harvard Business Review June 2017)

5.4 What is AI?

AI refers to computer programs that exhibit human-like intelligence such as logical reasoning, problem solving and learning. It comes in embodied (e.g. Robots) and disembodied (e.g. Apple Siri, Google Now) form.^{3 4 5}

5.5 Why should we look into it?

There are a wide range of benefits that AI can deliver; whether through optimization of existing processes and/or systems; or through the removal, by making them obsolete⁶. The various aviation use cases are expanded on in section 8.2.

³ <http://cpsc.yale.edu/research/artificial-intelligence>

⁴ <http://www-formal.stanford.edu/jmc/whatisai/>

⁵ https://www.cs.umn.edu/research/research_areas/robotics-and-artificial-intelligence

⁶ <http://www.airbus.com/presscentre/pressreleases/press-release-detail/detail/airbus-demonstrates-aircraft-inspection-by-drone-at-farnborough-innovation-and-digitalisation-for-production-ramp-up/>

The emergence of AI technology is expected to cause a disruption in the type of tasks that humans perform and the ones that are delegated to machines. While experts generally agree that the net difference between the number of jobs made obsolete versus created by AI is negligible- the composition of the arrays of skills required by the market is expected to evolve faster than the skills of available human resources can keep up; causing a widening of the labor-market skills gap⁷. Emergence of new entrants is also a threat that needs to be taken into consideration. This threat can only be diffused if there is the willingness to look beyond industry boundaries and scan the technological horizon with the intent to self-disrupt before the outsiders would do.

6 Fundamentals of AI

To understand and analyze the evolution of AI; one requires to define it across some simplified dimensions. The 4 dimensions below are inspired by DARPA's perspective⁸ on AI.



Figure 3: 4 dimensions of Intelligence

This method categorizes intelligence into:

- 1) Analysis and Conclusion: The ability to look at a problem and analyze the conditions and come to a conclusion.
- 2) Perceiving Outside World: The ability to use sensory input and turn it into an estimated immersive perception.
- 3) Abstraction of Knowledge: Taking knowledge applicable in one specific area, and applying it to a different area.
- 4) Learning from Experience: Taking constant learning from activities.

6.1 Evolution of AI

6.1.1 1st Generation AI: Rule Driven Reasoning

Initial progress was made when humans succeeded in incorporating knowledge into computer programs through the definition of static rules. For example in the early days; chess playing computer programs worked through a defined set of rules, and were able to perceive a very small portion of the outside world (the chessboard) in a limited domain; With no ability to learn and abstract knowledge.

⁷ http://www3.weforum.org/docs/Media/WEF_Future_of_Jobs_embargoed.pdf

⁸ <https://www.darpa.mil/about-us/darpa-perspective-on-ai>

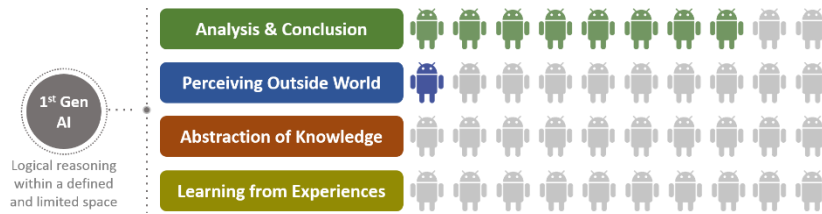


Figure 4: 1st generation AI capabilities expressed across the 4 dimensions

GPS navigation software is another form of 1st Gen AI. It's able to perceive the location, analyze and contextualize it on a map, and conclude with directions. It has very limited ability to cope with deviations from the routine. 1st Gen AI computer programs are still alive and kicking; delivering value to many industries.

6.1.2 2nd Generation AI: Learning through Big Data

Having access to lots of data, otherwise known as Big Data, has its challenges, however technological advancements in data management practices have turned the challenges into opportunities. 2nd Gen AI programs have leveraged this to learn from Big Data; Applying transformative algorithms to identify clusters, and patterns in datasets. For example in some machine learning branches the computer program is forced to find patterns in data through trial and error.

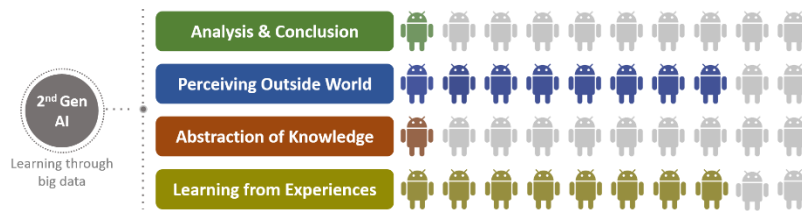


Figure 5: 2nd generation AI capabilities expressed across the 4 dimensions

2nd Gen AI is characterized by learning through analysis of data; but it lacks the ability of logical reasoning, understanding the context and abstracting knowledge to different domains. The learning is far from how humans learn. It's rather learning through well-defined statistical models that simulate the problem domain, and use data to constantly train the model. 2nd Gen AI can even be very unintelligent. Microsoft's twitter bot⁹ and the controversy around it, is a good example of how distortion in the training data can lead to unwanted results.

6.1.3 3rd Generation AI: Analytical Awareness

2nd Gen AI needs large amounts of training data to be able to learn, and draw conclusions. If questioned about a conclusion, the answer is almost always: "because the data says so". On the other hand 3rd Gen AI is aware of the analytical path and to a very limited degree the context of the analysis.

⁹ [https://en.wikipedia.org/wiki/Tay_\(bot\)](https://en.wikipedia.org/wiki/Tay_(bot))

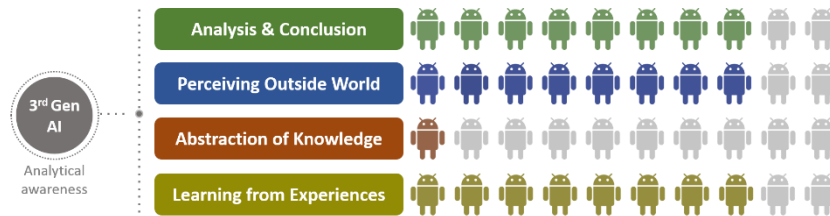


Figure 6: 3rd generation AI capabilities expressed across the 4 dimensions

3rd Gen AI doesn't need to see thousand example images of different aircraft damage, to be able to detect one on an aircraft.

6.1.4 4th Generation AI: Contextual Awareness

Understanding context and being able to go from one domain to another; abstracting knowledge and learning without the need for large amounts of training data are typical characteristics that separate 4th Gen AI from the previous generations.

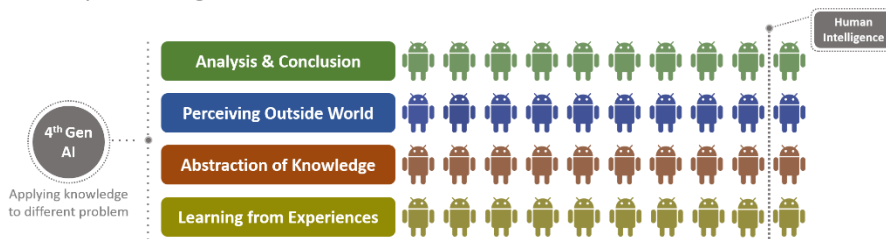


Figure 7: 4th generation AI capabilities expressed across the 4 dimensions

7 AI Capabilities

There are a vast array of use cases that are driven by the emergence, availability and accessibility of the overall AI technology. The technologies can be clustered in the following 7 capabilities¹⁰:

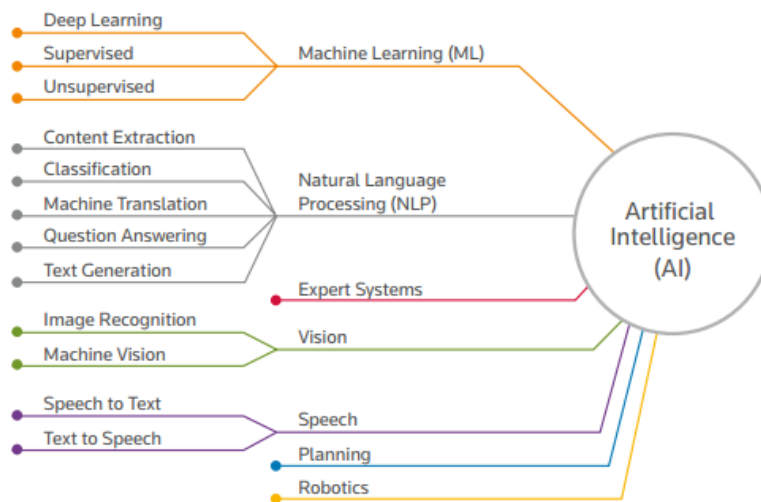


Figure 8: Different branches of AI capabilities

¹⁰ <https://www.neotalogic.com/wp-content/uploads/2016/04/Artificial-Intelligence-in-Law-The-State-of-Play-2016.pdf>

7.1 Machine Learning (ML)

ML is a branche within AI. It is a discipline concerned with the implementation of computer software that can learn autonomously. Expert systems and data mining programs are the most common applications for improving algorithms through the use of machine learning. Among the most common approaches are the use of artificial neural networks and genetic algorithms.¹¹

7.2 Natural Language Processing (NLP)

NLP is a field of computer science, AI concerned with the interactions between computers and human (natural) languages, and, in particular, concerned with programming computers to process large natural language data.¹²

7.3 Expert Systems

In AI, an expert system is a computer system that emulates the decision-making ability of a human expert. Expert systems are designed to solve complex problems by reasoning through bodies of knowledge, represented mainly as if-then rules rather than through conventional procedural code. The first expert systems were created in the 1970s and then proliferated in the 1980s. Expert systems were among the first truly successful forms of AI software.¹³

7.4 Vision

Computer vision is an interdisciplinary field that deals with how computers can be made for gaining high-level understanding from digital images or videos. From the perspective of engineering, it seeks to automate tasks that the human visual system can do.¹⁴

7.5 Speech

Speech recognition is the inter-disciplinary sub-field of computational linguistics that develops methodologies and technologies that enables the recognition and translation of spoken language into text by computers. It is also known as "automatic speech recognition" (ASR), "computer speech recognition", or just "speech to text" (STT). It incorporates knowledge and research in the linguistics, computer science, and electrical engineering fields.¹⁵

7.6 Planning

Automated planning and scheduling, sometimes denoted as simply AI Planning, is a branch of AI that concerns the realization of strategies or action sequences, typically for execution by intelligent agents, autonomous robots and unmanned vehicles. Unlike classical control and classification problems, the solutions are complex and must be discovered and optimized in multidimensional space.¹⁶

¹¹ <https://www.britannica.com/technology/machine-learning>

¹² https://en.wikipedia.org/wiki/Natural_language_processing

¹³ https://en.wikipedia.org/wiki/Expert_system

¹⁴ https://en.wikipedia.org/wiki/Computer_vision

¹⁵ https://en.wikipedia.org/wiki/Speech_recognition

¹⁶ https://en.wikipedia.org/wiki/Automated_planning_and_scheduling

7.7 Robotics

Robotics is an interdisciplinary branch of engineering and science that includes mechanical engineering, electrical engineering, computer science, and others. Robotics deals with the design, construction, operation, and use of robots, as well as computer systems for their control, sensory feedback, and information processing.¹⁷

8 AI Use Cases

The AI capabilities can individually or in combination be used in a wide range of use cases. In this paper the focus will be mainly on aviation industry use cases.

8.1 General Industry Use Cases

The industry use cases have been carefully mapped into the industry value chain.

8.1.1 Customer Touch-Point Enablers

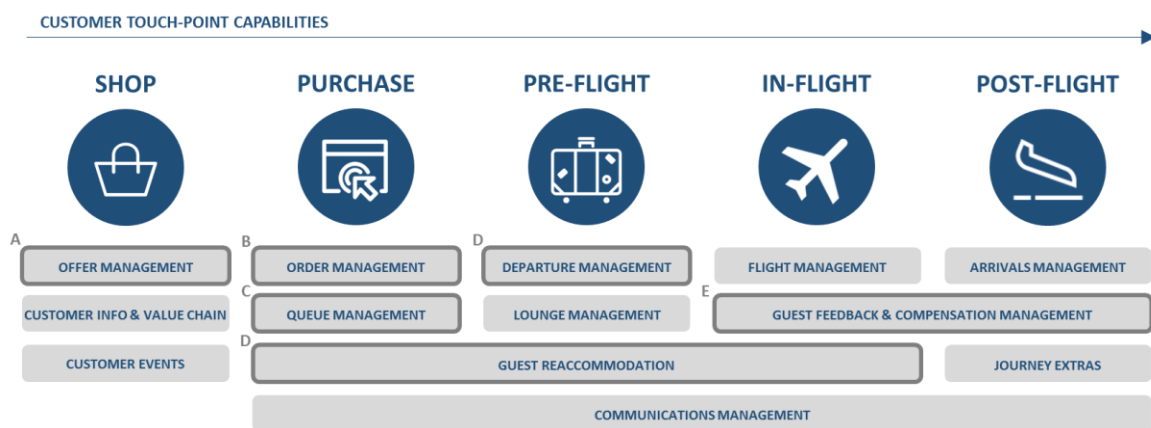


Figure 9: Customer Touch-Point Capabilities

Looking at the Customer Touch-Point Capabilities needed to deliver the core product to the customer; the following innovations are predicted to have an impact:

- A) **Intelligent Bot Era:** The search and booking experience to become as easy as having a conversation.
- B) **Dynamic Resource Allocation:** Queues minimized by predictive analytics, dynamic resource allocation & passenger notification.
- C) **Personalized Fulfillment:** Leveraging data & machine learning to better serve the customer during fulfillment phase.
- D) **Disruption Damage Control:** AI has the potential to take countless factors into account and propose the best option.
- E) **Complaints & Claims Management:** AI can autonomously handle customer requests, complaints and claims, ensuring compliance to regulations (e.g. EU261), optimizing airline resources, minimizing manual efforts, compensation costs, and loss of customer loyalty.

¹⁷ <https://en.wikipedia.org/wiki/Robotics>

8.1.2 Operational Enablers



Figure 10: Operational capabilities

In terms of Business capabilities needed to enable the running of “passenger airline” business. The following AI enablers are already available or just on the horizon.

- A) **Prediction:** With AI tactical, and operational business decision can be mapped out with accurate prediction of outcome and impact. Many different factors are taken into account in combination with historical data to develop predictions.
- B) **Correlations of data:** With the abundance of data, the challenge is now how to draw benefits from it without the need to spend enormous amounts of resources on data analysis. AI has the ability to take unstructured data and find correlations and patterns between even seemingly unrelated things, e.g. customer behavior and its impact on conversions.
- C) **Agile and adaptable:** Operations can be planned to perfection, however there are always things that disrupt the plan and sometimes require a re-planning exercise. AI enables operations to quickly and efficiently re-plan in case of disruptions, taking historical and real-time data into account to fine-tune the new plan.
- D) **Machine learning:** AI machine learning techniques allow the computer software to adjust its algorithm based on past data, and be able to learn from “experiences”.

8.1.3 Support and Management Enablers



Figure 11: Support and management capabilities

And in terms of Support and management Business capabilities, the following AI enablers have been identified:

- A) **Value Chain Risk Management:** Value chain partner (e.g. travel agents, distributors) expose airlines to external risks that can be detected and managed by AI. Examples include: Defaults and payment fraud.
- B) **Asset Protection:** AI can assist airlines with their assets (e.g. aircraft) tracking the status, location and other asset attributes, detecting anomalies and generating recommended actions.
- C) **Maintenance & Safety Checks:** Complex safety management activities require sophisticated and adaptable planning and scheduling taking many parameters into account. AI can support such activities.
- D) **Supply Chain Risk Management:** Supply chain partners (e.g. manufactures, fuel suppliers) expose airline to external risks that can be detected and managed with the use of AI. Examples include: Fuel supply risk detection; Fuel price fluctuations; Aircraft delivery delays.

8.2 Specific Industry Use Cases

8.2.1 AI and its impact on Air Traffic Operations

The use of advanced computing capabilities such as machine learning is still in its infancy. In the context of aviation air traffic operations, AI applicability remains at the proof of concept stage. In an industry that is data rich and at times information poor, experts see the potential, however, they do so with an understanding that the scope and applications must be palatable for regulators to approve. Advancements in automation and computing power, which utilize technologies associated with machine learning and data analytics models, are being used to enhance how we manage the ever increasing rise in air traffic. In this regard, an up and coming key influencer will be the rapid evolution and integration of Unmanned Aircraft systems (UAS) and their associated technologies.

The development of the UAS industry is fast paced, utilizing new technologies and operating systems that can technically out-perform today's infrastructure. UAS Traffic Management (UTM) systems, utilizing enhanced computing capabilities, will provide new opportunities for improving existing traffic management systems, separation standards and airspace planning designs. In particular, these systems will have an impact on:

- Self-separation; by the use of de-confliction algorithms and 'detect and avoid' systems to enable better, more efficient separation standards.

- Information management/data sharing; by requiring harmonized technical standards, performance-based guidelines and federated networks (i.e. all stakeholders speaking the same language) enabling fast and efficient information management and data exchange protocols.
- Optimized decision making; by automating elements of traffic management to execute policies, enforce access control and detect exceptions.

It will become increasingly more important to consider technologies that, while not directly associated with traditional air traffic management, may have a significant impact on the way we currently utilize civil airspace. This impact will help drive the development of future systems, which should assist in mitigating the complexities resulting from the expected increase in airspace users.

8.2.2 Advanced Business Intelligence

The availability of vast amounts of data requires adequate methodology and technology to streamline the Data-to-Action process. Advanced business intelligence can optimize and in many cases disrupt the way airlines run their business; some examples include:

- Marketing and Sales;
- Distribution;
- Pricing strategies;
- Customer loyalty;
- Network optimization;
- Fleet management.

For a long time BI was only about historical data; real-time capturing and use of data came later. And now with the advent of AI technologies, in particular Machine Learning; predicting the future is becoming a possibility.



Figure 12: Evolution of BI capabilities

Specific to the airline industry, a high potential application of machine learning is to assist the direct sales channels. Historical and real-time insights about the behavior of the customer pre-sales and post-sales could be translated into real-time tactical changes, e.g. adjusting the content presented to the customer on the website.

For example if a certain visitor browsing route across the website is resulting in more sales conversions, that route should receive more visibility on the landing page. Strategic and real-time tactical agility driven by data is no longer something of the future, but available at present. Data starts becoming valuable when it is turned into information and finally insight.

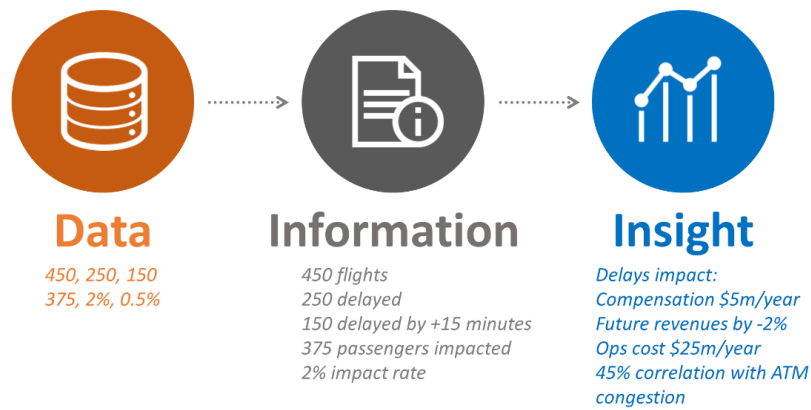


Figure 13: Data vs. Info vs. Insight

Other opportunities related to advanced business intelligence include:

- **Social media sentiment analytics:** Sentiment analytics is a methodology leveraging big data that allows businesses to understand the needs of their customers better. Customer surveys with painful efforts to get sufficient participation has been a loyal tool for decades, however there is something more powerful on the horizon with 100% participation. People constantly express their views and needs on social media. Capturing and turning this data into insights would allow businesses to predict the needs of the customers based upon their social media behavior with data sources including:
 - o Search engine keyword patterns;
 - o Social media updates (e.g. Tweets, Status updates);
 - o Articles/comments posted on social media (e.g. Facebook, LinkedIn, Instagram).
- **Correlative analytics:** Blending of different data sources is a great opportunity to identify patterns and use these to better analyze data and predict future behavior.

8.2.3 Ground Handling Robotics

The use of robotics driven by AI has the potential to streamline some ground handling processes either through improvement of the process or the ability to do it significantly faster. Some examples of high potential use cases in the ground handling area include:

- Safety checks
- Aircraft movement operations:
 - o Pushback;
 - o Towing.
- Aircraft turnaround operations:
 - o Fueling;
 - o Potable water loading and draining;
 - o Lavatory servicing;
 - o Catering;
 - o Aircraft loading and unloading;
 - o De-icing and anti-icing.
- Ground transportation on the ramp:
 - o Passengers (from/to Aircraft to/from Airport Terminal);
 - o Baggage;
 - o Cargo and mail.

8.2.4 Seamless Airport Security

Airport security is and will always be a high priority. However guarantying security shouldn't compromise the experience of the passengers. Ideally it should be as invisible as possible. AI, in particular machine learning technology can potentially unlock concepts that can facilitate ways to increase security while improving the passenger experience. Threats in the majority of times go hand in hand with anomalies in patterns. AI is able to consume vast amounts of data both historically as well as real-time and be able to detect anomalies.

8.3 Ongoing IATA AI Projects

8.3.1 Smart GDC¹⁸ (Customer Service AI)

There is currently a pilot project ongoing testing the waters with AI technology to streamline the customer experience. During the pilot AI technology is going to be leveraged to ease the work of customer service representatives, proposing suggested answers to be given to customers.

The scope of the pilot includes:

- Customer service query classification, assigning and ticket creation;
- 1st level customer support.

8.3.2 Travel Agent Fraud

The most common types of fraud are related to fraudulent defaults or fraud in the payment space (e.g. credit card). Both these types of fraud can quite accurately be predicted and help to prevent and minimize the exposure of IATA, airlines, agents and others to such threats.

A proof of concept has been ran for some time to develop a machine learning model consuming BSP¹⁹ data to make predictions. Tests have shown that the AI model developed can very accurate predict fraudulent defaults. IATA is still working on this model and is considering to deploy it across the IATA GDCs. Non-fraudulent defaults are more difficult to predict. However the investigation results recommend to consider more data sources feeding into the machine learning model to allow the model to find more patterns and increase its ability to relate patterns to default behavior.

8.3.3 Remittance Holding Capacity (RHC)

In the world of NewGen ISS²⁰ and the newly established multi-tier travel agent accreditation program, the concept of Remittance Holding Capacity (RHC) has been introduced. IATA has built the infrastructure and a platform to monitor sales in real-time. With fraud detection and other models to be built on top of it. This platform enables IATA to import and develop independent AI models. Current setup in the NewGen ISS environment is focused on leveraging business rules to detect when agents approach their RHC, triggering an event. The roadmap does include other features that go beyond business rules, i.e. entering the AI territory, specifically machine learning.

¹⁸ Global Delivery Center (GDC) where the back office functions for IATA's Financial Settlement Systems (FSS) have been consolidated into four locations. This allows IATA to better meet increasing expectations of airlines, travel agents, and freight forwarders.

¹⁹ Billing and Settlement Plan (iata.org/bsp)

²⁰ New Generation of IATA Settlement Systems (iata.org/newgeniss)

8.3.4 Transparency in Payments (TIP)

As part of the Transparency in Payments (TIP) project, IATA is building a solution (mostly based on statistical analysis) to identify real-time undeclared forms of payment on the BSPs, such as Virtual Account Numbers (VANs) and fixed numbers. This project aims to provide airlines with more visibility on the forms of payment.

8.3.5 IATA DGR driven by AI

IATA has partnered with a technology company to explore the use of an intelligent Virtual Assistant. The assistant would be driven by an AI platform in the shape of a question answering computer program. The tool could potentially read and learn the Dangerous Goods (DGR) manual in a short amount of time and be able to answer questions. The feasibility and viability of this concept is currently under investigation using a subset of dangerous goods, i.e. lithium batteries. The aim is to have an AI driven computer agent being able to answer questions (through a bot) around this topic 24/7, in any language; and always answer in accordance with the latest version of the industry standards and best practices.

9 Opportunities

AI drives efficiency improvement either by disrupting how certain tasks are performed, or by simply doing it faster than previous methods. The potential benefits that AI could unlock can be categorized into:

- Lowering resource requirements;
- Increasing efficiency.

In many cases the implementation of AI is low risk and doesn't require much investment. This is mainly due to the availability of open source solutions as well as a competitive market with many solution providers.

10 Threats

AI is rapidly developing and gaining more maturity and becoming much more accessible and affordable. There are numerous open source projects (e.g. Tensorflow²¹, Scikit-learn²²) which accelerate the development of this overarching technology. As a result there are many developers, start-ups but also well-established companies looking at different use cases and how they can extract benefits from applying AI. These development can be of threat, in terms of:

- Product cannibalization;
- Legacy product disruption;
- Lower perceived product value;
- Threat to routine and repetitive jobs.

²¹ "TensorFlow™ is an open source software library for high performance numerical computation. Its flexible architecture allows easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices." ([tensorflow.org](https://www.tensorflow.org))

²² "Simple and efficient tools for data mining and data analysis." (scikit-learn.org)

11 Preparing for AI

AI has the potential to generate more prosperity, distribute wealth, reduce poverty and enable people to more efficiently and effectively utilize the resources on the planet and beyond. However, at the very least; humans would need to have an education and training strategy in place to properly equip the next generation; otherwise one may end up with lots of new jobs, and lots of unemployed candidates unable to do them. The world is becoming increasingly immersed with game-changing digital technologies such as AI; with computer science playing a central role. Yet there are only a handful of countries where computer science is integrated into the mandatory pre-college curriculum.

11.1 Embracing the AI evolution

AI is coming and it will have no mercy for any obstacles on its way. Companies can choose to resist and maintain status quo to extend their survival period, or embrace AI and be part of the ongoing revolution. The road is certainly not free of challenges (e.g. regulatory, ethical) but if the plan is to stay in business on the long-term one can only do this by embracing the possibilities of AI and managing change faster than new entrants. Nothing is far-fetched anymore, and constantly setting over-ambitious goals is the only way to stay ahead of the curve.

11.2 Allocating resources to AI research and development

Implementing AI requires good understanding of the business architecture, and the context; but also good understanding of AI technologies and strategies to leverage these. Allocating resources to conduct research and development is instrumental to:

- Ensure there is an unbiased vendor agnostic view when it comes to matching problems and opportunities to AI technology solutions;
- Be able to execute AI projects fast and efficiently; accelerating the self-disruption process to stay ahead of new entrants;
- Accumulate up-to-date in-house AI knowledge and expertise.

11.3 Protecting digital assets from AI consumers

Digital assets, such as electronic documents, digital communication standards, and web services are exposed and can be consumed by AI machines with the risk of being cannibalized and replaced. It's imperative to protect digital assets by:

- Securing IP rights;
- Securing trademarks;
- Patenting concepts, standards, methodologies, techniques, and software;
- Technically preventing or making it difficult for AI machines to consume your digital assets.

12 Enquiries and feedback

For enquiries and feedback about this white paper you can contact IATA at innovation@iata.org.