ACRP Insight Event: Blockchain Technology and Airports

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1	Aeron	2018	*Aeron: Blockchain for Aviation Security*	Aeron (White Paper)	Tokenization, airports	Electronic log records, sharing information	7
2	Ahrash Aleshi	2018	*Secure Aircraft Maintenance Records Using Blockchain (SAMR)*	Embry-Riddle Aeronautical University	Blockchain, security, aviation	Aircraft maintenance, open-source data, record integrity	7
3	Alberto Rodriguez Ludeiro	2019	*Blockchain Technology for Luggage Tracking*	Distributed Computing and Artificial Intelligence, Special Sessions, 15th International Conference	Airports, Blockchain	Luggage tracking, sharing information	7
4	Arushi Arora, Sumit Kr Yadav	2019	*BATMAN: Blockchain-Based Aircraft Transmission Mobile Ad Hoc Network*	Proceedings of 2nd International Conference on Communication, Computing and Networking	Aviation, Blockchain	ADS-B, Blockchain, ATC, privacy, security, ledger, HashMaps	7
5	Chami Akmeemana/ Blockchain Research Institute	2017	*Blockchain Takes Off: How Distributed Ledger Technology Will Transform Airlines*	Blockchain Research Institute	Airport customs, Blockchain	Smart contracts, security, identity, booking, tokens, luggage, chain of custody, ledgers	8
6	Clark Merrefield	2018	*What Blockchains Could Mean for Government and Transportation Operations*	Volpe Center	Blockchain, transportation	Smart contracts, government, transportation, freight logistics, toll payments, ridesharing, autonomous vehicles, flight insurance,	8

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8	Davide Calvaresi	2019	*Trust in Tourism via Blockchain Technology: Results from a Systematic Review*	University of Applied Sciences Western Switzerland	Blockchain, tourism	Blockchain, tourism, trust, transparency	8
9	Dr. Sam Siewert	2018	*Why software engineers and developers should care about Blockchain technology*	Embry-Riddle Aeronautical University	R-DBMS, Blockchain	Blockchain, data management, general aviation, small unmanned aerial systems	9
10	Dusan Rajkov	2018	*Blockchain Aircraft Spare Part Management*	Delft University of Technology	Aviation, leasing, Blockchain, transparency	Blockchain, aviation supply chain, aircraft spare part track and trace capability, Maintenance, Repair and Overhaul (MRO) providers	9
11	Erich P. Dylus	2018	*The International Blockchain Registry of Mobile Assets*	Air & Space Law	Aviation, Blockchain	Tokenization, registry	9
12	Horst Treiblmaier, Irem Oender	2018	*The Impact of Blockchain on the Tourism Industry: A Theory-Based Research Framework*	Business Transformation through Blockchain, Volume 2	Blockchain, transportation	Tourism, world economic forum, transparency	10
13	IATA	2018	*Industrial Case: Blockchain on Aircraft's Parts Supply Chain Management*	International Air Transport Association	Blockchain, aviation	Smart contracts, Tokenization, Blockchain	10

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[15](#)	Kari Korpela, Jukka Hallikas, Tomi Dahlberg	2017	*Digital Supply Chain Transformation toward Blockchain Integration*	50th Hawaii International Conference on System Sciences	Aviation, Blockchain	Ecosystem, Blockchain, integration, supply chain, enterprise architecture	11
[16](#)	Lory Kehoe, John Hallahan	2017/2018	*Blockchain - a game changer in aircraft leasing?*	Airfinance Annual	Blockchain, aircraft	Aircraft leasing	11
[17](#)	Mag. Gernot Winter, et al	2018	*AVINOC - The Blockchain Solution Disrupting the Global Aviation Business*	Aviation Network Operation Chain	Business aviation (BizAv), Aviation Network Operation Centers (AVINOC)	Optimal supply chain, flight coordination, order management, infrastructural issues	11
[18](#)	Maisha Afrida Tasnim, et al	2018	*CRAB: Blockchain Based Criminal Record Management System*	International Conference on Security, Privacy and Anonymity in Computation, Communication and Storage	Airports, Blockchain	Criminal records, authenticity, cloud network, decentralization, law enforcement	11
[19](#)	Maisie Borrows, Eleonora Harwich, Luke Heselwood	2017	*The Future of Public Service Identity: Blockchain*	Accenture Consulting	Aviation, Blockchain	Distributed ledger technology, public service identity, Blockchain	12

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21	Michael D. Santonino III, Constantine M. Koursaris, Michael J. Williams	2018	*Modernizing the Supply Chain of Airbus by Integrating RFID and Blockchain Processes*	International Journal of Aviation, Aeronautics, and Aerospace	Aviation, Blockchain	RFID, supply chain, logistics media, maintenance, management	12
22	Mohamed Awwad, et al	2018	*Blockchain Technology for Efficient Management of Supply Chain*	International Conference on Industrial Engineering and Operations Management	Blockchain, Internet of Things (IoT), supply chain	Blockchain for validation, transparency, and traceability	13
23	Patel D., Balakarthikeyan, Mistry V.	2018	*Border Control and Immigration on Blockchain*	International Conference on Blockchain	Immigration, Blockchain	Blockchain and distributed ledger technology, immigration, gateless entry	13
24	Reisman, Ronald J.	2019	*Air Traffic Management Blockchain Infrastructure for Security, Authentication, and Privacy*	NASA Technical Reports Server	Aviation, Blockchain	Air traffic control, architecture (computers), chains, computer information security, prototypes, flight management systems	13
25	Robert John Rencher	2019	*Progressive Disintermediation of the Commercial Aviation Industry Ecosystem*	SAE International	Aviation, Blockchain	Learning from peer industries, aviation ecosystem	14

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27	Sanaf Naheed Nadeem	2018	*Can Blockchain disrupt the traditional airline distribution for the better? If so, what are the benefits of this new technology, and how can it be implemented?*	University of Westminster	Blockchain, security, aviation	Airline distribution system, emerging technology investment	14
28	SITA	2017	*Flightchain: Research into the Usability and Practicalities of Blockchain Technology for the Air Transport Industry*	SITA Lab	Blockchain, airport industry	ADDB, ACRIS, Bitcoin Blockchain, consensus, Dapp, DLT, Ethereum, Hyperledger, parity, proof of authority, proof of stake, proof of work, smart contract	15
29	SITA	2017	*Have Token Will Travel*	SITA Lab	Blockchain, airport industry	Identity management, tokens, biometrics	15
30	SITA	2016	*Travel Identity of the Future*	SITA Lab	identity, security, privacy, biometrics, tokens	Digital identity	15
31	Tarik Dogru, Makarand Mody, Christie Leonardi	2018	*Blockchain Technology & its Implications for the Hospitality Industry*	Boston University School of Hospitality Administration	Blockchain, aircraft	Blockchain, technology implications	16

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34	Wenchi Ying, et al	2018	*Digital Enablement of Blockchain: Evidence from HNA Group*	International Journal of Information Management	Airports, Blockchain	Digital enablement, IS implementation, empirical study	17
35	Yash Madhwal and Dr. Peter B. Panifilov, Higher School of Economics	2017	*Industrial Case: Blockchain on Aircraft's Parts Supply Chain Management*	Americas Conference on Information Systems	Aviation, Blockchain	Supply chain management, Blockchain, aircraft, segments	17
36	Yongxu Zhu	2019	*Blockchain Empowered Decentralized Storage in Air-to-Ground Industrial Networks*	IEEE Transactions on Industrial Informatics	Blockchain, security, aviation	Industrial IoT, stochastic geometry, smart contracts, security, sensors, atmospheric modeling	17

Document Descriptions

1. Aeron is a Global Aviation Register with Decentralized Record System. Aeron will work with national aviation authorities and international aviation agencies like EASA, to promote acceptance of the electronic log records based on Blockchain, to demonstrate integrity, reliability and transparency of record keeping. A smart phone application will ultimately replace obsolete paper records and would gain a global acceptance, enabling a single point of reference for private pilots, aircraft owners and operators, aviation enthusiasts and general public interested in aircraft charters, leisure flights and pilot training. Aeron solution will make flying safer for everyone. True "airline in a pocket" featuring integrity, reliability and easy validation.

2. We propose to enhance the security and transparency of aircraft maintenance records in the aviation industry through the use of Blockchain technology. A physical aircraft maintenance logbook is susceptible to being lost or destroyed. A nonexistent aircraft maintenance logbook hurts the confidence in integrity and reputation of the aircraft. Furthermore, fraud can occur through forgery of FAA personnel signatures and the installation of non-official aircraft parts. The scope of this work is to develop a secure Blockchain that can store aircraft service records and information in a digital distributed ledger. By keeping the maintenance logbook on a digital ledger, records can be stored indefinitely in a trusted environment with the integrity of records guaranteed. Additionally, to achieve being a distributed ledger, a consensus algorithm PoET is used to display the global state accurately to all users. The SAMR Blockchain uses the Linux Foundations open sourced software "Hyperledger" to facilitate an environment that mimics a real-world implementation. The Python Programming Language was used for SAMR's implementation of the Blockchain logic through creation of a permission-based Blockchain for holding the maintenance records.

3. Lost luggage is one of the main fears when boarding a plane, especially on long flights. Around 10,000 suitcases are lost every day at airports around the world. The proposed solution is to locate much faster and more efficiently the lost object. There are currently a multitude of players involved in this process, who could synchronize by sharing information, which would save airlines costs. This way, the customer and the airline can know where the luggage is at any time.

4. Automatic Dependent Surveillance–Broadcast (ADS-B) systems is a recent aviation technology, which has established its standing in the domain of communication between aircrafts and has almost replaced the conventional radar system for transmission of messages. Various loopholes related to privacy and security has been found in ADS-B, by researchers such as message broadcast tampering. In this paper, we propose a methodology based on BATMAN algorithm, which secures the communication between aircrafts and ground stations. This framework for authentication is a novel network topology based on a decentralized Blockchain. The authentication is done using a three-way handshake between On-Air Unit (OAU) and Ground Station (GS). The proposed technology involves a group formation of authenticated mobile nodes for communication using the distributed public ledger and further utilizing its security features. The impact of BATMAN algorithm is that it further secures AANET (Aircraft Ad-hoc Network) for ADS-B system.

5. The airline industry is surely one of the toughest. Historically, incumbents have been plagued by razor thin profit margins, high risk, unpredictable fuel and labor prices, and new challengers with disruptive business models. It is also subject to exogenous events like terrorism, capricious government actions, or natural disasters such as the April 2010 closing of the European air space because of a volcanic eruption in Iceland. With social media, any mistake makes headlines or goes viral. As a result, many airlines have failed or been acquired. The top three US survivors—American Airlines, Delta, and United—have all faced bankruptcy at some point. Perhaps because of these challenges, it is an industry driven to innovation. Blockchain will enable a whole new set of possibilities for passenger services, business processes, new revenues, and industry-wide problem solving. It may well be that Blockchain is the most significant development for airlines since the introduction of the computer. Chami Akmeemana is a founder and board member of the Blockchain Association of Australia. He focuses on several important areas. First, he looks at innovation to improve the passenger experience in terms of ticketing efficiencies, frequent flyer rewards, and passenger compensation. Second, he examines how Blockchain can bring airlines and their partners much closer together. Third, he explores areas where Blockchain can revolutionize logistics—from crew flight bookings, maintenance, and safety record keeping, to maximizing the capacity of charter flight, and addressing inefficiencies in cargo, customs, and clearing. Finally, he makes a number of recommendations that airline executives and their industry partners will find valuable.

6. Physical safety features like watermarks and color-shifting ink make paper currency difficult to counterfeit. A Blockchain is the digital analog to physical safety features on paper money. The Blockchain concept was introduced in the late 2000s as the virtual scaffolding for transactions using the digital currency bitcoin. They prohibit a bitcoin from being spent more than once. Blockchains are now being applied to a variety of industries, including transportation. Blockchains matter because they allow non-trusting members to interact over a network in a verified way, without a trusted intermediary. The idea behind bitcoin was to remove banks from financial transactions. The World Economic Forum estimates that by 2027, 10 percent of global GDP will be stored on Blockchains. Today, global GDP is about $80 trillion, 10 percent of which equals about $8 trillion. This report provides a high-level overview of Blockchain concepts and how they are being used in government and transportation.

7. For the last 80 years, the professional engineer has been the trusted 3rd party to banks, insurance, corporations, and governments for providing technical design, validation, and management of large-scale projects that support human safety, welfare, and productivity. With the advent of Blockchain technologies – the underlying technology of the Bitcoin cryptographic currency phenomenon - computer software is now capable of executing many types of financial transactions with unprecedented speed, accuracy and efficiency. Because Professional Engineering Protocol forms the basis of national infrastructure, anything that may impact the national finance or insurance industry can potentially involve the engineering industry. This creates challenges as well as opportunities for the engineering profession.

8. Trust-free and trust-regulated systems based on Blockchain technology (BCT) are currently experiencing the maximum hype and promise to revolutionize entire domains. Tourism products (intangible services) are highly dependent on trust and reputation management that is traditionally centralized and delegated to "expected" reliable third-parties (e.g., TripAdvisor). Although BCT has only recently started approaching the tourism industry and being employed in real-world applications, the scientific community has already been extensively exploring the

promises of BCT. Therefore, there is an impending need for organizing and understanding current knowledge and formalize societal, scientific, and technological challenges of applying BCT in the tourism industry. This paper moves the first step, presenting a systematic scientific literature review of studies involving BCT for tourism purposes. Providing a comprehensive overview, actors, assumptions, requirements, strengths, and limitations characterizing the state of the art are analyzed. Finally, advantages and future challenges of applying BCT in the tourism area are discussed.

9. Blockchain is a revolution for data management that you can use instead of or in addition to a traditional structured relational database management system (RDBMS). Here, you dig into R-DBMS and Blockchain (beyond use for crypto-currency and Bitcoin) by using a simple JavaScript Blockchain prototype that you can expand to use Hyperledger to explore an emergent use for general aviation and small unmanned aerial systems tracking. IBM has helped to bring Blockchain into much wider use for everything from supply chain logistics to medical information management (IBM Blockchain). At Embry Riddle, I'm working on just such a database and comparing options including R-DBMS only, Blockchain only, and a hybrid solution. I'm still working on determination of what will be best, but the more I learn about Blockchain, the more interested I have become. While we have yet to settle upon a data management solution, we know we need to replace our flat files as our system grows, and we're most likely going to use a combined approach with both R-DBMS and Blockchain distributed applications.

10. Due to the complexity of aircraft spare part management, the aviation supply chain and ecosystem are not deemed as transparent as desired. As a result, participants face additional cost of communication and compliancy as proprietary component data is not made immediately accessible. To solve these problems, Maintenance, Repair and Overhaul (MRO) providers currently consider using Blockchain to track and trace aircraft spare parts. Guided by Business Model Stress Test, this thesis evaluates the robustness of MRO business models when they use Blockchain as an aircraft spare part track and trace capability. Blockchain as an aircraft spare part track and capability is not only strategically relevant for cost-conscious innovating MROs, it also does not impose a risk to the robustness of their business model in most scenarios. MROs should engage in a regulatory-backed Blockchain consortium through which they share limited component data throughout the entire industry. If this is not possible, they can retreat from the consortium under the notion that their business model is threatened. Even though Blockchain could improve aviation supply chain and ecosystem transparency, the feasibility of the consortium is questionable. To remedy this concern, future research should focus on identifying strategic incentives for Original Equipment Manufacturers and aircraft operators to participate in the Blockchain consortium.

11. Moving the International Registry of Mobile Assets onto a Blockchain registry system that digitally "tokenizes" each registered asset would provide a more efficient and secure mechanism of authentication, while effectively eliminating many current risks of syntax errors and noncontiguous asset histories. This may be accomplished in accord with the current legal framework, without complicating the user interface on the front end, and allows for potential future inclusion of the asset tokens into smart contracts.

12. Digitalization is a trend that has heavily impacted the tourism industry. Horwath HTL (2015), the world's largest hospitality consulting brand, points out that technological (r)evolution and digital channels belong to the mega trends in tourism, which will influence mid- and long-term tourism development. The World Economic Forum (WEF) (2017, p. 3) states in its report on digital transformation in the aviation, travel, and tourism industry that "there is widespread recognition among industry leaders that the role of digital technology is rapidly shifting, from being a driver of marginal efficiency to an enabler of fundamental innovation and disruption." The WEF details recent industry trends, such as a growing demand for travel, the rise of the digital consumer, changes to the security landscape, and technological trends such as the rise of intelligent automation and the dominance of digital platforms. As a side note, the term "Blockchain" is mentioned only once in their 40-page report as a potential enabler for the safe and secure exchange of personal data.

13. The Blockchain technology is currently going through a phase in which it is gaining more maturity and the concrete benefits are becoming clearer. However, it is still not trivial how to leverage the benefits within the context of an appropriate use case where this technology is the most suitable solution. Classification of a wide range of use cases, consistently shows formation of clusters around a few areas of application, with many specifically leveraging Tokenization and Smart Contracts. While there are many reasons why this technology is uniquely positioned as a solution to many problems in business and beyond, there are still a few key challenges that need to be dealt with before adoption gains traction. Scalability, governance and cost of usage have been identified as the main obstacles. The value chain across the aviation industry is very collaborative with many partnerships between providers to orchestrate the delivery of travel products and services. Smart Contracts have a high potential to enable streamlining of business to business interactions. In particular to disrupt processes such as invoicing, reconciliation, settlement and accounting.

14. It is undeniable that we are in the midst of a digital revolution that holds the promise to reinvent the entire air travel experience. The 21st century is being defined by pervasive digitization and is characterized by disruptive and transformative processes that are underway in virtually every industry. Digital trends such as (1) social media, (2) the sharing economy, (3) hyper-personalized connectivity and (4) the Internet of Things are already transforming travel. In addition, it is forecast that air travel demand will double in the next 15 years. This new digital age presents the opportunity to not only reinvent the travel experience, but also to develop solutions that result in cost-effective capital expenditure and optimize existing infrastructure. Unfortunately, there is a general lack of a coordinated mindset that puts the passenger first. The air transport sector needs to move away from the legacy of organizations that exhibit entrenched 'tribalism' and self-interest. Airports, airlines, and government agencies need to collaboratively begin to identify and utilize the technological opportunities that are now becoming available. To achieve this will require a level of trust and sharing of data to even begin the process of innovation. Though digital solutions are being developed at an airport-by-airport level, to achieve any meaningful change in the global air travel system will require global solutions involving truly collaborative initiatives. This paper explores the opportunities and challenges faced by airport operators in redefining the passenger terminal aligned to the 21st century digital age.

15. Digital supply chain integration is becoming increasingly dynamic. Access to customer demand needs to be shared effectively, and product and service deliveries must be tracked to provide visibility in the supply chain. Business process integration is based on standards and reference architectures, which should offer end-to-end integration of product data. Companies operating in supply chains establish process and data integration through the specialized intermediate companies, whose role is to establish interoperability by mapping and integrating company specific data for various organizations and systems. This has typically caused high integration costs, and diffusion is slow. This paper investigates the requirements and functionalities of supply chain integration. Cloud integration can be expected to offer a cost-effective business model for interoperable digital supply chains. We explain how supply chain integration through the Blockchain technology can achieve disruptive transformation in digital supply chains and networks.

16. The aircraft leasing industry is one of the fastest growing industries globally. A number of factors have resulted in this growth, including but not limited to, a year-on-year increase in passenger traffic, the rise of low-cost carriers (LCC) and the growth of the APAC market. Given the nature of this capital-intensive industry, it is interesting to note some of the antiquated systems and practices, which are still commonplace. For example, the maintenance of an aircraft is a process that uses cumbersome databases at best and, at worst, a paper-based system prone to losses and errors throughout. With the rapid rise of digital technologies in other industries, it seems only a matter of time until the aircraft leasing game is affected. To that end, this article will explore the potential benefits of adopting Blockchain technology in the aircraft leasing industry and assess a number of potential use cases, which have a truly disruptive potential for all stakeholders involved.

17. The Aviation Network Operation Centers (AVINOC), which have been in existence since 2008, is an enterprise resource planning (ERP) software and business cloud application for BizAv, which has been further developed to this day. Inspired by the wide range of possibilities offered by Blockchain technology today, the development team decided in 2017 to transform existing knowledge from the ERP solution into a completely new system, AVINOC, as a Blockchain solution provides a transparent, integrated, permission-less and decentralized base data layer for the exchange of relevant information for the GA. The main focus here is on Business Aviation (BizAv). The aim of AVINOC is flight coordination, order management and infrastructural issues of the GA worldwide and, with the help of the integrated transaction and payment system, achievement of an optimal use of resources and a high level of cost reduction on the market. The primary goal is to strengthen the BizAv market with focus on reducing the time span of the information and payment flow to zero, thus creating an optimal supply chain. This will allow the entire global market to be strengthened and made sustainable for the future. It will furthermore result in positive effects on all other economic sectors of a country with well-defined BizAv. It will also enable future technologies, such as autonomous or semi-autonomous flying, to be effectively and efficiently deployed in organizations.

18. Criminal records are highly sensitive public records. By incorporating criminal records in a Blockchain, authenticity and rigidity of records can be maintained; which also helps to keep the data safe from adversaries. A peer to peer cloud network enables the decentralization of data. It

helps prevent unlawful changes in the data. This paper introduces a criminal record storage system by implementing Blockchain technology to store the data, which helps to attain integrity and security. Our system presents ways in which the authority can maintain the records of criminals efficiently. Authorities (e.g., Law enforcement agencies and courts) will be able to add and access criminal data. General users (e.g., selected organizations and/or individuals, airports, visa application centers etc.) will have access to the data so that they can look up criminal records. Proper and timely access to authentic criminal records is essential to enforce the law. The effect of corruption on the law enforcement forces will also decrease, as this will cut off an entire scope of corruption by removing any possibility of tampering with criminal records data by thorough accountability.

19. The Internet has been described as "the decisive technology of the information age" and Blockchain is now reinventing it. The realm of applications of this new technology seems to be limitless from payments to safe data sharing of Internet of Things or healthcare data. It has the potential to enable radical public services transformation in a more profound way than previous technologies. An identity management model powered by Blockchain could pioneer this change. Blockchain is a unique technology in that it allows the control of identity data to move from government to the citizen, securely and efficiently. It would enable citizens to view their public service identity via an identity app on their smartphone and share relevant data with government to access public services. This new model would reimagine the relationship between state and individual, as government would become the verifier, rather than the controller, of people's public service identity. Estonia, Dubai and Australia are trialing the use of Blockchain to transform identity management and the UK must do the same if it is to lead the group of digitally enabled nations.

20. Blockchains are immutable digital ledger systems implemented in a distributed fashion (i.e., without a central repository) and usually without a central authority. At its most basic level, they enable a community of users to record transactions in a ledger public to that community such that no transaction can be changed once published. This document provides a high-level technical overview of Blockchain technology. It discusses its application to electronic currency in depth, but also shows its broader applications. The purpose is to help readers understand how Blockchains work, so that they can be appropriately and usefully applied to technology problems. Additionally, this document explores some specific Blockchain applications and some examples of when a Blockchain system should be considered for use.

21. Radio frequency identification, or RFID, is one of the areas within the aviation industry that is gaining momentum for improving efficiencies across various operational functions. More airlines/airports and aircraft manufacturers are adopting this technology as a key strategic advantage in the future. Currently, many of the full-scale implementation organizations from late adopters have strategically integrated RFID technology into the manufacturing supply chain to tag parts and for airports/airlines to track baggage and passengers throughout their airport journey. Literature remains rather sparse in the implementation and success factors within the aviation supply chain as a number of businesses have kept much of the details discreet to differentiate themselves from their competitors. In this paper, we will examine the state of the early adopters in aviation to implement RFID technology into their supply chain for tracking parts, identifying information, logistics media, and other process improvements in component maintenance management. Airbus, which was the first company in the aviation industry to

adopt RFID, will be examined in detail. The review includes the growing numbers of airports (and airlines) use of RFID to track baggage and passengers. Using information from published secondary data, the researchers review the early adopters of RFID in aircraft manufacturing who are employing RFID to improve the supply chain. The authors review how the use of airports and airlines has transcended to passenger tracking to improve airport operational efficiency and increase passenger satisfaction. By identifying key trends in the aviation supply chain (e.g. Blockchain) and the value-added processes in manufacturing and passenger experiences, this paper heightens the awareness of areas in need of further empirical research in order to understand the key success factors with RFID implementation in aviation.

22. Increasing global demands in the supply chain in this fast-paced world entails more transparent and efficient supply chain management, which can be encountered with the use of Blockchain technology combined with the Internet of Things (IoT). This study explains the effects of Blockchain technology combined with IoT in terms of transparency, risk reduction, flexibility, speed from the customer's demand to the customer's deliverable. Supply chain objectives are achieved using various mechanisms of Blockchain technology by which the customer can track the real nature of the products getting delivered to them, which surges the value and trust of the organization. The Blockchain is a decentralized, digitized, public ledger of all cryptocurrency transactions. By implementing Blockchain, the traceability and capacity to share information about production processes will be made easier and trustworthy. Traceability takes center stage in organizations supply chain; furthermore, it is a tool in fighting product counterfeiting and protecting brands. Implementing Blockchain can revolutionize the way a supply chain works. This paper examines the case-studies on early implementation of block technology with IoT with special importance on the degree of deployment of Blockchain technology for validation, transparency, and traceability purpose at various industries; such as e-commerce, food, and warehousing.

23. In this paper, we propose a system using Blockchain technology to create a decentralized, secure, and scalable departure and arrival records of passengers. We provide a framework using Hyperledger Fabric, for maintaining the inter-port records of the passenger's entry and exit into a country as well as to facilitate gateless entry back to the passenger's country. We attempt to mitigate privacy and legal concerns over biometric data storage on the Blockchain. We also explore the possibility of modifying the existing kiosks to work with the Blockchain architecture at the backend so that passengers are not required to get familiar with a new procedure.

24. Current radar-based air traffic service providers may preserve privacy for military and corporate operations by procedurally preventing public release of selected flight plans, position, and state data. The FAA mandate for national adoption of Automatic Dependent Surveillance Broadcast (ADS-B) in 2020 does not include provisions for maintaining these same aircraft-privacy options, nor does it address the potential for spoofing, denial of service, and other well-documented risk factors. This paper presents an engineering prototype that embodies a design and method that may be applied to mitigate these ADS-B security issues. The design innovation is the use of an open source permissioned Blockchain framework to enable aircraft privacy and anonymity while providing a secure and efficient method for communication with Air Traffic Services, Operations Support, or other authorized entities. This framework features certificate authority, smart

contract support, and higher-bandwidth communication channels for private information that may be used for secure communication between any specific aircraft and any particular authorized member, sharing data in accordance with the terms specified in the form of smart contracts. The prototype demonstrates how this method can be economically and rapidly deployed in a scalable modular environment.

25. The re-invention of the global aviation industry is well underway. This dramatic change is being achieved through the use of emergent technology to facilitate a progressive disintermediation of traditional aviation business solutions and services. This progressive disintermediation will continue unabated as this technology is adopted and deployed within the aviation industry. The challenge and opportunity is to whom will lead this re-invention and how will it be accomplished. The integrated use of rapidly evolving technology (Blockchain, IoT, Artificial Intelligence, 5G Cellular Technology and Mobile Edge Computing) is facilitating an integrated more industry cooperative approach enabling this progressive disintermediation. The Boeing Company and other industry leaders are challenging themselves and others by embracing this re-inventive opportunity and by cooperatively learning from peer industries, then adapting the knowledge for applicability to the aviation industry to reform or re-define the aviation ecosystem. Boeing has conducted several proof of concepts with these respective technology sets to validate the efficacy of the technology and to establish a baseline understanding of the interoperability opportunity. What if we do nothing? How long can we wait? Three to five years and then the progressive disintermediation of the industry sectors will have formed new ecosystems with transformative business relationships leveraging the integrated capabilities of these five emergent technologies.

26. Airports are a prime target for terrorist organizations, drug traffickers, smugglers, and other nefarious groups. Traditional forms of security assessment are not real-time and often do not exist for each airport and port of entry. Thus, homeland security professionals must rely on measures of attractiveness of an airport as a target for attacks. We present an open source indicators approach, using news and social media, to conduct relative threat assessment, i.e., estimating if one airport is under greater threat than another. The three ingredients of our approach are a dynamic query expansion algorithm for tracking emerging threat-related chatter, news-Twitter reciprocity modeling for capturing interactions between social and traditional media, and a ranking scheme to provide an ordered assessment of airport threats. Case studies based on actual aviation incidents are presented.

27. The aim of this research is to determine whether Blockchain has the potential to disrupt the traditional airline distribution system and whether this technology will expedite the required transformation of the industry. The research question is answered through gathering insights on the topic from industry experts and intellectuals, who are specialists in distribution and emerging technologies. The responses received demonstrated that although Blockchain has many use cases in the air transport industry, distribution is not one of them. Unless there is evidence of a successful and reliable venture, Blockchain cannot be relied upon by the industry. Blockchain is subjected to issues pertaining to security, resilience, speed, scalability, regulations of cryptocurrency, and cannot be trusted with distribution - which is considered the driving force of the air transport industry. Instead, respondents proclaimed NDC as the true disruptor.

Whilst implementation may have taken a considerable amount of time and funding, it has been widely adopted in the industry including intermediaries, such as GDSs and travel agencies. Respondents also insinuated for IATA to be the neutral 'manager' in any development towards building a new distribution ecosystem. On this basis, it is recommended that airlines and all players of the distribution system invest in Blockchain or any viable emerging technology by funding research, opening up a portion of their inventories, allowing experimentations, integration and by collaborating with feedback. This cycle should be maintained in order for the industry to evolve effectively.

28. Blockchain has been heralded as a transformational technology. While several use cases have been identified by airlines and airports, research is required to establish the suitability and practicalities of using Blockchain to establish a 'single source of truth' for various data sets in use across the highly-connected air transport industry. SITA recognizes that there is also a real need for the industry to take the right approach, to ensure governance, standards, compliance, security and more. For this reason, SITA Lab, the technology research team at SITA, initiated a project to investigate the provision of a single version of the truth for flight status data. Called FlightChain, this is an air transport industry Blockchain research project established by SITA Lab and defined in conjunction with Heathrow Airport Holdings Limited (HAL) and International Airlines Group (IAG). In addition, Geneva Airport, and Miami International Airport joined the project part way through, demonstrating the scalability of the platform. In this research, FlightChain is a private permissioned Blockchain (implemented on both Ethereum and hyperledger-Fabric) that stores flight information on the Blockchain, using a smart contract to arbitrate potentially conflicting data. Data from LHR, BA, GVA and MIA is merged and stored on the Blockchain.

29. The emergence of 'single token travel' over the next few years is probably the most exciting development for passengers hoping to fast track through the airport. And the key to its success is gathering and verifying data as early in the process as possible to establish a robust token. This includes both biometric and biographic information. SITA is leading the way forward in stepping towards single token travel using e-passports through the development of SITA Smart Path™. Bringing Blockchain capabilities to bear, the solution captures a passenger's biometric details with a facial scan during an enrolment process at a kiosk or bag drop, whichever is the first touch point in the journey. Once checked against the passenger's travel documents, a secure single token is created and stored in a secure biometric database within the airport. It's then used at every interaction through the airport, for the duration of the passenger's journey, after which all biometric data is deleted.

30. The future of air travel will depend on traveler convenience and the security of knowing who is passing through each point of travel process. Travel security should not be an inconvenience to a traveler across different airports and airlines. In fact, this technology will enhance the travel experience while improving security. Travelers will be able to easily go through checkpoint after checkpoint with digital identity verification, having the confidence that fellow travelers going through the same checkpoints are who they claim to be. To enable this process, travelers will be granted a travel token embedded within their mobile app that also contains their identity. This information is certified by an agent or an automated kiosk during a registration process and the

digitally signed validation hashes are written to the public Blockchain. A traveler can present the information from their mobile app to agents from different airlines or to airport security. The agent can then validate the authenticity of the traveler's identity and their travel token via the Blockchain without accessing any proprietary databases or private data not required for each transaction.

31. Blockchain technology and its economic, social, and technological implications, mainly in the form of the cryptocurrency Bitcoin, have become hot topics of conversation. Indeed, Blockchain technology is primarily associated with Bitcoin because it is built on a Blockchain platform. However, Blockchain technology goes far beyond the cryptocurrencies such as Bitcoin, Ethereum, Litecoin, Ripple, etc. So the question becomes: what exactly is Blockchain technology? In this article, we attempt to answer this question, explain how Blockchain works, and discuss the general and hospitality industry-specific implications of the technology.

32. Schiphol Group has the ambition to become Europe's preferred airport. Next to this, they have the ambition to become the world's leading digital airport by 2018. To achieve this the airport has to continuously innovate. Schiphol Group does this by expanding the airport with the Capital Programme and by making the current airport smarter with the Digital Airport Programme. Both programmes aim to create an excellent seamless passenger process with a minimum of stressful moments. To decrease waiting times at check-in, Schiphol works on a project called Seamless Flow, that enables passengers to pass checks with biometric identification. To enhance passengers' control over their journey and to solve the challenges biometric identification brings, the concept of a self-sovereign identity is proposed. A self-sovereign identity is a system working with Blockchain technology in which the user has consent and control over who he shares his data with. In a self-sovereign identity system, identity providers provide the user of an attestation, a proof of correctness, for example that it is indeed the persons passport. The identity provider can be government for example who gives out your passport. From the same attestation a hash, a number that represents the attestation, is written onto the Blockchain. The relying party, an organization like for example an airline who wants a confirmation of the passenger's identity, can than compare what is presented by the user with what is on the Blockchain. When it's a match, your identity is confirmed. Until government enables such a system, Schiphol has the opportunity to act as an identity provider. They can create attestations with the enrollment kiosks that are going to be used for biometric identification in the upcoming years. To enable Schiphol to act as an identity provider, the Travel Wallet service is created. The app stores your data on your phone in a way only you are able to open it with your fingerprints. This way you never have to take out your passport or boarding card at the airport after you are enrolled. With the Travel Wallet there is no need for a check-in desk (assuming that everyone uses the self-service bag drop), physical border control or employees for the boarding process. By digitizing these processes, money, time and space can be saved.

33. A passengers' traveling journey throughout the airport is anything but simple. A passenger goes through numerous hoops and hurdles before safely boarding the aircraft. Many airports today are implementing isolated solutions for passenger processing. Some of these technologies include automated self-service kiosks and bag tag, self-service bag drop-off, along with

automated self-service gates for boarding and border control. These solutions can be integrated with biometric systems to enhance passenger handling. This thesis analyzes the current passenger processing technology implemented at airports around the world and their associated challenges that passengers face. A new passenger processing technology called a biometric single token identification (ID) is presented as a solution to help alleviate current issues. By using a medium-sized international airport as a case study, the results show that a single token ID is beneficial to the time it takes to process a passenger. Furthermore, it demonstrates that implementation of a single token ID with self-service technology can provide enhanced passenger travel experience, improving operational process efficiency, all while ensuring safety and security.

34. Blockchain, the distributed ledger underlying bitcoin, has attracted much attention and stimulated rich discussions. However, extant discussions are mostly conceptual expositions, and empirical evidence of how to use the technology is limited. This case analysis fills this gap by conducting a study on Hainan Airlines (HNA) group, a large conglomerate, which has successfully implemented a Blockchain-enabled E-commerce platform to offer employees flexible benefits. The case study unveils that Blockchain is of value in three ways: 1) issuing cryptocurrency, 2) protecting sensitive information, and 3) eliminating institutional intermediaries. These findings provide a reference point for IT and general managers who intend to use Blockchain to digitally enable their organizations further.

35. With the growth of aviation domain across the world, there has been steep demand in aircrafts. In this domain, avionic machines and hardware are shipped to single assembly hubs, located globally. All parts come with certain life expectancy, specific requirements and inevitable need for maintenance. In this paper, we will take an industrial scenario of aviation's industries' supply chain management, and demonstrate the necessitation of having decentralized system like Blockchain, not only assisting to maintain inventory of the aircraft's individual segments but also to monitor the performance, usage, etc. This will help to achieve a transparent network of aircraft's part's supply and will reduce the risk of availability of aircraft segments in black market and will help the analysts to analyze the supply, demands, source of availability of aviation parts and method to procure them from the right sources.

36. Blockchain has created a revolution in digital networking, by using distributed storage, cryptographic algorithms, and smart contracts. Many areas are benefiting from this technology, including data integrity and security, as well as authentication and authorization. Internet of Things networks often suffers from such security issues, which is slowing down widescale adoption. In this paper, we describe employing Blockchain technology to construct a decentralized platform for storing and trading information in the air-to-ground IoT heterogeneous network. To allow both air and ground sensors to participate in the decentralized network, we design a mutual-benefit consensus process to create uneven equilibrium distributions of resources among the participants. We use a Cournot model to optimize the active density factor set in the heterogeneous air network and then employ a Nash equilibrium to balance the number of ground sensors, which is influenced by the achievable average downlink rate between the air sensors and the ground supporters. Finally, we provide numerical results to demonstrate the beneficial properties of the proposed consensus process

for air-to ground networks and show the maximum active sensors density utilization of air networks to achieve a high quality of service.