Smart Contracts in Aviation

gbf Aviation Law Afternoon Workshop

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Smart Contracts in Aviation

1. Introduction to Blockchain Technology
2. Introduction to Smart Contracts
3. Use Cases in Aviation
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5. Conclusion

"The first generation of the digital revolution brought us the Internet of information. The second generation — powered by Blockchain technology — is bringing us the Internet of value: a new platform to reshape the world of business and transform the old order of human affairs for the better."

Don Tapscott

(one of the world's leading authorities on the impact of technology on business and society)

What is a Blockchain and how does it work?

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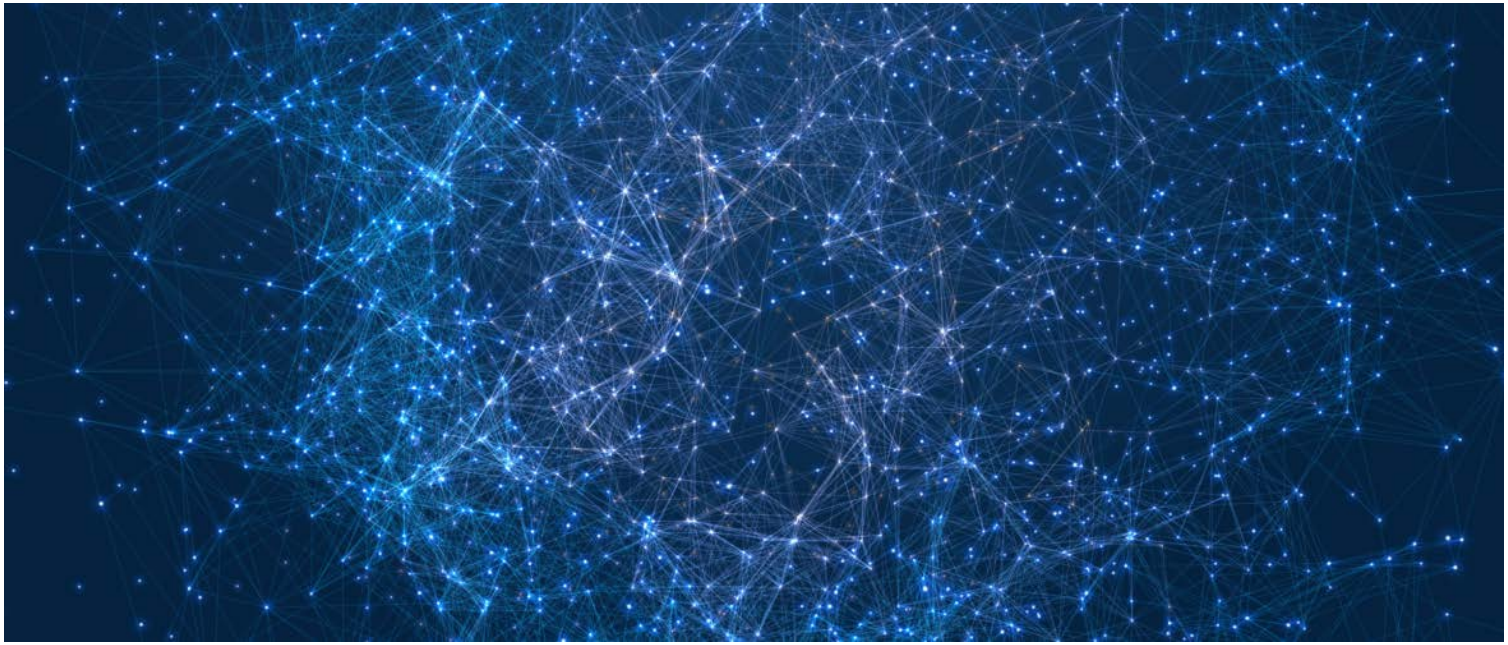
Distributed digital ledger, made up of many nodes running under a consensus protocol, consisting of transactions which are grouped in blocks, created by miners, and secured by Public Key Infrastructure

Distributed digital ledger

- Think of a simple database (like an excel spreadsheet) that can store all sorts of information (i.e., someone's name, age, address etc.).
- SNB maintains a ledger with respect to credits and debits between it and its member banks -> centralised ledger; all of the transactions inputted by one party at one place
- In contrast, Blockchain ledger -> distributed: **transactions stored on (several thousand) computers connected to a common network via the internet**

The Nodes



The Nodes

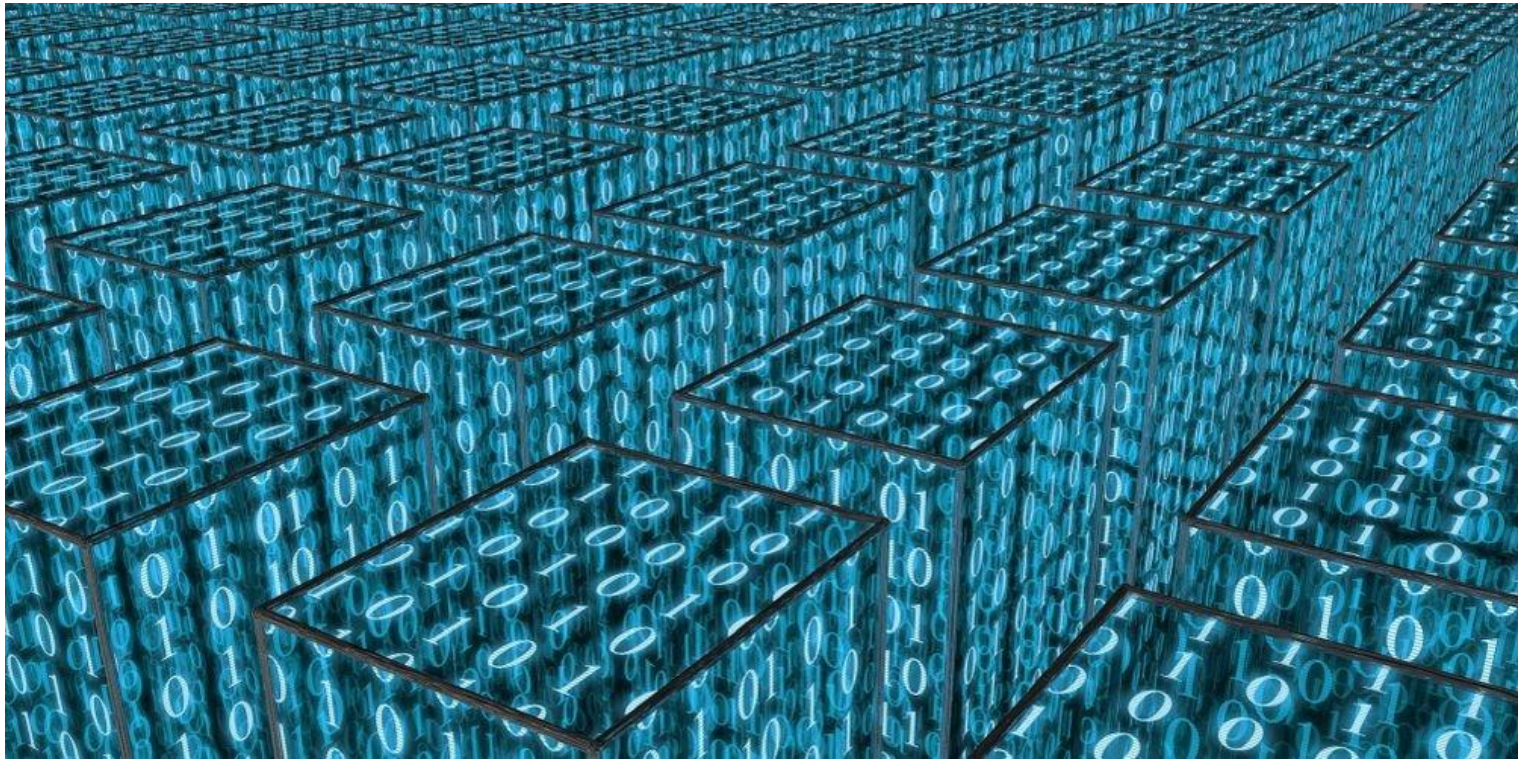
- **Computers where transactions are stored**
- Each node contains complete history of every transaction completed on a particular Blockchain beginning with the first transactions that were processed into the first block on that Blockchain

The Protocol

The Protocol

- **Nodes of the Blockchain network operate under the same set of rules** -> **protocol**
- At the heart of every Blockchain -> agreed upon protocol that ensures that only information upon which the network reaches **consensus** will be included in the Blockchain

The Blocks



The Blocks

- **Data structure where transactions stored on the nodes are grouped**
- Simply a convenient way to aggregate transactions into larger batches for processing purposes
- Transactions bundled up included in a block do not necessarily have any relationship with each other

The Miners

The Miners

- **Responsibility for bundling transactions and processing blocks** -> unique subset of nodes
- Role as the historical record keepers
- Once a miner successfully mines a block that block is subjected to a cryptographic hash
- Hash carried forward and becomes a part of the next block to be mined, which block is then subjected to a cryptographic hash
- Process continues over and over again so that every block is back-linked to the blocks before it

The Miners

- Impossible to easily go back and change a record in a prior block
- Significant barrier to manipulation
- Primary reason Blockchains are considered immutable

Once a transaction is a part of the Blockchain, its place in history can't be changed.

Public Key Infrastructure (PKI)

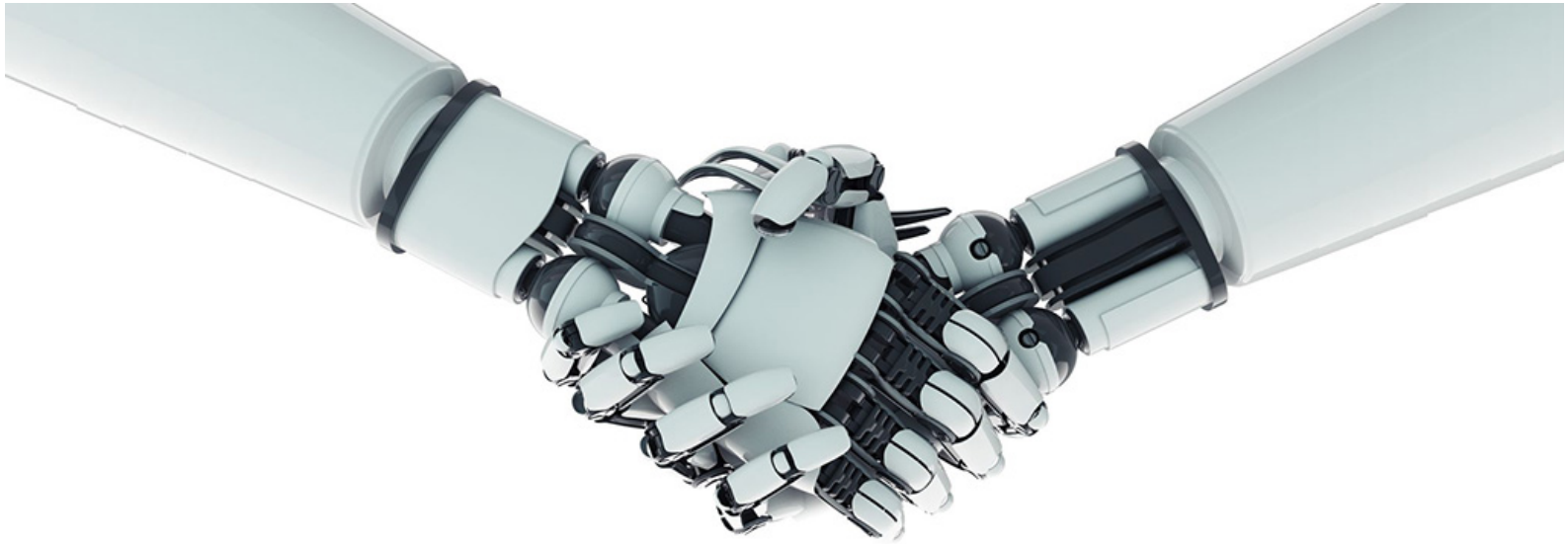
Public Key Infrastructure

- PKI considered the most secure form of encryption in widespread use today
- Using a mathematical equation to produce a pair of alphanumeric keys known as a public and private key
- Public key can be given out to others and shared freely
- Private key must be kept secret
- **Anything encrypted using the public key can only be decrypted using the private key** - the public key provides no clues as to the composition of the private key
- This one-way relationship makes modern PKI virtually impossible to crack

Summary

- **Network** made up on many individual computers (**nodes**) running according to a **consensus protocol**
- Creation of a tamper-proof **distributed digital ledger** of transactions
- **Transactions** are grouped together in a data structure called **blocks**
- Blocks are created by the operators of the nodes (**miners**) and are **cryptographically linked** -> Blockchain
- Impossible or extremely difficult to change or remove blocks of data that are recorded on the Blockchain ledger
- Technology uses **public-key cryptography** to secure transactions -> trusted transactions

Smart Contracts



Smart Contracts

- Blockchain technology extended by the **capability to execute programming code to accommodate smart contracts** (**Blockchain 2.0** - Blockchain as a programmable distributed trust infrastructure)
- Extension transformed Blockchain from a distributed system that mainly focuses on storing transaction data into a distributed system of virtual machines that executes smart contracts

Smart Contracts

- **Digital code is not just a representation of the agreement – it is the agreement**: smart contract contains the terms of the agreement, transformed into machine-readable scripting code
- The Blockchain is the distributed computer running that smart contract code
- Complete execution of the agreement occurs immutably; legal enforcement not necessary or even possible
- Possibility of highly reliable communication of future outcomes

Smart Contracts

- If smart contract needs to refer to facts of the world -> information must be provided through external data feed -> **oracles (trusted entities who submit extrinsic information through cryptographically signed messages)**
- Remarkable consequence: contracts among third parties unknown to each other can now be entered into due to the trust that is built into the Blockchain
- => Smart contracts may be a bigger idea than the cryptocurrencies

Summary

Smart contracts are self-executing digital transactions using decentralised cryptographic mechanisms for enforcement.

Use Cases: Aviation Industry

The perfect match: The characteristics of the airline industry - and also the broader travel industry - align very well with the capabilities of the Blockchain and in particular smart contracts.

Use Cases: Airlines

Use Cases: Airlines

- Travel journey powered by data sharing among multiple actors and touchpoints
- From booking to arrival, players can include airlines, online travel platforms, card providers, airports, immigration, government, hotels, car rental agencies and more
- From the moment online search for an air ticket to the time of arrival at destination, airline is just one of around 26 business partners involved in the aviation chain
- Each actor requires, collects, stores and often shares traveler and operational information

Use Cases: Airlines

- Each member of that chain is taking a profit margin; one that is often higher than the airlines, who take on most of the risk
- IATA's financial settlement systems handle around $400 billion per year - of that, around $7.7bn goes in banking fees
- $7.7 billion is more than 20% of the estimated net profit of the entire global airline industry in 2016 ($34.8 billion)
- Blockchain and smart contracts may offer the possibility to reclaim this money with less dependence on some intermediaries

Use Cases: Airlines

- IATA looking at how a Blockchain payments system could work for airlines
- IATA is also working to develop 'single passenger tokens' to address identity management in the commercial aviation industry

Use Cases: Airlines

- Lufthansa Group entered into partnership with Swiss startup Winding Tree, a decentralized business-to-business marketplace for travel content built on the Ethereum Blockchain
- Startup will assist Lufthansa in building and testing decentralized, Blockchain-based travel apps that meet the requirements of airlines
- In the future, airlines, hotels and other travel service providers can offer their services on this Blockchain-distributed digital marketplace

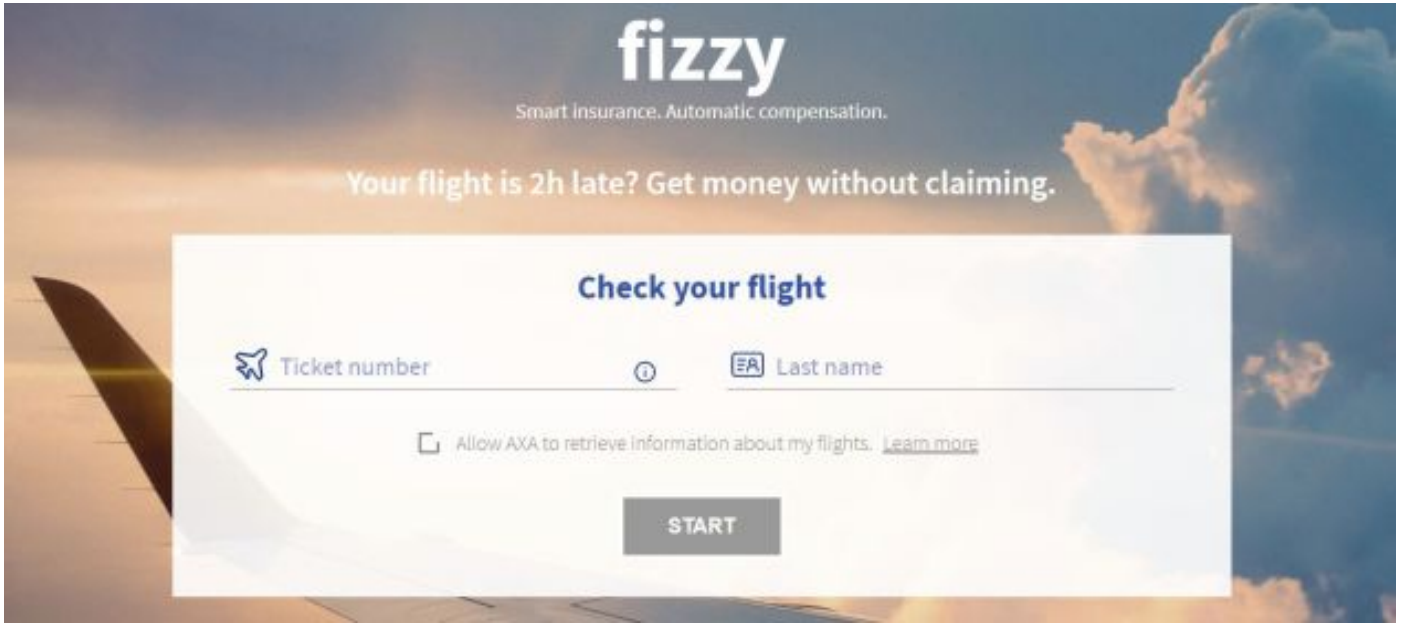
Use Cases: Airlines

- New partnership is bringing Lufthansa also into the world of initial coin offerings (ICOs)
- Lufthansa might be investing in Winding Tree as part of its forthcoming sale of a token called LIF
- LIF will be the mechanism with which users can book travel
- Anyone owning LIF tokens will be able to book hotels, flights and cruises directly on the Blockchain

Use Cases: Airlines

- Air Lituanica and Air Baltic are now accepting bitcoin for flight tickets
- Virgin Galactic would accept bitcoin payments

Use Cases: Insurance



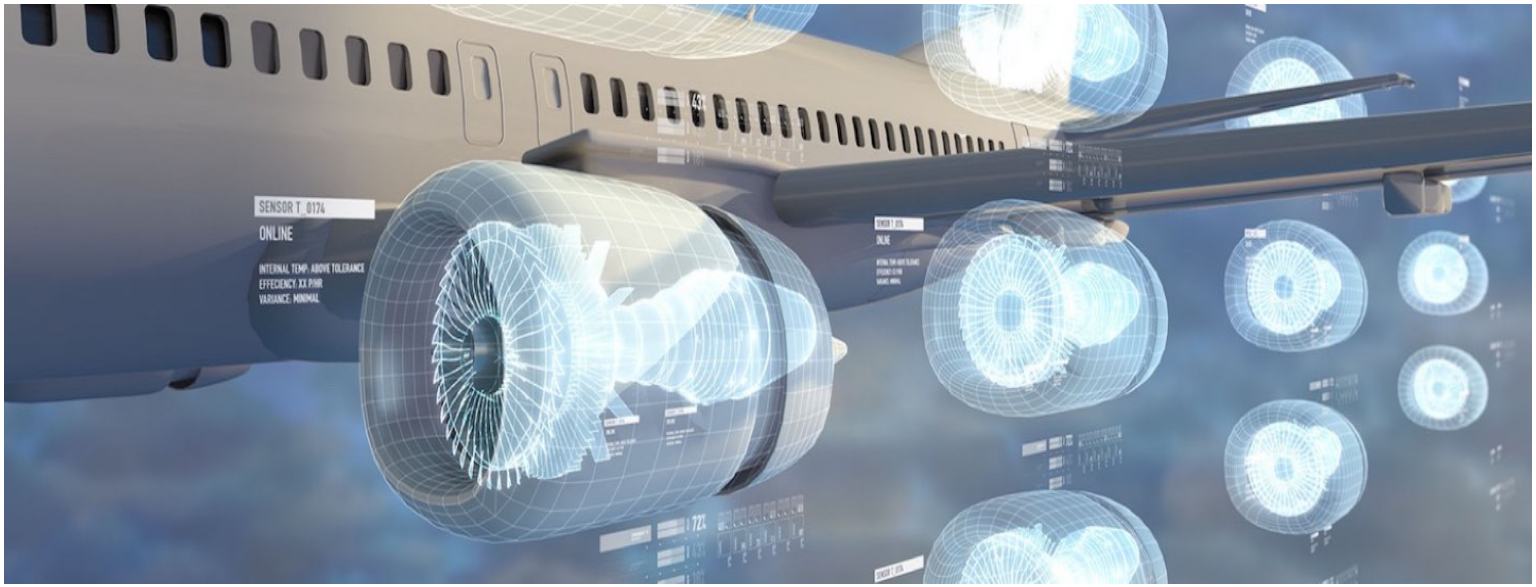
Use Cases: Insurance

- AXA developed new flight delay insurance product that uses Blockchain technology to store and process payouts
- The product, called Fizzy, is a “smart insurance” tool that flyers can use to insure their trips if their flight is delayed by two hours and more
- Use of smart contracts by way of self-executing piece of code that triggers once certain conditions are met on a Blockchain
- For now, insurance payouts are being made in government-issued currencies; in the future it wants to denominate those payments in cryptocurrencies

Use Cases: Insurance

- Early working example “parametric insurance" – originates a pre-established pay-out based on a triggering event, rather than compensate for loss
- Traditionally limited to large-company catastrophe bonds, executed on technology platforms, parametric policies can "go small“
- Potential to cover a wider range of eventualities and reach a much broader audience and increase customer satisfaction by removing uncertainty
- Significant impact on the insurance sector

Use Case: OEM parts/Supply Chain



Use Case: OEM parts/Supply Chain

- Modern aircraft consists of 2–3 million parts
- Knowing where parts from very important in assuring that they have the right specification and they are not counterfeit
- Many parts so-called “tracked items” - not only their provenance, but the entire maintenance history need to be transparent
- The many participants in the lifecycle of such an asset, from manufacturer to transporter to maintainer to operator, most have their own disparate systems
- => quite difficult to build up that one, single picture of the truth when looking at that asset’s entire lifecycle

Use Case: OEM parts/Supply Chain

- All participants could submit a transcript of the important transactions into a purpose-specific, distributed ledger to where only those participating have access
- The manufacturer would initially bring the Blockchain for the asset to life and each participant would add the relevant blocks to it
- 100% verifiable, 100% traceable and 100% trustworthy history of the asset's lifecycle

Use Case: OEM parts/Supply Chain

- Air France is looking at how it can apply Blockchain technology to track workflows within its aircraft maintenance systems
- A major obstacle: much of airline data isn't actually kept digitally - until paper-based processes are modernized, Blockchain wouldn't be as helpful as envisioned

Use Case: Aviation Finance

Use Case: Aviation Finance

- Introduction of smart contracts in operating lease, sale & purchase, completion and financing transactions
- Implementation of a public tracking registry for ownership and security interests in airframes, engines and parts
- Implementation of a private trading platform for debt and equity interests in aircraft

Legal Issues

Legal Issues: In general

- Cyberspace not free from government interference -> smart contracts are not only subjected to "code as law" but are governed by the law of the land
- Many limits to freedom of contract in general -> there will be many limits in contract law and regulation on the autonomy and self-enforcement of smart contracts
- **Smart contracts do not exist in a legal vacuum just as cyberspace is not cut off from the real world**

Legal Issues: Contingencies

- Key benefit of smart contract lies in the heart of its most critical and coveted feature: automation
- Little or no human intervention -> much cheaper, faster and less ambiguous in execution and leave almost no room for human error once set into motion

Legal Issues: Contingencies

- But: Things simply don't always go according to plan
  - Sophisticated software-based system imperfect - any error in the contract's code may result in an irreversibly faulty transaction
  - Commercial scenarios so complex and unpredictable that the code will fail to embed all possible answers to all possible questions
  - Developments in the law
  - Contractual terms which cannot be expressed through formal logic, because they imply human judgment
  - Contracts can't specify an outcome for every possible state of the world
- **Unable to adapt to changing circumstances and the parties' revised preferences**

Legal Issues: Contingencies

- Solutions
  - Increasingly, artificial intelligence (AI) can be applied to the drafting, managing and enforcement of smart contracts
  - Hybrid approach, whereby human decision-making would be permitted by code at certain identified critical junctures; inclusion of a pre-programmed safety switch functionality
  - References to oracles to assess performance
  - Incorporation of arbitrator who can resolve uncertain cases in favor of one party or the other through a multisignature mechanism
  - Creating smart contracts that comprise of complementary digital and analog terms

Legal Issues: Contingencies

In the foreseeable future smart contracts will often have to rely on courts and arbitration in matters of doubt.

Legal Issue: Legality

- Because the smart contract is self-executing and self-enforcing, an action in court finding the terms unenforceable may have no practical effect; they will be performed regardless
- **There is also no mechanism to stop a smart contract from implementing a term that is illegal**
- Mechanisms have to be developed

Legal Issues: Physical Link

- If smart contracts should prevail, the **need for links to the physical must be established**
- For example: claim that person has title to a piece of land, holder of a public key, legal capacity -> verification
- In general, all rights and obligations registered in smart contracts must rely on the validity under applicable law, and often on the certification by some government or third-party authority, that conditions under applicable regulation have been made

Legal Issues: Mandatory Law

- Issues where the parties cannot deviate in their contracts from the mandatory provision laid down by contract law
- Certain legal principles so fundamental to the regulation of economic activity -> courts will not enforce otherwise valid contracts if these principles are not complied with
- Court will provide remedies to the aggrieved parties to a smart contract that has been executed, if the contract would be deemed invalid by the court due to local versions of concepts such as fraud, duress, forgery, lack of legal capacity and unconscionability
- **There are also limits to the freedom of smart contracts**

Legal Issues: Applicable Law

- Smart contracts raise important jurisdictional questions - same issues were raised when the Internet began to develop
- Unlike a traditional web-based service, there is no central server on which the company does business
- Smart contract is effectively executed on every node across the network (in the case of Bitcoin and Ethereum means execution across the globe)
- Global reach -> important **specify in the smart contract what laws will govern the transaction** and to be confident that any court will honor the choice of law

Legal Issues: Consumer Law

- Many smart contracts will have a consumer and a business as the parties
- **Smart contract terms with groups of users that are protected by legislation have to comply with minimum rights and prohibitions**
- The legal position of such groups cannot be worse under a smart contract than under traditional contracts
- If this is the case, courts will invalidate a smart contract that fails to comply, regardless of automation and self-enforcement

Legal Issues: Anti Money Laundering

- Ability to exchange cryptocurrencies for fiat currency and vice versa coupled with ability to move cryptocurrency from person to person around the globe -> ideal vehicle to launder money
- **Blockchain technology has potential to become one of the most effective tools in fighting money laundering**
- In particular: Blockchain technology would allow transactions to be reported to a common ledger accessible to all financial institutions who can use this ledger to verify that related transactions are congruent with the stated intentions and information provided by customers

Conclusions

- The opportunities for the aviation industry in the area of smart contracts are significant and the manner in which legal contracts are built, and in some cases, enforced, will be dramatically different than today.
- However, this innovation will dovetail with our existing legal system – not replace it.
- For a long time to come, courts will be necessary for those to seek redress when a “smart contract” does not operate as intended.

Conclusions

Steps to be taken now:

- Stay informed on the status and development of this technology
- Buy some cryptocurrencies to get acquainted with the processes, to get the feeling
- Understand what Blockchain technology can or could realistically do for your business and what is not feasible

Thank you for your attention!

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