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TOKENIZING AIRCRAFT ASSETS ON A DISTRIBUTED LEDGER

An inventory management solution built for British Airways Engineering.

Andrew Ibsen MSc Viva Defense March 2024

Outline

- Introduction
- Problem Statement
- Objectives
  - Current Strength and Limitations
  - User friendly inventory management system
  - Tokenizing Airline Spares, Tools and Equipment
  - Assessing the Stores Keeper App
- Conclusion
- Future Improvements and Research

BIO

Current

British Airways **2022 - Present**

Duty Maintenance Manager - JFK NY, US

Previous

British Airways **2019-2022**

Licensed Aircraft Engineer - Performance Recovery Team - UK

Icelandair **2011 - 2019**

Licensed Aircraft Engineer - CRS Staff Line/Base Maint. - IS

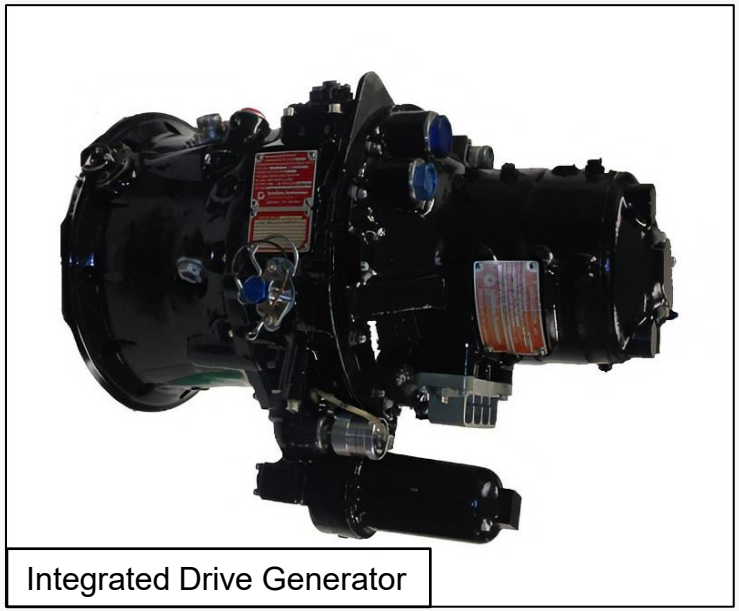
Technician - Support Staff Line/Base Maint. - IS


BRITISH AIRWAYS
FRAGILE


- $1M AOG

How can Blockchain technology serve BA ENG JFK?

- Another missing piece – A CF6 engine IDG misplaced, valued at $250K.



Integrated Drive Generator

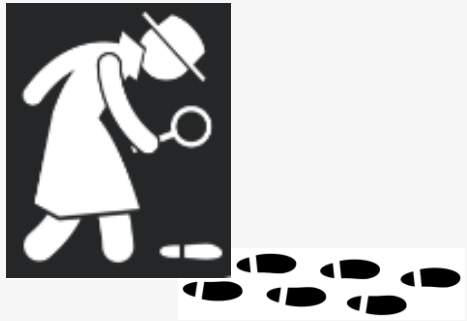
Context - British Airways Engineering, JFK

- 35 flights a day, 9 of which BA transits.
- 10 contracted maintenance support
- Includes oversight of inventory.

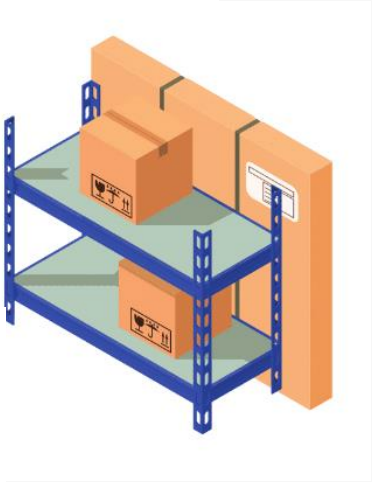
Airline inventory includes

- Aer Lingus
- Iberia
- Qantas
- British Airways
- ANA
- Air New Zealand
- Norse Atlantic

Problem Statement



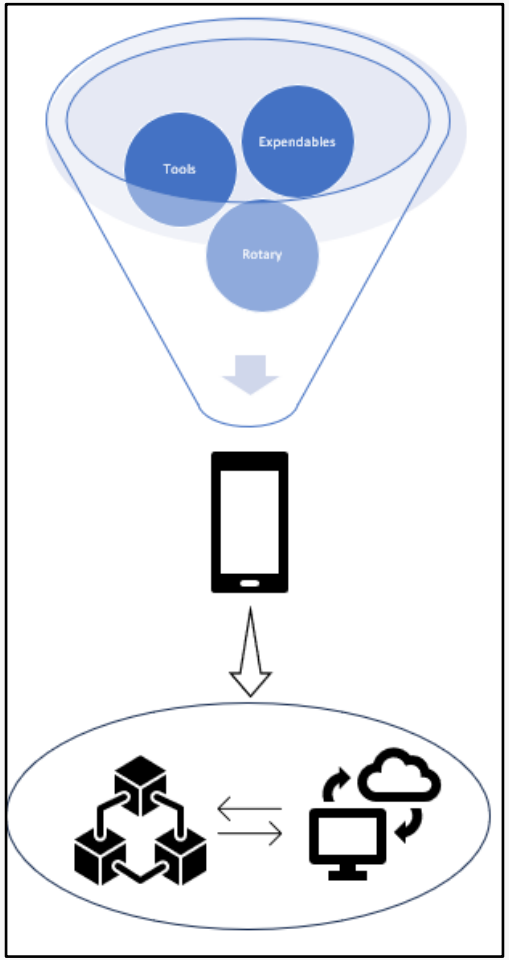
- Item traceability
- Accountability in the aviation supply chain
- Storage facilities – storing of aircraft parts
- Lack efficient inventory management systems



Hypothesis

- Transforming items into hashes, and movement of parts into transactions

- Through an user-friendly interface that harnesses user data to transact on the blockchain.



Objectives

1. Understand the current strengths and limitations of spares management at BA's JFK station.
2. Build a user-friendly inventory management system, capable of tokenizing spares.
3. Test the viability of tokenizing spare parts in BA’s stores.
4. Qualify and quantify the impact of the proposed solution to tokenize spare parts.

Methodological Approach

- Empowering the team to bring about change, with before & after:
  - Surveys
  - Interviews
  - Focus Groups
  - Meetings
- Developing technology in-house
  - Consultation with company experts
  - Systematic testing via structured experiments
  - Before & after spot-checks

Current Strengths and Limitations

Strengths	Limitations
Familiarity	Confusing
Non-Technical, Basic	No Standardization
No Single Point of Failure	Lack of Traceability
Already Established	Manual Data Entry

User-Friendly Inventory Management App

- Harnessing MS Power Apps to create a seamless user interface to manage inventory and gather data.

Assessment of the Stores Keeper App

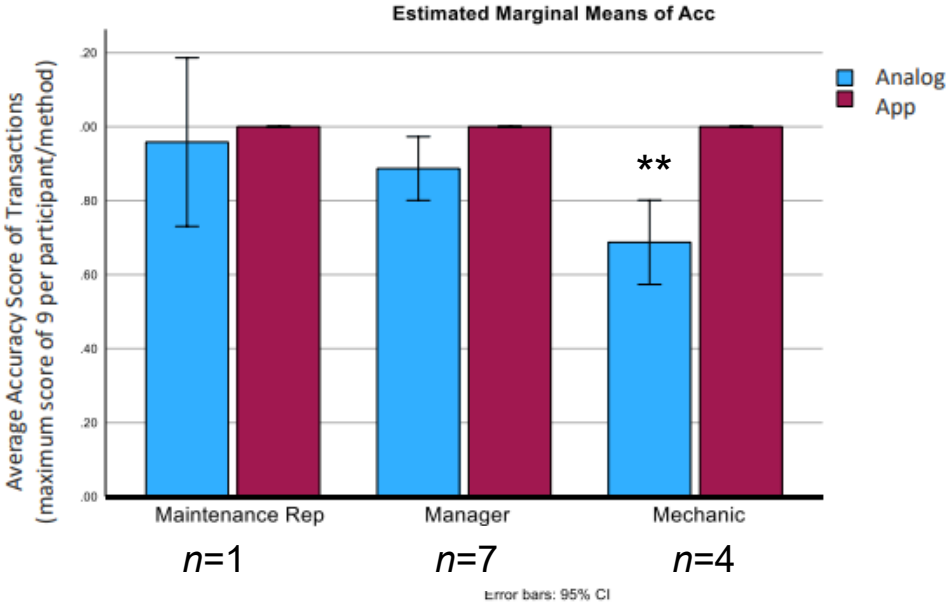
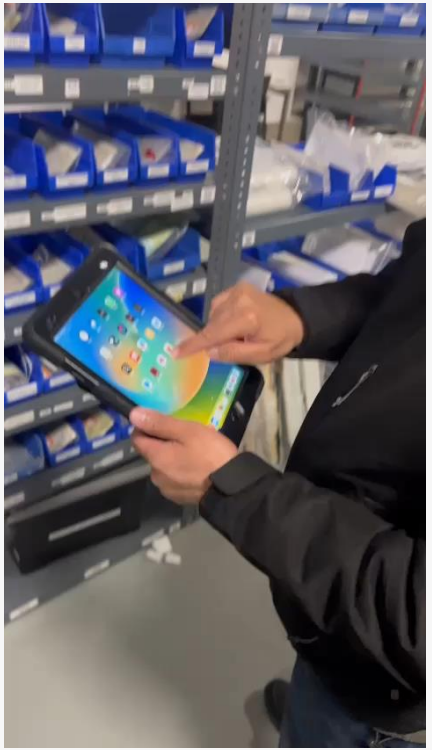


Figure 19 - Accuracy Score of Transactions by Employee Category for the Analog Method as Used at Time 0 (Blue) and the Mobile Application's Prototype (Magenta).



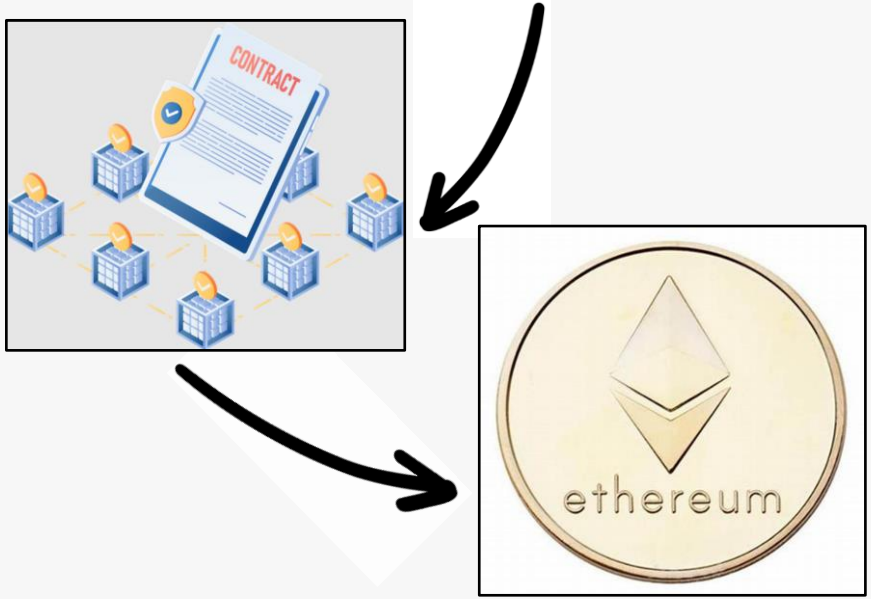
Home - Stores Keeper (sharepoint.com)

Tokenizing Items on the Blockchain

- Unique identifier for each spare, created in a string.
- Immutable record of each spares movements as transactions.
- A smart contract that prevents erroneous transactions in terms of quantity.

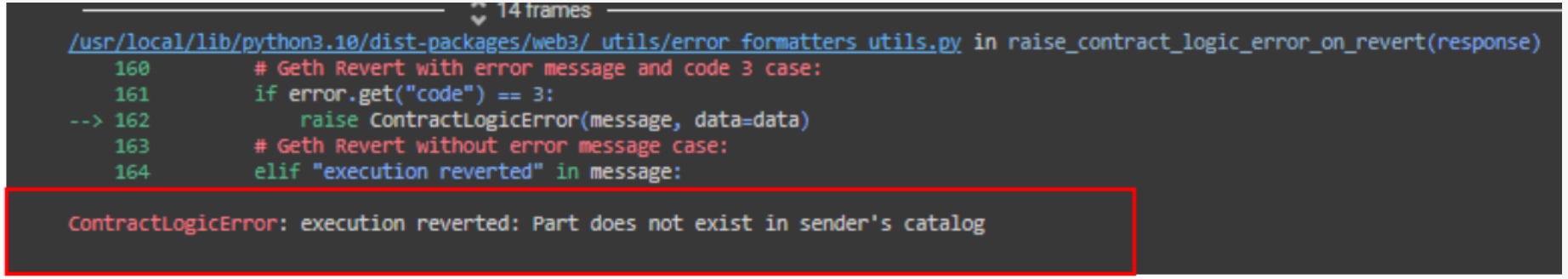
```
#Create a Unique Identifier for each part == tokenization

Part_Number=[Airline1[x]+str(Part_Name1[x])+str(Description1[x])+JFK_Location1[x]+str(Serial_Number1[x])+str(Batch_Number1[x])+str(Time_Expiration1[x]) for x in range(len(Transaction_type1))]
```



Assessing the Blockchain Component

- Transaction from the Log to the Blockchain
- Error simulation



- Link to the Ethereum scan contract page.

Etherscan

Contract Address 0xf28E2c1c3ec439dC7EaD7Eddb4cC12C7a00FB20a | Etherscan

Impact of the Solution

- The app has gained traction
- Before and after spot check:

$150K saved

Current System	New System
Outdated Excel Spreadsheet	Easy to use App
No Standardize Location System	Standard Hierarchical Location System
No Processes	Clear expectations
Untrusted Accuracy	Absolute Accuracy
No Accountability	Accountability
Limited Traceability	Irrefutable Traceability

Conclusion – Objectives

1. Understand the current strengths and limitations of spares management at BA's JFK station.
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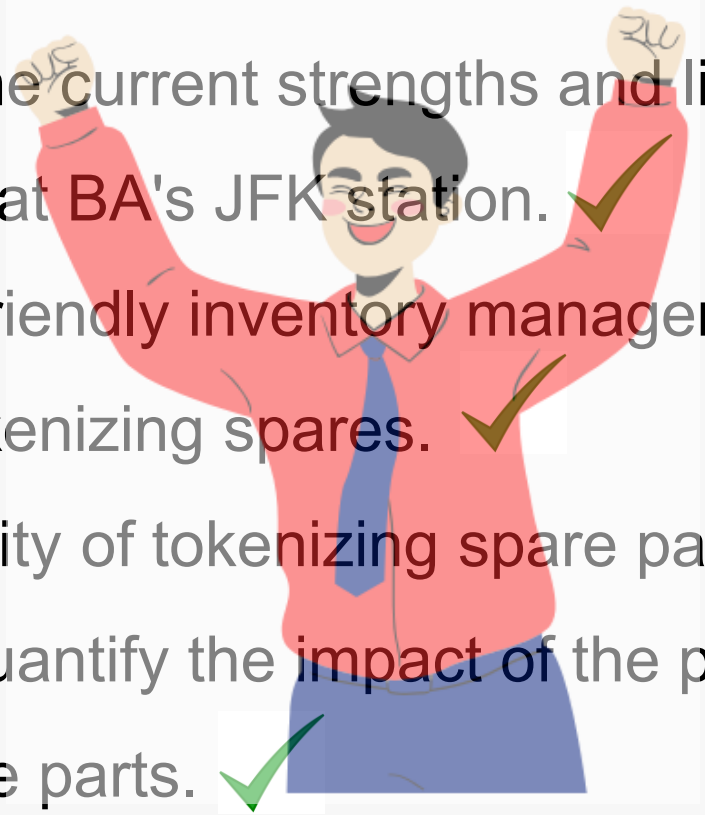

Conclusion – Key Takeaways

1. The system at time 0 lacked accountability.
2. Stores Keeper App increases accuracy and saves time.
3. The blockchain component creates an immutable record.
4. Cost-saving is evident after 3 weeks of deployment. All items accounted for.

Future Improvements and Research

- Workflows and processes with BA Cyber.
- Consumable item purchasing automation.
- Role out to other stations across NA – Playbook.
- Automating the current blockchain workflow – Custom Connector.

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www.city.ac.uk/department

17:51

British Airways

IN | Transfer | OUT

Part Number	Description	JFK Location	Bato
MA30A1001	*V* ACTR FU...	T8-C-1-6-0	000
102LA2AG	*V* TAT PRO...	T8-C-1-7-0	000
GREEN HOS...	1 in GREEN ...	T8-C-4-1-0	N/A
10Pc Extrac...	10Pc Extract...	T8-F-5-6-0	N/A
1693M61P08	12 Point Cou...	T8-D-1-8-10	N/A
MHHBDS16...	120 FT.LB TO...	T8-E-3-1-0	000
MHHB160-...	150 FT.LB TO...	T8-E-4-1-0	000
MHHB160-...	150 FT.LB TO...	T8-E-2-3-1	232
MHHB160-...	150 FT.LB TO...	T8-E-2-3-1	000
20L Bucket	20L Bucket	T8-F-3-1-0	N/A
2380	2380 EASTM...	T8-G-3-1-0	E12
7067	2380 IDG GU...	T8-F-2-1-0	T15
14002	3/4"DR 300-...	T8-E-2-7-0	000
MHHCDS40...	300 FT.LB TO...	T8-E-1-3-0	000
A12001-15	3L Bucket	T8-F-2-6-0	N/A
FLX2-201	3M Peltor D...	T8-F-4-4-0	000
MT74H52A...	3M Peltor Gr...	T8-F-4-8-0	N/A
MT74H52A...	3M Peltor Gr...	T8-F-4-8-0	N/A
MT74H52A...	3M Peltor Gr...	T8-F-4-4-0	000
MT74H52A...	3M Peltor Gr...	T8-F-4-4-0	000
ARALDITE2...	50ML CARTR...	T8-CI-9-5-1	000
ARALDITE2...	50ML CARTR...	T8-CI-9-5-1	000
MHHCDS80...	600 FT.LB TO...	T8-E-1-3-0	000
MHHCDS80...	600 FT.LB TO...	T8-E-EXT	000

11:45

EXIT

Stores Keeper

JFK JOHN F. KENNEDY INTERNATIONAL AIRPORT

Quick Find

Receipting

u213103

Andrew Ibsen

andrew.ibsen@ba.com

Transaction Log

15:41

EXIT

Stores Keeper

JFK JOHN F. KENNEDY INTERNATIONAL AIRPORT

Quick Find

Receipting

u161870

Richard Cotterell

richard.cotterell@ba.com

Transaction Log

22:10

EXIT

Stores Keeper

JFK JOHN F. KENNEDY INTERNATIONAL AIRPORT

Quick Find

Receipting

u162092

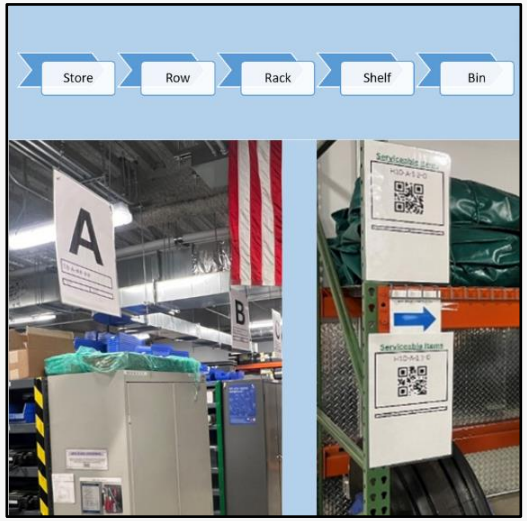
Alan Larmour

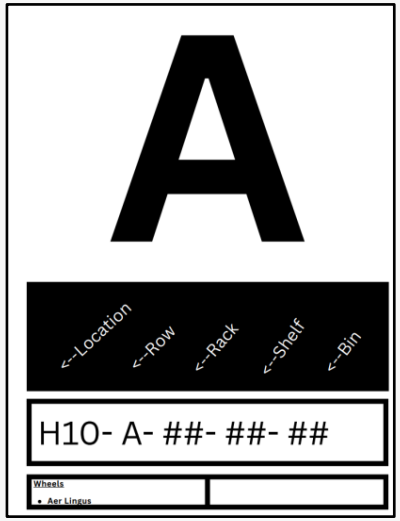
alan.larmour@ba.com

Transaction Log

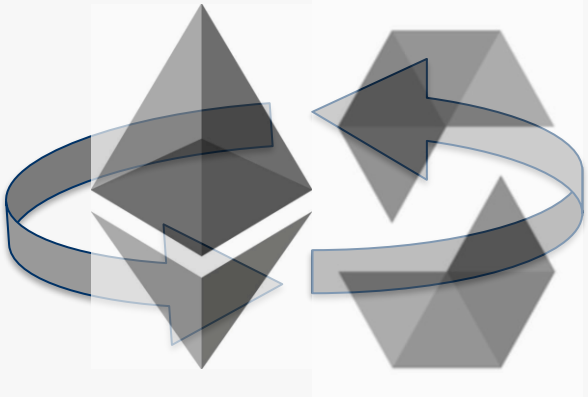
Literature Review

- Benefits of QR coding for inventory management.





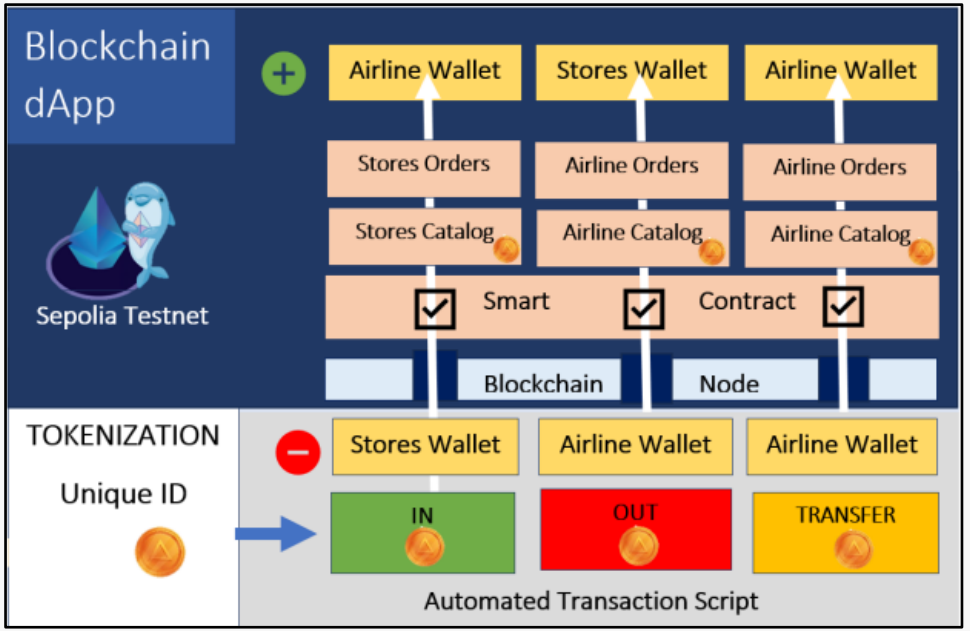
- Smart contracts on the Ethereum blockchain coded in Solidity.



Annex 2

3. Tokenizing Items: Blockchain Component

- Stores Wallet is the User.
- All transactions pass through the store's wallet.
- The stores wallets holds the smart contract.
- Each Airline holds its own catalogue with their tokens.



Could this have been prevented using Blockchain technology?

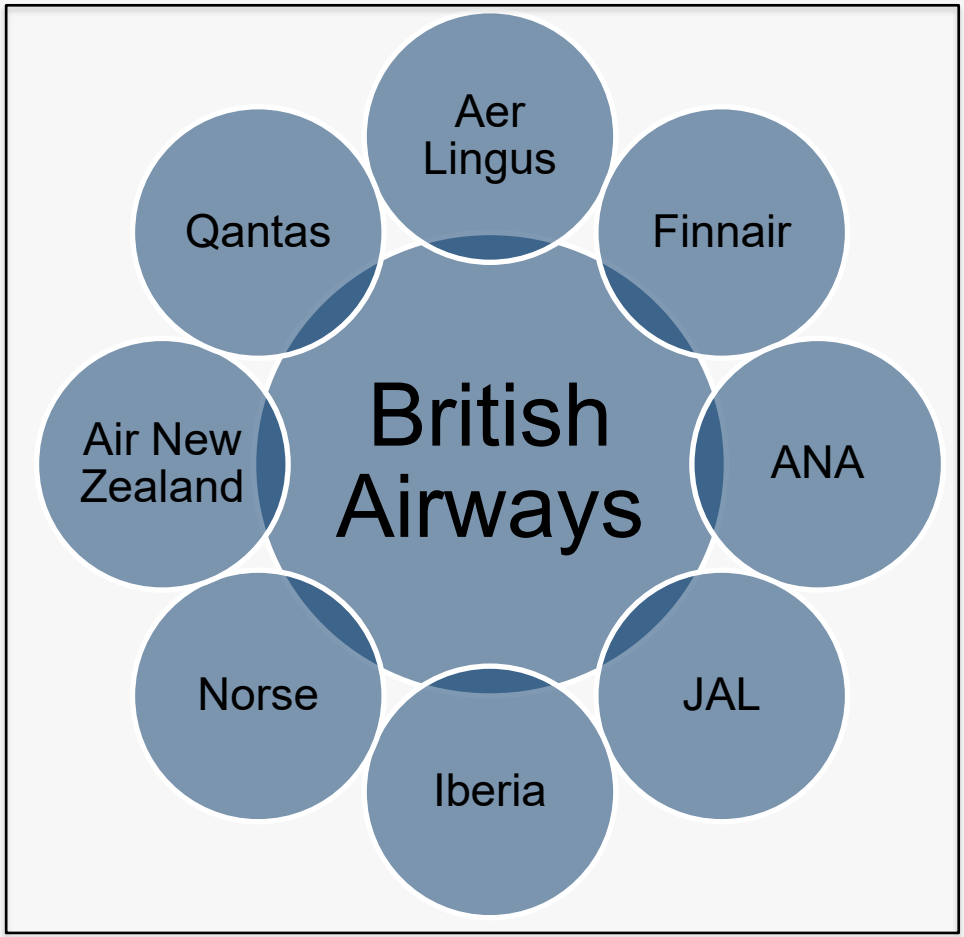
BUSINESS

F.A.A. Orders Airlines to Ground Some Boeing 737 Max 9 Jets After Midair Emergency

An Alaska Airlines plane made an emergency landing at the Portland, Ore., airport on Friday after a hole opened up in the plane while it was in flight.

By Mark Walker and Niraj Chokshi

PRINT EDITION F.A.A. Grounds Some Boeing Max 9s After Scare | January 7, 2024


British Airways
Aer Lingus
Finnair
ANA
JAL
Iberia
Norse
Air New Zealand
Qantas

4. Impact of the Solution

- The app has gained traction
- Positive feedback
- Reinforced sentiment of empowerment
- Used across the board
- Quick Find Function used often

Current System	New System
Outdated Excel Spreadsheet	Easy to use App
No Standardize Location System	Standard Hierarchical Location System
No Processes	Clear expectations
Untrusted Accuracy	Absolute Accuracy
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Limited Traceability	Irrefutable Traceability

How I came about this project?

- I had a passion for logistics and optimization. Coming from a maintenance and engineering background, I wanted to connect with new technologies.
- *- Insert photo from work at T5 Heathrow*
- British Airways have a major distribution center at Heathrow called BADC. I had looked into starting the project there, but it was a huge undertaking. Getting promoted to go JFK made sense to explore synergies of a smaller location but with enough volume to make the project viable.

Annex 1

Power Apps | Stores Keeper (Editing)

Environment
British Airways Plc (defa...

Back | Insert | Add data | New screen | Editing

Fill = fx RGBA(9, 33, 98, 1)

Tree view

Screens Components

Search

New screen

App

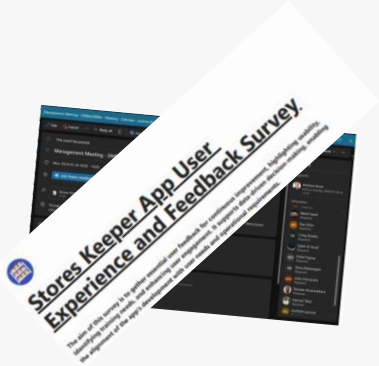
Home_Screen

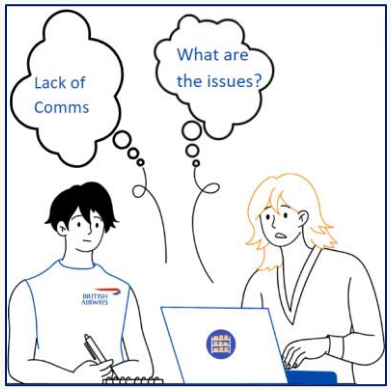
Button1_2
Quick_Find_Button_1
Image5
Image4
Label1_2
Label1_1
Label1
Image3
Stores_Keeper_JFK_Title
About_Button

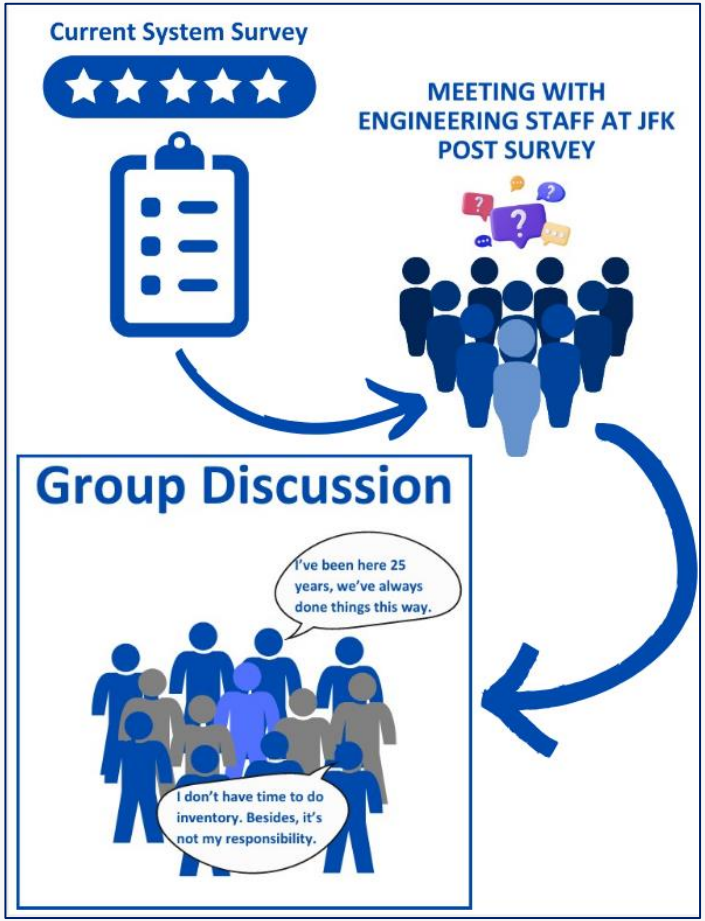
SCREEN

Methodological Approach

- Empowering the team to bring about change.
  - Meetings
  - Surveys
  - Focus Groups & Interviews

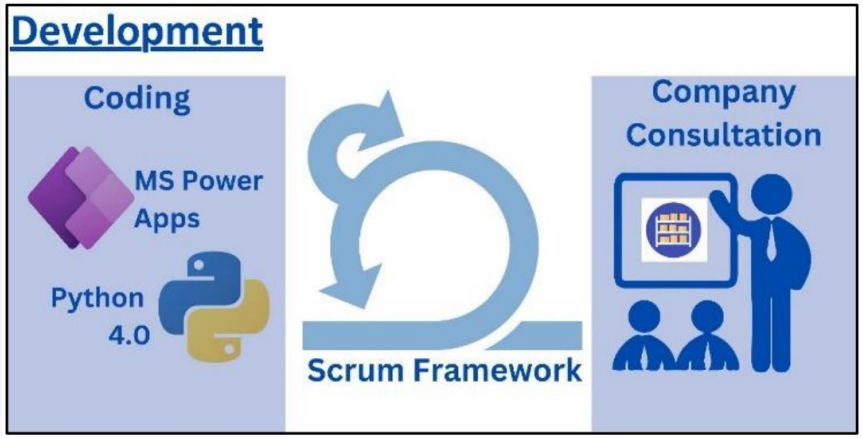






User-friendly inventory management system

- Harnessing MS Power Apps to create a seamless user interface to manage inventory, gather data, and implement local working procedures.



Annex 4

System Implementation

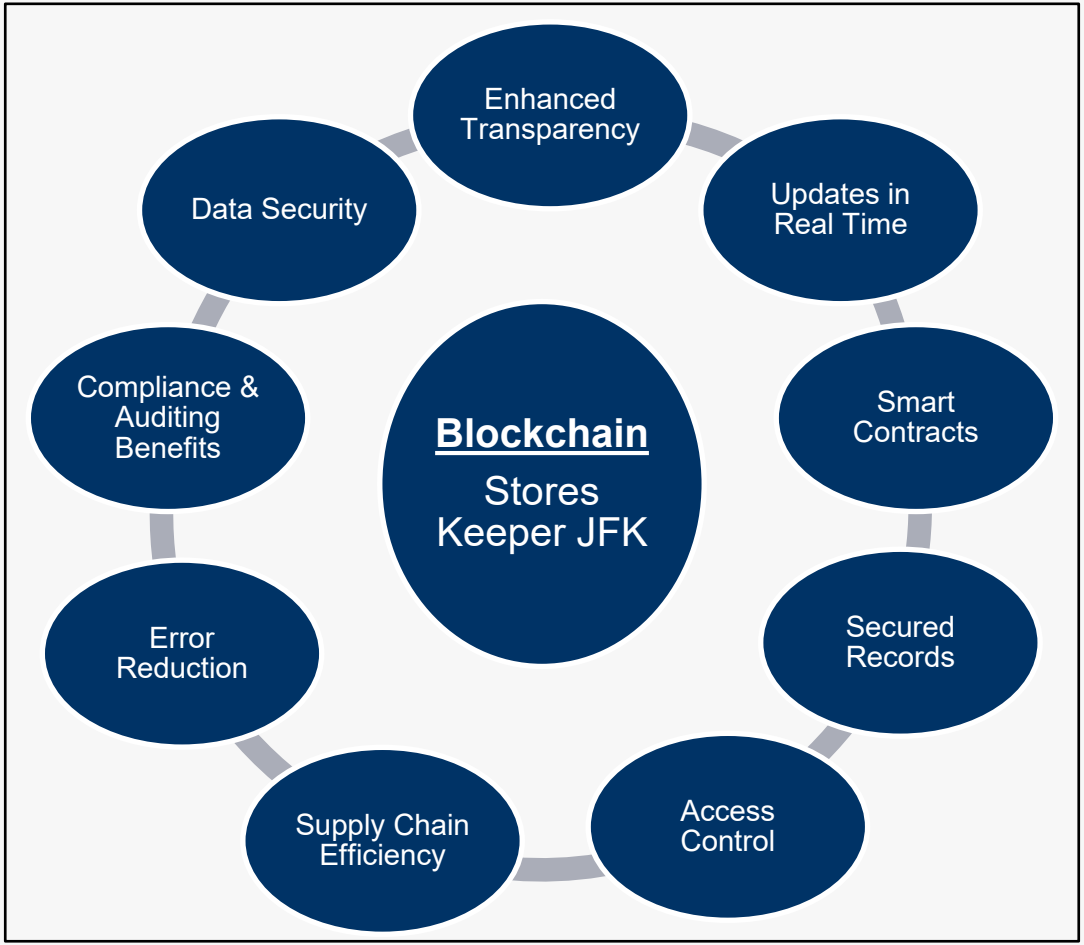
- Using resources and tools available to create an in house solution.

Annex 5

4. Assessing the Stores Keeper App

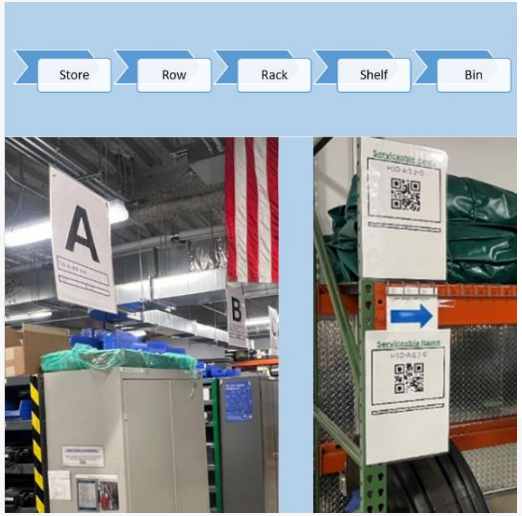
- Other graphs and tables of results of the experiment

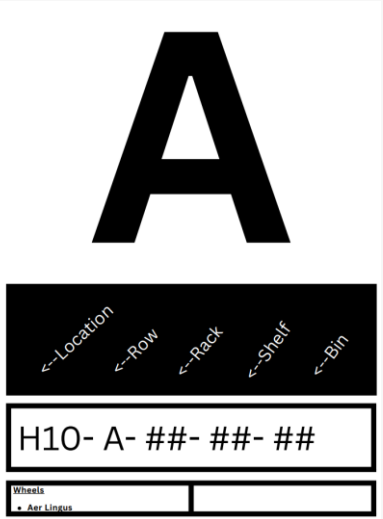
Annex 6


Blockchain
Stores Keeper JFK
Enhanced Transparency
Updates in Real Time
Smart Contracts
Secured Records
Access Control
Supply Chain Efficiency
Error Reduction
Compliance & Auditing Benefits
Data Security

Current Strengths and Limitations

- Creating a standardized location system for stores.





Annex 7

Soft Conclusion

- Navigating local working regulations regarding unionized work environments.
- Meetings with Cyber BA to create new processes.
- Creating a MS Power Apps group for other individuals within BA – “BA MS Power App Community.”