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Designing Blockchain Enabled Customer Experiences for New Digital Services.

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This practice-based paper presents a case study of designing services utilising blockchain technology. Blockchain provides an extremely secure record of transactions and has the potential to simplify and automate many complex processes. In this example Blockchain is used to validate a person's identity through a digital passport. In using Blockchain the customer journey becomes highly automated and has no points of user interaction, which user-research revealed has both benefits and disadvantages. The paper discusses the challenges and opportunities of highly automated processes and proposes a framework of design principles to be used when developing Blockchain and technology-based services that produce invisible processes.

***Keywords**: Blockchain; Distributed Ledger; Zero UI; Service Design; Design Principles; Service Enablers; Emerging Design Practice:*

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Introduction

As we travel through what has been termed the 4th Industrial Revolution (Schwab, 2015), enabled by Artificial Intelligence, machine learning, Big Data and Blockchain, a plethora of applied technology systems has created a rich source of new capabilities with the potential to deliver new services and human experiences.

Design practitioners respond and embrace new developments in technology with the objectives to acknowledge functional need, context and emotional reaction to the possibilities that technology provides. In the race to deliver the benefits of technology, the need to accelerate technical development is often at odds with the time and effort required for design processes. However, there is an inherent risk in pushing technology that can result in failure as end users (people) fail to understand the benefits or have difficulty in using innovative technology solutions (Douthwaite, 2002).

Designers focus on a human centred approach and design technology solutions from a starting point of human needs, contexts and usability. Mike Cooley (2008) identified that "Human centredness asserts firstly, that we must always put people before machines, however complex or elegant that machine might be" – and the impact of poor or unconscious design can lead to barriers that slow the adoption of innovation and increase the risk of failure.

The emerging range of powerful data tools are highly attractive, both commercially and politically, due to their scale, ease of access and their ability to automate and remove costly operations, processes and potentially human labour. There are many benefits and innovations from these technology enablers but there are also concerns around issues such as the security of personal data, the potential for bias in automated decision making based on historical data and the lack of transparency in how they work. We can apply the methods of design that are human centred, bring critical analysis and insight and envision and prototype possible solutions in order to ensure the next generation of technology is successful and has lasting value.

This paper is a case study of how design methods have been applied to new services based on Blockchain technology. Blockchain is one of the most complex and elegant mathematical machines yet created. Scalable and secure enough to create cryptocurrencies and as robust and tamper proof as we have yet achieved, Blockchain provides a new level of security and automation. By replacing cumbersome and lengthy processes it has the potential to radically simplify the next generation of service experiences.

As the paper describes, a by-product of the use of Blockchain is the removal of the interactions with humans. By creating a secure and highly automated process the result is an invisible user experience. This lack of interface has been termed "Zero UI" (Goodman, 2015). These include user interfaces that respond to non-screen and non-touch interfaces by using voice or gesture or where a user experience is transparent with virtually no interactions. Zero UI and invisible interfaces hide the powerful platforms of Artificial Intelligence and machine learning, machine to machine data (the Internet of Things), operating over globally connected fast networks, at enormous scale through cloud storage. Secured by complex protocols such as Blockchain, decisions become highly automated based on factors that combine an individual's identity, geographical position, historical data and behaviour along with risk and security policies: all invisible to the user.

Research Objective

In designing the human experience of Blockchain, designers have begun to identify the benefits and best practices to ensure usable and accessible new services. This has focused mostly on the design of Blockchain-enabled cryptocurrencies such as Bitcoin (Nakamoto 2008), and platforms such as Etherium (Tan 2018). The opportunity is for research to capture and reflect on further emerging design practice from the experience of designing Blockchain-enabled services that move beyond cryptocurrencies and offer new services and experiences.

This paper describes a project where a human centred service design approach has been embedded in the development process for Blockchain-enabled digital identity project. Design thinking and service design practice is extending the possibilities for new technology enabled services so that their benefits can be realised and adopted. The learnings from of the project have been used to develop design principles that can be applied to future applications of similar technology enabled services.

Project Context

This case study describes the development of a Blockchain identity system being developed by a UK company ObjectTech, currently seen on the web site www.objectivetgg.com Much of the work remains protected by their intellectual property, but the general findings and principles developed from the project for developing future Blockchain services are presented here.

The initial opportunity for Blockchain-enabled identity developed around the problem of processing large numbers of passengers landing at international hub airports. Hub airports provide the initial landing point for passengers connecting to locations within a country or continent. Airports across the United States, Middle East and Asia service millions of passengers each year in transit to other countries or global events such as Expos, the Olympics, Soccer World Cups and religious pilgrimages such as the Haj.

The number of passengers flying at the start of this project was projected to double in the next 20 years (World Bank 2018) – in spite of concerns about the environmental impact of air travel and the impact of the Covid-19 pandemic. This growth has put pressure on the human resources required, time taken and data processing of travellers as they pass through an airport.

Entry into a country is dependent on the presentation of a passport, a physical document establishing identity. The passport also contains additional permissions through visas or work permits, for specific periods of time. This document is checked for each individual at the point of disembarkation and entry to a country.

The desire to process large numbers of travellers more rapidly has driven the development of automated passport reading machines. Using a combination of facial recognition from a camera and a document reader for the passport, it is possible to reduce the numbers of staff, increase the speed of processing and reduce the length of peak time queues.

Blockchain has been identified as an enabler for a new type of digital passport (Forbes June 2019) – one that validates with total accuracy and security a person's identity and can instantly permit a traveller into a country without any physical interactions, allowing passengers to simply walk off a plane and across an international border.

Introduction to Blockchain

Blockchain is a high-profile technology that is driving the development of new platforms and services. Initially used as the basis of cryptocurrencies such as Bitcoin, the technology is being used by a number of new business models and companies developing innovative platforms that are beginning to impact traditional industries.

Blockchain works by combining a system of timestamped records that are shared and linked by complex encryption algorithms. Any transaction can be recorded in a "distributed ledger" and validated by a peer to peer system that effectively ensures that the record cannot be altered.

Blockchains provide a highly secure basis for any type of transaction. This level of tamper-proof security has enabled cryptocurrencies, where highly complex Blockchains are used to "mine" coins that can be traded, without the requirement of a financial platform of the sort provided historically by the banking industry.

Beyond cryptocurrencies, other applications have developed. "Smart Contracts" (M Bartoletti, L Pompianu, 2017) allow for automatic and instant distribution of funds between various parties. This is particularly useful for financial transactions and simplifies back-end systems. Supply chains can be tracked with great accuracy and components or produce tracked and their origin validated. These systems are being used to identify and track individual items to ensure authenticity. Aero engine parts, for example, can be logged with a Blockchain that validates their source and history ensuring that fake or substandard parts do not make their way into maintenance and repair systems (Korpela, Hallikas, Dahlberg 2017).

Blockchain for Identity

The use of Blockchain to provide highly secure validation of a person's identity is the basis for ISO Standard committee work since 2015 (ISO/TC 307). Blockchain based companies such as Evernym (www.evernym.com 2019) have developed a host of potential applications across finance, healthcare, government and insurance. The benefits of Blockchain are in providing trusted digital relationships using the concept of self-sovereign identity.

Blockchain digital identities have an attractive feature that means the system can confirm your individual identity without the need to transfer the details that have been used to validate you. The system sends a token, called a hash, that contains no data other than the confirmation. In principle, Blockchain identity systems require no storage of your details inside third party organisations. Identity theft is a common occurrence and in May 2020 a security breach at airline EasyJet led to criminals accessing the accounts of 9 million customers. Blockchain removes the need for data to be stored by companies, data can be held securely by an individual, hence the term self-sovereign identity (Der, Jahnichen, Surmelli, 2017).

Blockchain Enabled Digital Passports

An obvious use of a Blockchain identity system is to create a fully digital passport. The system of a digital passport incorporates biometrics in the same way as passport readers, with facial recognition technology matching the

image with a recorded image. The image data of the Blockchain has the additional feature of being constantly updated by everyday use of personal devices that already use facial recognition and therefore will reflect an individual's current appearance - not an image taken up to ten years previously as is used in a physical passport. The system has the potential to add other relevant data such as location history and social media data to increase accurate checks of a person's identity.

A robust digital passport system needs a number of components and processes to operate:

- Biometric validation of a person, usually through facial recognition software from digital cameras
- Validating organisation - a body that issues national identity documents such as a national passport office
- An agreed Blockchain protocol (following ISO standards) that allows a Blockchain identity to be issued by the identity validating body (i.e. passport office)
- A safe data bank and access protocol for your identity that service providers can access to validate your identity and then provide services (entry into a country and others)

Once these system elements are in place, passport control can become entirely automated. This means that the experience of a passenger travelling through an airport on to a plane, disembarking and travelling through the destination airport and into the country can be completely invisible to the passenger. The checks and protocols are carried out in the background and, as long as there is no problem with your travel status, you are free to simply walk out of an airport without any physical passport checks or queues.

Other Identity Scenarios

Outside of closed and secure airport environments, Blockchain identity systems have been seen as a solution to establishing identity where documentation has been lost or is not available. Conflict in areas such as Syria have led to a crisis in identity documentation for the large numbers of refugees escaping conflict (Worldbank, 2017). Many have left their homes without their belongings and have no evidence of their identity. A range of biometric devices from fingerprint readers, mobile phone facial recognition and voice sampling have been used to establish the identity of people who have no documentation. Establishing who people are enables aid to be allocated and tracked and predicts where resources are required. The GSMS report "Refugees and Identity" (2017) reports how the UN have been in the forefront of developing biometric and Blockchain protected identities – though more recent reports (Latonero 2019) have described the potentially negative consequences of creating dependency on technology solutions for large numbers of undocumented people.

Benefits and issues with Blockchain

Blockchain has a number of advantages that make it attractive for identity systems and by automating many physical interactions, can simplify the user experience.

Trust - Blockchain is secure by design – the system has been designed to be essentially impossible to tamper with and the chain makes visible any event or change in the sequence. When connected to an authenticating body such as a passport office, a high level of authorisation and validation of a person's identity is enabled. Current systems of validation require face to face identity checks and documents that prove address and residency, occupation, educational background. A secure Blockchain based digital system can be applied to other applications that require private data such as financial or medical records.

Data security – the strength of validation provided by Blockchain allows access to data or services to be accessed with a high degree of certainty. Contracts, individual components and people's identities cannot be tampered with or faked. Access to an individual's data can be restricted to that person only, removing threats of data and identity theft.

Safe, Immediate Transactions – linking the identities of two parties in a transaction removes all possibility of failure or misdirection. Other parties cannot hack in to reroute or cream off any part of the transaction.

Frictionless Service Experience - direct immediate transactions create the opportunities of seamless events and experiences replacing previously complex processes.

Compliance – rules, policies, anti-bias patterns and personal preferences and behaviour can all be built into blockchain transactions to ensure transactions are compliant, safe and accurate. Human error or bias is removed.

There a number of issues that have been identified as barriers to the use of Blockchain (Iansiti, Lakhaani, 2017).

Reputation - Blockchain is complex and poorly understood by public users and consumers. Media reports of criminal behaviour and risky cryptocurrencies mean that new services have to establish a positive narrative about the strengths of Blockchain and answer consumer concerns.

Environmental Impact - cryptocurrency platforms require a lot of energy to cool their data centres and this is increasingly being noticed by an environmentally aware society (Potter,2020).

Interoperability - there are many different platforms being developed for both public and private access. Some large organisations are developing their own platforms whereas other platforms are being developed for cross-industry sharing (R3, 2019).

Dependency on Facial Recognition - recent research into racial bias of facial recognition systems has added to wide public concern that these systems are undesirable and inaccurate, with research into facial recognition software from IBM, Microsoft and Google registering up to 35% inaccurate readings for darker skin tones compared to 1% inaccuracy for whiter tones (Boulamwini & Gebru, 2018).

Data storage - leakage, theft or misuse by criminal organisations or governments is a threat to public trust. Cases of large data losses at airlines and credit agencies has reduced confidence in the security of transactional data stored in third party locations. Even reasonable and potentially helpful sharing of data is treated with mistrust. The proposed sharing of personal data to improve medical treatment through the UK National Health Service (NHS) caused a backlash in public attitudes to data usage (Banner 2019) which is currently a concern in the use of data to track Covid-19 cases.

Design approach to a "Zero UI" digital passport experience

Although it was assumed that the benefits of a Blockchain-enabled process would create a better user experience, it was decided for this project that it would be valuable to develop the human experience of the digital passport and identity systems using service design methodologies.

Service design has been defined as 'the designing and marketing of services that improve the customer experience, and the interactions between the service providers and the customers' (Stickdorn and Schneider, 2012). Service designers combine sets of tools and methodologies from various design practices such as user experience, product design and design thinking to solve problems and find solutions to a broader set of problems beyond the design of a specific artefact (Brown, 2009). Service designers works at a systemic and organisational level as well as crafting the specific touchpoints of a service or customer experience. In this case study, digital and service designers worked alongside the technical development team and Blockchain specialists to design the strategy for Blockchain services and form the detail of the digital passport user experience.

The hypothesis of the design team was that the invisibility of the identity checking processes would be a significant change for travellers used to paper documentation and would, at the very least, need to be explained for people to be prepared, comfortable and have trust in the system without inducing stress or worry. The seamless nature of the experience seemed potentially positive, but it was important to validate this with people who would be using the system at the target date of October 2020.

The project followed a design process as defined by the Double Diamond diagram established by the UK Design Council in 2005 (Ball 2019). This provides a useful high-level framework with which development and design teams can align their activities. For this project key activities included:

Discovery

- Establishing who, what and how users will interact with these new services and how the technology experience can be designed from a human-centred perspective. This research with small focus groups was carried out into issues around identity, data, and travel
- Journey mapping – mapping current identity document and travel experiences and mapping new blockchain journeys to identify and test expectations and perceptions of seamless Zero UI experience

Definition

- Identifying principles for digital identity including security, data protection and relationship to commercial or government services
- Establishing the core service benefits of Blockchain
- Identifying barriers and issues associated with the use of Blockchain

Development

- Envisioning the digital passport experience
- Envisioning additional service experiences opportunities
- Creating design principles for Blockchain enabled services

Deliver

- Future Scenarios – presented by a video showcasing possible connected experiences and services enabled by Blockchain and other digital platforms to identify partners and strategic direction for the company

Discovery - User Research

To identify the reaction of potential travellers and user to a digital passport, research was conducted with 21 individuals who represented broad categories of travellers and who were based in different cultures and continents:
Solo Business Travellers - US, European and Asian
Couples Leisure Travellers – initial focus on European and Middle Eastern, young to senior
Family Leisure Travellers – multi-generational families from senior to children
Individual Young Travellers

The method developed for the research combined techniques that would gain insights into people's expectations of travel and their relationship to the physical passport. Interviews with participants discussed recent travel experiences and asked them to imagine a future experience by writing a letter of thanks and a letter of complaint to the imagined experience. This was followed by an explanation of the alternative digital passport along with prepared storyboards describing the new travel experience, how it would check your details and allow a person through the airport at the start and completion of the journey. The team created a map of current travel experiences starting with obtaining a passport and visa to post trip recollections to gain insight into current pain-points around travel that might be solved by Blockchain and digital passports and then capture the emotional and practical needs of the proposed digital experience.

Summary of feedback on the Blockchain Digital Passport

The insights from the research participants highlighted aspects that were very positive but also uncovered significant concerns about the new process. The outputs from the interviews were structured into themes to give clarity and explain to the wider team the positive aspects and the areas that needed specific design solutions to improve the user experience. The main themes identified were:

Invisible interfaces - the removal of passports provides a seamless and fluid experience but passengers showed that this was initially a confusing and uncomfortable experience. Without conscious feed-back to acknowledge where they were in the system, passengers were unsure that they had passed through passport control and were free to travel or leave when they had arrived at their destination.

Lack of a Physical Document - the absence of a physical document was unnerving for some and created discomforts. Many of the research group were concerned about system failure. In addition, there are many features of a physical passport such as visa and entry stamps that provide a record of travel that have, for some, strong emotional value.

The use of Blockchain - when explained that the system used Blockchain encryption, the research group found it difficult to understand and were worried by the negative perceptions of Blockchain and whether it was a trustworthy technology. Passengers struggled initially to imagine the benefits for them or how this could lead to enhanced personal services and experiences.

Use of Facial Recognition - the passenger interaction with the system is triggered by passing a camera that matches a face to the passport data held on the Blockchain. Facial recognition left passengers uncomfortable and raised questions about how images would be stored or if they would be reused. Although it was explained that data was not stored by the airport after travel, this was not believed.

Designing the Blockchain journey

The research showed that it was vital to design a digital passport journey that was visible and would allow users to understand where they were in the process in order to build trust that the system would work and not cause issues that they would not be able to control.

The detailed workings of transactional systems are largely invisible but when we use, for example, a debit card to pay at a chip and pin terminal, we are aware that systems are transacting through notifications on the screen that confirms key stages in the process. In a fully automated system, as envisaged for a digital passport, the removal of all interactions with the process creates new problems that suggests a requirement for feedback systems to acknowledge that the process is operating correctly.

Design is a discipline that is concerned with how we shape physical and virtual interactions with the world. Even when transparent and invisible, there is still a decision to be made of how that transparency is sensed or appreciated. Dan Norman's book, "The Design of Everyday Things" (Norman, 2013) introduces the concept of affordance, originally defined by James J. Gibson's work on visual perception "The Perception of the Visual World" (Gibson, 1950). Norman applied the concept to industrial design using examples such as door handles to describe how shape communicates purpose and confirms the direction and likely outcome of an interaction. The Blockchain world is one of invisible interactions and zero interface, without affordances from the environment to guide and make meaning. The challenge therefore is to reintroduce affordance: the clues and wayfinding that allow users, whether a person who is experiencing a system for the first time or one who has become familiar from repeated use over time.

The service design method of mapping a user journey in time across the different stages of a process was a useful tool used by the combined design and development team to analyse the individual events of the process. The team were then able to add a new layer of possible events that pinpoint where new affordances can improve comprehension and trust in passengers. This allowed for a new journey to be imagined and designed in detail.

The design team used an established five step journey framework to create new journey concepts. For each step, the delta or difference from the familiar historical passport process created by the Blockchain system was mapped. The impact in terms of user navigation or awareness was identified and then new events, notifications, acknowledgements or responses, were developed and prototyped in new scenarios.

Journey Stage	 Awareness	 Engage	 Use	 Grow	 Advocacy
Event	Advance notification of new passport process	Entering point of departure	Idenity validated passport and visa approved	Confidence in process and use of data	Extending use of blockchain services
Issue	No touchpoints or interactions with users	Facial Recognition invisible to users	Automatic validatation, process is invisible	Ensure confidence in process and use of data	Showing value in other uses: payments, health
Design Solution	Advance education and touchpoints to explain process	Provide digital process tracking to educate and set expectations for seamless experience	Notifications to communicate progress and confirm successful entry	Transparent trip records, digital passport , permission & control.	Standardisation, protocols, seam-less sytem & multiplatform integration
Touchpoint	Emails, time and location notifications close to point time of travel	Applications, geo alerts to notify start of the passport process	Device notifications, alerts, haptics confirming progress	Personal data vault, secure identity app, national passport identity	Secure personal access & control via apps

Figure 1. Journey Framework used to construct user context, issues and design concepts

The journey framework represents the user's view of the steps at each stage. The user requirement, emotional or functional is mapped and new experience solutions are designed. The touchpoints and actions can then be captured and scenarios for new journeys designed. Through a series of design workshops, new journeys were developed and prototypes prepared for further user testing with the research group.

Emerging Design Themes

The resulting journey mapping and design process developed specific design interventions that could manage and support users through the experience. These interventions showed several similarities which could be classified as themes:

Transparency - creating a transparent narrative that explains the underlying processes and benefits they bring builds confidence of the systems in users. Blockchain brings authenticity and validation that cannot be fooled or altered. It brings trust and clarity and allows contracts and truth to be established and made visible. This is a powerful enabler for service design and should be articulated throughout the user experience.

Seamless Experiences - Blockchain delivers seamless services and removes physical steps, interactions with the systems, the need for duplication and repetitive form filling. A 'once only' philosophy to data entry joins up platforms, service providers and systems to work together, confident in the data and identity of any person and flexible to deliver the correct amount of data, no less and no more.

Personalisation and Control - creating truly personal services that learn and reflect our behaviour and preferences allows us to chose whether to receive or not receive information, perhaps to keep us safe or deliver relevant marketing communications. Blockchain presents a unique opportunity to identify, protect and give consent to share data that will provide automatically personalised services.

Collaboration - Blockchain is usually developed by experts in encryption, complex algorithms and quantum levels of mathematical theory. To ensure comfortable and accessible user experiences, it is necessary for service designers to bring their techniques of human centred design, problem reframing, creativity and prototyping to ensure that the unique enabling qualities of Blockchain result in good customer experiences that are trustworthy, safe, secure and transparent. Co-creation and collaboration will ensure a shared objective of usable and effective Blockchains services

Design Principles.

As the user experience for digital passports and other Blockchain-enabled services were developed, the themes were developed into a set of principles that might be valuable when designing new services and experiences that remove interactions and points of contact with the underlying process.

Design Blockchain services as a journey, not a process - Blockchain design documents usually describe the complex interactions between identity authorities, third party service providers, individual data, biometrics, devices and networks. But these linkages are not what is experienced by users. An overview of a Blockchain user experience can be invisible: a zero UI requiring no interaction. The hypothesis of the project is that mapping out how people will engage and build trust in new seamless systems requires journey signposting, confirmations and points of access. Mapping as a journey allows for user experiences to be designed that reduce fears, maintain transparency and control and confidence from start to finish.

Ensure Data Transparency - understanding who is accessing data is a key outcome of this project. The Self-Sovereign Blockchain platform ensures that parties who request access to your data only interact with the Blockchain hash that confirms a match of identity. For a passport, this is a simple exchange between airline security and your national passport authority. As other services are developed, interactions with emergency or medical services are possible. Beyond that, commercial organisations can provide highly personalised services and products, available as you walk past or into a retail outlet. Understanding who, and when your identity and personal data is being accessed allows the user to grant permission in each case.

Provide Affordance - clues and triggers to comprehend and communicate key stages of the process, that they about to happen, have happened and can be viewed or modified. The principles below contribute to our ability to see, comprehend and adopt otherwise invisible actions.

Give Proactive Notifications - advance education, explanation and event warnings allow users to be chaperoned through processes and to understand when automated blockchain identity processes have happened. Digital devices and ubiquitous enablers such as geo location can be used to trigger notifications of upcoming events. This could be as you approach facial recognition cameras which will validate your identity or register that you have successfully passed through the process and are free to enter a country.

Create Interfaces for Dynamic Permissions - control of access to data by a third party requires an interface. This could be binary, open or closed to data sharing, or pre-set according to a user's context, activity, day of the week or time of day. It can be a set of variable settings from totally private, emergency only data exchange to access to all, where service benefits may be desirable (to receive personal loyalty schemes for example).

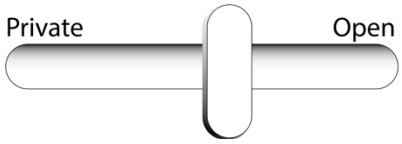

Figure 2. Diagram of a slider interface for increasing or decreasing permission to access data

Confirm Key Steps in the Journey - location or process notifications and alerts linked to transactions or locations through voice, sound, screen or haptic feedback, via devices which will confirm you have successfully completed a part of the system process.

Make Visible the Authorisation Provider - confidence in Blockchain and the platform will be linked to the strength of the validation authority. A national passport office is the authority required for a digital passport. It will be important to trust and have clarity of your status (this is the equivalent of forgetting your passport). Openness and clarity that your travel status and visas are in place is a requirement that also applies to services such as insurance, loyalty or membership organisations.

Allow for Memories - Blockchain provides a tamper proof memory of every transaction. For many applications such as the digital passport, there are strong emotional ties to historical travel, how you choose to express your national identity (you may French and European, British and Welsh). Replacing the physical records of country stamps and visas is a powerful way of returning an invisible digital process into an emotional and historical record.

Once in Lifetime Sign-In - Blockchain identity can be used across a wide range of transactions which traditionally require individual log-ons, form filling and re-use of data that has to be validated at every occasion. Blockchain can provide trustworthy information on identity or transactions without the requirement for repetitive form filling and duplication of processes.

Envisioning the design principles and other Blockchain enabled services

In designing for the user scenario of a digital passport for seamless international travel, a number of other opportunities were identified that could be linked to a person's digital identity. By connecting highly secure and personally protected self-sovereign identity, seamless connections with other systems and services can be imagined. These include payment systems, linked to international exchange rates, travel and accommodation services and health care. Providing instant access to data unlocks complex international issues and validations and ensures a safe and seamless travel experience.

In addition, the role of the passport as a document establishes identity to enable basic access to society. It is required for finding accommodation, getting a job or opening a bank account. As a physical document it is easily lost, stolen or forged. For those who are marginalised in society, such as the homeless or refugees, where identity papers or passports might be missing or unattainable, access to financial security, social support and medical services can be cut off.

To bring the principles to life and to showcase the future applications and benefits from Blockchain-enabled services, the design team developed a set of scenarios. To enhance the understanding and test the benefits and barriers of these new experiences, a series of videos were developed. An overall future vision video captures the essence of how digital identity could transform travel and a series of innovative new services and experiences. The video can be viewed at https://www.objectivetgg.com

Future Vision Scenarios:

The vision video describes a variety of scenarios that describe the benefits of Blockchain authenticated identity:

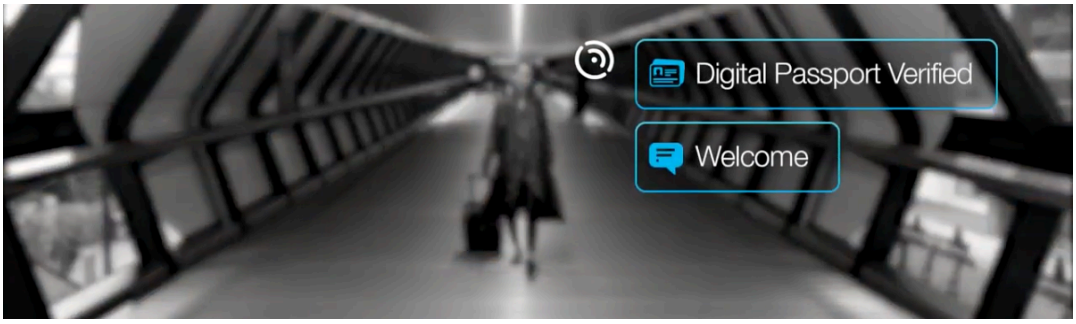

Figure 3 - Scenario 1, Seamless borders.

Facial recognition matches Blockchain data to validate individual identity, making international borders frictionless and processes invisible. Using mobile phone notifications and haptics to confirm processes have been completed confirm that the passenger is free to enter the country. Data collection is not required, the passenger identity is anonymous but the system confirms that passenger identity matches the digital passport.

Design Principles (Figure 2, Scenario 1):

- Design as a Journey – from home to final destination
- Proactive Messaging – advance education on first use of digital identity as a passport
- Affordance – process completion and location triggered as the passenger leaves the airport
- Authorisation – based on the passenger's national passport office
- Memory - date and location stamped on the blockchain and usable in digital identity applications

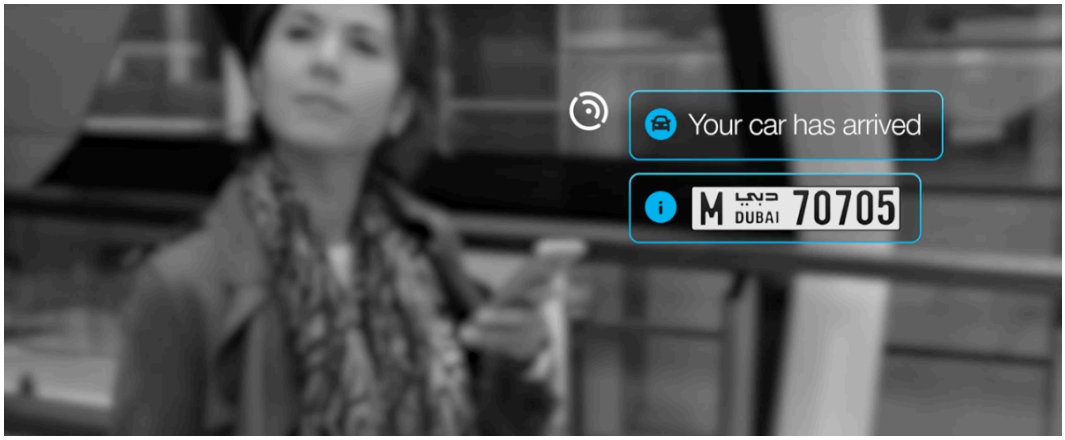

Figure 4 - Scenario 2 - Identity Transaction

Identifying and validating a drive provides safety and confidence in human service providers. In this case the mobile is used to connect to the identity blockchain.

Design Principles:

- Design as a Journey – identifying benefits of trustworthy identity from other service provider
- Confirmations – driver and car identity

Figure 5 - Scenario 3 - Payments

The ultimate driver of identity is payment transactions. Taking the 2018 Amazon Go vision https://www.youtube.com/watch?reload=9&v=NrmMk1Myrxc to its logical conclusion, identity enabled systems allow for immediate and transparent payments where you chose your item and walk out of the store. In this case the trip is paid for automatically using an identity validated digital wallet connected to a bank account.

Design Principles:

- Design as a Journey – from home to final destination
- Confirmations – confirmation and alerts that the system has worked and payment made
- Authorisation – based on the passenger's bank account
  Memory – receipt stored in blockchain

Figure 6 - Scenario 4 - Recognition

The Internet of Things has long promised a new level of personalised services building on your personal preferences and data base of behaviours to proactively connect you to products and services. in this case identity recognition is enabling a personalised greeting and any personal preferences matched to the customer. Room entry is automatic as you approach the door.

Design Principles:

- Design as a Journey – from home to final destination
- Proactive Messaging – the hotel can follow and prepare for the arrival of the traveller
- Authorisation – identity validated by the passenger's national passport office
- Memory – Personal preferences, room style, tone of voice, health allergies, favourite activities can be stored and used to provide a personal service
- Single Sign On – all data can be exchanged without forms or duplication

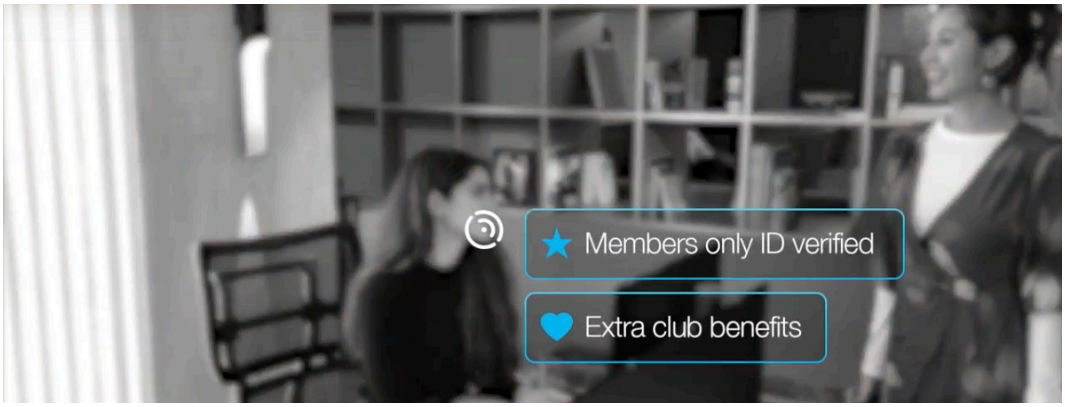

Figure 7 - Scenario 5 – Access

Identifying access to exclusive services and building loyalty reward programmes.

Design Principles:

- Proactive Messaging – to the service provider, that a member is close by or in the country
- Authorisation – membership status can be checked
- Memory – personal preferences, stored and used to deliver unique services

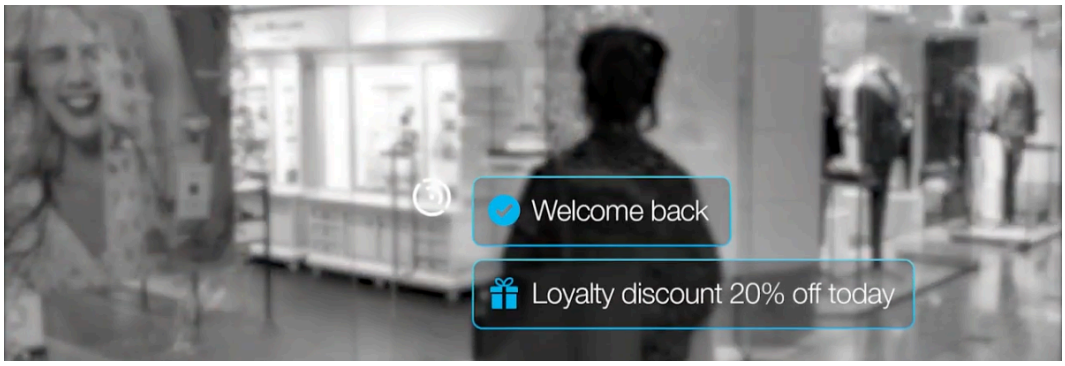

Figure 8 - Scenario 6 – Retail Experiences.

Identification at a store entrance unlocks recognition and personal incentives to shop and build loyalty - making data sharing valuable and desirable.

Design Principles:

- Design as a Journey – development of customer experience
- Authorisation – brand loyalty and reward schemes
- Memory - date and Location stamped on the Blockchain and usable in digital identity applications

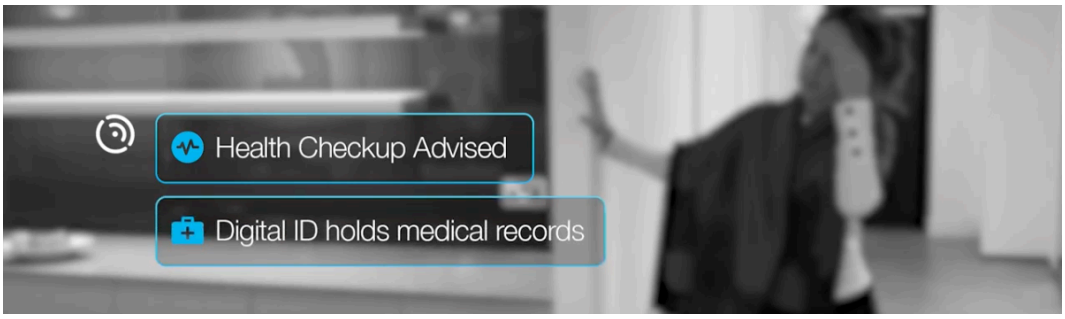

Figure 9 - Scenario 7 - Personal Data.

In the example of medical data, relevant information can be shared, securely and in confidence. Proactive warning of allergies, medical history and preferred methods of treatment can be shared in an instant with any medical service provider.

Design Principles:

- Authorisation – trusted medical provider

Conclusions

This case study shows how service design methodologies have developed a more human-centred experience for one of a new generation of automated services that depend on a complex technology-based system. With Blockchain and other similar technology enabled systems, speed, scale and efficiency make them attractive in streamlining and replacing complex human processes. The applications of Artificial Intelligence, for example, includes many complex decisions with important consequences for those involved, whether calculating sentences in court convictions or deciding which patient will most benefit from an organ transplant. In this case, the security and accuracy of Blockchain provides the means to allow, or bar, entry to a country.

One of the consequences of these processes is that the means of control and user interaction disappears and automated decisions become opaque and irreversible. Systems are susceptible to unintentional and unchecked bias and interactions lack the affordances of control and safeguarding of individual data.

Design methods have the capacity to shape such technologies to be future proof and human focused and in doing so remove both economic and social risk. Design solved the challenges created by the transparency and invisibility of Blockchain enabled services – how do we understand and have confidence in our transactions? What if things go wrong, how do we mend and redo? How do we transition to seamless and transparent experiences confident that we can revisit, validate, check and confirm? And how do we stay in control of the consents that may become automatic with unwanted consequences?

Applying service design practice and methodology transforms technology opportunity into human benefit. In this case study, design methods made a substantial impact on the outcomes. By working with potential users, insights led to the design of the user journey that mitigated against their fears and concerns. Secondly, broader exploration of the experience generated a series of innovative scenarios which will stimulate the development of new services. Finally, the themes from the user research led to a framework of design principles which can now be developed and tested with future applications of Blockchain services. These principles have the potential to challenge and improve the governance of technology systems to ensure they operate without confusion in an accessible, usable, transparent, unbiased and seamless way.

Blockchain has the potential to free us from process, system-based restrictions, biased and prejudiced decisions, form filling and duplication. From the experience of arriving at Dubai airport to shopping at a Prada store or arriving at a refugee camp in Turkey, service design practice and methodologies will help these developments be useful and valuable in the realm of commerce, identity and security and create transformational experiences for both the wealthiest and the most vulnerable in society.

In times of global pandemic and the aftermath, we will be looking for solutions that explore zero interfaces free from the risk of physical contamination. Blockchain and a host of automated systems will enable these new experiences but design tools and methodologies will be required to ensure they are truly accessible, inclusive, transparent and fair to all users.

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