**Referring directly to the paper ‘Artificial Intelligence Implementations on the Blockchain. Use Cases and Future Applications’ (Sgantzos & Grigg, 2019) explain the following:**

**What is AI?**

**What is an AIA, and why might it be useful to place AI on the blockchain?**

**What is Conway’s Game of Life and what is its relevance to Bitcoin?**

**Is Bitcoin Turing Complete?**

Artificial intelligence (AI) is defined by Professor John McCarthy as the science and engineering of making intelligent machines, related to the task of computers understanding human intelligence *(McCarthy, 2007).* In other words, artificial intelligence is the creation of machines that can think in a way similar to a human.

An AIA is an artificial intelligence agent which, unlike the trained framework, continues to learn from users newly imputed data *(Grigg & Sgantzos, 2019).* AI code can be stored on the blockchain, this creates an opportunity for technological advancement as a large number of users can learn from a large amount of data *(Grigg & Sgantzos, 2019)*. Placing AIA on the blockchain means existing code repositories can be used, translation of coding languages can be done easily and patterns in data can be identified *(Grigg & Sgantzos, 2019).*

Conway’s Game of life is a form of cellular automation with two states and two dimensions *(Grigg & Sgantzos, 2019)*. Cellular automation is used to represent the smallest possible computational unit to act as a neuron within some genetic algorithm *(Grigg & Sgantzos, 2019).* Conway’s Game of Life is played on a 2D grid and consists of the following rules: populated cells with less than 2 neighbours die, populated cells with more than 3 neighbours die, unpopulated cells with at least 3 neighbours become populated, populated cells with 2 or 3 neighbours survive *(PR Newswire, 2020).* The relevance to bitcoin is that Conway’s Game of Life is Turing-complete, so should this game be replicated on the Bitcoin-SV blockchain it would provide evidence for the Turing-Completeness of bitcoin *(PR Newswire, 2020).*

Something can be proved to be Turing-complete should it be able to execute and replicate another Turing-complete algorithm. Bitcoin SV has been argued by some to be Turing-complete while others believe it does not have the computational power to be. It is argued that bitcoin script does not enable the use of loops which restricts its algorithmic output and means it would not be considered as Turing – complete *(Wright, 2016).* However, it is also widely discussed that the bitcoin scripting language that creates new blocks could also be argued to be an endless loop which, given the right conditions, could perform as a ‘while loop’ which is a Turing-complete algorithm so would provide evidence for the argument that bitcoin itself is Turing-complete *(Jansen, Ddhili, Gouiaa & Qasem, 2020).* In Grigg & Sgantzos’s paper they describe that should the blockchain’s computing capability be Turing-complete, then it would have the ability to run any cellular automation such as Conway’s Game of Life *(Grigg & Sgantzos, 2019)*. They also discuss previous research has been conducted into the proof of the blockchains ability to run cellular automation in the form of CA110 *(Grigg & Sgantzos, 2019)*.

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**Monzo Business Report and Strategic Recommendations**

**Preface**

This report will first define and outline the business model of app-based challenger bank Monzo. This will include a description of current published user data and an analysis of the area this FinTech is disrupting using the World Economic Forum taxonomy. Next, recommendations will be made based on the profitability problems Monzo are currently facing due to reduction in interchange fee profits caused by the ongoing pandemic. This report will be concluded with a summary of the identified issues facing Monzo and the recommendations provided to help address these.

**General Background**

Monzo is an online challenger bank and was launched in 2015 by Tom Blomfield, previously a chief technology officer at Starling Bank *(Makortoff, 2021).* Monzo has a full banking license and has been regarded to have revolutionised the customer-facing side of banking and current accounts through their simple to use app *(Powell, 2020).* This shift from traditional banking resulted in Monzo receiving a large number of customers eager to deposit their funds *(Powell, 2020)*. In the 2020 financial year Monzo increased from 1.6 million customers to 3.9 million despite the financial strains of the pandemic *(Monzo, 2020).* This growth continued into 2021 with Monzo reporting a current customer base of 5.11 million *(Monzo, 2021a).* The main selling points of a deposit account with Monzo are that it gives its users no fees when using their card abroad, instant phone notifications for transactions, built-in app features for money management and even allows its customers the ability to receive their salaries a day early *(Cavaglieri, 2020).*

As a FinTech firm, Monzo creates disruption to the traditional financial services sector. The World Economic Forum conducted research into the areas of disruptive innovation in the financial sector. From this they published a framework of the 6 financial areas and 11 clusters of innovation *(World Economic Forum, 2015).* Monzo falls into the deposits and lending financial service function and its innovation that creates pressure on the traditional financial industry is referred to as ‘shifting customer preferences’. The World Economic Forum discussed how challenger banks such as Monzo are becoming so popular. This was stated to be because of a generational shift in customer adoption of new technologies and new preferences for financial products *(World Economic Forum, 2015)*. This means customers are now looking for more user friendly, technology-based, customer focused banks to deposit their money. The online challenger banks provide their customers with easier access to financial services as they no longer need to physically go to a bank. This provides great convenience which is becoming more and more important to consumers in a variety of sectors.

Monzo creates its profit through a variety of activities. Monzo receives a small interchange fee from a merchant when a customer makes a purchase using their card *(Viktor, 2021).* They also receive a fee of 50p per day for deposit accounts that are overdrawn *(Viktor, 2021)*. Similarly to more traditional banks whose biggest asset is their loans, Monzo allows loans of up to £15,000 and profits from the interest charged to these accounts *(Viktor, 2021)*. Finally, Monzo earns interest on the deposits from their customers as they can lend these funds to other financial institutions and reclaim the interest earned as profits. These are all ways that Monzo can earn profit from its users who open one of their free to use deposit accounts. However, Monzo also offers business accounts and premium accounts which require a monthly subscription fee to use *(Kelly, 2020)****.***

Despite its popularity growth, Monzo warned its customers and shareholders that the pandemic was causing great concerns that the challenger bank may not be able to continue operating as it had been unable to break even *(Megaw, 2021).* The reason for Monzo’s profitability issues is user’s reduction in spending during the pandemic. It is becoming apparent that Monzo customers utilise their accounts for disposable income purchases such as restaurant meals rather than for other services commonly offered by banks *(Megaw, 2021)*. This could be a result of lack of confidence in new challenger banks, so customers use their traditional bank account for other financial activities such as loans and overdrafts. Consumer confidence is an issue that Monzo should investigate further along with how to encourage users to utilise other aspects of Monzo’s financial service offerings such as loans.

**Recommendations**

Monzo may be facing profitability problems caused by the pandemic but they also have an opportunity to create success from it. The pandemic has further accelerated the changing preferences of consumers in regard to the use of physical banking. More consumers are opting for the convenience of online challenger banks which can be seen with Monzo’s increased customer base. However, Monzo face the lack of consumer confidence suffered by many FinTech firms. This means that customers may only use their Monzo accounts for budgeting and small purchases while using a more traditional bank to store savings and as their main current account. It would therefore be beneficial that Monzo advertise their banking licence and their financial services compensation scheme protection. Although this is standard for any FCA registered bank, this may not be known by the general consumer so would be beneficial for customer confidence. Monzo’s new customer base makes advertising more cost effective. This is because the firm can target their advertising in-app to their new users who may not yet be utilising Monzo as much as they could. This means the firms marketing budget could be used elsewhere to create a good brand image. Other FinTech firms have improved their brand image and therefore customer confidence by creating environmentally friendly schemes such as Ant Financials’ Ant Forest. Ant Forest rewards its users for every green activity they participate in with ‘green points’, when a user has collected enough points a tree is planted *(United Nations, 2021)*. Ant Forest is very successful and has attracted 500 million users, resulting in the planting of 100 million trees *(United Nations, 2021).* This not only shows excellent corporate social responsibility of a business, but also attracts more users to the platform, resulting in more time spent on the app. If Monzo created an ethical scheme this would attract more users and also increase consumers’ confidence in the brand, potentially leading to them depositing larger quantities of money and using more of Monzo’s financial services.

Another point of concern for Monzo is their lack of usage of customer deposits. It was reported in their 2020 published balance sheet that Monzo had only issued £124 million of loans (£56 million of which were actually overdrafts) when customers had deposited around £1.4 billion into their accounts *(Powell, 2020)*. This means Monzo are not utilising the full extent of their asset base and are being particularly strict on loan amounts and criteria for acceptance. If Monzo were to lend more money, they would earn more interest and become more profitable. This is how traditional banks make their most income. This issue is believed to be caused by Monzo being focused on its growth as a new company rather than its profitability *(Powell, 2020)*. It would therefore be beneficial for Monzo to spend time and resources on building a loan model that works for them. This is a way for them to ensure they increase the amount of funds they loan out while guaranteeing it is going to reliable, credit worthy places. These increased loans will be of great importance to the profitability of Monzo as current economic uncertainty and constant competition could move customers away from the challenger bank should they not offer the banking services to the standards their customers expect. With the pandemic bringing worries of negative interest, Monzo needs to act quickly to set up a successful loan model. This is because negative interest is very dangerous for challenger banks, particularly those which hold onto money and deposit them with the central bank rather than investing or loaning the funds out *(Weeks, 2020).* If negative interest was implemented, banks would have to pay interest to store their funds at the central bank which could result in high liquidity risk. Therefore, Monzo should prepare for these circumstances in order to manage their risk exposure.

**Summary**

In summary, Monzo has the customer base, funding, business model and potential to become a profitable business in the future. However, economic uncertainty and the pandemic has identified the areas that are currently stopping the firm from breaking even. Monzo should use the pandemic as an opportunity to start utilising the increase in deposits they’ve gained from a rise in users and start gaining interest on these in order to ensure the survival of the firm. The company should also look to ways to gain the confidence of their users, this would mean they would start using Monzo as their main current account and for larger purchases resulting in more income for the company. This can be done by directed advertising or activities that increase brand image perception.

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