National College of Ireland

A Study on the Perception of Adopting Blockchain-Based Music Distribution Applications Among Independent Artists in Ireland.

MSc Research Project
MSc FinTech

Joshua Allotey
Student ID: 21154252

School of Computing
National College of Ireland

Supervisor: Brian Byrne

National College of Ireland

Project Submission Sheet – 2022/2023

Student Name:	Joshua Asuquo Allotey		
Student ID:	21154252		
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A Study on the Perception of Adopting Blockchain-Based Music Distribution Applications Among Independent Artists in Ireland.

Joshua Asuquo Allotey
21154252
MSCFTD1
National College of Ireland

Abstract

This study investigates how trust in blockchain technology influences the adoption of blockchain-based music distribution applications among independent Irish artists. This study assesses relevant past literature on blockchain technology and the music industry to provide greater context on the field of study. Guided by the Theory of Reasoned Action, the study conducts a survey featuring Likert scale questions and employs R for data analysis. Techniques such as Principal Component Analysis, Factor Analysis, Ordered Logit Regression, KMO, Bartlett's test, and Cronbach's alpha are applied to the dataset. Findings unveil the impact of trust on artists' technology adoption choices, providing valuable insights for the music industry, technology developers, and policymakers.

Keywords: Blockchain Technology, Independent Artist, Music Distribution, Theory of Reasoned Action.

1. Introduction

A music artist is an individual who creates, produces, or performs music professionally or intends to do so. Independent music artists manage their entire music creation, promotion, and sharing process without a record label's involvement. Record labels act as investment banks for musicians, providing resources which enhance music creation, distribution, and promotion. While some independent artists gain recognition, historically, they often receive less attention and income compared to those signed with record labels. Notable exceptions include artists like Tyler, The Creator, Frank Ocean, and Chance the Rapper, who achieved global success independently. Nevertheless, historically, independent artists tend to go unnoticed and make less income when compared to those signed to record labels.

The rapid advancement of technology in the past 30-40 years has revolutionized music creation, enhancing speed, efficiency, and quality. The emergence of the first Digital Audio Workstation (DAW) in 1977 by 'Soundstream' marked a major leap forward, allowing musical computation on a minicomputer setup (Cortez, 2022). Modern DAWs empower individuals with laptops or phones to create music anytime, eliminating the need for studio access. Social media platforms became pivotal for music promotion. The first platform, 'Six Degrees,' was launched in 1997 by Andrew Weinreich, paving the way for Facebook, Twitter, Snapchat, and Instagram. Online music streaming, a landmark advancement, began with 'Napster' in 1999 and gained prominence through Spotify, Apple Music, Soundcloud, and Amazon Music. This innovation significantly transformed music consumption, with streaming

constituting 54% of total consumption, encompassing subscription, video, and ad-supported streaming (Ferjan, 2023).

The new-found ease of access to music creation, distribution, and promotion hasn't guaranteed instant success for independent artists, nor has it eradicated the challenges that artists face. Challenges like copyright protection, limited fan engagement, and a fair royalty payment system persist. Success for artists means generating enough income from various avenues like royalties, live shows, merchandise, and brand partnerships, to sustain their full-time music careers.

Independent artists often rely on streaming royalties and local gigs as their primary income sources. Three types of royalties include 'pay-outs to recording owners,' 'public performance royalties,' and 'mechanical royalties.' Among these, mechanical royalties, earned from online music streaming, are significant for independent artists, especially from popular platforms like Spotify, Apple Music, Amazon Music, and TIDAL (Yonata, 2023). For instance, Spotify pays about $0.0033 per stream (Business Insider, 2021), while Apple Music, Amazon Music, and TIDAL pay $0.008, $0.00402, and $0.01284 respectively (Producer Hive, 2022). Achieving a milestone of 1 million streams on one song might earn an artist around $3,300 (Spotify), $8,000 (Apple Music), $4,020 (Amazon Music), and $12,840 (TIDAL). Independent artists might take years to reach such milestones, particularly without the support of a record label's exposure.

This data suggests that, in most instances, pursuing full-time music as an artist is financially challenging, especially without record label support. Outsourcing services like production amplifies costs. High living expenses in Ireland often necessitate secondary jobs, impinging on crucial music creation time. Financial constraints, combined with music's easy replication and limited fan interaction on most streaming platforms, create a gap in artists' distribution needs.

For artists, an ideal platform would mean fairer income via royalties, robust copyright protection, heightened artist-fan interaction, and comprehensive performance insights. Blockchain-based music platforms like 'Musicoin,' 'eMusic,' 'BitSong' (Oyinloye, 2022), and the Irish-owned 'SoundMint' offer these features. Surprisingly, Irish independent artists have yet to widely embrace these platforms, perhaps due to limited awareness of blockchain technology or residual scepticism following the cryptocurrency market crash in May 2022. Nevertheless, with such promising positive implications for the use of blockchain services for distributing music for independent artists, coupled with the lack of adoption in Ireland, the opportunity detailed above motivates the following research question:

> "*To what extent will trust in blockchain technology impact the likelihood of adoption of blockchain-based music distribution/streaming applications by independent artists in Ireland?"*

2. Literature Review

What is Blockchain?

Blockchain is a peer-to-peer technology that records transactions onto a decentralised and distributed ledger. In 2008, blockchain was developed and introduced in conjunction with

the invention of "Bitcoin" (Sitonio & Nucciarelli, 2018). For peer-to-peer networks to work, they require many computers or devices connected to the network acting as ‘nodes’. Each node holds a copy of each transaction on the public ledger. As a result, the ledger can be updated with transactions without the supervision of any third party (Lindgren & Ghafoor, 2023).

A mechanism known as ‘proof-of-work’ is utilised by ‘miners’ (network nodes employed exclusively for obtaining new tokens in a blockchain network) to verify transactions, which are viewed as updates to the ledger on the blockchain. According to Sitonio and Nucciarelli (2018), ‘proof-of-work’ involves miners competing to solve challenging mathematical or cryptographic functions that aid in the creation of new blocks. 'Digital signatures' are used to secure transactions on a blockchain network (Crosby et al. 2016). Before a transaction is sent to the recipient's public key, it acquires a digital signature from the sender's private key. To complete the transaction, the recipient uses the sender's corresponding private key to verify and authenticate the digital signature (Crosby et al., 2016).

Transactions turn into blocks once verified by miners and are permanently added to a sequence of blocks, forming a blockchain—a connected record of transactions (Biscontini, 2023). This blockchain technology ensures strong transparency, as all nodes possess identical, reliable information. Additionally, it guarantees security and immutability, preventing the alteration of verified transactions. These attributes underscore the current influence and future potential of blockchain technology. In the context of the research question, there is a chance that an artist’s trust in blockchain can be enhanced with the knowledge of these key transparency, security and immutability features that blockchain offers which can ultimately lead to a higher chance of adoption.

The Music Industry

Historically, the music industry comprises three primary bodies: artists, record labels, and the audience. Artists engage in music creation, composition, singing, and production. Record labels undertake the distribution and promotion of music produced by their signed artists. The audience includes individuals engaged in the reception of these processes through listening (Kiresci, 2021). Kiresci (2021) outlines two distinct categories of record labels within the music industry: major record labels and independent record labels. The major labels encompass prominent global conglomerates such as Sony Music Entertainment, Universal Music Group, and Warner Music Group, collectively referred to as the 'big three.' These entities hold significant influence across the global music landscape, effectively establishing dominance within the industry (Kiresci, 2021).

Major Record Labels

Major record labels offer a range of artist-focused services, such as management, music production, sound engineering, and legal support, fostering the optimal development of the artists' musical creations (Kiresci, 2021). Despite major labels initially commanding over 85% market share in 2016 (including EMI) (University of Minnesota, 2016), the share dipped to nearly 80% (78.86%) in 2023 (Hype Bot, 2023). This shift can be attributed to the emergence of digital streaming and downloads, leading to a decline in music sales from $14

billion in 2000 to around $7 billion in 2015 (Macy et al., 2015). The growth of streaming, while convenient for consumers, poses profitability challenges for both artists and labels.

The impact this trend has had on major labels may discourage emerging artists from pursuing label deals. For artists, this may come at the cost of assuming more responsibilities such as music production, performance, mixing, mastering, and promotion (Macy et al., 2015). Balancing these tasks can be challenging, especially when independent artists often juggle other commitments like education or employment. An alternative option involves outsourcing these tasks to independent professionals, albeit at a higher cost. Thus, emerging artists face a choice between label support and self-reliance, depending on their portfolio and standing in the industry. Opting for an independent path may require artists to seek a platform that can optimize their earnings, enabling them to fund professional assistance or enhance their music-related revenue. This is an avenue where blockchain technology could offer valuable contributions.

Independent Record Labels

In contrast to major record labels, there are independent record labels. These labels encourage artists to “make music on their terms, away from the dominance of major record labels” (Madeleine Amos, 2021). They function as smaller entities similar to major labels but are distinct and operate independently, without major label affiliations and with their own funding. Notable independent labels, like 'XL Recordings', 'R&S', 'Warp', and 'Ghostly International', have achieved significant popularity and influence (Complex, 2017). Despite their substantial reach, they remain independent by not being part of the 'big three' record labels. These indie labels have succeeded by fostering collaborative platforms that enable them to overcome previous limitations, such as geographical isolation and the connections within major labels (McLeod, 2005).

Despite the economic challenges associated with remaining independent in the music industry, the independent record label business model and being an independent artist offer various positive outcomes. These positives include enhanced collaboration opportunities among artists, producers, and sound engineers. Furthermore, the independent landscape fosters entrepreneurship, enabling individuals to develop marketable skills that can be reinvested within the music community. Notably, these gains align with McLeod's (2005) perspective on the industry's potential for a healthier future, fostering creativity and diverse expression. Similarly, the impact of file-sharing and digital distribution, as supported by Walzer (2016) and McLeod (2005), has facilitated music's accessibility and discovery. However, despite these advancements, a sense of incompleteness persists from the lack of an appropriate platform to work from. This gap is where blockchain technology could play a pivotal role, as evidenced by the literature explored of its features and potential benefits for independent artists.

Fragility of Music Careers

The music industry presents hurdles for sustained success due to fierce competition and the impact of gatekeepers such as artistic directors and managers. Musicians often hinge on their reputation, facing career fragility, particularly without job stability (Moxey and Daniel, 2023). The COVID-19 pandemic abruptly halted live performances, triggering widespread job loss for musicians. Transitioning performances to online platforms was a short-term fix, leaving the industry's fate uncertain. The aforementioned positives blockchain

can pose for artists and the music industry The potential benefits of blockchain for artists and the music industry indicate that even if live performances were to become infeasible again, artists could still enhance their financial support through increased earnings from blockchain platforms. This could level the playing field in a way as artists with bigger reputations would be making the most money from live shows compared to lesser-known artists.

Blockchain in the Music Industry and its Impact on Artists

Blockchain and Royalty Payments

Utilizing blockchain technology in the music industry, especially for independent artists, requires addressing key concerns: secure storage, rights protection, and direct artist payments. The research examines how blockchain aids artist payments, with music royalties being payments for intellectual property use, distributed among stakeholders (Yahya & Habbal, 2021). Lack of transparency in income transmission leaves artists with minimal earnings due to intermediary charges (Zhao & O'Mahoney, 2018). Blockchain's smart contracts ensure clarity by automating contract terms and transparently executing payments (Crosby et al. 2016). This improves payment speed and minimizes conflicts (Turchet & Ngo, 2022). Blockchain's hosting of technologies like NFTs (non-fungible tokens) gifts artists an enhanced ability to control the allocation of royalties associated with their music (Galphat et al., 2023). Blockchain's potential impact on independent artists' royalty payments is evident, particularly in blockchain-based music distribution or streaming applications. The next focus is on how blockchain enhances artists' rights preservation and handling.

Blockchain and Copyright Management

Music copyright grants artists various rights over their creative works, including authorship claims, protection of integrity, and control over distribution (Zhao & O'Mahoney, 2018). These rights enable artists to profit from their music by regulating its usage. There are two main types of music copyright: sound recording and musical composition, covering performers and producers as well as songwriters, composers, and publishers, respectively. With digital audio workstations (DAWs) gaining prominence, these copyrights are converging (Bontempi et al., 2023). Online platforms expose intellectual property to copying and imitation, fostering piracy and undermining artist recognition (Ramani et al., 2022). In the past decade, there has been less tolerance for unauthorized use of copyrighted content. Major online platforms, especially those with user-generated content, have adopted strong content moderation systems to reduce copyright violations (Brovig-Hanssen and Jones, 2023). One of the systems has been digital rights management (DRM). DRM involves techniques such as altering file formats and flagging trusted devices to prevent unauthorized access, although it has limitations in terms of backup management (Ramani et al., 2022). Despite the positives of DRM systems, they possess limitations like creating difficulty for legal consumers at times when searching for, accessing, using, and sharing digital information goods (Ciriello et. al, 2023).

Blockchain emerges as a suitable solution for DRM, addressing copyright discrepancies across music platforms (Zhao & O'Mahoney, 2018). Blockchain's immutable database can securely store copyright information, ensuring accuracy and preventing tampering. Smart contracts further enhance this by enabling unchangeable ownership records (Ramani et al., 2022). Additionally, digital watermarks can be embedded in audio files,

aiding in copyright protection and distinguishing authorized listeners (Ciriello et. al, 2023) (Zhao & O'Mahoney, 2018). In the context of copyright protection, blockchain also opens up the possibility for artists to use NFTs to prove ownership of their original music on blockchain networks (Galphat et al., 2023). This further aids in eradicating the unlawful reproduction of artists' music.

The existence of blockchain-based music platforms like 'Audius,' 'OPUS,' and 'Emanate' demonstrate the practical implementation of the key concerns that require addressing as these platforms and more facilitate direct royalty payments, enhance copyright protection, and operate within a decentralized blockchain ecosystem (Oyinloye 2022).

What Might it Take for Artists to Adopt Blockchain?

Outlined above are reasons why blockchain serves as a fitting modern-day solution to the key concerns faced by independent artists but with commercial solutions existing, what factors could be hindering blockchain adoption in this context? The Theory of Reasoned Action (TRA), developed by Fishbein and Ajzen (1975) (Nickerson, 2023), provides valuable insights into the behavioural motivations of individuals based on their intentions and attitudes. When considering the adoption of blockchain technology by independent artists for music distribution, attitudes represent artists' evaluations of the advantages offered by blockchain technology, such as enhanced transparency, heightened security, and the potential for direct artist-fan payments and interactions. Positive attitudes towards these benefits build trust and are likely to contribute to the adoption of blockchain platforms. Positive attitudes towards these benefits cannot be experienced by the artists without prior knowledge or beliefs of the benefits, therefore, knowledge of blockchain technologies is required for any trust to be built. This positive attitude, driven by trust, can directly influence the intention to adopt blockchain technology. Artists who believe that blockchain can deliver on its promises are more likely to express a strong intention to embrace it for music distribution. As a result, trust and knowledge play crucial roles in driving the intention to adopt blockchain technology in the music industry.

The above research shows that, for independent artists to become likely to adopt blockchain, a certain level of trust needs to be built within them, and to build this trust, a foundation of knowledge must be set within them first. In attempting to address the research question effectively, it becomes imperative to assess the levels of knowledge and trust among independent artists.

Research Contribution

The research carried out as part of this project will not only ascertain the current level of knowledge around blockchain technologies within independent artists in Ireland, but it will build it up and use both the pre-study and post-study knowledge and trust benchmarks to measure how much of a factor trust is in the likelihood of these artists adopting the technology. Existing research does not address the utilization of these technologies specifically among independent artists in Ireland. Therefore, this study aims to pioneer and provide insights into this unexplored territory, addressing the research question.

3. Research Methodology & Design Specification

A. ***Research Methodology***

The primary goal of the study was to identify how much of a factor 'trust' is in influencing an independent music artist to adopt a new technology to distribute their music with. The study was carried out with the use of a survey which was sent out to independent music artists within Ireland. The survey was brief and contained questions that returned basic demographic data from the artists, information about their music-related habits, and information about their attitudes towards blockchain technologies. Most importantly, in the survey, were the sections learning the artists' attitudes to blockchain technologies as their attitudes were gauged before and after the study, with an educational piece about the real-world implications blockchain can and is already having on the music industry with information about existing platforms. The questions were asked in a simple, clear, and easy-to-understand manner and the participants were informed that no sensitive data was required and that any data collected would be disposed of before the completion of the research.

Data Collection and Sample Size

The survey was aimed at and distributed to artists using social media as the primary dissemination channel, although, the survey was distributed to artists through multiple channels. Firstly, it was sent out using the researchers personal Instagram account, leveraging their existing network of contacts within the artistic community. Additionally, the survey was shared on the Shed Residents account (Dublin-based electronic music events collective) via a story post, which boasts a considerable reach of 4.8k+ followers among which are some up-and-coming independent artists within Ireland. Furthermore, the survey dissemination was greatly facilitated by friends and acquaintances who actively participated in sharing the survey, further expanding its outreach. A total of 76 respondents participated and provided their input in the survey. This number of respondents can be seen as indicative of how particular the targeted demographic is.

Scales and Measurements

A five-point Likert scale as such – 1 = Strongly Disagree, 2 = Somewhat Disagree, 3 = Neutral, 4 = Somewhat Agree, 5 = Strongly Agree – was used in the survey to gauge the artists' levels of knowledge and trust in blockchain along with their likelihoods to adopt blockchain before and after reading the educational piece (SurveyMonkey).

B. ***Design Specification***

To derive meaningful insights from the data collected in attempts to answer the research question, the data was analysed using the R programming language in Google Colab (Click HERE to view) to read in the data, create perceptive visualisations from the data, run Principal Components Analysis (PCA), Factor Analysis (FA), and Ordered Logit Regression (OLR) models on the data, and perform the Kaiser-Meyer-Olkin (KMO) test, Bartlett's test of Sphericity and the Cronbach's Alpha Test.

Null and Alternative Hypotheses

Before starting the experiment, it is important to set out the null and alternative hypotheses. The chosen significance level was 0.05 as it is the standard alpha.

Null Hypothesis (H0): There is no significant relationship between trust in blockchain technology and the likelihood of adoption of blockchain-based music distribution applications by independent artists in Ireland.

Alternative Hypothesis (Ha): There is a significant relationship between trust in blockchain technology and the likelihood of adoption of blockchain-based music distribution applications by independent artists in Ireland.

Survey Formation

The survey sent out to independent artists contained 10 questions. The variables resulting from these questions can be categorised in 3 ways, 'demographic variables', 'behavioural variables', and attitudinal 'variables'. The demographic variables were 'Age' and 'Gender', the behavioural variables were 'Streaming.Platform.Used' and 'Distribution.Platform.Used', and the attitudinal variables were 'Current.Platform.Satisfaction', 'Knowledge.Before', 'Trust.Before', 'Adoption.Likelihood.Before', 'Trust.After', and 'Adoption.Likelihood.After'. The behavioural questions set out to ascertain the artists' habits with streaming and distribution platforms while the attitudinal variables set out to ascertain the artists' levels of knowledge, trust, and likeliness to adopt blockchain technologies for their music distribution before the study and after reading the educational piece about the study in the survey.

Data Cleaning

The data received from the survey did not require any cleaning as all questions in the survey were made mandatory to complete given the survey's concise nature.

Descriptive Statistics and Visualisations

The minimum, median, mean and maximum measures for the numerical Likert scale data were produced giving the most basic insights into the nature of the data recorded. This was subsequently followed by rich visualisations in the forms of Pie and Bar Charts to facilitate a more comprehensive understanding of the data and trends within the data.

Principal Component Analysis (PCA)

Principal Component Analysis is a technique used for reducing dimensionality in extensive datasets. It achieves this by converting a comprehensive array of variables into a more concise set that retains the core information present in the initial dataset. It helped to capture the most significant variance in the data, retain essential patterns from the data and discard the less important information. PCA was used to inform how many factors EFA would be attempted with.

Exploratory Factor Analysis (EFA)

Exploratory Factor Analysis is a dimension reduction method that identifies underlying factors (latent variables) that explain the patterns of correlations between observed variables. EFA helped to expose the underlying structures and patterns within the data and to present them in a simpler form. Often utilised to identify unobservable constructs in psychological, behavioural, or social sciences and reduce the complexity of datasets while displaying important information about the relationships between variables.

Kaiser-Meyer-Olkin Test (KMO)

The Kaiser-Meyer-Olkin (KMO) test assesses data for suitability for factor analysis. It helps to measure the proportion of variance in variables that can be explained by underlying factors, determining the appropriateness of applying factor analysis. Ranging from 0.0 to 1.0, KMO values above 0.6 indicate suitability, while lower values suggest inadequacy.

Bartlett's Test for Sphericity

Bartlett's Test of Sphericity checks if variables are suitable for factor analysis by testing their intercorrelation. A significant result suggests that factor analysis may be appropriate, while a non-significant result indicates it may not be suitable.

Cronbach's Alpha Test

Cronbach's alpha assesses the internal consistency of a scale or questionnaire. High alpha values (>= 0.7) indicate good reliability, while low alpha values (< 0.7) suggest the need for improvement.

Ordered Logit Regression Model

The ordered logit or ordinal logistic regression model is a statistical method used to analyse data with an ordinal dependent variable. It is suitable for analysing data with ordered response options, such as the Likert scale data from the survey. The OLR model was used to estimate the relationships between the other individual independent variables with the Adoption.Likelihood.After variable as the dependent variable.

Ethical Issues

The questionnaire provided to respondents was clear and easily understandable regarding its purpose, content, and how their participation contributes to the research objectives. Personal information, such as names, locations, and email addresses, was not collected to ensure confidentiality. Participants were guaranteed that any data collected could not harm them and would be disposed of before the completion of the research.

C. ***Implementation / Solution Development***

Inspiration for the implementation of the PCA and FA solutions was derived from Murphy (2021), Dang (2021), TechVidvan (2021), Statistics Solutions (2021), and Katchova (2021). Inspiration for the implementation of the ordered Logit model was derived from Katchova (2021). The implementation of the methodology began with the loading of required libraries and reading in the data. The attitudinal variables were bound to the variable 'X'.

Descriptive Statistics

The averages of each of the Likert scale variables gave the first indications as to how positive or negative artists felt regarding the questions they were asked. The standard deviations and variances of the Likert scale variables showed how dispersed the data points were from their means with the variances showing the squared differences, providing introductory insight into the data.

Visualising the Data

A correlation matrix of the attitudinal variables was first created (seen in Figure 1). It displayed some strong correlations between variables but most notably, some lacklustre correlations among variables with 'Current.Platform.Satisfaction'.

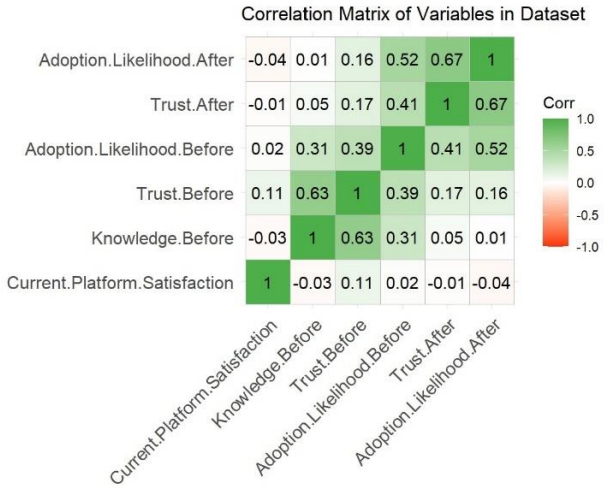

Figure 1: Correlation Matrix of Attitudinal Variables

From here, visualisations were created to enhance the insights derived from the data and make them more comprehensible. The demographic data is visualised in Figures 2 and 3:

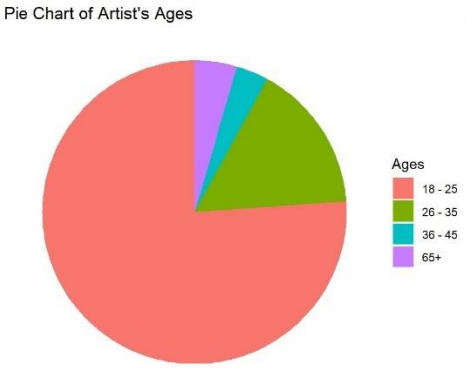

Figure 2: Pie Chart of Artists' Ages

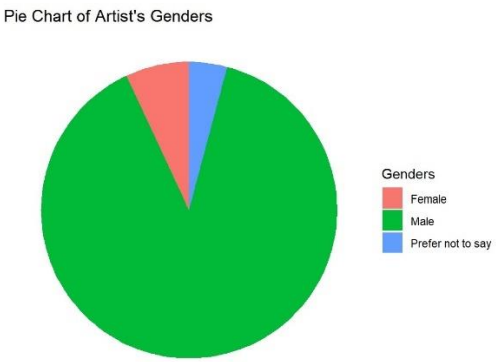

Figure 3: Pie Chart of Artists' Genders

After these, bar charts were generated to display artists' interactions with platforms for personal use or distribution purposes, as seen in Figures 4 and 5:

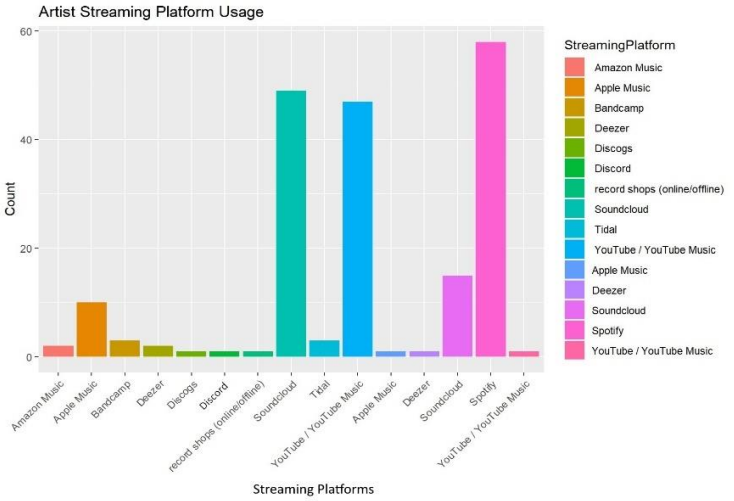

Figure 4: Artists Streaming Platform Usage

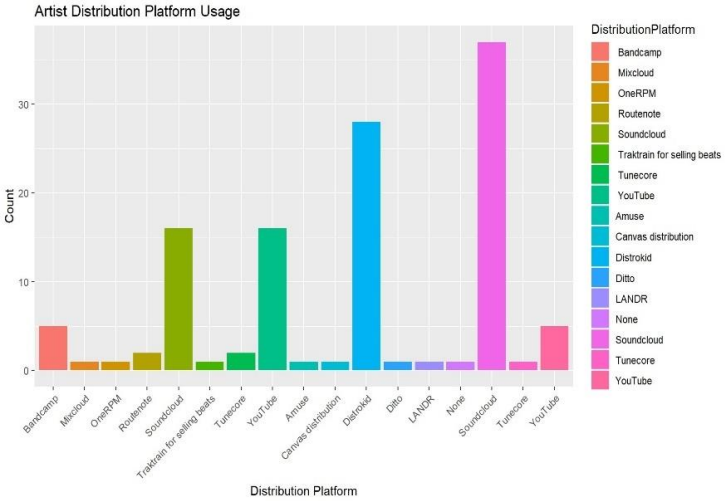

Figure 5: Artists Distribution Platform Usage

Following these charts, visualisations of the attitudinal variables were generated providing a quick overview of artists' sentiments towards their current distribution workflow, seen in Figure 6;

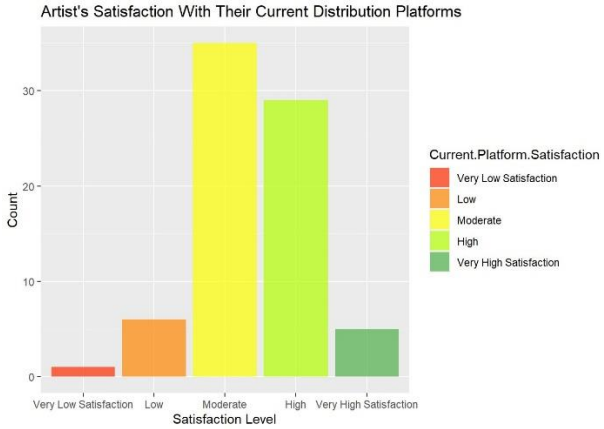

Figure 6: Artist's Satisfaction with Their Current Distribution Platforms

Their sentiments towards blockchain technologies before the study (figures 7, 8, and 9);

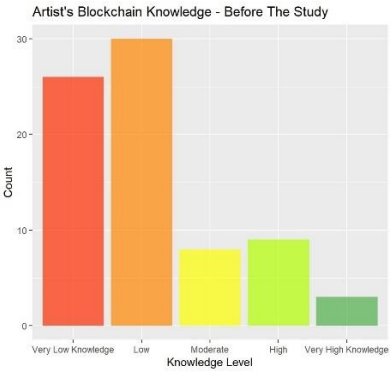

Figure 7

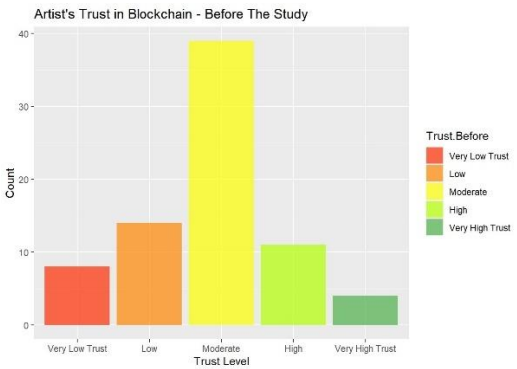

Figure 8

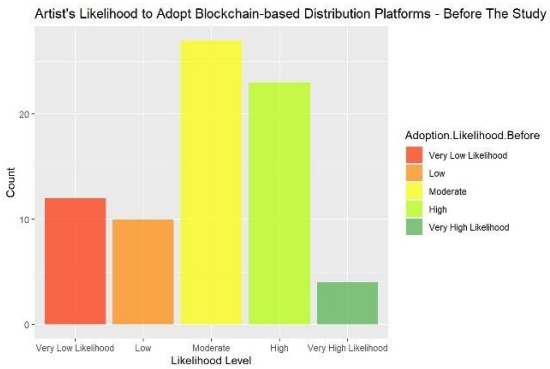

Figure 9

Their sentiments towards blockchain after learning the potential benefits blockchain has for them (figures 10 and 11):

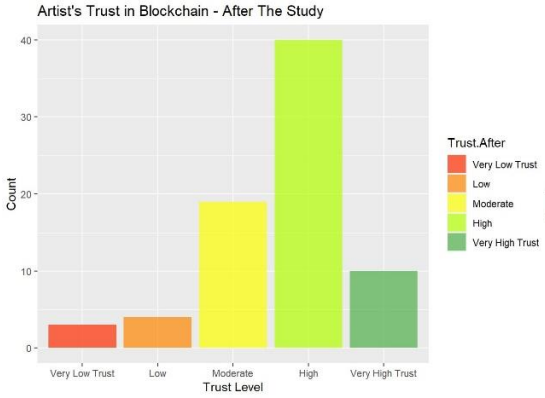

Figure 10: Artist's Trust in Blockchain – After The Study

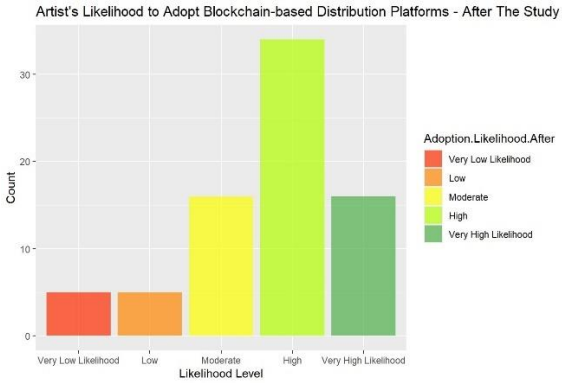

Figure 11: Artist's Blockchain Adoption Likelihood – After The Study

Principal Component Analysis

Having derived enhanced insights from the data through the graphs, carrying out factor analysis required prior PCA to extract a guideline on the number of factors to use. The PCA model was fitted with the variable 'X' containing the attitudinal variables producing these graphs:

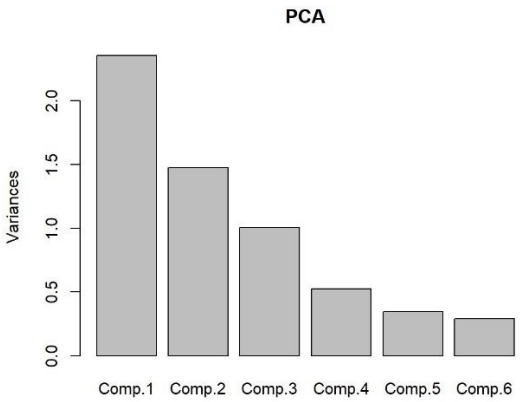

Figure 12: PCA Plot

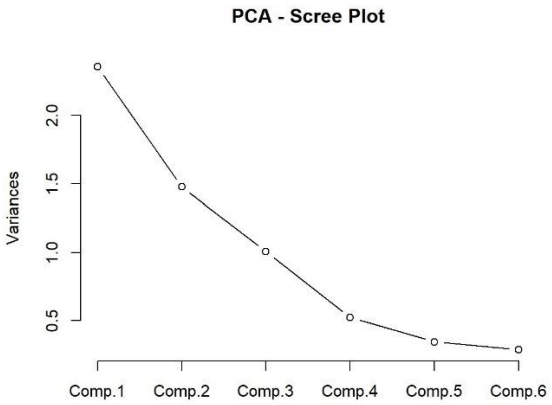

Figure 13: PCA Scree Plot

Following PCA, components with eigenvalues above 1.0 were selected to determine the number of factors to run factor analysis with (based on the 'Kaiser Criterion') (Statistics Solutions, 2021). As visible in figures 12 and 13, 3 components possessed eigenvalues exceeding 1.0, therefore, 3 factors were used in the factor analysis. Courtesy of PCA, a visualisation of how the variables load onto different factors can be seen through a Biplot as shown in Figure 14:

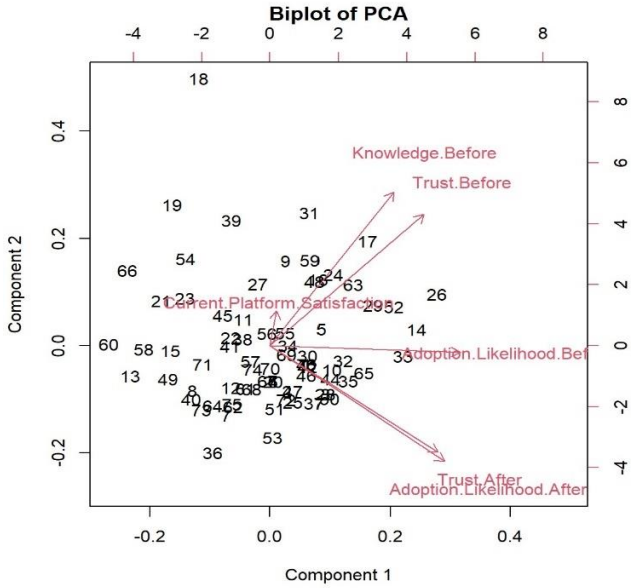

Figure 14: PCA BiPlot

Factor Analysis

After determining the number of factors for the factor analysis, the model was fitted using 3 factors and a 'varimax' rotation to reduce cross-loadings, minimize smaller loading values and, make the factor model clearer. The factor analysis model produced Figure 15:

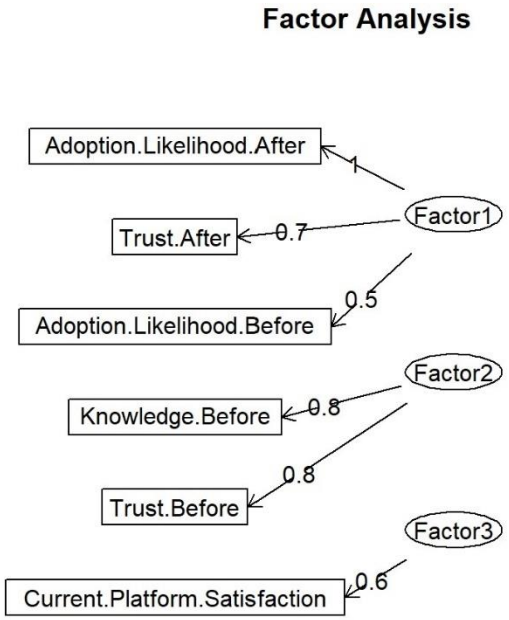

Figure 15: Diagram of Variables Loading onto Factors

KMO, Bartletts Test of Sphericity & Cronbach's Alpa

After receiving the model's output, tests were conducted to evaluate the adequacy and reliability of the results. Firstly, the KMO adequacy test was deployed to evaluate the suitability of conducting PCA and FA on the dataset. The dataset 'X' returned a Measure of Sampling Adequacy (MSA) of 0.62, just above the threshold that is considered acceptable (0.6). The 'Current.Platform.Satisfaction' (CPS) variable returned an MSA of 0.22 adding to

its poor correlation values seen earlier. Bartlett's test for sphericity returned a p-value of 7.76 (< 2.22e-16) indicating strong statistical significance from the dataset and basis to reject the null hypothesis. The test statistic was found to be significant with the Chi squared (119.96) and degrees of freedom (10) values indicated substantial differences in variances across the variables in the dataset 'X'. Consequently, the assumption of sphericity is violated. Cronbach's Alpha test couldn't be carried out with a singular variable loading onto one factor giving reason to decrease the factors used in the FA model by 1. The negligible utility of 'CPS' for PCA and FA coupled with it solely creating a new factor were enough reasons to exclude the CSP variable and 3rd factor. Using an improved dataset coupled with refined parameters for FA, the PCA and FA processes were executed again.

PCA and FA – Round 2

The second round began with extracting the 'CSP' variable from the dataset creating the new dataset 'X2'. The PCA model was fitted with 'X2' and produced graphs that suggested using 2 factors for the FA (figures 16 and 17):

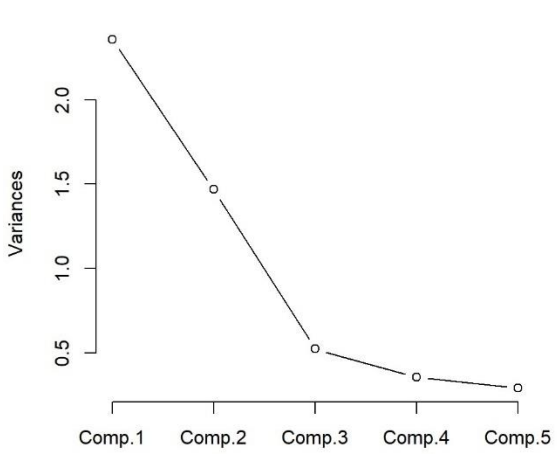

Figure 16: PCA 2 Plot

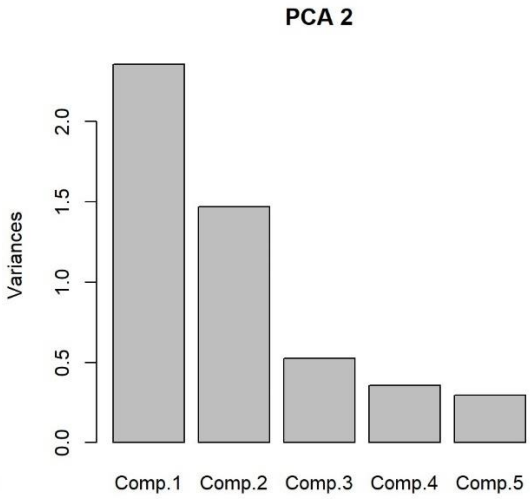

Figure 17: PCA 2 Scree Plot

The PCA on 'X2' created a nearly identical Biplot except for the absent 'CSP' variable, seen in Figure 18:

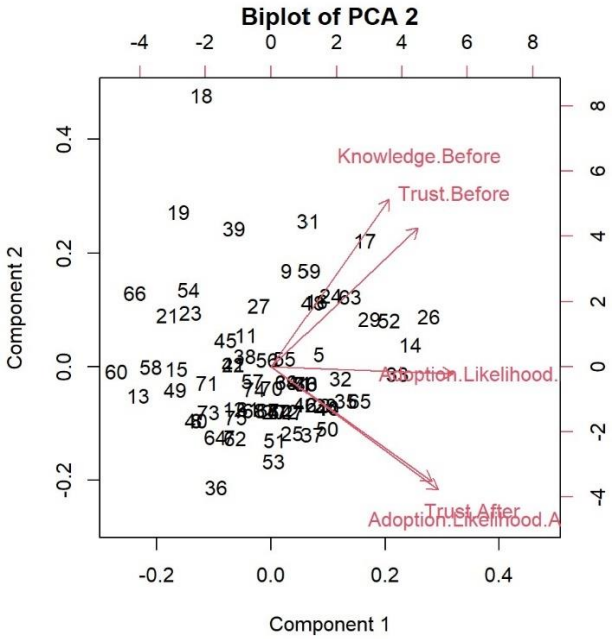

Figure 18: PCA 2 BiPlot

The new FA model showed a cleaner representation of the underlying factors within the dataset, as seen in Figure 19:

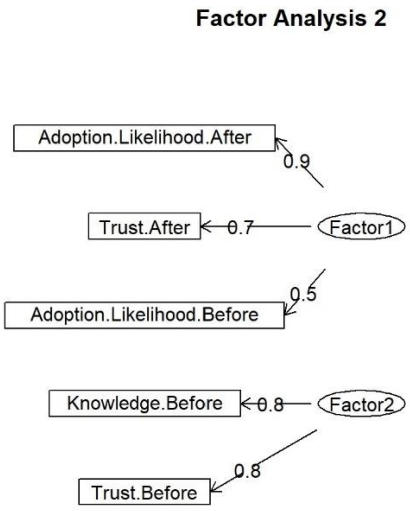

Figure 19: Diagram of Variables Loading onto Factors – FA.new

Following the second round of tests, an ordered logit regression model was fitted with the Likert scale data. 'Adoption Likelihood After' was set as the dependent variable with the rest of the Likert scale (ordinal) variables being used as predictor variables. The logit model was subsequently used to predict the probabilities of artists' post-study blockchain adoption based on the Likert scale data submitted by them and to compare them with the actual distribution data from the dataset. The actual values are shown in Table 1.

Value	Frequency	Percentage
1	5	6.578947
2	5	6.578947
3	16	21.052632
4	34	44.736842
5	16	21.052632

Table 1: Original Frequency Table of 'Adoption Likelihood After'

D. Evaluation

The demographic pie charts in Figures 2 & 3 show heavy male and young adult participation. From an age perspective in particular, the results in figures 9 & 11 show that younger artists and individuals, in general, are more likely to adopt new technologies as they are generally more tech-savvy.

Whilst there was an option of "Any blockchain-based music distribution platform" when asking artists what distribution platforms they used, there were picks for this option which can be seen in its absence in Figure 5. This coupled with the generally low knowledge of blockchain by artists captured in Figure 7 proves how unpopular blockchain platforms for music are within Ireland.

Whilst artists seemed to be content with their distribution platforms (figure 6), most popularly Soundcloud, Distrokid, and YouTube (figure 5), a positive shift in adoption likelihood was witnessed after (figure 11) the artists learn about blockchains benefits as opposed to before (figure 9). Artists' trust in blockchain also followed a similar positive trajectory (figure 10) after learning more about blockchain than the trust they had before the study (figure 9). From the visualisations alone, it is clear to see that the two improvements in trust and likelihood to adopt from before and after the study can be greatly attributed to an increase in knowledge for the artists.

The results of the PCA (figure 18) and FA (figure 19) further reinforced the fact that an artist's trust in blockchain before the study was strongly related to their level of knowledge of blockchain, whilst, their trust and adoption likelihood after the study were strongly related. Although the artist's perceived knowledge around blockchain post-study was not recorded, it is safe to assume that their newly-found knowledge was driving their newly-found trust and subsequently their increased likelihood to adopt blockchain. These findings align with the Theory of Reasoned Action (Fishbein and Ajzen, 1975) (Nickerson, 2023), as attitudes (trust) towards blockchain were influenced by knowledge, and increased trust likely led to a higher likelihood of adoption. This is visualised below in Figure 21:

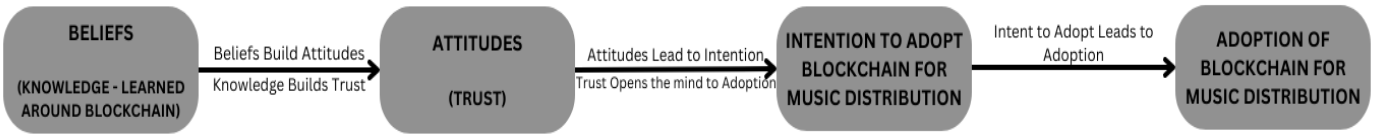

Figure 20: Theory of Reasoned Action Applied in This Research Scenario

KMO, Bartletts Test of Sphericity & Cronbach's Alpa

The second round of testing provided slightly better results. The KMO test provided an overall MSA of 0.63, an increase of 0.01 from the previous round, proving that overall the data was reliable to perform PCA and FA on. Bartlett's test for sphericity provided an even smaller p-value of 5.15 (< 2.22e-16) for the 'X2' dataset meaning that there was strong evidence to reject the null hypothesis. The test statistic was found to be significant with the Chi squared (119.96) and degrees of freedom (10) values indicated that the differences in variances among the variables are relatively smaller than 'X'. Therefore, the assumption of sphericity is not met. Lastly, Cronbach's Alpha test was used to measure the internal consistency of the produced factors as both factors produced raw alphas of 0.77 which were above the 'acceptable' internal consistency threshold of 0.70.

The coefficients produced by the ordered logit model suggest that an artist's likelihood to adopt blockchain was likely to grow higher with lower satisfaction with their current platform (CSP Coef = -0.2249), although this effect was not statistically significant (CSP p-value = 0.4790). An artist's likelihood to adopt blockchain was likely to be higher the lower their initial knowledge around blockchain was (KB Coef = -0.2249), although this effect was still not statistically significant (KB p-value = 0.1869). An artist's likelihood to adopt blockchain was likely to be a little higher with more trust in blockchain by them before the study (TB Coef = 0.2256), this effect was relatively statistically significant (TB p-value = 0.4673). An artist's likelihood to adopt blockchain was high if they were already likely to try it out before (ALB Coef = 0.7440), this effect was statistically significant (p-value = 0.0040). Finally, and most importantly, an artist's likelihood to adopt blockchain was said to be very high once they built up a high level of trust in blockchain after reading the educational piece (TA Coef = 1.6911) and this effect was highly statistically significant (p-value = <0.0001). The model predicted almost the exact same percentage distribution as the frequency table of the actual dependent variable (Adoption Likelihood After) based on the independent variables within the dataset as shown in Table 2.

Value	Frequency	Percentage	Predicted.Probabilities
1	5	6.578947	6.355675
2	5	6.578947	6.553039
3	16	21.052632	21.971170
4	34	44.736842	43.949132
5	16	21.052632	21.170984

Table 2: New Frequency Table of 'Adoption Likelihood After' with OLR predicted percentages

4. Conclusions & Discussion

In conclusion, this study introduced some of the challenges Irish independent artists and independent artists, in general, are facing today and suggested blockchain as a technology that could alleviate artists of these challenges. It delved into relevant research around blockchain as a technology, showing how blockchain's inherent features provide enhanced transparency, heightened security and copyright protection, and a platform for direct artist-fan payments and interactions.

The research tackled how the music industry functions with major and independent record labels, contrasting the influence of major labels and their associated difficulty of accessibility with the lesser but still effective influence of the independent labels and their

fostering of growth in independent artists. Independent labels were shown to be a better option for artists who wished to opt for such a route but the gap that blockchain technologies can fill persisted.

The Theory of Reasoned Action was invoked to guide in shaping concepts for the development of a solution aimed at addressing the research question. It showed that to encourage blockchain adoption by independent artists, trust must be cultivated, hinging on a prior establishment of foundational knowledge and that assessing current trust and knowledge levels is vital for potential solutions.

Based on the results from the PCA, FA and OLR models, it becomes obvious that a strong relationship between a higher level of trust in blockchain and a higher likelihood to adopt blockchain exists. Concluding therefore, that in the context of the research question, a high level of trust will result in a high likelihood of adopting blockchain technologies for an artist's method of music distribution.

This study carries promising implications for independent artists, the music industry, and technology developers. However, its scope was constrained by the relatively small and specialized population of independent artists in Ireland. To extract more comprehensive insights, a global survey of a larger independent artist demographic beyond Ireland could uncover a richer array of factors affecting the likelihood of adopting blockchain technology for music distribution.

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Appendix

Link to Google Collab - https://colab.research.google.com/drive/1RfeO4EihQ92DuiW7OZBSsECqX3jt6b_U?usp=sharing

Link to Google Forms Survey - https://forms.gle/u6DHZPGgdgQBYdGy9

Link to Research Project Presentation Video - https://www.youtube.com/watch?v=6kQMb3dyeGI

Link to Code Artefact Live Demo - https://youtu.be/0OVa5RJH-ws