National College of Ireland

The Impact of the Adoption of Peer to Peer (P2P) Lending and Regulatory Regime in Central Africa: Case Congolese lending Transition (Democratic Republic of Congo (DRC)

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ABSTRACT

In the era of technological innovation, the socio-technical transition approach has been widely embraced and adopted across continents in more detail the impact caused by both social and technological changes. This new financial service segments Peer-to-Peer online lending in the case of the Democratic Republic of Congo central Africa, its influence on the regulatory regime and the Congolese individual lending needs to be explored. The large research gap between the regulatory regime and the online Peer-to-Peer lending platforms in DR Congo and neighbouring countries in Central Africa remains unexplored and needs to be addressed in its socio-technical transitions aspect. The research complements the abovementioned gaps by studying and investigating Congolese individual lending, as well as the correlation that exists between internet usability, connectivity, accessibility and Peer-to-Peer online lending, and finally exploring the blockchain Technology feasibility of deploying Smart contracts between borrower and lender on the Ethereum solidity remix platform. Thus, the limitations of conducting this research are illustrated and a proposal for a future research agenda.

Keywords—Socio-Technical Transitions, Individual lending transitions, Regulatory Regime, Peer-to-Peer lending platform, Blockchain Technology, Smart Contracts, Ethereum, Solidity, Remix, MetaMask, Random Forest, XGBoost, Linear Regression, Liner Regression, Regression Model, Multi-Level Perspective, Three Level-Framework, Niche innovation

1. INTRODUCTION

The rise of technological innovation in the financial sector across the globe has caused a paradigm shift in the lending system in the continent of Africa, increasing at the fastest pace in the West and East of Africa, now the innovative technology disruption is gaining ground in the Central African countries, the case of the Democratic Republic of Congo (DRC).
Peer-to-Peer (P2P) lending which is an online platform that focuses on a collateral-free lending system targeting individuals and businesses, facilitating a borrowing process with little or no credit history, and matching individual lenders' criteria or requirements pose a great threat and challenging to traditional lending institutions and banks whilst offering attractive interest rates and minimum credit profiling checks whilst reducing operating costs and overheads.
Being a disruptive segment in the technology arena, Blockchain technology is rapidly gaining popularity adoption by traditional banking, financial services and other sectors this project report also explores the feasibility of the extension of Blockchain for the Peer-to-Peer online lending segment.

Following the research, the topics are research aims & research questions, a statement of the problem and, the reasons why it is so relevant, which are presented in sections 1.1, 1.2 respectively
Secondly, the clarification based on research gaps, the research aims and objectives, and also research questions are in section 1.3.

Secondly, this research report composes of the four key elements to be examined:

- Individual lending transition
- Socio-technical transition
- Regulatory Regime
- Peer-to-Peer Lending
- Blockchain Technology (Smart Contracts)

These are introduced in sections as part of the literature review in respective order 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6 respectively.

Thirdly, key findings and other contributions related to the research are revealed in section 1.4.

1.1 RESEARCH TOPIC

The Impact of Adoption of Peer-to-Peer Lending and Regulatory Regime in Socio-Technical Transitions: The case of Congolese Individual lending Transition (Democratic Republic of Congo DRC)

1.2 RESEARCH AIMS & RESEARCH QUESTIONS

This research report aims to fill the abovementioned research gaps.
First, this research examines the forgotten role of regulation in Socio-Technical Transition processes.
Secondly, this research addresses challenges as Geels (2018a) proposed regarding niche-regime interactions layout as the examination of the bi-directional interactions that occur between the niche and the regime while transition processes are taking place.
There is an increased attraction to the governance of Socio-Technical Transition from transition scholars (Bos and Brown, 2012; Docherty et al., 2018).
However, limitation efforts have been observed noted in this regard, concerning regulations.
Thirdly, this research digs into identifying the impact of the adoption of Peer-to-Peer lending and regulatory regimes. Finally, this research enlarges the scope of existent Socio-Technical Transition literature by investigating the transition that slowly but surely takes place in the financial sector in the Democratic Republic of Congo (DRC)

Thus, the research objective of this thesis is :

> **To understand the impact of the adoption of Peer-to-Peer (P2P) lending and the regulatory regime in a financial sector Socio-Technical Transitions in the Democratic Republic of Congo (DRC) Central Africa: the case of Congolese Individual Lending Transition**

The main research question (RQ) for this thesis is:

> **RQ: What is the impact of the adoption of Peer-to-Peer lending and regulatory regime in Socio-Technical Transitions: Case Congolese Lending Transition in the Democratic Republic of Congo (DRC)**

To answer the main research question, this research delves into a Socio-Technical Transition that occurred in the individual lending sector initiated by the rise and development of Peer-to-Peer lending. The main research question is taken on in this research through responding to the following sub-research questions (SubRQs):

SubRQ1: What are the trajectories of P2P lending and the regulatory regime in the case of Congolese individual lending transition?

SubRQ2: How do P2P lending and the regulatory regime influence each other in the process of Congolese Individual lending transition?

SubRQ3: What is the generalised trajectory of the regulatory regime in Socio-Technical Transition?

SubRQ4: How is the coordination of the impact of Peer-to-Peer lending adoption and regulatory regime promoted in Socio-Technical Transition?

SubRQ5: How the utilization of smart contracts within the Blockchain technology empowers and accelerates Peer-to-Peer lending adoption

1.3 REASONS AND MOTIVATION

The rapid growth of the FinTech space in the African Continent is uncanny, with an exponential number of start-ups, and Peer-to-Peer lending platforms adoption.
Central African countries the case of the Democratic Republic of Congo is showing signs of interest in the FinTech sector, it is emerging as a technological enabler, an alternative to traditional financial institutions in the region, enhancing financial inclusion and accelerating innovation across sectors. Hence, the growing influence of FinTech has raised concerns and challenges that enable us to qualitatively analyse the impact of the adoption of Peer-to-Peer lending online platforms on the Socio-Technical Transition, regulatory regime and individual lending transition perspectives and the using Blockchain Technology (Smart Contracts) in the Democratic Republic of Congo (DRC).

1.4 KEY FINDINGS AND CONTRIBUTIONS

The Congolese Individual Lending Transition is divided into three phases as follows: the Pre-development phase, the Take-off phase, and the Stabilisation phase. So, these three transition phases are one accord with three Peer-to-Peer lending development phases that were identified by the participants/interviewees, namely the initiation phase, rapid development phase, and rectification phase. Hence, based on the data analysis undertaken, the trajectories of Peer-to-Peer lending and the regulatory regime in the case of Individual Lending Transition and the landscape of interactions between them were also identified.
With regard to the impact of the adoption of Peer-to-Peer online lending platforms and novel practices use of Blockchain smart contracts, the development of a new regulatory regime for online lending bills was proposed by actors to the Central Bank of Congo and the National Assembly in the Democratic Republic of Congo (DRC). The existing individual lending regime for traditional banking institutions, microfinance, and informal lending individuals has not yet undergone a structural reconfiguration despite the rise of new Peer-to-Peer online lending practices. To deal with complex, multi-level, multi-actor reality in Socio-Technical Transition processes, policy mix, individual policies' integration and instruments are one suited approach to achieve regulatory goals (kern and Howlett, 2009; Flanagan et al, 2001) and was identified as a solution to enhance regulation enforcement and advance the coordination of regulation and radical technological innovations of Peer-to-Peer online lending in Socio-Technical Transition processes. Thus, the analytical framework proposal exhibited in this research enables each researcher to take a deeper look into transitions from macroscopic and

microscopic perspectives and reach a high level of achieving a comprehensive understanding of actors, processes, and interactions amid actors in Socio-Technical Transitions, the case of the Democratic Republic of Congo (DRC)

Fig 1: Peer-to-Peer (P2P) online lending platforms

2. RELATED WORK

2.1 SOCIO-TECHNICAL TRANSITIONS

The research field of Socio-Technical Transition is relatively young, however, some research streams of relevant studies were conducted.

Firstly, The Socio-Technical Transition does not underline technological change. Rather, the focus is on the evolution of technological innovation and society, considering various factors such as technology, institutions and human agency (Geels, 2004).

Along with the exponential development of information and communication technology (ICT), and increasing technological innovations, so much so, Peer-to-Peer online platforms are effectively being developed and disseminated in modern society.

The Socio-Technical Transition approach is one of the ways to conduct Social and technological analysis of changes or variations that have been caused by radical innovations (Whitmarsh, 2012). The focus of each study related to the related work (literature) regarding Socio-Technical Transition is classified into six groups as follows: niche innovation development, socio-technical regime change, external factors for transitions, and analytical usability. Socio-Technical Transition studies are unfolded through analysis, and research gaps are observed, and identified.

2.1.1 Niche innovation development

Technological innovation has been observed through rapid growth and development and considers to be the main factor leading to Socio-Technical Transition. The early development of innovations has been broadly discussed from niche formation and innovation scaling perspectives. Lopolito et al. (2011) focused on the development of niches development the Socio-Technical Transition processes. A three-level framework of niche formation was suggested that includes the following three mechanisms: willingness, power, and knowledge.

According to the suggested framework, a niche development process contains four phases:

- Absent niche (with willingness, power, and knowledge absentt)
- Undeveloped niche (with willingness present, power and knowledge absent)
- Proto niche (with willingness and power present, knowledge absent)
- Full niche (with willingness, power, and knowledge present)

2.1.2 Socio-technical regime change

Rotmans et al (2001), noted that the evolution of one regime is composed of four stages of transition as follows: pre-development, take-off, acceleration, and stabilisation.
With respect to the four transition stages, the following are identified: conflicts, adaptation, resistance, and socio-economic losses in the Socio-Technical Transition process, which allow various actors, and innovations to replace old practices. For instance, Hurlbert et al. (2011) asserted the transition management approach to
analyse the evolution of socio-technical regime change of the power sector in Saskatchewan, Canada.

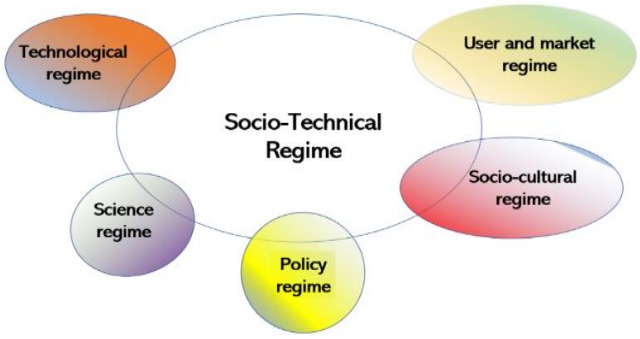


Fig 2: The relationship between Socio-Technical Regimes Approach: Case of the Democratic Republic of Congo (DRC)

2.2 REGULATION AND REGULATORY REGIME

2.2.1 Regulatory Regime

Peer-to-Peer lending platforms' disruption in Central Africa in the case of the Democratic Republic of Congo (DRC) has aggravated the dilemma of regulation, as it obfuscates limitations around the financial sector, introducing new business models, new products and technologies in lending activities with the opportunities of accessing and processing huge amounts of information. The concept of regulation has been differently interpreted by some scholars and researchers, given different definitions. According to (B. Baldwin et al, 1998), regulation is recognised as an identifiable and distinct mode of government activity. Many researchers perceive regulation as a responsive tool to achieve risk mitigation and reduction

(Haines, 2011). In the case of the Democratic Republic of Congo (DRC), the Central Bank of Congo which is the financial supervisor of each segment of financial services in the country has not yet defined a regulatory framework governing Peer-to-Peer (P2P) platforms and Crowdfunding platforms, and legislative requirements or bills proposed by policymakers have been made public yet. According to (Vogel, 2018), the regulatory regime constitutes two major elements that have been identified are regime organisation and regime orientation.

Regime organisation outlines institutional structures as well as other agencies that execute the regime orientation, whereas regime orientation brings out the visions, beliefs and other tools/instruments of regulation. Moreover, these two regimes (organisation and orientation) are of great importance to achieving regulatory goals by setting out a regulatory regime development plan, with respect to Peer-to-Peer online lending platforms in the Democratic Republic of Congo (DRC). Hence, a radical technological innovation impact of Peer-to-Peer lending platforms has great possibilities to challenge the existing regulatory regime, due to regulation insufficiencies, regulators' lack of professional understanding and knowledge and regulators' lack of regulation experience on new technologies to competently support or control the development and dissemination of innovations (Ludlow et al, 2015).

The review of the regulatory status of the FinTech sector in the Democratic Republic of Congo is not properly defined by the Central Bank of Congo, it states that each financial institution, microfinance needs a buffer, Capital requirement to be operational, which on the other hand is identified as a mismatch between the existing regulations and regulation that is required for FinTech business Thus, further research findings on how innovations of Peer-to-Peer online lending are influenced by the development of regulatory regimes are to be undergone and the trajectory at which regulatory regimes' track of development are set out in Socio-Technical Transition also requires identification.

2.3 PEER-TO-PEER (P2P) LENDING

The research explores the impact of the adoption of Peer-to-Peer lending and regulatory regime in Individual Lending Transition. It is known that FinTech lays the foundations for the rise and development of Peer-to-Peer lending.

2.3.1 Concept of Peer-to-Peer (P2P) lending

The main difference between Traditional bank lending institutions links directly with individual borrowers and lenders, whereas Peer-to-Peer(P2P) lending platforms play the intermediary role. Peer-to-Peer (P2P) lending already existed for a decade in the Democratic Republic of Congo, known as "*Banque lambert ",* however, it is still operational and informal today. As a result, the emergence of The FinTech segment has brought innovation, and flexibility in terms of accessibility to capital and the development of Peer-to-Peer lending to another level impacting the lending behaviours of each borrower and lender, thus enabling a smooth transition of individual lending sectors.

2.3.2 Risks of Peer-to-Peer lending

The potential risks have become inevitable, and the emphasis has increasingly been placed on the regulatory side of this new field in the financial service industry (e.g Slattery, 2013; Marvin, 2017) Although many governments have taken an effective intervention approach head-on across the globe, which has indeed been acknowledged and recognised to support, and helps Peer-to-Peer (P2P) lending's development (Roger and Clarke, 2016), in many countries, the regulatory framework and regulations are still in progress, neither complete. In the case of the Democratic Republic of Congo (DRC), the Central Bank of Congo being the regulatory authority body does not have regulatory guidelines in place yet, and a brand-new minister of Digital was created in the Congolese government under the leadership of the new President, that has submitted some legislative bills relating to the functioning of this minister of Digital. Thus, this sufficiently proves from a transition perspective the positive impact of Peer-to-Peer (P2P) lending vis a vis the existing and traditional lending systems in place and also confirms that the process of interactions between Peer-to-Peer (P2P) lending and regulatory regime remain unexplored and unexploited.

2.4 INDIVIDUAL LENDING TRANSITION

The rapid growth of Information Communication Technology (ICT) also shows a rapid development that still overcoming inflationary momentum, global economic slowdown, and even global financial crisis has shaped the financial industry transformation. The Individual lending Transition into new technological innovation in the case of Congolese people in recent years has exponentially grown and improved, given the high rate of youth in terms of population growth rate, despite a very low internet connectivity penetration rate.

A large part of the population, individuals and businesses tend to look for newness in innovation, digitalisation and when it comes to access to funds for businesses, there is a need change to break away from traditional lending practices in favour of new models of lending that offer flexibility to access funds. Most scholars' attention has been focused on this novel financial sector, which led them to be concentrating on lending studies' factors such as "the impact of a success rate of acquiring loans" (Ciuchta and O'Toole, 2016; Freedman 2017) and "default risks" (Aksakalli et al, 2015).

2.5 BLOCKCHAIN TECHNOLOGIES

Blockchain technology's rapid growth across Africa has significantly grown in terms of popularity due to the emerging technology behind Bitcoin. It has the potential to the existing financial systems such as clearance and settlement. Hence, the Government, as well as private sectors of the Democratic Republic of Congo (DRC) perspectives on this innovative technology have been so far positive. Since it is suitable as a Peer-to-Peer decentralised

distributed ledger technology, that has the ability to improve and make any digital asset immutable, trustworthy, transparent and secure without involving a third-party intermediary.
In the Eastern and Western parts of the African continent, with the rise of blockchain-based Peer-to-Peer lending platforms causes Central African countries (DR Congo) in particular once lagged behind, now are looking forward to levelling With this respect, S.Chakrabroty et al(2009) suggested, a blockchain-based credit risk analysis framework that simply could obtain borrower's information from various sources including credit sources, the eligibility of the individual to access credit, R Zitouni et al proposed his protocol and a business model that is purely based on blockchain and accessible through a mobile phone suitable for targeting on small scale provinces or counties. Furthermore, Q.Yang et al (2019) proposed the design of a smart loan contract for lenders, whereby the lender submits a loan request and conversely the borrower submits a repayment request, and the smart contract deployment automates the interest rate calculation and transfers of the funds from the borrower to lender.

2.5.1 Blockchain Technology - Smart Contracts

(Brenn Hill, 2018), The concept of smart contracts was first conceived by researcher Nick Szabo in the mid-1990s. A Smart contract is considered one of the key pillars of blockchain, however, its deployment is of great importance as it is automatically executed once predetermined terms and conditions are met, thus, enforcing and executing the agreement between unknown and untrusted parties This research project deploys a proposed blockchain-based framework for Peer-to-Peer lending and executes the smart contracts for collateral request, loan request, IERC20 Token smart contract, ERC20 smart contract, investor repayments and Government Corporate Tax collection in percentage (%)

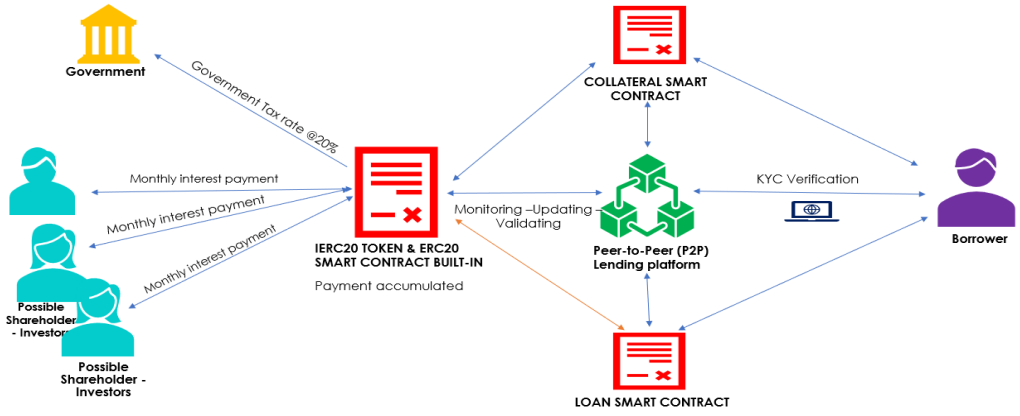


Fig 3: Sequence Diagram: Flow of activities in. Peer-to-Peer (P2P) lending Blockchain Smart Contract

2.6 ANALYTICAL FRAMEWORK

2.6.1 The Multi-Level Perspective (MLP) on Socio-Technical Transition

It is a conceptual framework that analyses the coexistence of society and technology. Hence, based on this multi-level framework, both global and local models for Individual lending Transition are proposed. As suggested by Scott (1995), the institutional theory suggests that steady and stable social systems lay their foundations on these institutions' elements including rules, norms, and belief systems, neo-institutional theorists differentiate between three types of institutions: regulatory, normative and cultural-cognitive. In the case of the Democratic Republic of Congo (DRC), the Central Bank of Congo is the only financial regulator, so no other third-party financial agency operates in the country. Moreover, it displays more cultural elements due to their socially constructed symbolic representation (Durkheim, 1961) and cognitive as they offer essential templates to frame individual perceptions and decisions.
Thus, a multi-level analytical framework is built, wherewith research questions are answered.

2.6.2 The Three Level Framework

The Multi-Level Perspective underlines that there is no single driver for Socio-Technical Transition. However, the transition prevents causes in a feedback loop "Circular causality" and enables interaction processes of multiple dimensions of developments, and at any levels that are interlinked and mutually reinforcing within this three-level framework including the niche innovations (micro level), social-technical regime (macro level) and external socio-technical landscape (macro level). The research question on the impact of the adoption of Peer-to-Peer (P2P) lending and the regulatory regime in the Democratic Republic of Congo(DRC) enables us to identify three sequential phases during the transition as follows:

1) ***Pre-development phase***
   Where all variations take place, including radical niche innovation that gradually gains accumulative momentum. As shown in Appendix
2) ***Take-off phase***
   Where the existing regime begins to change due to the impact of financial innovation. As shown in Appendix
3) ***Stabilisation phase***
   Where there is a slowdown in social change and final achieving dynamic stability. As shown in Appendix

3. RESEARCH METHODOLOGY

Several open-source websites were used to deepen the research investigation and to conduct further analysis and studies:

Organization for Economic Co-operation Development - www.oecd.com
World Bank - www.worldbank.com
Central Bank of Congo - https://www.bcc.cd/com
Minister of Digital in the Dem. Republic of Congo - https://numerique.gouv.cd/
Africa internet penetration - https://www.statista.com/
Africa Open Data - https://africaopendata.org/

3.1 DATA GATHERING

Fieldwork that was carried out for data collection from June to August 2022. Both documentary research and online channels/phone calls and semi-structured interviews were carried out during the fieldwork, and hence, both primary and secondary data were taken into consideration. Secondly, datasets were imported from various open-source websites to build predictive analytics models and finally, Blockchain Technology smart contracts concept on "Peer-to-Peer lending Collateral loan" was examined for further research investigation.

3.2 DATA COLLECTION

The data collection process for this research involved four phases:

1) pilot study
2) Formal data collection (Interviews) & Regulatory Regime
   Research Methodology, Approach 1
3) Formal data collection (Machine learning Methods) - Research Methodology 2 & Modelling Approach. Data was collected from open-source websites (Organisation for Economic Co-operation Development (OECD) and the World Bank and the International Telecommunication Union (ITU) to conduct further research on the Internet connectivity penetration rate in the Democratic Republic of Congo (DRC) neighbouring countries in Central Africa.

4) Formal Blockchain Technology Peer-to-Peer (P2P) lending: Smart Contracts loan - Architecture & Deployment – Research Methodology 3

3.2.1 Pilot Study

A pilot study was conducted in June 2022. 4 pilot interviews were conducted including 2 interviews with Journalists, 1 interview with a Peer-to-Peer online lending platform and 1 with an authority regulator. This pilot study aimed to get an understanding of the Congolese Peer-to-Peer lending market and Individual Lending Transition development so that the data

collected during the formal interviews are more focused and detailed and when finalised, it matches the four stages of the transition process which are the Pre-development phase, take-off phase, and stabilisation phase.

3.2.2 Formal data collection (Interviews) – Research Methodology 1

Data collection constitutes documentary research and a series of semi-structured interviews. The latter was conducted from June to July 2022. Policies and regulation documents related to Congolese Individual Lending Transition were searched from the Central Bank of Congo (BCC) website and other relevant information was also searched from the Congolese Ministry of Digital website. To gain a broader and deeper knowledge of the impact of the adoption of Peer-to-Peer lending and the Individual Lending Transition regulatory regime in the Democratic Republic of Congo (DRC), a series of semi-structured interviews were conducted, as it has been acknowledged to be useful and most of the cases applied as a qualitative technique in case studies (Myer and Avison, 2002)
A total number of 24 formal semi-structured interviews were conducted: see (Table2.2)

Table 2.2a – Informants – semi-structured interviews

INFORMANTS/PARTICIPANTS				
Peer-to-Peer Platforms	Regulatory Authorities	Commercial Banks	Peer-to-Pee (P2P) lending users	Journalists
4	3	2	5	10
Notes: 24 formal semi-structured interviews, including (Call, Chat). Each interview lasted 45 to 60 mins				

Source: Author's own -Research Methodology1

Table 2.2b Interview arrangement

Time	Activity	Participants
June 2022	Pilot interviews (Fieldwork)	2 Journalist 1 Regulatory Authority 1 Peer-to-Peer (P2P) lending users

June – July 2022	Formal Interviews (Fieldwork)	4 from P2P lending platforms 2 from Regulatory Authorities 2 from Commercial Banks 4 Peer-to-Peer (P2P) lending users 8 Journalists
Notes: 24 formal semi-structured interviews, including (Call, Chat). Each interview lasted 45 to 60 mins		

Source: Author's own -Research Methodology- 1a

A great number of Journalists that were interviewed, gained expertise dealing with Economy and Finance matters and their holistic view of the Congolese Individual Lending Transition case. Informant/Participants were informed of the purpose of the interview and a questionnaire was sent via email before carrying out the interview, in agreement with their own experience and unique roles. As shown (Table 2.2b).With regard to the interview process, the data was divided into two categories. The first category concerns development processes and the interactions between Peer-to-Peer lending and the regulatory regime. The data in this category were coded using the concept-driven coding approach. The other category relates to industry and regulation dimensions.
The data in this category were coded using the data-driven coding approach. The guideline related to semi-structured interviews are detailed in Appendix 1

Table 2.2c Categorising and coding interviewees

Interview Code	Organisation Code	Interviewee role
G1, G2, G3, G4	Peer-to-Peer Lending Platform	Director
M1, M2, M3	Regulatory authority	Official
T1, T2	Commercial bank	Staff
D1, D2, D3, D4, D5	NA	User
Z1 – Z10	Online News	Journalist

Source: Author's own – Modelling Approach 1b (See full table. Appendix 4

Data Analysis: *Regulatory regime (Research approach & Modelling)*

This research adopted a systematic data analysis approach and modelling with regard to the regulatory regime, a qualitative data analysis that includes data preparation, data categorising and coding(Table 2.2c) that have been analysed and identified Thus, investigations were

conducted as follows: Research Approach and Research Modelling on regulatory regime. See (Fig5 & Fig6) respectively.

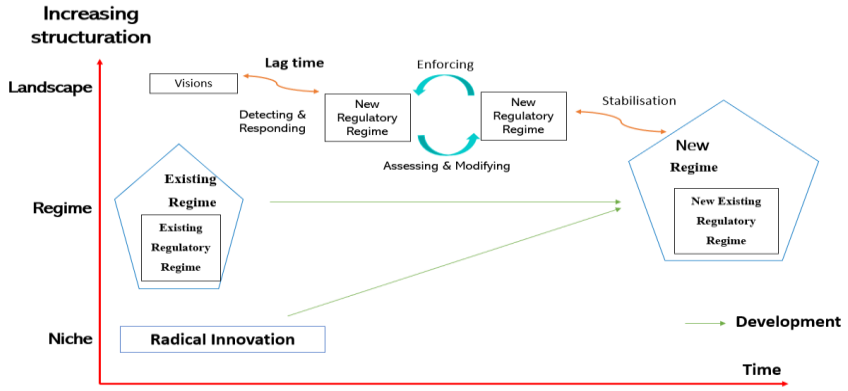


Fig 4: Modelling Approach - Regulatory regime 1a

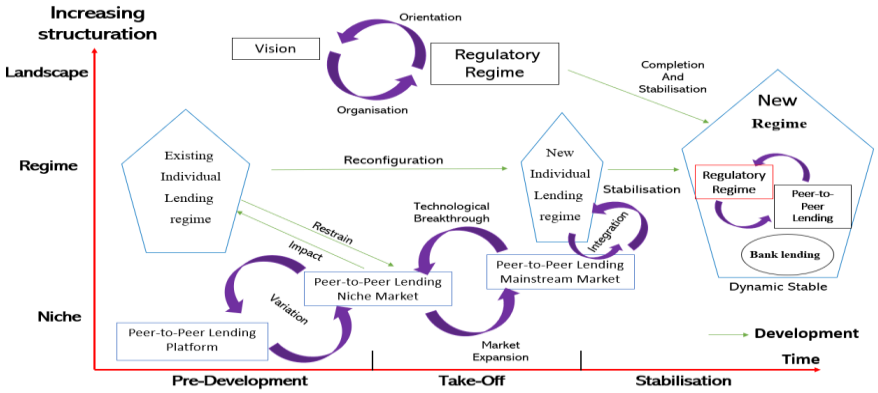


Fig 5: Modelling Approach- Three phases(Regulatory regime)1b

3.2.3 Formal data collection (OECD & World Bank)- Research Methodology 2

Data was collected from the abovementioned open-source websites: Dataset imported as an Excel CSV file containing Central African countries :
The research is reproducible by Python Google Colab and can be found here:
Google Colab
https://colab.research.google.com/drive/1A8NTydYTC4LMoTN9yS3JmLaekrzhnrpi?usp=sharing

Table 2.3 Dataset Open sources

Dataset description – open sources		
10 Observations	OECD and World Bank	International Telecommunication Union (ITU)
	21 Variables	7 Variables

Source: Author's own – Dataset open sources

In total, the dataset comprises 10 observations and 28 variables, only 10 observations and 11 variables were retained as part of the data selection to build acceptable Machine Learning regression predictive models as shown in (Table 2.3)

Dataset

This process involved data collected from open sources such as Africa's internet penetration, the Organisation for Economic Co-operation Development (OECD) and the World Bank. As shown in (Table2.3). We observed 10 Observations (Democratic Republic of Congo DRC, Angola, Burundi, Central Africa Republic, Rwanda, Uganda, Republic of Congo, Tanzania, Uganda and Zambia) and 28 Variables were retrieved from the following open-source Population, density Human Development Index (HDI) and OECD, World Bank and other variables on the African digital trends (connectivity penetration) to build predictive analytics Regression Model in terms of Internet User rate, Mobile data prices country, Evaluation of Regulation rate, and home connectivity, thus, the Democratic Republic of Congo (DRC) is the observations target and the Internet_Users is the independent/target variable. Additionally, 6 Variables were retrieved from the international telecommunication Union website.

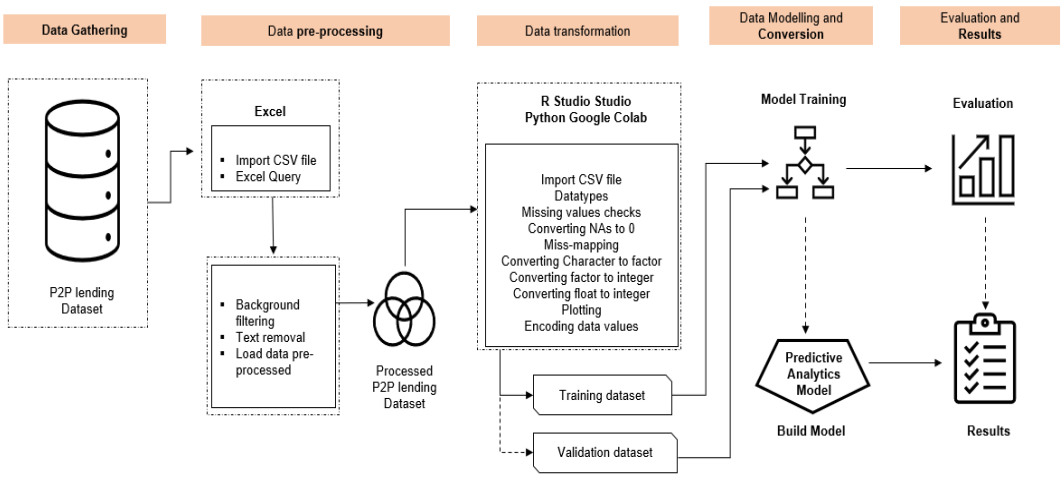


Fig6: Research Methodology2 – preparation & Evaluation processes

Step 1: Data Gathering involves 28 datasets combined from two open-source websites as abovementioned

Step 2: Data Pre-processing involves background filtering, and text removal using Excel query to ensure a clean categorical and numerical dataset. To process the data preparation in this report, web scrapping was used which is the extraction technique that allows the use of other tools to create, modify or update the raw dataset. Misclassified numerical and categorical variables were scrutinised and properly checked, and unnecessary decimal points were removed and filtered out datatypes accordingly. And then reloaded and saved as an Excel.csv file format.

Step 3: Data transformation involves splitting the dataset to conduct further explanatory data analysis (training, validation and Model), as result, five regression model techniques were distributed as follows, Linear regression model to be run on R Studio Cloud and four others (Random Forest, XGBoost, Support Vector Machine SVM, K-Nearest Neighbours KNN were deployed using Python Google Colab programming to undergo these two stages: training and validation dataset. The Peer-to-Peer (P2P lending contained 11 variables on average (Population_2020 with 2.9267, Density with 1.375, Growth, HDI_2020 with 5.04, Internet Users with 2.21, Home Internet with 7.4, Active Mobile with 2.06, Mobile data prices with 2.1, Individual Internet with 1.23, regulation evaluation as Ev_regulation with 8.0 and Area), and No Nulls/NAs were also found, 17 out of 28variables were dropped, converting variables from object to integer), and Neural Networks/Tensor Flow function was used to increase the diversity of the training set by applying it randomly, random seed = 6, target size (10, 11). The Peer-to-Peer lending data was split into a ratio of 80:20 for training and validation.

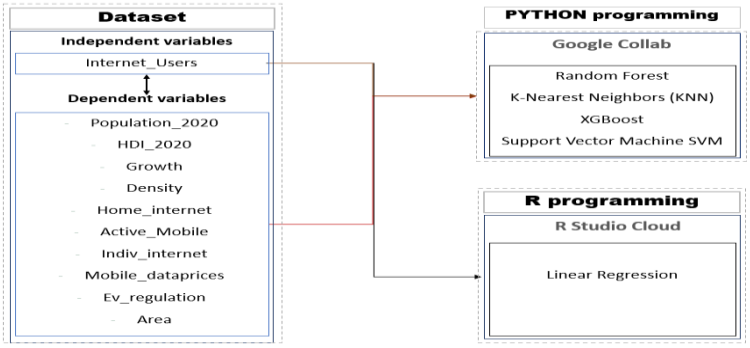


Fig7: Modelling Approach 2; Machine learning Modelling technique approaches

Step4: The internet penetration rate per user in the Democratic Republic of Congo (DRC) including its neighbouring central African countries determines the level or measurement of scalability by which Peer-to-Peer lending online platforms could leverage up in terms of clients/investors, customer acquisition and sustainability in the region. Therefore, the data modelling framework architecture proposed or deployed involves Regression model techniques to build a model based on the prediction accuracy rate result, using the targeted/independent variable (Internet_Users) see Fig 8:

- R Studio programming was used to predict the accuracy rate, R-squared, and p-value using the Multi Linear regression (LM) predictive Model, determining the relationship between independent and dependent variables considering the linearity.
- Python Google Colab programming was used to build a prediction model using: Random Forest (RF), XGBoost (XGB), K-Nearest Neighbours (KNN), and Support Vector Machine (SVM) enables us based on the predicted model outcome/ accuracy scoring rate, whether or not Peer-to-Peer online lending platforms can thrive in Central

- Africa given the low internet connectivity penetration rate along with high data prices. See (Fig 8)

  The abovementioned five regression model techniques were thoroughly analysed and predicted as shown in Fig8 as well as the evaluation and the performance of each variable of the regression model using both training and testing datasets to predict the R-Square, Adjust R-Square, Mean Average Error (MAE), Mean Square Error (MSE), Root Mean Square Error (RMSE), Linear coefficient and p-value.

3.2.4 Formal Peer-to-Peer lending Blockchain Technology (Collateralised Smart Contracts loan deployment) – Research Methodology 3

In this research, there are 3 elements to unify in order blockchain technology smart contracts and for further analysis using Solidity Ethereum programming language and JavaScript.

- Peer-to-Peer Lending online platform
- Ethereum Solidity programming via Ethereum Remix websites
- MetaMask website to deploy smart contracts to wallet account created

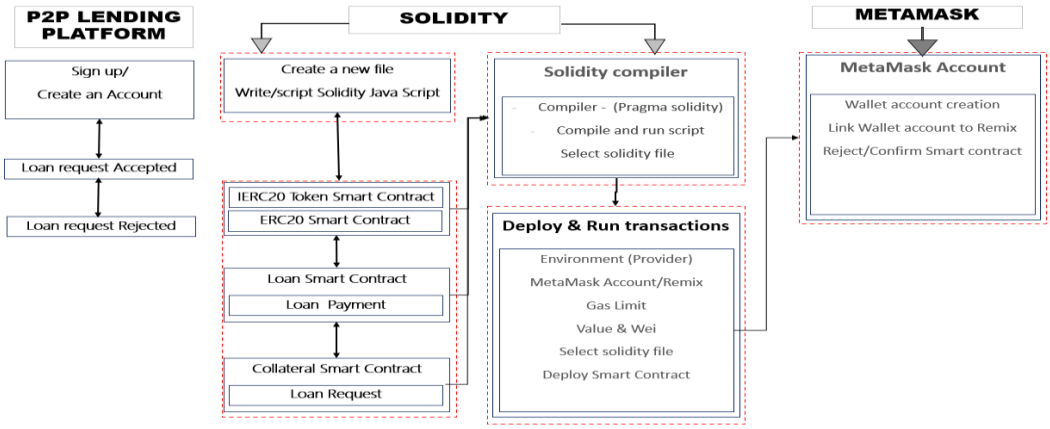


Fig 8: Research Methodology 3 Peer-to-Peer lending Blockchain Technology Smart Contract loans (Ethereum Solidity & MetaMask)

3.2.5 Peer-to-Peer Blockchain (Smart Contracts) Modelling Approach 3:

The immutability of the Blockchain technology used on Peer-to-Peer online lending platforms in the Democratic Republic of Congo, though it is in its infancy stage in the country, it provides security and transparent and immediate shared information.

In this research, the modelling approach of developing the following smart contracts: Collateral smart contract, Loan smart contract, IERC20 Token smart contract, and ERC 20

smart contracts were successfully deployed via the Ethereum platform website known as "Remix", using Ethereum JavaScript programming called "Solidity. See Appendix 2

- ✓ Blockchain Technology Smart Contract for Peer-to-Peer Lending platforms (Writing Smart Contracts on Remix website, the environment chosen on Remix was Metamask as the injected provider, Ropsten MetaMask testing wallet account (0x492…) was used for smart contract deployment and JavaScript for coding syntaxes (see below
- ✓ Sign Up to the MetaMask website (Wallet Account) to view smart contracts deployed.
- ✓ The Ethereum Solidity JavaScript developed takes into Government Tax rates and investors' monthly interest payments.
- ✓ Peer-to-Peer lending platform
- ✓ Borrower
- ✓ Stakeholders

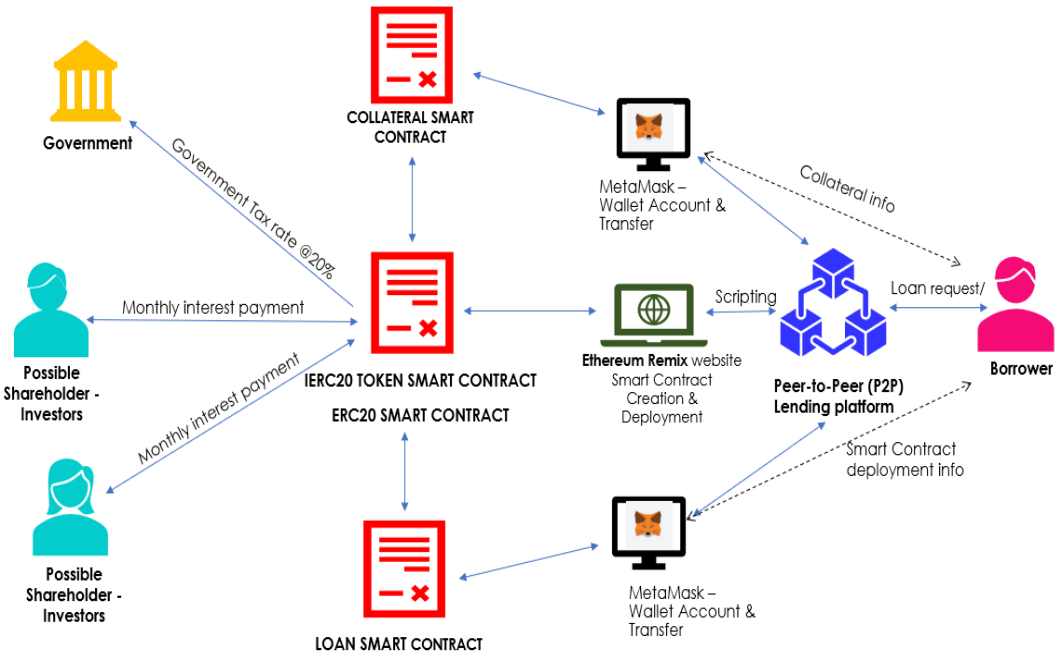


Fig 9: Modelling Approach 3: Blockchain Tech. Peer-to-Peer lending Smart Contracts

4. DESIGN SPECIFICATION

The Impact of the Adoption of Peer-to-Peer (P2P) lending and regulatory architecture (in combines Interviews - P2P lending Regression Model, Blockchain and key drivers as shown in Fig 5. However, the components of Interviews, P2P lending Regression Model Blockchain and inference as discussed in section 4.1: Interviews-P2P lending Regression Model – Blockchain and in section 4.2:Key drivers.

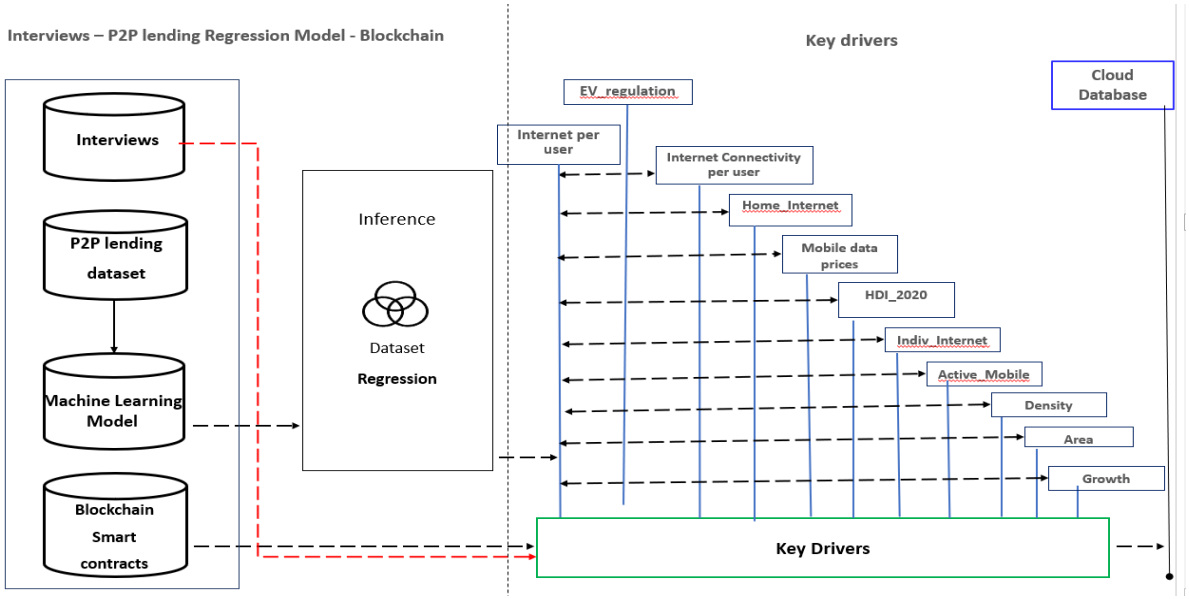


Fig10: Peer-to-Peer (P2P) lending Framework Architecture

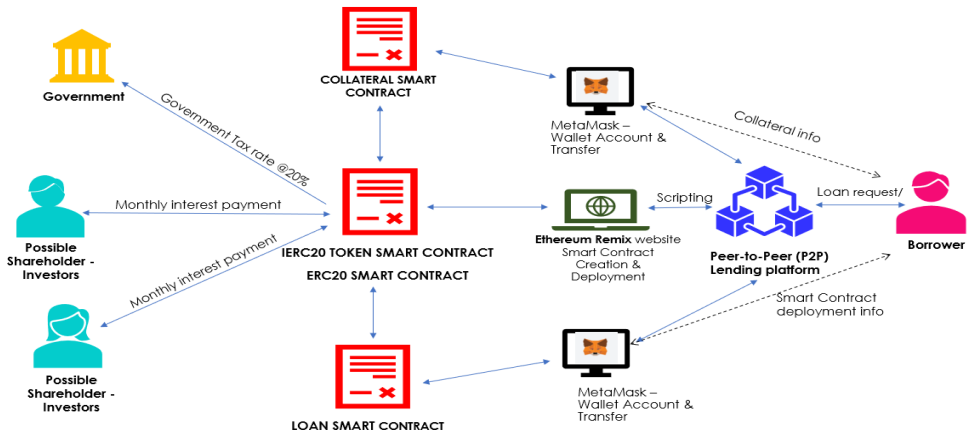


Fig11: Peer-to-Peer lending Blockchain high-level Smart contract loan architecture

4.1 Interviews – P2P lending Regression Model - Blockchain

a) *Interviews:* With regard to the interviews both concept-driven data categorising and coding and data-driven categorising and coding were illustrated in Appendix 2 and 3 respectively.

b) *P2P lending Regression Model:* P2P lending dataset is saved temporarily in a cache for the Regression Model for the Machine Learning Model to carry out inference. The Machine Learning Model is composed of Linear Regression (LM), Random Forest (RF), XGBoost, Support Vector Machine (SVM), and K- Nearest Neighbors KNN. Thereafter, an inference is generated by the Machine Learning Model from the imported P2P lending dataset which provides a corresponding accuracy rate (R-squared) to the dataset regression. To ensure that the independent/dependent variables selected are accurate and precise, the variance score and R-squared were set to 60%.

c) *Blockchain smart contracts deployment* has two architectures. The first architecture associated with the P2P lending framework as shown (Fig12) is linked directly to key drivers and the borrower (Internet_user) whereby all the data generated from the Ethereum platform (Remix) are saved in Cloud. The second Blockchain architecture (Fig15) is independently formed due to the technicality of the blockchain technology, whereby the P2P lending platform plays an intermediary role between borrower and investor, creating 3 smart contracts on the Ethereum Solidity Remix platform to deploy (IERC20 token/ERC20 combined, Collateral and loan), the environment used scripting construction (JavaScript), Ethereum Cryptocurrency transfer and smart contract deployment, wallet account creation for instance (MetaMask, Etherscan)

4.2 Key drivers

Key drives employed include the following(Ev-Regulation, Internet_Users, Home_internet, Mobile-dataprices, Active_Mobile, Indiv_internet, Population_2020, HDI_2020, Density, Growth, Area). See (Fig5).

Internet_Users is the target/independent variable that is produced on the model's inference of a Regression dataset, it takes account of the number of users accessing internet services, and an element for Peer-to-Peer online lending platforms could utilise to increase traffic to their platforms and close deals between borrowers and investors. As shown in (Appendix 7)

5. IMPLEMENTATION

5.1 Interviews

The implementation of the interview process contains the following to explore:
Process-oriented Dimension and Perception-Oriented Dimension
See Appendix 4: Crisis of Confidence - Concept-driven data categorising and coding -
See Appendix 5: Example of Data-driven data categorising and coding

5.2 P2P lending Machine learning Model

The Peer-to-Peer lending dataset was imported from the document drive into Python Google Collaboratory (Colab) programming for pre-processing and model training as shown in Fig11

In Training 8 variables are used and 2 variables are used for validation and evaluation (Testing). For optimum use of computing resources, data was imported to Google Colab to deliver data in batches of 28 observations, after data pre-processing only 11 were chosen for the model.
The TensorFlow models were trained with the P2P lending dataset and also each of the following modelling techniques (Linear Regression, Random Forest, XGBoost, K-Nearest Neighbors KNN, Support Vector Machine SVM) was accurately trained and tested with one target/independent variable (Internet_Users). It was used to develop 5 predictive regression models and the Peer-to-Peer lending model runs inference on the P2P lending dataset, as it retains constantly data in the cache for quick inference when executing the R-squared score button is triggered for further predictive analytics on which modelling techniques to best fit, in this case, to predict the internet connectivity correlation per user in DR Congo and neighbouring countries.

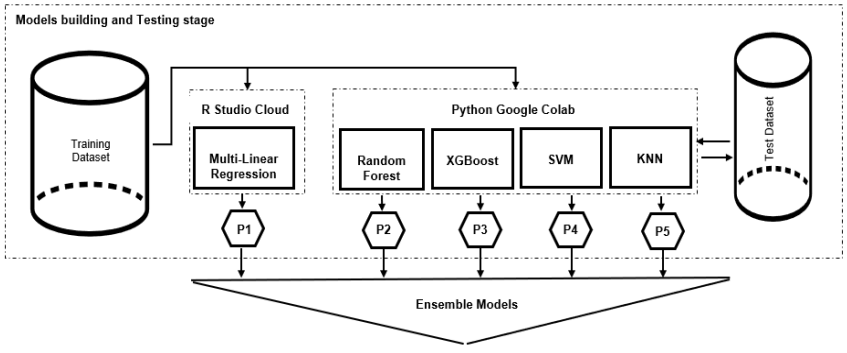


Fig 12: P2P lending Training & Testing prediction Model implementation)

5.3 P2P lending Blockchain Smart contracts

The borrower needs to create/ or have a MetaMask wallet account using ETH as the required cryptocurrency, in order to activate the loan request function (smart contract loan) and P2P lending platforms are the bridge between lender and borrower, ensuring both parties' interest is secure. The Ethereum remix platform uses **WEI** which is *the smallest denomination of the cryptocurrency ETHER (10^{10}).*The loan smart contract is created by the borrower in making a loan request, and this creates a loan between the two parties (borrower and lender).
There are 5 values (Attributes) that are parameterised by this loan request and also constitute the terms and conditions of the loan as follows:

- **Interface ERC20 Token (ierc20token)**
  1 token is equal to or equivalent to 1 ETH to be considered by the investor/lender as collateral
- **Amount of the Collateral**

This value is equal to the Token received as collateral

- **Loan_amount**

It represents the WEI (ETH cents) which is the value in decimals of the amount to be borrowed

- **Payoff_amount**

Equivalent to "WEI" is "ETH Cents" that the borrower must pay if he/she wants to reclaim back its token (collateral)

- **Loan duration**

This is the time period given to the borrower to pay off the loan once he/she received it.
What is needed to import in building the smart contract syntax is the IERC20 token.sol file created that includes (the regular ERC20 for the purpose of KYC validation process for both–borrower and lender) see (Fig15)

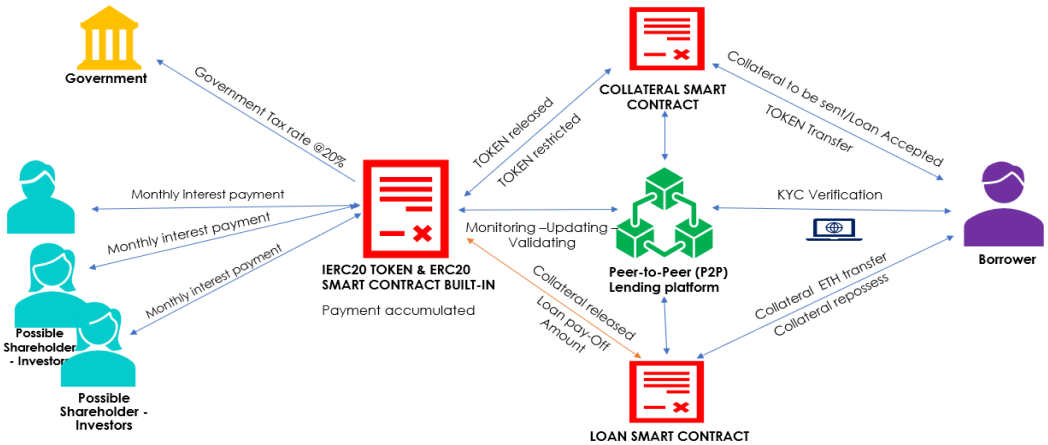


Fig 13:Peer-to-Peer lending high-level Blockchain solidity (IER20 Token/ERC 20 and smart contract loans) implementation

6. EVALUATION

6.1 Interviews

While conducting interviews with[Z8, Online News], as a result, it shows that the regulatory regime led by the Central government and the Central Bank of Congo has significantly shifted, as they have been pressurised by Peer-to-Peer online lending platforms and forced the regulatory regime to shift from being cultural cognitive-oriented to regulative-oriented.

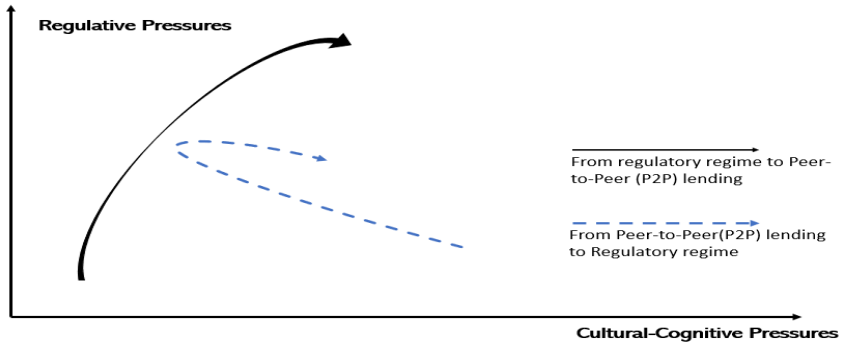


Fig 14: The mechanisms of interactions relationship between Peer-to-Peer Lending and regulatory regime

Conversely, the cultural Cognitive pressures take longer to change if the regulators do not anticipate enforcing a new regulatory regime and stabilising a smooth transition to Peer-to-Peer online lending adoption.

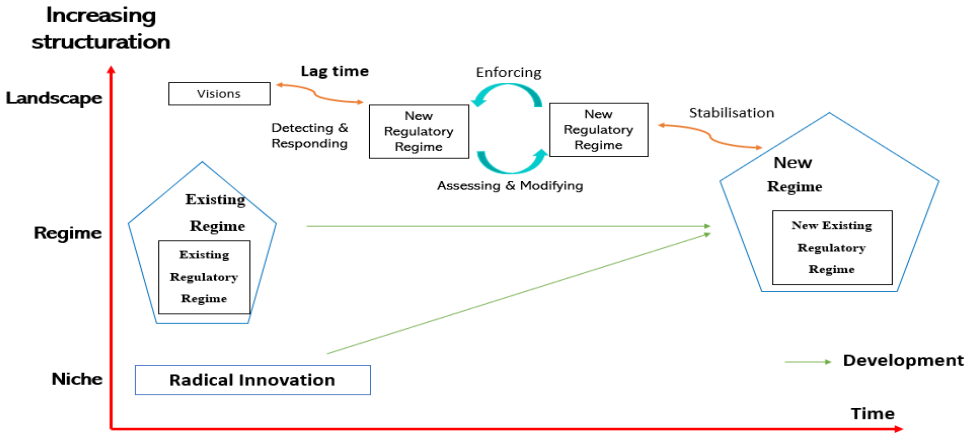


Fig15: The Trajectory model of the regulatory regime's development in Socio-Technical Transitions

6.2 P2P lending Machine learning Model

The performance of the proposed model was analysed using Python Google Colab, however, the evaluation comparisons were conducted, and the chosen target/independent variable was “Internet_Users” per user, comparing the 9 DR Congo Neighbouring countries, which shows a clear correlation between the dataset variables and also the interviews conducted to build a predictive model based on the level of internet connectivity in Central Africa in DR Congo in particular, as known the underline core business model and operation of Peer-to-Peer online lending is Internet connectivity. The result revealed that among the five model techniques (Linear regression, K-Nearest Neighbors, Random Forest, XGBoost) the linear regression trained and tested has underperformed badly, whereas the XGBoost modelling technique outperformed with the best accuracy R-squared of 73.84% and random Forest 57.05% respectively. See (Fig17)

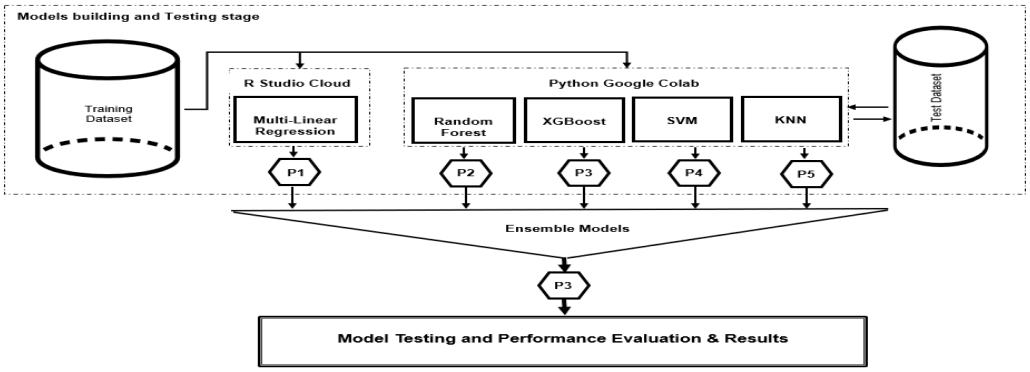


Fig16: P2P performance Evaluation and Results

EVALUATION AND COMPARISON OF ALL THE MODELS

Target/ independent variable : INTERNET USERS

```
models = pd.DataFrame({
    'Model': ['Linear Regression', 'KNeighbors KNN', 'Random Forest', 'Support Vector Machines', 'XGBoost'],
    'R-squared Score': [acc_linreg*100, acc_knn*100, acc_rf*100, acc_svm*100, acc_xgb*100,]})
models.sort_values(by='R-squared Score', ascending=True)
```

	Model	R-squared Score
0	Linear Regression	-87262.163445
1	KNeighbors KNN	-0.224889
3	Support Vector Machines	-0.224889
2	Random Forest	57.051736
4	XGBoost	73.847958

Fig17: P2P lending (Evaluation & Comparison) in Central Africa (Internet per User)

Normally, the variance score prediction is low when you combine several models, however, in this case, XGBoost was well fitted with a variance score of 73.84% and a low R Mean Square Errors of 28 per cent (%), seconded by Random Forest above average at 57% See(Fig18).

On the other hand, other models such as Keras regression using Neural Network and had a run with EPOCHS of 400, although we only had 11 observations, KNN, SVM, and Linear Regression underperformed, the model predicted using Neural Network had a negative variance score below 1

Table 6.2 : P2P lending dataset – Evaluation and comparison of 5 models

	R-Square	MAE	MSE	RMSE
XGBoost	73.84%	2.80	7.91	2.81
Random Forest	57.05%	3.28	14.48	3.80
KNN	-0.22%	5.21	30.31	5.50
SVM	-0.22%	5.21	30.31	5.50
Linear Regression	-872.62	116.19	26427.05	162.56

Fig18: Models vs R square and Errors Metrics

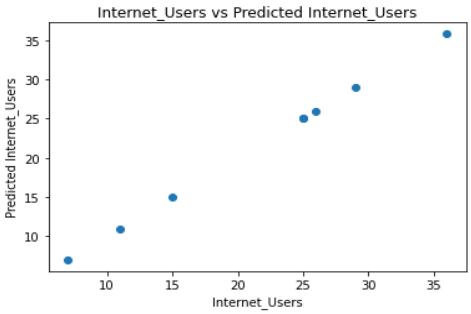


Fig19: XGBoost independent variable Internet_Users vs Predicted Internet_Users

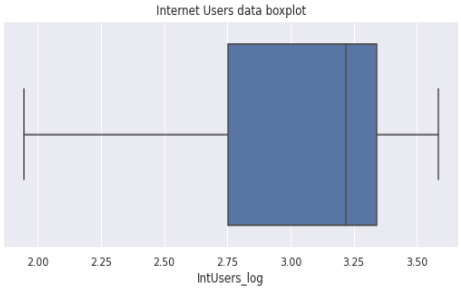
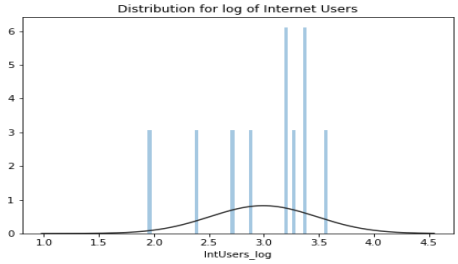


Fig20: Target variable with no outliers



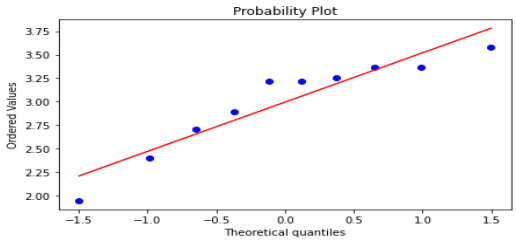


Fig21: Normal distribution (target/independent variable- Internet_Users)

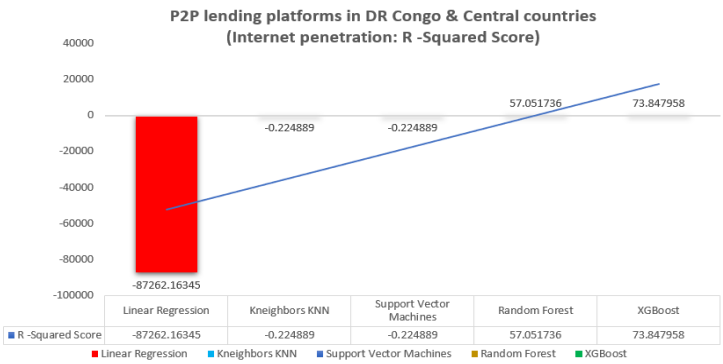


Fig24: Evaluation and comparison of predictive Models

6.3 P2P lending Blockchain Smart contracts

The business logic was tested, the IERC20 token and ERC20 standards JavaScript's were accurately evaluated and successfully deployed to the testing Ropsten MetaMask account, and the three smart contracts that include (Collateral and loan) were successfully implemented and evaluated (see Fig22). Ethereum Solidity Remix platform and Metatask platform where the cryptocurrency used (ETH) to exchange the ETH Token against the collateral. The proposed Peer-to-Peer blockchain smart contract model will secure loan transfers between both parties (borrower & lender) and Government tax deductions. See(Fig15) and more detail on the config manual and Artifacts

Fig22:Peer-to-Peer lending MetaMask – Solidity high-level architecture

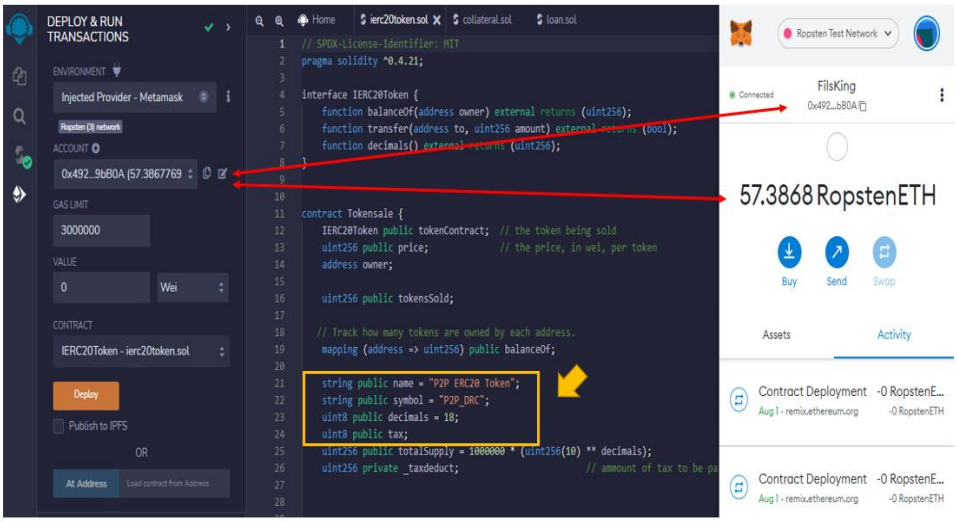


Fig23: P2P Lending Solidity Smart contract deployment Results

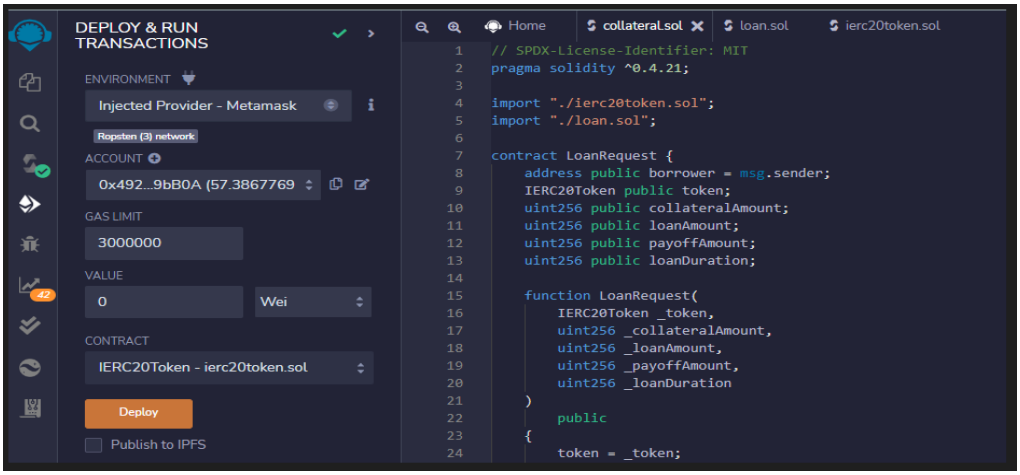


Fig24: P2P Smart Contract Collateral deployment

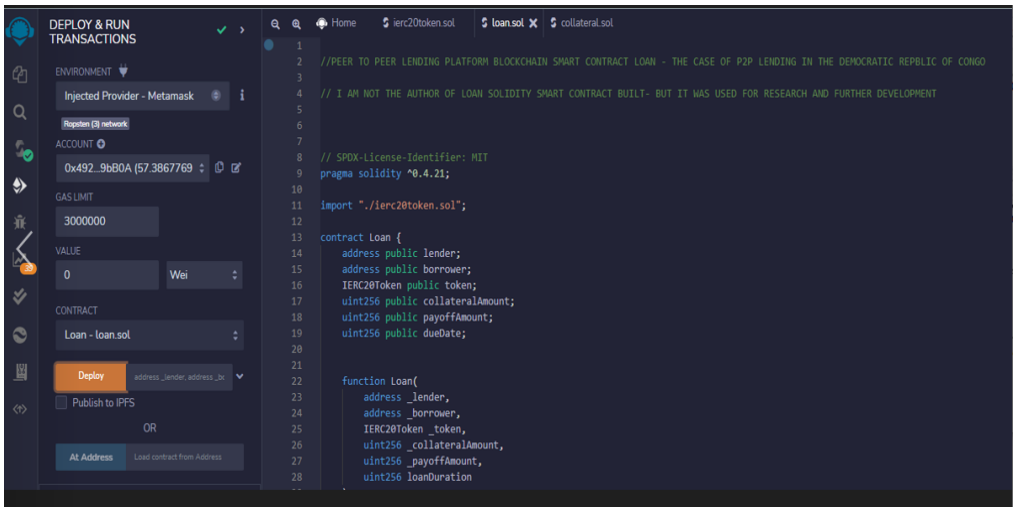


Fig25: P2P lending Smart Contract loan (Approval & Repayment)

6.4 Discussion

The result can be translated to the lack of a regulative regime from the central government to keep up with the technological innovation trends of the century, which requires constant 24/7 internet connection, thus, impacting the adoption of the Peer-to-Peer (P2P) lending industry in terms of growth, which demonstrate that the regulatory regime remains in the initiation stage, in this case, the Congolese individual lending transition and the normative pressures were examined and identified that the bonds of interactions between Peer-to-Peer lending and the regulatory regime will remain.
The predictive model using the XGBoost modelling technique shows an increase in terms of internet connectivity per user, people are more engaged in new technology and would be willing to raise capital via online lending platforms. See Fig23).
On the other hand, the blockchain technology, all the three smart contracts (IERC20 Token &ERC20 standards, Collateral and loan) created were successfully executed and deployed on the Ethereum Remix platform

7. CONCLUSION AND FUTURE WORK

Romans et al. (2001), proposed four stages of Peer-to-Peer development, however, the data shows that the development of Peer-to-Peer lending in DR Congo could be divided into three (Pre-development phase, Take-off phase, Stabilisation phase), however, it remains at its infancy Pre-development phase from 2020 to 2022.
SubRQ1 was examined by identifying the trajectories of Peer-to-Peer lending and the regulatory regime in the case of Congolese individual lending transition
SubRQ2 was examined by identifying the interplay between Peer-to-Peer lending and the regulatory regime and adopting the concept of the organisational field from institutional theory.
SubRQ3 was examined by identifying a broad trajectory of the regulatory regime in Socio-Technical Transitions, which shows the regulatory processes and stabilisation of the regulatory regime in transition processes.
SubRQ4 was examined by identifying appropriate strategies and approaches for innovation regulation in Socio-Technical Transition, by which the coordination of the innovation and regulatory regime can be promoted.
SubRQ5 was examined by identifying tools and methods on how to utilize smart contracts effectively to accelerate the adoption of Peer-to-Peer lending in DR Congo

The need for Peer-to-Peer lending platforms as one of the financial services segments in Central Africa, and the people of the Democratic Republic of Congo (DRC) have embraced this new trend with open arms, as it is almost ubiquitous, and justified by a large number of unbanked, a weak low banking penetration rate, high loan denial rate and the internet connection, the mobile data prices per Gb, internet access per home and individual across the neighbouring countries as indicators, sufficiently align and correlate with the machine learning prediction scores.

The Congolese central government and the Central Bank of Congo must imperatively be responsive to set out a regulatory framework and guidelines for any novelty and also decentralise the political systems, which would lead to more comprehension role of politics in regulatory development, financial inclusion and adoption of online lending platforms in Socio-technical Transitions. There are several limitations to consider, which on the other hand would benefit researchers and academics from further research and contribution.

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Appendix 1

Table 1.1 Key events in the Pre-development phase and their significance

Key Events	Time	significance					
		Process-Oriented Dimension			Perception-Oriented Dimension		
		Niche	Regime	Landscape	Regulative	Normative	Cultural-Cognitive
Existing individual lending regime (Bank lending & Civil lending)	Before 2020		A stable regime for many years		Not - established regulatory regime	Burdensome procedure and limited inclusiveness	Formal perception, and common ways to request loans for individuals. On the basis of Congolese traditional culture and local custom "Banque Lambert"
Not approved Establishment of MyGoldRev	January 2020	P2P lending platform. Niche innovation appeared within the existing regime			regulatory regime Not - established yet	A new way to acquire loans and a new approach to financial management	

Appendix 2

Table 1.1 Key events in the Take-off phase and their significance

Key Events	Time	significance					
		Process-Oriented Dimension			Perception-Oriented Dimension		
		Niche	Regime	Landscape	Regulative	Normative	Cultural-Cognitive
	November 2020			The Central Bank of Congo & Central government paid attention to this emerging FinTech industry		P2P lending was not recognised by the central government. Regulators tried to understand the meaning, value and opportunities and outcomes	

Appendix 3

Table 1.1 Key events in the Stabilisation phase and their significance

Key Events	Time	significance					
		Process-Oriented Dimension			Perception-Oriented Dimension		
		Niche	Regime	Landscape	Regulative	Normative	Cultural-Cognitive
Central bank of Congo: issue of Decree: [2021] suspension of activity			Restricted the expansion of online lending. Hindered the development of P2P lending		P2P lending regulatory framework has not been approved yet		

Appendix 4

Example of Concept-driven data categorising and coding

The damage of crisis of confidence since the year 2020 regarding the suspension of the online financial management Mygoldrev was a heavy blow to the online lending industry. According to questionnaires and interviews conducted, the number of normal operating Peer-to-Peer lending platforms has dropped significantly to 2 or 3. lending The Central government have highly valued the crisis of confidence; however, the regulatory authority has not yet set out a framework to anticipate further development of the online lending industry. Furthermore, Peer-to-Peer online lending platforms have no guidance policy for supervision, to prevent illegal behaviours, in the case of MyGoldrev. Thus, Peer-to-Peer online lending platforms need to pursue sustainability, rapid growth and development						
	Process-Oriented Dimension			Perception-Oriented Dimension		
Event	Niche	Regime	Landscape	Regulative	Normative	Cultural-Cognitive
Crisis of Confidence		Threatened the (P2P) online lending industry	Increase pressure on the Central Bank of Congo and the Central government	Encouraged the introduction of regulatory policies	Should eradicate illegal behaviours for online (P2P) lending platforms	

Appendix 5

Example of data-driven data categorising and coding

Data	Description of phenomena	Codes	Themes	Aggregated
Peer-to-Peer online lending was indeed a financial technological innovation disruptor, the old financial regulation guidance was no more compatible and did not fit the new online lending industry. Policymakers, regulatory agencies, and professionals require to upskill their knowledge, not only the online lending industry is new to practitioners, yet they did not have sufficient knowledge of the field.[M2 Regulator Authority 2]	Policymakers and regulators lack professional knowledge regarding radical innovations	Professional knowledge and Expertise	Regime orientation	Regulatory strategy
The field of online lending has the potential to explore by small businesses and individuals that traditional financial institutions had not offered. However, the only question remains that the online industry had not been regulated since the suspension of Mygoldrev. The benefits of Peer-to-Peer lending. We also acknowledge the factor risks and the negative opinions spread across the country [M3Regulator Authority3]	The need for a general regulatory policy framework, regardless of the rapid growth of innovation in the sector	General policy	Responding	
It is imperative for regulators to affirm their authority in what's happening in this new disruptive segment in the financial industry and to have a clear understanding of the	Putting forward an online lending policy to identify and address existing	Identification	Detecting	Regulatory approach

whole industry and the problems that have occurred and amend them accordingly by putting forward a draft of policies and implement those measures as guidelines, standards and to conduct a thorough modification on behaviour aspect of the online lending industry. [Z8, Online News 7]	problems and future outcomes by conducting assessments on behaviour modification			
The general policy that regulates Financial Institutions, Microfinance applies to Peer-to-Peer lending platforms, which means that Capital requirements (Buffer) must meet the Central Bank of Congo's obligations. It is unclear for Peer-to-Peer online lending platforms given their business model (online operation) is different from traditional institutions. Therefore, revised or new policies were required. [G3, Peer-to-Peer (P2P) platform 2]	Development of new policies and establishment of a complementary regulatory framework	Complementary policy	Modifying	

Appendix 6

Table 2.2c Categorising and coding interviewees

Interview Code	Organisation Code	Interviewee role
G1	Peer-to-Peer Lending Platform 1	Director
xG2	Peer-to-Peer Lending Platforms 1	Director
G3	Peer-to-Peer Lending Platform 2	Director
G4	Peer-to-Peer Lending Platforms 2	Director
M1	Regulatory authority 1	Official
M2	Regulatory authority 2	Official
M3	Regulatory authority 3	Official
T1	Commercial bank 1	Staff
T2	Commercial bank 2	Staff
D1	NA	User
D2	NA	User
D3	NA	User
D4	NA	User
D5	NA	User
Z1	Online News 1	Journalist
Z2	Online News 1	Journalist
Z3	Online News 2	Journalist
Z4	Online News 3	Journalist
Z5	Online News 4	Journalist
Z6	Online News 5	Journalist
Z7	Online News 6	Journalist
Z8	Online News 7	Journalist
Z9	Online News 8	Journalist
Z10	Online News 9	Journalist

Appendix 7

Home_internet: which is the proportion of households with Internet access in the DR Congo and its neighbouring countries, generated on the model's inference a Regression dataset, indicate the level of households to access P2P lending online platforms information features.

Mobile_dataprices

Indiv_internet is the percentage of individuals using the internet in DR Congo and neighbouring countries, as generated on the model inference of a Regression dataset, it illustrates the percentage of individuals who could potentially access capital through P2P online lending platforms from investors.

Active_Mobile is the broadband subscriptions per 100 inhabitants, which is generated on the model inference of a Regression dataset, as the fixed broadband subscriptions global rate stands at 12.5 per cent, the African continent estimated around 0.5 per 100 inhabitants, it shows the difficulty for P2P online lending platforms to acquire prospective borrowers.

Growth: this indicator was taken via the World Bank, Organisation Economic Co-Operative Development (OECD) open sources, is generated on the model inference of a Regression dataset, indicates the economic growth of Central African countries, DR Congo in particular and could be useful for P2P online lending platforms as an economic driver.

HDI_2020 Human Development Index (HDI) is created on the model inference of a Regression dataset and serves as a benchmark of DR Congo and neighbouring countries on a literacy basis to help P2P lending platforms in terms of borrower acquisition.

Density the population density as it is produced on the model inference of a Regression dataset and could explore a large number of prospective customers by P2P online lending platforms.

Population_2020 is created on the model inference of a Regression dataset, this data was taken to give a broader perspective of DR Congo and neighbouring countries, which enables P2P online lending platforms to capitalise on their targeted market.

The area is generated on the model inference of a Regression dataset, and this variable in terms of size that P2P online lending platforms could explore to improve businesses' capacity.

EV_regulation is produced on the model inference of a Regression dataset and allows for quantification of the level of regulatory evolution across Central African countries, in DR Congo in particular.

Appendix 8

The Impact of the Adoption of Peer-to-Peer lending and Regulatory Regime in Socio-Technical Transitions: The Case of Congolese Individual Lending Transition (Democratic Republic of Congo DRC)

Thank you for taking the time to read this Participant Information Sheet regarding the study in which you are invited to participate, in as part of my master's degree research study at The National College of Ireland (NCI). Your contribution to this study is highly valued and deeply anticipated. However, before deciding whether to participate, it is important that you fully understand what the study involves and what it may involve. For that reason, please take the time to read the following information. Should there be a question or concern which you wish to raise, please feel free to ask me for more information.

Who will conduct the research?

Mr Fiston Kiangata, MSc candidate for MSc in Financial Technology FinTech at National College of Ireland NCI will lead the research.

Title of the Research

The Impact of the Adoption of Peer-to-Peer lending and Regulatory Regime in Socio-Technical Transitions. The Case of the Congolese Individual Lending Transition (Democratic Republic of Congo DRC)

What is the aim of the research?

This research aims to explore how the impact of the adoption of Peer-to-Peer lending platforms and the regulatory regime in socio-technical transitions by investigating the innovative effect of Peer-to-Peer (P2P) lending and the corresponding regulatory regime in Congolese individual lending transition.

Why have I been chosen?

There are stakeholder groups identified as the main actors participating in the Congolese individual lending transition: Peer-to-Peer (P2P lending platforms, regulatory authorities, traditional commercial banks, and P2P lending users. The informants of this research are mainly selected from the above stakeholder groups. In addition, to gain 24. For some more general views of Congolese individual lending transition, journalists are selected as an alternate data source.

It is considered that you have the expertise in the innovation of Peer-to-Peer lending or the regulatory regime in any of the above-mentioned perspectives. We are interested in your specific aspirations, views, attitudes, and roles in the Congolese individual lending transition process.

What would I be asked to do if I took part?

By participating in this study, you will be invited to participate in a semi-structured interview via online channels where the researcher will ask a series of open-ended questions.

The interview is intended to be an interactive process through which you are encouraged to express your practical experience and opinions on the impact of the adoption of Peer-to-Peer lending and the regulatory regime in the Democratic Republic of Congo (DRC).

Each interview will last approximately 1 hour. The interviews will be audio recorded if your consent

Appendix 9

Limitations

Firstly, due to time, interviewees' availability and resources (some Interviewees could not afford to stay longer for the interview because of high-cost mobile data prices in the Democratic Republic of Congo DRC. However, the interviews were conducted mainly focused on the Capital Kinshasa, with the most FinTech entrepreneurs and Peer-to-Peer lending platforms that were consulted, relatively advanced in that regard compared to Lubumbashi, Goma and other states. This may be looked upon as data bias more or less. Thus, further research is required could enable and incorporate more samples in terms of cities and states that have the equivalent level amount of Peer-to-Peer online lending platforms.

Secondly, the last research conducted on the Individual Lending Transition dated until the end of 2020, ceteris paribus as it follows, the findings provided in this research take account of the recent developments in Central Africa, and the Democratic Republic of Congo DRC in particular.

Lastly, this research is the first academic endeavour to analyse "the Impact of the adoption of Peer-to-Peer lending and the regulatory regime in Social-Technical Transition, the case of Congolese individual lending transition" in the Democratic Republic of Congo (DRC). Further research could be carried out on investigating other financial services segments that could have an impact and influence on the transition processes in Central African countries.

APPENDIX 10

RESEARCH QUESTIONS

RQ: How do the Peer-to-Peer (P2P) lending adoption and regulatory regime impact social-technical transition?

The main research question is addressed in this research by answering the following sub-research questions (SRQs):

SubRQ1; What are the trajectories of P2P lending and the regulatory regime in the case of Congolese individual lending transition?

SubRQ2: How do P2P lending and the regulatory regime influence each other in the process of Congolese Individual lending transition?

SubRQ3: What is the generalised trajectory of the regulatory regime in Social technical Transition?

SubRQ4: How is the coordination of the impact of Peer-to-Peer lending adoption and regulatory regime promoted in Social Technical Transition?

SubRQ5: How the utilization of smart contracts within the Blockchain technology empowers and accelerates Peer-to-Peer lending adoption

10.1APPENDIX B

INTERVIEWEE QUESTIONS ENGLISH VERSION

A. QUESTIONS TO ALL INTERVIEWEES

1) Personal information (role, responsibilities, work experiences, etc.)
2) What are your thoughts on key drivers for the development of Peer-to-Peer lending and the initiation of individual lending transition in the Democratic Republic of Congo DRC? And What are they?
3) What do you think are important technological breakthroughs for Peer-to-Peer lending?
4) What do you think are distinctive characteristics of Peer-to-Peer lending?
5) Do you think there are any risks of Peer-to-Peer lending? If so, what are they?
6) How many stages do you think the development of Peer-to-Peer lending in the Democratic Republic of Congo (DRC) can be divided into? What are the features of these stages?
7) What events or activities do you recognize as milestones of individual lending transition or Peer-to-Peer lending development in the Democratic Republic of Congo? What are the significances of these milestones?

8) What are the constraints of individual lending transition of Peer-to-Peer lending development in the Democratic Republic of Congo (DRC)?

B. SPECIFIC QUESTIONS FOR DIFFERENT GROUPS OF INFORMANTS

Specific questions for informants from Peer-to-Peer (P2P) lending platforms

1) In general, how do you think the Peer-to-Peer lending industry is affected by the regulation during the Congolese individual lending transition process?
2) What regulatory policies and events in the regulatory dimension have significantly influenced the Peer-to-Peer lending industry?
3) How was your Peer-to-Peer lending platform influenced by these policies and events?
4) How did your Peer-to-Peer lending platform respond to these events and policies?
5) What do you think are the barriers to Peer-to-Peer lending development?
6) What are the most-risky aspects of FinTech lending/P2P lending platforms in the Democratic Republic of Congo (DRC)?
7) What are the main challenges that Peer-to-Peer lending platforms are facing?
8) What do you think of the Use of Blockchain technology and smart contracts by Peer-to-Peer Platforms?

Specific questions for journalists

1) Can you please give an overview of the development of the Peer-to-Peer lending industry and the corresponding regulatory regime during the Congolese individual lending transition?
2) What is your attitude toward the Peer-to-Peer lending industry? Has your attitude ever changed? If so, what factors caused the changes?
3) How do you perceive the relationship between the traditional individual lending system and the Peer-to-Peer lending industry in the Democratic Republic of Congo DRC?
4) What is your perception of the relationship between the Peer-to-Peer lending industry and the regulatory regime in the Congolese individual lending transition?
5) What kind of approaches do you think can promote the coordination of the development of Peer-to-Peer lending and the development of the regulatory regime?

Specific questions for informants from regulatory authorities

1) What is your perception of the relationship between the Peer-to-Peer lending platforms and industry as a whole and the regulatory regime in the Congolese individual lending transition?
2) What are the drivers and goals set out for the regulation of Peer-to-Peer lending in the Democratic Republic of Congo (DRC)?
3) What factors do you think caused the government to initiate the development of this regulatory regime on Fintech and Peer-to-Peer platforms in particular?
4) What are the challenges in terms of regulatory enforcement? How do you overcome these challenges?

Specific questions for informants from Commercial banks

1) How do you think commercial banks have been influenced by the development of Peer-to-Peer (P2P) lending?
2) How do you perceive the relationship between the traditional individual lending system and the Peer-to-Peer (P2P) lending industry in the Democratic Republic of Congo DRC?
3) How commercial banks were influenced by these events? How did you respond to these events?
4) How do you think the Peer-to-Peer (P2P) lending industry and the regulatory regime have influenced each other during the Congolese individual lending transition?

Closing questions

1) What do you think the future of Peer-to-Peer lending in the Democratic Republic of Congo (DRC) is like?
2) Is there anything else you would like to share with me regarding this case?