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MASTER THESIS

« Investigating Crowdfunding Success and Backer Behavior for African Startups»

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Abstract

This study looked into how crowdfunding campaigns targeting African startups are influenced by their success drivers and funders' actions. Crowdfunding has appeared as an important different financing solution with possibility to tackle problems encountered through usual routes of financing in Africa, like high-interest loans, strict collateral terms and conditions, as well as restrictedness on the availability of venture capital.

The research's primary goal is to recognize what makes successful crowdfunding projects in Africa, know citizens' characteristics, reasons and producers' decision-making mechanisms, and come up with knowledge-based useful advice.
After studying regional, temporal as well as technological impacts, this study gives practical ways of improving crowdfunding drives, using machine learning models like logistic regression, random forests, support vector machines as well as XGBoost. In light of this, these very same models are then employed in analyzing broad ranges of data in order to have a clear view concerning the profile of supporters, their reasons as well, as how they think critically which contribute positively towards sustainable economic growth and advancements within Africa.

This discovery shows how using crowdfunding can be transformational in providing access to finance to many people while at the same time creating a more participatory and dynamic approach for starting businesses in Africa.

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Chapter I

1.1. Introduction

Crowdfunding is the action of funding a project or idea by obtaining various financial contributions in small amounts from a large number of people, typically via the internet [1]. The three main components of this crowdfunding demonstration are the venture initiator who proposes the idea/project to be funded, individuals/groups who support the idea, and a platform that brings the parties together to carry out the idea [1].

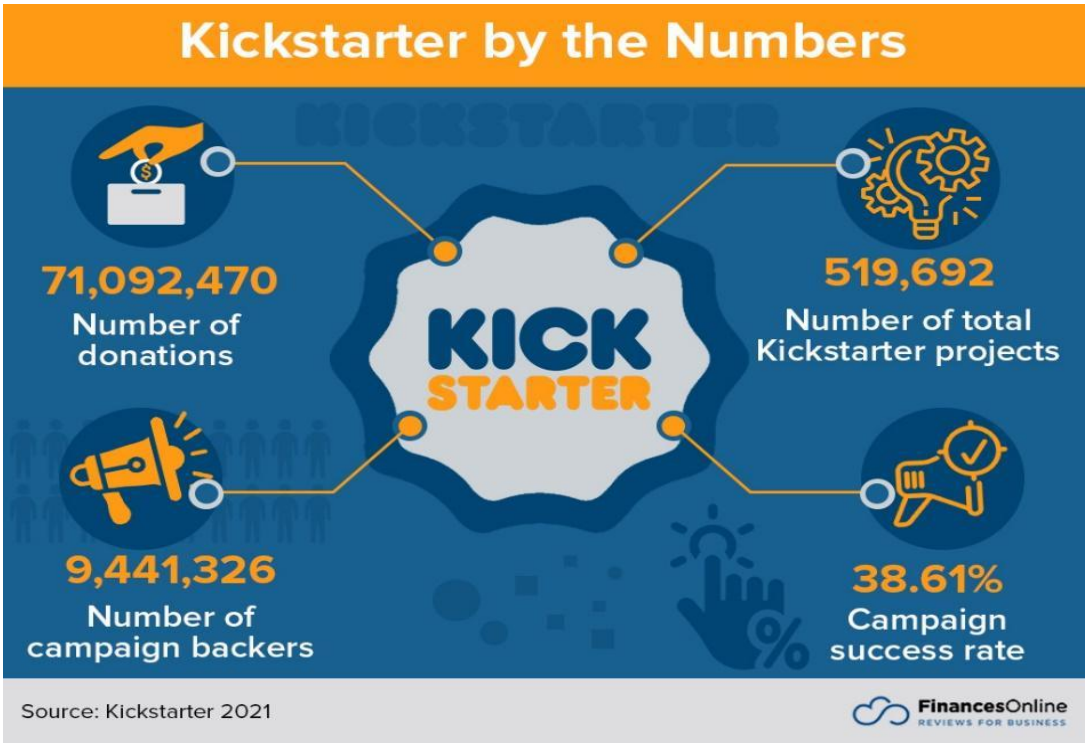

Figure 1 - Kickstarter the most famous crowdfunding platform of all time by numbers (2021).[1]

1.1.1. Background of Crowdfunding in Africa

Despite creative individuals' and ideas, Africa has an entrepreneurial spirit that is strong burning within it [20]. Unfortunately, for the time being, this hope is still not fulfilled since securing financing for the enterprises has always been tough making it difficult for many prospective businesses to be implemented

[1]1 Chang, J. (2024, May 17). One of the biggest impediments to opening and operating a business is the lack of capital. For this reason, a. Financesonline.com. https://alternatives.financesonline.com/crowdfunding-statistics/

and developed [4]. In order to fully understand crowdfunding's transformative capabilities in Africa, It needs to first focus on historical impediments that have deterred would-be entrepreneurs:

- Banks: Traditional banks behave more like fortress than gateway for young firms, hence sometimes loan requests meet doubt where one has to provide a near impenetrable wall of security, a guarantee and well documented track records of achievements-something which most new businesses lack but need for financing to thrive. This situation is not a healthy one. Because start-ups do not have sufficient creditworthiness to get loans, they find themselves thus unable to establish credibility that would enable them access financing – thereby limiting creativity around novel concepts [21].
- High interest rates: Even if a determined entrepreneur manages to breach the bank's defenses and secure a loan, the victory can be short-lived. The interest rates attached to these loans can be crippling, a hidden usurer lurking within the supposedly legitimate system. These exorbitant costs quickly eat profits up, strangles life out of a business and preventing it from taking any height at all. This hampers the creativity and negatively affects the spirit of industry thereby barring the way for the collective development of African countries [27].
- Lack of venture capital: Investors have increased their venture capital investments in Africa recently offering some good news. There is hope looming but when you take a deep look at it, you realize that it is unevenly distributed. Most venture capitalist funding gravitates towards existing firms within particular sectors that are only a few. Additionally, those targeted ones are usually characterized by the possibility of quick massive development in size. This then creates another problem area whereby the chasm is very big since innovative entrepreneurs with ideas still at their infancy lack financial backup while others who are not in favor cannot access any finance from VC investors [4].

a. Emergence of Crowdfunding

Crowdfunding is like hope in the dark, lighting up African entrepreneurs who have had their financial shadowed by traditional finance for a long time. This new way of financing brings competition to the table shaking up the former model with an easier, broader participation basis for securing capital [16].

Below is the advancement into the exact benefits, which turn crowdfunding into a real game-changer for African enterprises:

- Traditional banks are imposing fortresses whereas crowdfunding platforms open them for a wide scope of start-ups. No rigid demands are imposed any longer; neither do piles of paperwork exist. Lately, there has been a complete adoption of less experienced projects by these sites because they have understood that novelty matters most rather than past success only. By doing this, it allows even more African businesspersons to follow what they are passionate about into reality without being limited by physical location or ability to raise money. For example; imagine a Young entrepreneur from Kenya who has an idea on how best one can substitute worn out car parts but does not know where he can get the finances needed for this kind of enterprise- he would definitely benefit from such an opportunity which offers a chance for anyone involved in fashion industry globally to support his charitable cause while volunteering their time or resources such as skills while donating them online [16].
- Flexibility: There is no single crowdfunding solution; it introduces different funding strategies, which can be used by business owners depending on their demands and aims. These include such models as equity crowdfunding involving provision of shares in the business to investors or reward-based crowdfunding where participants get rewards for their contributions. Entrepreneurs can be creative and strategic in their fundraising approach. This means that across various industries and stages of development, crowdfunding can be a powerful tool [17].
- Community building: Crowdfunding presents a reassuringly painless alternative to the old administrative procedures involved in conventional sources of funds. Volumes of documentation, extensive loan applications that drag for months no longer characterize loan application procedures. In fact, hardly any documents are need for crowdfunding platforms; this makes it easier for business owners to prepare and implement attractive campaigns that can attract sponsors [8].

  Crowdfunding is not just a way to raise money; it also gives impetus to alterations. It grants power to African start-ups, encourages inventiveness, and supports a richer, more openhearted world of commerce. About this matter, it is clear that by disrupting the traditional financial institutions, by providing a variety of choices, utilizing the most

potent networks there can ever be, and making entry requirements less stringent, crowdfunding appears ready enough to shape the economic prosperity of Africa [3].

b. Early Stages and Challenges

While crowdfunding in Africa is in its infancy compared to more advanced regions, it has recorded remarkable growth over the last few years [5, 6]. Nonetheless, it faces various challenges including:

- Low awareness where many potential backers and start-ups within the African continent are still unfamiliar or do not trust online funding platforms [7].
- Limited internet access where Digital infrastructure and internet connectivity are at different levels in different countries within Africa, which may impede people from participating in these activities [7].
- Regulatory uncertainty remains one of the critical issues holding back the successful implementation of crowdfunding on the continent as laws governing it continue to change thereby creating doubt among entrepreneurs as well as those who run these platforms.
- There is always an urgent need for secure ways that can accept money yet maintain confidentiality when making online payments in order to make people believe more about what they are buying [4,8].

Even with these difficulties, it cannot be denied that crowdfunding has a great potential when it comes to aiding start-ups in Africa. In as much as increasing the awareness, improving infrastructure and having supportive regulatory frameworks are some of the challenges that one needs to overcome, its role in financing African innovation and entrepreneurship is likely to become more pronounced [21].

Figure 2 - Crowdfunding platforms across the world (2023) according to P2PmarketData.com[2]

c. Regional and Local Crowdfunding Platforms

Of unique needs distinct cultural contexts recognizing various Africa regions, several regional and local crowdfunding platforms have emerged to cater to specific entrepreneurial ecosystems and address the limitations of global platforms:

- Ensuring proper localization of interface, marketing tools and communication used on such platforms so as to appeal more local audiences [2].
- Navigate regulatory changes and effectively integrate into mobile money systems or payment gateways by knowing what law including payment system regulations in each country one operates within requires.
- Different African entrepreneurs' campaign success can be boosted even more if certain platforms provide particular support measures or apprenticeship schemes [3].

Africa has a conducive environment for crowdfunding because both of historical antecedents, mobile currency capability and emergence of continental hubs which have enabled such funding to assist entrepreneurs overcome money challenges besides promoting cooperative ecosystems enhancing inventiveness and expansion [11].

[22] Bednorz, J. (2023, December 6). Crowdfunding Statistics Worldwide Market Update 2023. https://p2pmarketdata.com/articles/crowdfunding-statistics-worldwide/

In general, while African entrepreneurs have endured numerous obstacles in obtaining standard finance for many years, crowdfunding appears to be a positive way out as it is easy to reach, flexible and helps people to come together. Hence, while still new with lacking awareness and little infrastructure support, Africa has seen an impressive increase in the number of crowd funding projects which opens wider opportunities for further advancements.

It is imperative to intensify on awareness creation avenues, information circulation, regulatory structures that back up technological advancements and payment frameworks that cannot be easily compromised if this dynamic financial system has to achieve its ultimate aim. Crowdfunding has the potential of transforming into a powerful tool for advancing entrepreneurship through addressing these preoccupations while creating a conducive environment, hence facilitating innovation among Africans – thereby empowering small-scale business owners as well as innovators who receive support from well-wishers at the same time [11].

Figure 3 - Active crowdfunding project in Africa on Indiegogo.[3]

[3] Appsafrica. (2016, September 25). Crowdfunding in Africa is gaining momentum. AppsAfrica.com | African Mobile and Tech News - Tech Events in Africa. https://www.appsafrica.com/crowdfunding-in-africa-is-gaining-momentum/?__cf_chl_rt_tk=vbPbp99y4uJ2leWgLT6_wmHomH79nep61R7il77rh2Y-1716358064-0.0.1.1-1301

1.1.2. Importance of Investigating Crowdfunding Success

The Significance of Researching Successful Crowdfunding in Africa Already at its top stage, crowdfunding in Africa associates with the following potentials:

a. Increased Financial Inclusion

Many beginning entrepreneurs lack the proven record of success or any substantial security demanded by traditional financial institutions. It is, therefore, common to find such potential businesses left out in the cold by these tight-lending standards often adopted by banking institutions found across Africa. Crowdfunding is best at this point. This is because it enables business owners to raise funds from a bigger group of sponsors hence making possible the following:

- Financing for a Variety of Business Ventures: Crowdfunding platforms accept different types of companies from cutting-edge technology start-ups all the way to backyard craft cooperatives. That kind of all-embracing approach breeds a verity of entrepreneurs in an Africa that is livelier than ever [4].
- Giving more power to women and minorities who are also entrepreneurs of whom have even more access difficulties to traditional finance. This, however, changes when Crowdfunding enters into the picture as they can put their ideas to potential backers who see and believe in what they have in mind as well as its effect [4].
- Democratization of capital: Crowdfunding democratises capital by enabling ordinary people to actively participate in driving progress. This democratization of capital therefore enables societies to financially endorse businesses they consider worthwhile, generating a feeling of mutual possession and commitment towards the economic development of the continent [9].

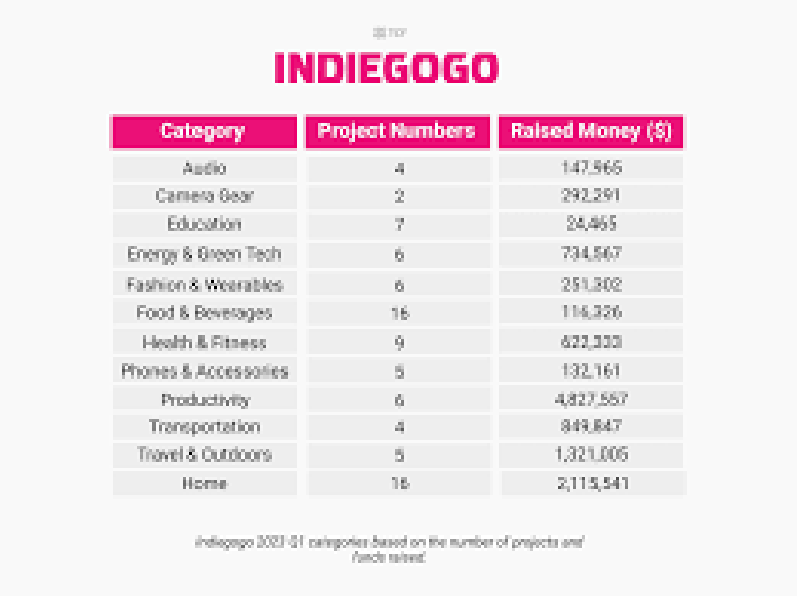

Figure 4 - Indiegogo in numbers by category [4]

b. Booming Start-up Ecosystem

Africa is experiencing a surge in entrepreneurial activities, with start-ups addressing the challenges and creating solutions that are relevant to the continent [12]. In this context, crowdfunding presents an invaluable platform for these ventures to:

- Showcase Potential: Through crowdfunding campaigns, start-ups can exhibit their ideas and services to an international audience thereby attracting not only investors but also potential customers and partners [11].
- Allow African Entrepreneurs to Access a Global Pool of Investors: Beyond the geographical boundaries, crowdfunding is an advanced financing tool that brings together various investors across the globe with African entrepreneurs thereby broadening up their access to finances and promoting international cooperation.
- Faster Company Growth: With funding from crowd funding sources, new companies can grow rapidly thus enabling them to invest more on R&D activities; scout new markets as well as make greater social changes [11].

c. Unlocking Local Capital

[4] Zohrabyan, S. (2024, January 11). Indiegogo and Kickstarter statistics: 1st quarter of 2023. Crowdfunding PR & Marketing Blog - the Crowdfunding Formula. https://blog.thecrowdfundingformula.com/indiegogo-and-kickstarter-stats/

Crowdfunding has given African start-ups the power of accessing a resource, which used to be under-exploited: local capital. There are two ways of doing this:

- Community Support: In crowdfunding, these ventures can collect financial resources from their own regions thereby ensuring that the venture's success will be considered as if it were part of them and they will be greatly involved in its establishment.
- Diaspora Investment: The African diaspora possesses the great potential as a prospective source of investments. This is possible with crowdfunding platforms linking start-ups to these people, letting them invest in the development of their motherland and remain connected with it.

The inflow of such indigenous capital not only makes personal business projects more viable but also helps create increasingly autonomous and stable business environments in different parts of Africa [16].

d. Addressing Specific Challenges

African start-ups usually tackle such hurdles like the following:

- Limited infrastructure: having no steady needful transportation or power supply systems may impede business operations.
- Regulatory hurdles: The complex laws often consume much time and cash for upcoming firms.
- Fragmented markets: it is tough to operate in different economic areas that have different consumer tastes and habits [17].

Crowdfunding solves these problems through:

- Market Validation: Building crowdfunding campaigns are similar to conducting market research–they gauge backer interest levels while collecting comments from backers; thus providing an opportunity for entrepreneurs to ascertain whether their ideas are workable or not before embarking on an expensive venture.
- Pre-selling Products or Services: With crowdfunding, business owners have an opportunity to make early sales of their goods or services in order to make some money that can help in avoiding unnecessary expenditure on products that nobody needs.
- Creating Customer Relationships: Throughout a crowdfunding campaign entrepreneurs can directly engage the potential customers to build a loyal customer base, get important feedback [16].

e. Empowering Grassroots Innovation

In order to take control of one's development, local communities have been assisted by crowdfunding. This makes it possible for them to get ventures assisting them in meeting their unique problems especially those that look into making clean energy available, make sure that health services are affordable and at the same time those that support sustainable agricultural technologies. It can be also added that, compared to top-down development models, there are more sustainable and culturally relevant solutions when crowdfunding is used to empower grassroots initiatives [19].

f. Data-Driven Insights

Data from crowdfunding platforms shows a lot about how backers behave, how campaigns work and what trends there are in terms of investment. Analysing this data with Africa in mind gives ideas that can be used by:

- Individual crowdfunding campaigns: Entrepreneurs can grow some ideas on pricing approaches, ways of making campaigns popular, and style borrowed from their fellow successful people from this region.
- Policy makers: By understanding investment trends and identifying underserved sectors, Policymakers can develop targeted initiatives to support specific industries or regions within Africa [16].

g. Building Capacity and Collaboration

Crowdfunding is not just about raising money; it also provides valuable entrepreneurial experiences. During the campaigns, entrepreneurs can learn a lot like for example fundraising strategies where a successful campaign involves coming up with attractive pitches, effectively communicating with supporters, and managing web-based fundraising tools. Entrepreneurs can also learn about Marketing and Storytelling, business owners are educated on creating an exciting account of their start-up that can efficiently communicate its value with possible financiers at the same time appealing to them emotionally. Another topic, Community Engagement, is designed to ensure that those taking part in crowdfunding are able to succeed in their work through the construction of a powerful virtual social network. In this way, they can be able to deal with comments and grievances as well as acquire interpersonal relationship abilities, which are very necessary [16].

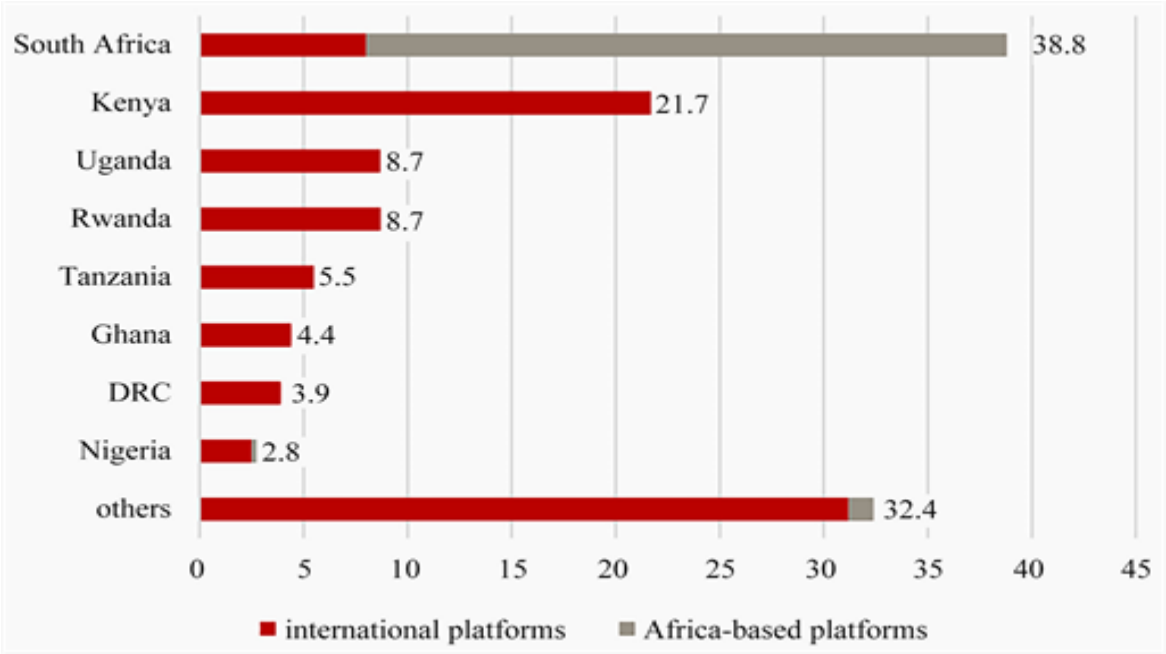

Figure 5 - Active international/local crowdfunding platforms in Africa[5]

Africa's crowdfunding could significantly affect the economy, increase access to financial services, and make various ecosystem players stronger. By researching this, we will be able to contribute more credibly to the establishment of a stronger and stable crowdfunding environment that promotes innovation, self-employment and shared prosperity in Africa [17].

1.1.3. Research Questions

- Q1: Which factors determine whether a crowdfunding campaign for African start-ups will be successful?
- Q2: How do backers differ in terms of demographics, motivations and decision-making processes from African start-up campaigns and that of other regions?
- Q3: What are ways in which African start-ups can attract and engage potential backers on crowdfunding platforms?

1.1.4. Objectives of the Research

- Examine how regional, timing, and technological factors like those found only in Africa influence the progress of crowdfunded businesses.
- Produce insights based on data to drive recommendations about campaigns in Africa.

[5] Adjakou, O. J. L. (2021). Crowdfunding: Genesis and Comprehensive review of its state in Africa. Open Journal of Business and Management, 09(02), 557–585. https://doi.org/10.4236/ojbm.2021.92031

- Discover crowdfunding platform best practices that serve African start-up requirements and environment of funders

1.2. Methodology

1.2.1. Historical Overview of Crowdfunding Research

Research on raising funds through online platforms, crowdsourcing studies has received relatively new attention from the scholarly community [8]. Even though allusion to this concept had been made in various articles before, it became an independent research domain around late 2000s or early 2010s parallel with the rapid rise of such platforms.

1.2.1.1. Early Stages (2000s):

The earliest investigations zoomed in on why contributors or innovators behave as they do while later ones delved into why people or institutions engage in fund sourcing activities driven by their convictions this way. Pioneer researchers built models through which to conceptualise how crowd funding works relying on various areas of investigation such entrepreneurship, e learning among others.

Much emphasis was placed on understanding crowdfunding in relation to functionality, success determinants and challenges, particularly in developed economies such as the United States and the United Kingdom [8].

1.2.1.2. Evolution and Expansion (2010s onward):

Research diversified to explore different types of crowdfunding beyond reward-based models such as equity and loan-based crowdfunding. The geographical scope has expanded along with growing interest in crowdfunding within emerging economies and developing countries thus leading to some preliminary analysis reports on the African context.

Studies [12, 16, 27] have concentrated further on particular areas within crowdfunding, such as platform design, campaign characteristics, regulatory frameworks, and what influence this phenomenon has on innovation and entrepreneurship. In-depth analyses on crowdfunding campaign dynamics and backer behavior were enabled by the increasing prominence of data analysis methods like big data and machine learning.

1.2.1.3. Current Trends and Future Directions:

Research is still ongoing on Crowdfunding across various contexts this includes specific industries [4], cultural nuances [34] as well as different geographical regions [5].

New aspects being looked at involve block-chain technology being used in Crowdfunding, the importance of social media and other online communities regarding this and the whole point of ethics in Crowdfunding.

The study on what Crowdfunding will lead to in terms of long-term affects to entrepreneurship ideas generation among individuals, public economic development as well as possible changes at S&E levels of various stages has not ended yet.

1.2.1.4. Challenges and Limitations:

Many current studies are dealing with separate campaigns or immediate impact therefore they are not able to tell us what could be the future benefit on this form of finance, called 'crowdfunding'. Inadequate availability of research materials is affecting the type of information researchers get while poor standards makes it hard for them to effectively address global issues because no single region has all the answers.

The nature of development in this area is evolving at a rapid pace, this implies that research methodologies need constant changes in order to keep up with the established procedures and newly appearing tendencies.

The crowdfunding research field is always evolving with a view to better comprehend this growingly essential financial and innovation framework. The improvement made so far is notable; however, it will be essential to tackle the current issues faced and explore further areas of study for a profound understanding of the diverse situations in which crowdfunding influences [16].

1.2.2. Methods of Literature Review

1.2.2.1. Methods of White Literature Review

- Inclusion:
    - Peer-reviewed academic journals, conference proceedings, and reputable industry reports.
    - Studies published in the past 1-5 years to capture recent trends and developments.
    - Research directly focused on crowdfunding for African start-ups or providing relevant insights applicable to this context.
    - Studies investigating crowdfunding success factors, backer behavior, or both.

- Exclusion:
    - Studies not focused on crowdfunding or the African start-up context.
    - Editorials, opinion pieces, and blog posts lacking rigorous research methodology.
    - Research papers, which cannot be accessed entirely with UrFU subscription.
- Search Process
- Chosen Libraries:
    - Academic databases: Sciencedirect, Scopus, Elsevier.
    - Industry reports and publications: World Bank, African Development Bank, crowdfunding platform reports.
- Timeframe: 2019-2024
- Search Query:
    (Crowdfunding OR Crowd-funding) AND (African start-ups OR Africa) AND (success factors OR backer behavior OR decision-making)
    Additional keywords based on identified relevant studies and emerging themes.
- Analysis Process
    Step 1: Screening: Title and abstract screening based on inclusion/exclusion criteria.
    Step 2: Full-text Review: In-depth analysis of selected articles, extracting relevant data.
    Step 3: Data Synthesis: Organize and categorize findings according to research questions and identified themes.
    Step 4: Reporting: Summarize key findings, analyze their implications for African start-up crowdfunding, and identify potential future research directions.
- Data Extraction
    - Data on crowdfunding success factors and how they influence campaign results.
    - Information about a backer's location, motivation and decision making in the context of Africa.
    - Strategies in which African start-up companies can appeal for and involve supporters using online platforms designed to help them raise money.
    - Derive rendered component models that can examine factors for success or behaviours of backers from papers.

- Data Synthesis
    - Discovering common themes and pattern in different studies, which will give us an idea about crowdfunding success factors and backer behavior for African start-ups.
    - Comparing results of studying one region or industry, such as the US economy, agriculture sector in Midwestern states or tech companies in Silicon Valley (mention data used here) where other findings are compared against data obtained by different methods in order to pinpoint issues pertaining only to Africa.
    - Developing evidence-based recommendations for African start-ups that will enable them to conduct their crowdfunding campaigns profitably and find possible investors.

1.2.2.2. Methods of Patent Document Analysis

- **Patent Search in the Context of Crowdfunding for African Start-ups**

Patent Databases:

Global:

Google Patents which is a database covering major patent offices globally.

World Intellectual Property Organization (WIPO), which provides patent data resources across the globe while also allowing researchers to scout for all sorts of patents from various sources.

On a regional level, African Intellectual Property Organization (OAPI) is responsible for making available registered patents within its jurisdiction (including seventeen African countries)

- **Analysis of crowdfunding patents**

Limited access to vast number of patents on crowdfunding platforms or technology is caused by the newness of the crowdfunding market particularly in Africa. Although one may find some common types of patents concerning security, web-based platforms, and payment processing; there may not be so much attention given to such a distinct type as a 'crowdfunding patent' [10].

However, there are benefits of analyzing patents that are adjacent to crowdfunding in terms of understanding technological landscapes and future possibilities.

Even though there are a few registered crowdfunding patents, the technology field remains fertile ground for research through considering other patents that may be related to those existing. It is possible to gain the information needed to not only

enhance the research but also add to the creation of a strong innovative African crowdfunding sector by acknowledging limitations and following good searching practices.

- **Identification of Innovative Practices in Crowdfunding**

Creators and backers alike may expect crowdfunding platforms to adjust according to their requirements by pioneering some new methods that will facilitate the whole process. Given here is insight on the most encouraging innovations on crowdfunding realms:

a. Gamification: Fun and Engagement:

- Mechanics: Crowdfunding is being gamified as platforms include game elements such as points, badges, and leaderboards in them. For example, backers for sharing it on social media, referring friends or contributing to a campaign can earn points. These leaderboards show who the top contributors are which in turn helps stimulate healthy competition while promoting increased involvement.
- Benefits: By encouraging backers to share the project more widely, gamification increases campaign visibility. It also increases engagement by making the experience more fun and interactive, which in turn motivates backers to return to the platform and contribute further. Additionally, by creating a shared experience and enhancing positive interactions among backers, it fosters a sense of community [11].

- **Social Media Integration:**

Leveraging Existing Networks:

Campaigns can be taken forward on popular social media sites such as Facebook, Twitter, and Instagram hence leading to direct interaction between the creators and their audience. The strategies are enabling creators to easily post campaign updates, images and other calls to action used in such platforms. Utilizing influencer marketing, campaigns are shared with already established audiences through working together with relevant people.

Platforms give creators the ability to stream live so as they can interact with possible supporters in real-time, answer any question they may have and build trust. Why Social media integration contributes to the expansion of the target market since it leverages social connections as well as existing networks. In addition, Influencer partnerships use established people's credibility and exposure to get fresh supporters as well as gain pace.

Live streaming helps creators to connect more personally with funders, enabling them show their passion and deal with questions directly.

Hybrid Crowdfunding: Blending Rewards with Equity:

- Idea: The model joins the conventional way of crowdfunding where the first people who try to develop a project are rewarded by equity participation. As in old funding platforms, sponsors of a project are rewarded with physical objects based on the amount they funded. Moreover, they are given ownership in a firm that helps them participate in its future growth prospects.
- Benefits: Hybrid crowdfunding creates higher motivation for backers because their interests are more in line with what makes it profitable in future. They are able to raise more funds because their potential investors could be willing to support their company with money along besides purchasing the product. With this strategy, it is possible to appeal to a wider spectrum of financiers like business angels who are into both profits and aiding tech start-ups at the same time.

Data-Driven Analytics: Insights for Informed Decisions:

- Tools and Techniques: In an easily understandable format, creators receive insights using data visualization tools such as dashboards and reports; this is how they form backer demographics, preferences, and campaign performance data in such platforms as they make use of sophisticated data analytics tools.
- Value for Creators: Allow creators to tailor their campaign strategies to specific backer segments with databased insights so that they can identify effective communication channels, refine messaging based on backer preferences and optimize their offerings to resonate with their target audience. In addition, these same insights may be used in informing prospective product development as well as marketing strategies, which could be instrumental overall, success of any venture.

b. Subscription-Based Crowdfunding: Building Sustainable Support:

This model helps backers to make regular contributions to current projects instead of just one-time promises. It offers creators a more predictable funding source, which lets them plan and conduct their ventures better by making it possible for them to know how much they can raise in advance. Subscribers feel more connected to campaigns they are funding because they know donations will be regular [17].

The audience who respects the author a lot is the one that already receives a lot of value from his work. The luckiest sometimes get from freebies, and all it takes is to participate in this creative competition. At the same time, it all happens at once.

As the crowdfunding landscape changes, we can expect more creative approaches. Platforms refine what they offer as they aim to meet dynamic demands by the crowdfunding community and guarantee both creators and contributors a successful journey.

- **Patent Trends in Backer Engagement Technologies**

There is a limitation in terms of authorized "crowdfunding" patents. However, several other patents can also be taken in order to improve participation from supporters as well. Here are some new developments being observed through proper scrutiny:

Sentiment Analysis: Understanding Backer Emotions:

- Technology Developments: Natural language processing (NLP) and machine learning algorithms are being developed to analyze backer comments, social media posts, and other forms of feedback. There are tools that can reveal whether the sentiment is positive, negative or neutral. For instance, the tools can pinpoint any repeat concerns or complaints mentioned by the financial supporters.
- Benefits: Creators can use sentiment analysis to learn about the feelings and thoughts of backers concerning their campaign. Thus, it helps them to address any worries beforehand, give constructive feedback in case there are any complaints made by disgruntle customers or adjust communication techniques so that they fit well with that audience. Understanding how a backer feels towards your product will lead you in forming close ties with them while at the same time nurturing an environment that is friendlier and accommodating for all towards their ventures [28].

Predictive Modeling: Predicting Backer Behavior:

- Technology: Developments of machine learning techniques have enabled researchers to scrutinize crowdfunding historical data archives such as campaign specifics, supporter demographics, as well as donation methods used. This machine can foretell if the upcoming venture will survive among other things tell an investor which projects are worth investing in.

- Applications: Predictive models are important for making effective decisions regarding campaign design, resource allocation, and marketing strategies in a creator's perspective as they help them identify the factors that are associated with a successful outcome. To backers, these models offer insights into investment opportunities, which can enable them to make informed decisions based on data analysis [24].

Block chain-based Identity Verification: Building Trust and Security:

- Technology: The secure and transparent nature of block chain technology has led to its investigation of verifying backers' identities in crowdsourcing platforms. It helps lower the chances of fraud from using false accounts and ensures that the money is channeled to secure people.
- Benefits: Block chain based identity verification could actually result in encouraging creators and their backers by boosting the platforms security and trust levels. This could help in facilitating more participation even for individuals who would doubt the security levels. Furthermore, it can also simplify the verification process hence enabling faster and more efficient transactions between these two parties [44, 45].

Virtual Reality (VR) and Augmented Reality (AR) Experiences: Immersive Engagement:

Technology: Virtual Reality (VR), as well as Augmented Reality (AR), are some of the emerging technologies with potential to change the world. Backers would greatly benefit from such technologies since they provide more interest in regards to their support on different platforms.

Impact: VR/AR technology helps investors gain more trust in a project that creates a stronger emotional attachment to it, supporting it with financing while making the experience more interesting and memorable for everyone. In addition virtual/augmented reality offers the option of having better product showcases or demonstrate how things work; or else can be utilized for educational processes especially when trying understand certain phenomena better than ever before but through unusual approaches compared to their nature [23].

Gamified Backer Rewards: Enhancing Motivation and Loyalty:

Concept: One method to explain this development is by integrating gamification into the old incentive schedules for loyal supporter motivation and commitment furtherance. With ladder-like offerings, contributors obtain superior privileges along with growing donations; mark chains may be exchanged for special

materials and happening or collection tools might be used to exhibit premier funders.

Advantages: Gamified rewards transform the crowdfunding into an entertaining exercise that keep on provoking backers to chip in more funds throughout the campaign period and always be involved actively in the exercise. They play a role in promoting a feeling of togetherness and motivation channeled to a common goal among supporters at the same time as they can create room for healthy rivalry and social engagement among them, too [23].

The trends in patents show how different kinds of technology have the potential to change entirely the way artists interact with their supporters during campaigns, make crowdfunding more vibrant and livelier, and result in the success story of various unique concepts. To keep abreast with these developments and consider where they fit, it is possible for platforms and creators to be successful in the fundraising climate that keeps on changing all the time.

- **Expanding on Documentation Analysis and Key Information Extraction in Patent Search**

We explored this documentation in pursuit of crowdfunding patents appropriate for African start-ups; categories within the initial draft exclusively shaped our focus:

Crowdfunding Platforms:

Platform design and functionality: patents covering:

Patents have been issued on the design and functionality of the platform with the following areas covered: The number of African countries' residents that have mobile phone handsets is quite high, therefore, the best way for mobile authentication to be done in Africa should be through the use of phone numbers.

Alternative Ways to Prove Identity: For unbanked people or individuals without national ID cards like homeless people, the proposal of different ways that the proof can be shown such as utility bills or voter registration cards and local microfinance institution accounts. Permits linking to social media account by end-users in order to leverage mainstream online identities for verification.

Campaign Creation Tools and Features:

In Kenya, M-Pesa, MTN Mobile Money and Airtel Money are the basic local payment gateways. [7] This means that residents for cash transactions mainly use these. Even though they are strongly committed to their new project ideas hoping

they will make an impact on their life, the contributors will not have difficulties understanding how to transact using these channels.

Multilingual support: By offering campaign, creation tools in multiple languages used in different parts of Africa will make it easier for others around the globe who want to access them despite their location.

Offline pledge options: Allow backers to contribute through offline channels like mobile money agent locations or cash collection points, considering potential limitations in internet connectivity in some regions.

Risk Management and Fraud Prevention Systems:

Social network analysis: Analysis of the creator's connections and online presence using social media analysis can be employed to identify fraudulent activities in which he or she might be engaged.

Community moderation: Communities are moderated through established solid structures to find suspicious campaign elements as well as for tagging users with inappropriate behaviors.

Third party risk scoring: Incorporate credit bureaus or local financial institutions in partner for risk assessment service, coupled with limited access to traditional credit history data for many Africans [18].

Tools for Community Building and Communication:

Popular social media platforms have been included in comparison with WhatsApp, Facebook or local platforms that are essential in numerous countries for campaign promotion and community engagement that are integrated into popular social media platforms. It should also include such tools like culturally sensitive communication tool like the one for example voice messages because the level of coercion can be too much.

Integration of AI-driven translation tools for effective communication between creators and backers, thus bridging language barriers.

Organization of offline community building events like workshops or meet-ups in specific locations to foster a sense of community and trust among backers and creators.

Backer Analytics:

In crowdfunding, there is a new study of backer analytics. In the near future, many data will be available to describe backer behavior and forecast campaign success thanks to the use of artificial intelligence and machine learning algorithms. Yet,

the interest in its development and application through patent filings is increasing. These filings suggest what AI can achieve once it utilises backer demographics, contribution patterns as well as sentiment from comments/feedback on any given project. Such an analysis is essential in determining the success of any campaign since it helps you to know which aspects need to change while enabling you target messages towards particular supporters. It is possible then for us to identify what people giving funds are sensitive about plus their reaction towards varied aspects of a certain project episode and accordingly [24].

Financial Technologies:

Processing of payment:

Different patents revolving around: Payment gateways that are secure and efficient best suited for African infrastructure and regulations that may possibly include integration of mobile money. Arrangements of micro-payment that allow for negligible donations and targets people without bank accounts. Start-up funding through cross-border transaction facilitation supported by transparency and security availed by Block chain as related to African start-ups [16, 45].

Additional Categories:

Communication and marketing: the Study of trademarked practices to:

- How to use social media platforms along with other channels of communication prudently among Africans.
- How to modify marketing tactics that will appeal to Africans who support you and make sense within their culture as well.
- Regulatory compliance: Examine patented ways of providing solutions for ways through which regulatory needs of crowdfunding platforms running in Africa can be met.
- "Know Your Customer" demands as well as "anti-money laundering "rules.
- Key Information Extraction: looking at patent documents, there are a few bits of information that have to be pulled out in order for one to draw closer into the deep insight.
- Technical details: The patented technology's working principles have to be comprehended along with technical specs or implementation details as well as algorithms.
- Novelty and non-obviousness: What makes this invention different from other ones that already exist or some of its basic characteristics

making such a difference should depend on whether it is valuable or not within the patent perspective.

- Potential applications: There may be opportunity in Africa's abundance of poor start-ups for the patented technology to be adapted and employed in the aspects of crowdfunding.

- Limitations and potential challenges: In relation to the case of Africa what are some of the limitations, demerits or drawbacks hindering the use of this patented technology?

- Commercialization potential: It should also ascertain whether there are any market needs, which may be satisfied using this patented technology and the existence of such factors as well as its feasibility, in general [27].

It may be comprehended that existing technological solutions in crowdfunding area by conducting intensive patent search and analyzing relevant documents and thus gain valuable information that can guide our investigation on success factors and backer behaviour among African start-ups. This is important because it gives us a better chance of getting more funds from donors during crowdfunding in Africa. The text below discusses more on models and theories, which were brought up earlier [27].

- **Challenges and Opportunities in Applying Patent Knowledge to Crowdfunding Research**

Applying patent knowledge to crowdfunding research presents both significant challenges and exciting opportunities:

Challenges

Limited Applicability:

Emerging markets are being taken into account. In their formative years, African crowdfunding markets are still in an early stage and the relevance of patents from another place may not be valid. There is an emphasis on platform uniqueness. Patents may concentrate on different platforms' functions, thereby missing the larger ecosystem and neglecting those dedicated to African start-ups solely.

Rapidly Changing Surroundings:

With the advent of new patents all the time, it compels scholars always to look out for the latest technological advancements so that they can understand the changing topography.

Legal Focus on Issues:

To avoid misunderstanding and realize the purport of certain patents; the carefulness in analyzing those that pertain to intellectual property by having some knowledge on this area of law.

Opportunities

Identifying Future Trends:

Future functionality insights: patents analysis give important hint on technology and future functionalizes that can be employed in crowdfunding sites, which shapes research strategies and help, foresee future service needs.

Informing Strategic Development:

Strategic decision-making: Start-up and platforms may leverage patent intelligence to determine prospective innovation points in African crowdfund.

Search for ways of licensing relevant technologies capable of boosting their platform functionalities and Enhancing the entire crowdfunding experience become well informed concerning their technological development roadmap so that they keep being competitive in addressing the changing needs of artists and supporters [16, 17].

Addressing Research Gaps:

Closing the Knowledge Gap: The Knowledge Gap can be filled through Patent analysis that can help delve into how emerging technologies could be applied within the Africa context. Academics will get a better understanding of how these technologies can be customized to take care of peculiar threats and possibilities through analyzing the endorsed online inducements, threat assessment, and security [12].

Collaboration and Knowledge Sharing:

Researchers can cooperate across regions with experts who are found in different developing countries and have established crowdfunding markets better than others to exchange on patent knowledge and best practices related to crowdfunding research. This is a way of boosting knowledge sharing and culture for better implementation purposes [11].

Advocacy and Policy Development:

How researchers can inform policy development and regulatory frameworks through analyzing patent trends and their potential impact on the crowdfunding landscape. This can be done in order to foster innovation by providing a conducive

environment, which protects intellectual property rights while encouraging growth in responsible and sustainable African crowdfunding ecosystem.

Applying patent knowledge to crowdfunding research, despite challenges that come with it, has some important benefits. The only way for scientists to participate in turning point for innovation, strategic development and progress in Africa's crowdfunding fund is by recognizing these obstacles, taking full advantage of what is there and nurturing partnerships. This will enable authors' capacity building and tying them to respective backers [10].

1.2.2.3. Backer Behavior Models and Theories

Machine Learning Models:

- Regression models:
- Example: Predicting the amount of contribution based on campaign characteristics like funding goal, project category, and reward structure, alongside backer demographics like location, age, and income (when available).
- Benefits: Allows creators to set realistic funding goals and optimize resource allocation. Platforms can identify promising campaigns with higher potential funding based on historical data.
- Challenges: Data quality and availability are crucial for accurate predictions. Relies on historical data, potentially missing novel campaign characteristics that attract backers [28].

- Classification models:
- Example: Predicting the likelihood of a backer contributing based on their previous backing behavior, social network connections, and engagement with a campaign (e.g., leaving comments, sharing on social media).

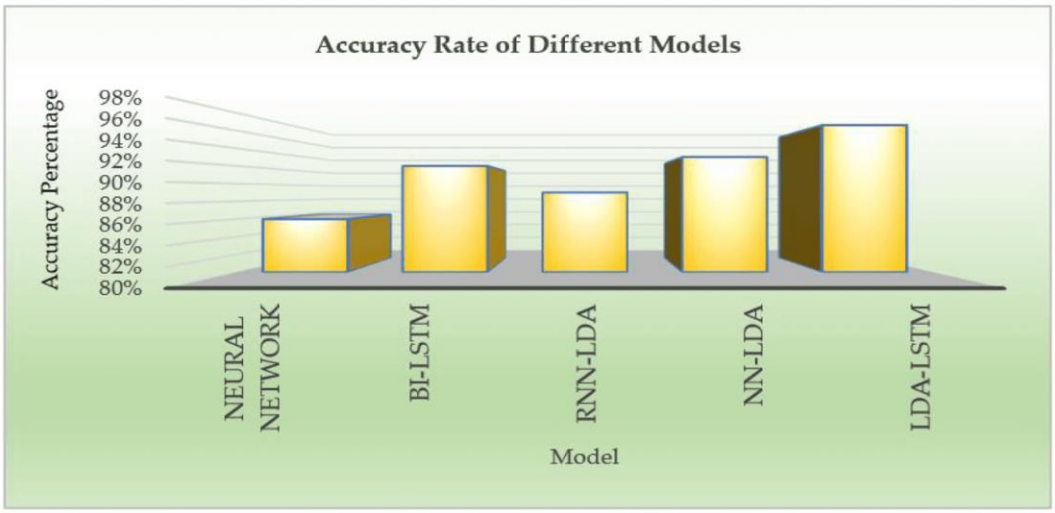

Figure 6 - Accuracy of different models used extensively to predict Crowdfunding[6]

- Benefits: Enables targeted marketing campaigns towards backers most likely to support specific projects. Platforms can recommend relevant campaigns to individual users based on their preferences.
- Challenges: Requires a large dataset of labeled data (backers who have contributed or not) for effective training. Model performance can be affected by data biases and changes in backer behavior over time [28].

● Clustering models:

- Example: Grouping backers based on their risk tolerance, motivations (altruistic vs. financial), and preferred project types (e.g., creative, environmental, technological).
- Benefits: Allows for targeted communication and reward structures based on backer segment. Helps creators tailor their campaign message and outreach strategies to resonate with specific backer groups.
- Challenges: Requires large datasets and robust clustering algorithms to ensure meaningful and accurate groupings. Oversimplification of backer behavior into distinct categories needs to be acknowledged [28].

Theories:

● Prospect Theory:

- Key takeaways: Individuals experience losses more intensely than gains. Framing campaigns to emphasize the negative consequences of not

[6] Shafqat, W., Byun, Y., & Park, N. (2020). Effectiveness of machine learning approaches towards credibility assessment of crowdfunding projects for reliable recommendations. Applied Sciences, 10(24), 9062. https://doi.org/10.3390/app10249062

supporting a project (e.g., missing a social impact opportunity) might be more effective in some cases.

- Application in African context: Consider the cultural perceptions around risk and loss aversion in different African regions when designing campaign messaging and framing rewards.
- Limitations: The theory does not solely explain backer behavior and should be integrated with other models and contextual factors [28].

● Social Influence Theory:

- Key takeaways: Individuals are influenced by the behavior and opinions of others. Leveraging social proof (e.g., highlighting the number of backers or positive testimonials) and influencer marketing can be effective strategies.
- Application in African context: Utilize relevant social media platforms popular in specific regions and identify local influencers who resonate with the target audience and project values.
- Limitations: The theory might not account for individual differences in susceptibility to social influence among backers [22].

● Goal Framing Theory:

- Key takeaways: Framing a campaign's goal as an achievement (e.g., "reaching X amount will allow us to...") can be more motivating than focusing solely on avoiding losses (e.g., "we need X amount to avoid project failure").
- Application in African context: Utilize clear and concise campaign goals that emphasize the positive outcomes achieved through successful funding.
- Limitations: The effectiveness of framing can vary depending on the specific project, backer characteristics, and cultural context.

● Additional Considerations:

- Cultural adaptation: Models and theories developed in Western contexts might need adjustments to account for the unique cultural landscape in Africa, considering diverse motivations, communication styles, and risk perceptions of backers [22].
- Data limitations: Access to large, high-quality datasets for training and evaluating machine-learning models can be a challenge in Africa. Exploring alternative data sources (e.g., social media engagement, user surveys) and data augmentation techniques might be necessary.
- Ethical considerations: Responsible and ethical use of machine learning models is crucial. It's essential to avoid bias in data collection, model

development, and application. Transparency is key, ensuring backers understand how their data is used and protected.

By effectively utilizing and adapting these models and theories, considering contextual factors and ethical implications, researchers and crowdfunding stakeholders can gain valuable insights into backer behavior in Africa. This knowledge can ultimately pave the way for designing more successful campaigns, fostering a more inclusive and thriving crowdfunding ecosystem for African start-ups.

1.2.2.4. Cultural and Regional Variations in Crowdfunding Success

Crowdfunding experiences significant cultural and regional variations across the globe, making a one-size-fits-all approach ineffective. Here's a breakdown of key aspects to consider:

- Cultural Influences:
- Motivations: Backer motivations differ markedly among cultures whereas in specific areas financial rewards are possibly the most important factor for some people but in all others it is about making the world better for everyone or aiding that close by." This means knowing what really pushes people into action creatively when setting up successful campaigns. Additionally, when structuring rewards, it is important to take into account which motives are prevailing
- Communication styles: It is important to have effective communication so people can trust you and support you. It is necessary to adjust communication strategies to local cultural peculiarities and preferred language. This could mean including pictures, telling stories etc. or using relevant social media platforms.
- Risk perception: When it comes to crowdfunding, the way that different cultures think about risk plays a big part in how people go about it. Some societies may require strong assurances and want to be sure by testimonials or endorsements because they are more afraid of it while others are okay with new things that might look dangerous.

- Regional differences:
- Regulation and legal frameworks: Crowdfunding rules and laws rules differ greatly across various regions. Creators need to understand these particular regulations within any given region so that they may create

campaigns that meet all statutory requirements. At the same time, platforms should align their activities to conform to local regulations.

- Financial infrastructure and payment systems: Regions can access and trust digital payment systems differently. As a result, some regions may have low levels of investor participation, thus necessitating that creators and platforms consider other alternatives, such as mobile money and offline payment methods.
- Technological infrastructure and internet access: A lack of uniformity exists concerning technological infrastructure and internet access connectivity and technology accessibility in various regions might not be uniform Offline outreach strategies may be necessary or less bandwidth-intensive communications channels used, especially in rural areas

One thing to note about Africa's strong community support in relation to crowdfunding is how social impact plays out here. The importance behind incorporating mobile money is because there are no other better options like banks around. Understanding regional divergence in crowdfunding performance is critical for conditioning programs and systems toward specific contexts. When taking into account such things creators as well as their hosts or even people investigating, possibilities will be able edge together towards greater inclusion.

1.2.2.5. Crowdfunding Case Studies in Developing Economies

- M-Changa (Kenya): M-Changa is a mobile money-based crowdfunding platform specifically designed for the Kenyan market, allowing individuals to raise funds for various purposes through mobile phones.

In 2016, a Kenyan woman used M-Changa to raise funds for her daughter's life-saving heart surgery in India. The campaign garnered widespread support, exceeding the target and highlighting the platform's potential for medical fundraising in resource-limited settings.

- Milaap (India):

Milaap is a leading peer-to-peer lending platform in India, focusing on microfinance and social impact projects.

Milaap has facilitated funding for various projects, including rural electrification initiatives, education for underprivileged children, and micro-entrepreneurship ventures. Their transparent model, detailed borrower profiles, and focus on social impact have contributed to their success [13].

- Zidisha (Various):

Zidisha is a micro lending platform operating in several developing countries, including Rwanda, Zambia, and Bolivia. They connect lenders directly with borrowers, fostering personal connections and promoting responsible lending [14].

Zidisha has facilitated loans for numerous individuals and small businesses, enabling them to invest in agricultural equipment, start small businesses, and overcome financial hurdles. Their focus on individual stories and fostering connections between lenders and borrowers has been impactful.

- Фонд «Нужна Помощь» (Russia):

Фонд «Нужна Помощь» is a Russian crowdfunding platform primarily focusing on medical fundraising.

The platform has played a crucial role in raising funds for individuals requiring expensive medical treatments not readily available in Russia. The platform's focus on transparency and verification of fundraising campaigns has helped build trust with donors [15].

These case studies provide a glimpse into the diverse applications and impact of crowdfunding in developing economies. By learning from these successful models, we can gain valuable insights into how this innovative financing tool can be further adapted and utilized to address challenges and empower communities in Africa.

1.3. Outcomes

1.3.1. Answering research questions

- **Q1: Key Factors Influencing Success:**

Financial Sustainability and Viability:

Many researches [8, 9] emphasize the critical role of demonstrably strong financial planning. This includes:

Clear and realistic financial projections: Projecting future revenue streams, expenses, and potential profitability allows backers to assess the project's potential for sustainability and financial return.

Transparency in financial statements: Providing access to audited or well-documented financial statements builds trust and confidence in potential backers.

Focus on Sustainable Business Models: Beyond just financial projections, displaying a sustainable business model is vital. This demonstrates the long-term

viability of the venture and its ability to generate revenue and impact beyond the initial crowdfunding campaign.

Campaign Design and Communication:

Effective Storytelling: Studies [1, 4] highlight the importance of compelling storytelling. This involves:

Connecting with backers on an emotional level: Sharing the story behind the start-up, the passion of the team, and the impact the project aims to achieve can resonate deeply with potential backers and encourage support.

Using clear and concise language: Avoid technical jargon and ensure a broad audience easily understands the campaign message.

Visual appeal: Utilizing high-quality visuals, such as images and videos, can effectively capture attention and display the project in an engaging way.

Clear Project Goals and Milestones: Defining specific and measurable project goals allows backers to understand what the campaign aims to achieve and how their contributions will be used.

Outlining clear milestones along the project timeline demonstrates transparency and keeps backers informed about progress.

Regular Communication and Updates: Maintaining consistent communication throughout the campaign builds trust and keeps backers engaged.

Sharing regular updates on progress, challenges, and achievements fosters transparency and demonstrates accountability.

Platform Choice and Community Building:

Understanding Platform Landscape: Research and select crowdfunding platforms with a strong focus on African start-ups. These platforms will likely have:

Experience and expertise: Familiarity with the specific context and regulatory environment in African countries.

Established networks of potential backers: Access to a community of individuals interested in supporting African ventures.

Marketing and outreach capabilities: Tools and resources to help reach a wider audience of potential backers.

Building a strong community around the campaign: Utilize social media, local events, and partnerships with relevant organizations to connect with potential backers beyond the platform.

Encourage supporters to share the campaign with their networks, leveraging the power of word-of-mouth marketing.

Foster a sense of community and belonging among backers, keeping them engaged and invested in the project's success [25].

Regulatory Environment and Compliance:

Understanding and complying with relevant crowdfunding regulations in the specific African country is crucial. This might include:

Registration requirements for both the platform and the start-up itself.

Disclosure and transparency obligations regarding financial information and campaign details.

Restrictions on investment types or amounts for backers.

Consulting with legal professionals familiar with African crowdfunding regulations is highly recommended to ensure compliance and avoid potential legal hurdles [18].

Social Impact and Local Relevance:

Research trends suggest highlighting the social impact and positive contribution to local communities can resonate with potential backers. Consider:

Identifying and articulating the specific social impact the project aims to achieve. This could be job creation, community development, addressing environmental challenges, or improving access to essential services.

Demonstrating how the project aligns with local needs and challenges. Displaying a deep understanding of the local context and a commitment to addressing local issues can resonate with potential backers within the African community [18].

- **Q2: Backer Differences: Demographics, Motivations, and Decision-Making:**

While limited data specifically addresses African backer demographics, drawing insights from research in other developing regions and considering the unique African context, we can potentially uncover the following:

Demographics:

Due to the dynamic nature of the African crowdfunding landscape, obtaining accurate and recent demographic data on backers is challenging.

However, general trends might include:

Younger generation: Research in other regions suggests younger individuals might be more likely to participate in crowdfunding. This could potentially hold true in Africa as well, considering the growing youth population.

Tech-savvy individuals: Individuals comfortable using mobile technology and online platforms might be more inclined to participate in crowdfunding.

It is important to mention these are general trends, and the specific demographics of backers might vary depending on the platform, project type, and geographical location within Africa.

Motivations:

While financial return can be a factor, researches [5, 7, 10] suggests other potential motivations for backers in developing regions, which could also apply to African backers:

Social impact: Supporting projects that contribute to positive social change within their communities can be a significant motivator.

Relationship building: The potential to connect with and support local entrepreneurs and businesses can be appealing to some backers.

Supporting innovation and local development: Backing innovative projects that hold the potential to address local challenges or contribute to economic growth can be a driving force.

Emotional connection: The story, passion, and values of the start-up can resonate with backers and inspire them to support the project even beyond purely financial motives.

Decision-Making:

Similar to backers in other regions, African backers consider several factors before making investment decisions [19, 27, 10]:

Project feasibility: This includes evaluating the overall viability of the project, based on the team's experience, the market potential, and the clarity of the business model.

Team credibility: Assessing the experience, skills, and record of accomplishment of the founding team is crucial for building trust and confidence in the project's ability to succeed.

Potential impact: Understanding the intended social and economic impact of the project can be a significant consideration for backers who prioritize positive social change.

Risk-reward profile: Weighing the potential risks associated with the investment against the potential returns, both financial and social, is essential for informed decision-making.

Transparency and communication: Backers are likely to value transparency and clear communication from the start-up team throughout the campaign. This includes access to relevant information, regular updates, and responsiveness to questions and concerns.

It is important to remember that these are general insights based on available research and trends. Further research focusing specifically on African crowdfunding backers is necessary to gain a deeper understanding of their unique demographics, motivations, and decision-making processes.

- **Q3: Strategies for Attracting and Engaging Backers:**

Building upon the identified key factors, here are expanded strategies to attract and engage potential backers:

Tailored Communication:

Construct compelling narratives that resonate with the African context and audience.

Highlight the social impact and local relevance of the project, emphasizing how it addresses local needs and challenges.

Using culturally relevant language and imagery to connect with potential backers on a deeper level.

Translate campaign information into local languages if necessary, to reach a wider audience and overcome language barriers [27].

Leverage Local Networks:

Collaborate with local organizations, influencers, and community leaders who can help spread awareness about the campaign and connect with potential backers within their networks.

Participate in local events and conferences to display the project and connect with potential investors.

Build relationships with media outlets in the target region to secure media coverage and reach a wider audience [11].

Data-Driven Strategies:

If available, utilize platform data and analytics to understand backer demographics, preferences, and engagement patterns.

Analyze successful campaigns within the region or industry to identify best practices and tailor the approach accordingly.

Use A/B testing to experiment with different messaging, visuals, and campaign elements to see what resonates best with the target audience [36].

Transparent Communication:

Provide clear and concise information about the project, including the goals, team members, financial projections, and how you will utilize the funds raised.

Be transparent about potential risks and challenges associated with the project.

Regularly update backers on the progress, milestones achieved, and any challenges encountered.

Respond promptly and openly to questions and concerns from backers to build trust and maintain engagement [36].

Offer Unique Rewards:

Consider offering rewards that are culturally relevant or cater to the specific interests of potential African backers. This could include:

Experiences or products connected to the local community or cultural heritage.

Opportunities to meet the founding team or participate in the project's development.

Discounts or early access to products or services the start-up will offer [36].

Embrace Mobile Technology:

Given the growing mobile phone penetration in Africa, ensure the campaign is optimized for mobile devices and easily accessible to potential backers on the go.

Explore the potential of mobile-based advertising and marketing strategies to reach a wider audience and drive engagement [36].

1.4. Management Task Formulation

Goal: To develop and implement a comprehensive strategy for African start-ups to optimize their crowdfunding campaigns and achieve greater success in attracting potential investors.

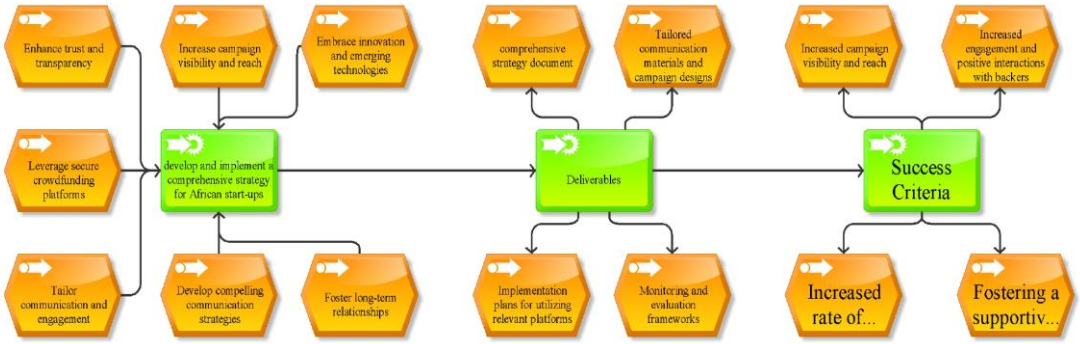

Figure 7 - Management Task Formulation

Management diagram

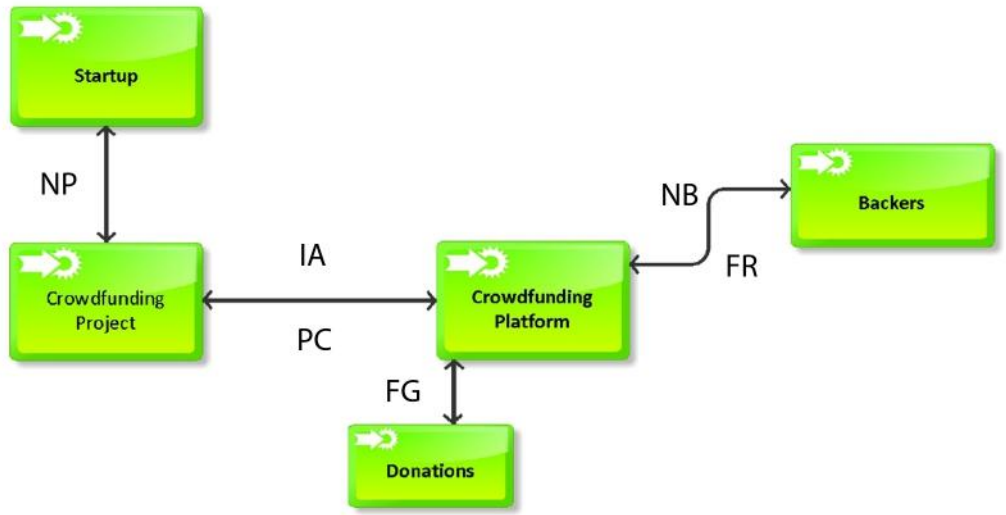

Figure 8 - Management diagram

Table 1: Management task formulas

FG	The total amount of capital a project seeks to raise	N/A
IA	The amount of money an individual contributes to a project	N/A
ROI_P	The potential profit gained on an investment, based on projected future value	ROI_P = (FV - IA) / IA
ROI_A	The actual profit gained on an investment after all fees are deducted	ROI_A = NP/ IA
NP	The actual profit gained on an investment after all fees are deducted	NP = TFR - PC - SFR
FR	The percentage of the funding goal achieved	FR = (TFR/ FG) x 100%
DLC	The remaining time for the project to reach its funding goal	If the campaign isn't done yet => DLC = (Today - PSD)
NB	The total number of individuals who contributed to the project	N/A
AVG	The average amount of money contributed by each backer	AVG = TFR/ NB
SF	The fee charged by the crowdfunding platform for a successful campaign (usually a percentage of the total raised funds)	SF = SFR (%) x TFR

FG = Funding Goal

IA = Investment amount

ROI_P = Return on investment (Projected)

ROI_A = Return on Investment (Actual)

NP = Net Profit

FR = Funding Rate

DLC = Days left in campaign

NB = Number of backers

AVG = average contribution

SF = Success fee

FV = Future Value

PSD = Project start date

TFR = Total funds raised

SFR = Success fee rate

PC = Platform cost

This formulation outlines the key elements of the management task, providing a clear direction and framework for developing and implementing strategies to optimize crowdfunding campaigns and unlock the full potential of this powerful financing tool for African start-ups.

1.5. Chapter I Conclusion

Navigating the Crowdfunding Landscape for African Start-ups - A Journey of Innovation and Impact

Africa is a special continent for crowdfunded activities, largely due to the high entrepreneurial attitude and possibilities for social-economic change. Therefore, fully maximising the potential of the technology necessitates a focus on distinct issues and a comprehensive strategy.

This exploration has underlined the significance of accepting databased input. Through making good use of existing data sources, doing focused research, as well as using sophisticated analytics tools, start-ups from Africa can comprehend more about their customers, learn from their own best practices, and adjust their strategies in the best way possible to reach out to the people they serve.

Additionally, engaging would-be supporters might be hard without understanding various cultural norms. Therefore, accounts tailored towards specific audiences, employing situational language and visual communication as well as translation facilities can bring together diverse communities in a manner that makes sense to participants because of their shared values.

Trust and transparency are crucial for the success of funding activities. To build confidence among supporters, a crowdfunding activity should have: an indication of how funds would be and are used responsibly over time; demonstration strong financial planning; maintain consistent communication; use secure platforms. Moreover, tapping on block chain and AI may increase safety in a definite way such that it is hard to hack into accounts which might contain people's private information that can be accessed only by them or by fraudulent means; introduce new types money collection such as fractional ownership; personalize communication strategies with AI.

Technology by itself is not sufficient but rather local partnerships are of great importance. It is essential to have relationships with the local organizations and media who can ensure that the African community is well catered for and reaches many people through the influencers who are available in such societies. In addition, in order to get more support, it is important to develop good relationship with backers over time. People who need more information on one hand, may request some kind of community based scheme even while sponsors turn into advocates just from contributors which makes them feel really happy about who they were prior funding the projects on another hand [16, 17].

In conclusion, to navigate the landscape of African crowdfunding involves many things such as use of scientific data in understanding the people or society that the system serves, use of locally acceptable methods in communication, building trust and confidence through various means including using modern approaches that will promote integrity and honesty, development and usage of innovative technologies and forming operational alliances with other companies at home.

Every African business enterprise that hopes to involve itself in this process should embrace these aspects, because they make them get more out of using a small sum of money contributed by a large number of individuals online than they would by seeking single major donor; thus all this will enhance crowdfunding purposes through voluntary assistance for different functions.

In addition, an up-to-date study and cooperation are of great importance for the knowledge development of providing assistance in current African crowdfunding environment. For more efficient strategies design and more globally supported crowdfunding campaigns we need to compare local peculiarities across the world

looking at what influences backer demography and motivation factors specifically through a focused study which includes such things as analyzing how block chain or AI affect things at different scales, conducting regional comparison researches and so many other things that can help one to come up with better plans and encourage many others' sharing in greater prosperity.

Unlocking crowdfunding success for African start-ups does not just mean getting funds; it means using collective resources to make local communities powerful, solve major problems, and speed progress toward better, sustainable tomorrow. In other words, it is proof that people can come up with new ideas together and change for good.

Chapter II

2.1. Related technologies

2.1.1. Natural Language Processing (NLP):

In the realm of African start-ups, Natural Language Processing (NLP) has great potential to be used when it comes to determining the achievement of raising funds online and an investor's trend. The results generated through machine learning algorithms such as XGBoost can be enhanced further by employing NLP methods during analysis of text data from crowdsourcing platforms [41].

- **Analyzing Project Descriptions and Pitches:**

Keyword Extraction: NLP has the capacity to detect the most often used terms in prosperous crowdfunding campaigns. These terms can indicate the best way to reach out to people who will fund a project. This will help creators of a project write an informative description or give effective arguments in favor of their ideas [40].

Sentiment Analysis: NLP techniques can be used to determine the general mood (positive, negative, neutral) in project descriptions and pitches. This means that identifying the persuasive strategies that move backers could also have an effect on the emotional appeal of one's campaign [40].

Topic Modeling: NLP can categorize project descriptions based on the underlying themes or topics they address. In this way, we can see whether some areas or types of projects get more funding than others do in the African start-up scene [40].

- **Backer Behavior and Engagement**

Identifying Motivations and Preferences: By analyzing comments, reviews, and discussions on crowdfunding platforms, NLP can help identify the motivations and preferences of backers. This can include factors like their investment priorities, risk tolerance, and the types of social impact they seek [42].

Understanding Concerns and Doubts: NLP can detect negative sentiment or concerns expressed by backers in online forums or social media conversations. By addressing these concerns proactively through project updates or FAQs, campaign creators can build trust and encourage investment [42].

- **Social Media Buzz and Community Analysis**

Measuring Campaign Visibility: NLP can analyze social media mentions and online discussions related to some crowdfunding campaigns. It can provide insights into campaigns and the effectiveness of social media strategies that aims at Crowdfunding [42].

Identifying Influencers and Communities: By analyzing on social media and on the real life the online interactions, NLP can identify influential people or communities that can help the project reach the African start-up ecosystem. Collaborating with these influencers or engaging with relevant communities can increase campaign exposure [42].

- **Refining Communication Strategies**

Tailoring Messaging: Based on the insights gained from NLP analysis, project creators can tailor their communication strategies to resonate with different backer segments. This might involve using specific language or addressing concerns relevant to their target audience [43].

Developing Personalized Communication: NLP techniques can be used to personalize communication with backers based on their past interactions or investment behavior. This can create a more engaging experience and potentially increase the chances of successful investment [42].

2.1.2. Network Analysis

Network analysis has become a useful instrument for examining complex relationships within the African crowdfunding system. By uncovering the interconnections between start-up companies, investors and crowdfunding platforms, it reveals funding networks in addition to potentials for cooperation between various parties including backers [25].

- **Mapping the Crowdfunding Landscape**

Visualizing Connections: The practice of network analysis makes it easy to create certain images in the mind, which are called network graphs. They show how closely related start-ups, investors or different platforms are. By seeing such visual presentations, it becomes possible to know who matters most, where joint efforts cluster and maybe how a particular African start-up could raise its first investment or subsequent funds [25].

Identifying Funding Networks: From the flow of investments made by start-ups to investors on one hand, network analysis can be used to uncover both entrenched

funding patterns as well as new investor clusters. Such information is extremely vital for new or nascent businesses that want to meet suitable partners for their investment proposals.[25]

Understanding Collaboration Patterns: Network analysis allows us to discover how start-ups cooperate, connect and create partnerships. Doing so may bring into the open working collaborative models that yield success and encourage fresh partnerships in the African start-up ecosystem [25].

- **Backer Behavior and Investment Trends**

Investor Portfolio Analysis: By using network analysis, the venture portfolios of individual financiers can be investigated to unravel their investment preferences, levels of risk aversion as well as possible interest in particular sectors or types of projects. This is important because through understanding the behavior exhibited by financiers, operators of campaigns can then create strategies specifically aimed at luring those who are genuinely interested in what they are offering [26].

Identifying Influential Backers: By using network analysis, it is possible to identify the influential supporters who link more than one start-up in such a network. These influentials could be angel investors, venture capitalists or even reps from crowdfunding platforms and subsequent engagement may result in increased financial prospects as well as visibility increase for a start-up [26].

Community Detection: Community detection by means of network analysis can enable the identification of groups of supporters who share similar interests or investment techniques. In effect, a firm that has just been started can use it to approach particular groups with customized communication, which can finally result in more committed shareholders [26].

2.1.3. Social Network Analysis

Social Network Analysis goes beyond traditional network analysis as it scrutinizes the social interactions and information flow that characterizes the African crowdfunding ecosystem, exploring questions of who is connected to who and how, where does the information spread and what is its impact on crowdfunding success [21].

- **Unveiling Backer Communication Patterns**

Mapping Backer Interactions: Social Network Analysis can highlight potential communities of interest or discussion groups by mapping communication channels (likes, comments, messages) between supporters, not just those that invest in similar projects [21].

Identifying Influencers and Opinion Leaders: Social network analysis uses the flow of information and the frequency of interactions among backers to identify key figures in the network. The persons may be either experienced donors who provide useful ideas or people who strongly support particular projects [21].

Understanding Diffusion of Innovation: developers to trace how information on crowdfunding projects is distributed in the social web use social network analysis. This will allow them to pinpoint the most effective communication channels and ways to reach more people at once [21].

- **Analyzing Project Popularity and Visibility**

Identifying "Viral" Campaigns: By determining how certain campaigns go viral within a network, Social network analysis uncovers. It helps one see what makes a project become viral–this refers to its popularity among others involved with whom you have not been included before or after their reception by some group member who posted them anywhere online-social media sites or blogs alike for example. [5]

Sentiment Analysis Integration: Comment threads when analyzed will enable to determine different comments, which are on either the positive side, the negative side, or neutral. From these, we can deduce the fears likely to be in backers' minds and hence act upon them in terms of communication [5].

- **Optimizing Crowdfunding Strategies**

Targeted Outreach: Analyzing backer communication patterns and identifying relevant communities allows for targeted outreach strategies. Campaign creators can engage with specific groups or influencers to maximize campaign visibility and attract the right kind of backers [3].

Building Social Proof: Social network analysis can reveal how backers are influenced by the opinions and actions of others. By displaying positive feedback and early investment from credible backers, campaign creators can build social proof and encourage further investment [7].

Community Management: By understanding the dynamics of backer communities, campaign creators can develop effective community management strategies. This might involve fostering discussions, addressing concerns, and creating a sense of belonging to encourage continued engagement [7].

2.1.4. Sentiment Analysis Tools

Analyze social media conversations and online reviews surrounding crowdfunding campaigns to gauge public perception and potential risks.

Identify concerns or doubts backers might have and tailor communication strategies to address them proactively [7].

Text Mining Techniques

Extract insights from unstructured data like forum discussions and blog posts to understand backer motivations, challenges, and preferences.

Identify emerging trends and topics of interest within the African crowdfunding landscape [16].

2.1.5. Machine Learning for Recommendation Systems

Develop personalized recommendations for backers based on their past investment behavior and project characteristics.

Recommend promising African start-ups to potential investors based on their investment criteria and interests [26].

Explainable AI (XAI):

Gain deeper insights into how machine-learning models like XGBoost make predictions about crowdfunding success.

Understand which project features and backer behavior patterns contribute most significantly to the model's predictions.

This can help refine campaign strategies and improve communication with backers based on data-driven insights [38].

Block chain Technology

Explore the potential of block chain-based crowdfunding platforms to enhance transparency, security, and efficiency in fundraising for African start-ups.

Securely manage fundraising activities and track investment flow using block chain technology [31].

2.2. Comparative Analysis

Many studies explored machine-learning models to predict crowdfunding success/failure rates for campaigns; we found few papers that are worth mentioning:

2.2.1. "Predicting Crowdfunding Success Using Machine Learning"[23]

This paper uses Logistic regression, Random Forest and Support Vector Machines (SVM) as their method; it focuses on identifying key factors (e.g. Project

category, funding goal, social media reach) that have an impact on success. It uses as evaluation metrics: Accuracy, precision, recall and F1-score.

2.2.2. "Backer Behavior in Reward-Based Crowdfunding: A Machine Learning Approach"[24]

This paper uses Gradient Boosting Machines (GBM) for a comprehensible analysis; it focuses on analyzing backer's demographics, project characteristics and a comparable dynamics to predict backer behaviour like the funding amount and what investment decisions will be made. It uses as evaluation metrics: Mean Squared Error (MSE), R-squared for backer's funding amount and classification metrics for investment decision prediction.

2.2.3. "Deep Learning for Crowdfunding Success Prediction"[25]

In pursuit of grasping temporal dynamics of crowdfunding campaigns, this study explores the ability of Recurrent Neural Networks (RNNs). The centrality, thus, is on how a project's updates, the funding rate or backer attitude will determine its success. It evaluates the accuracy, precision, recall and F1-score that are important in distinguishing between successful and unsuccessful crowdfunding campaigns.

2.2.4. "Exploring Feature Engineering and Machine Learning for Crowdfunding Success Prediction in Africa"[26]

Methodology: Logistic Regression is compared to Random Forest, centering on African campaigns. Scope: Enhances feature engineering and chooses models dependent on African crowdfunding setting, whereby economic indicators including sentiments in social media in Africa can be factors. Evaluation Criteria: Standard classification metrics are used for forecasting success.

2.2.5. "Investigating Backer Motivations in African Crowdfunding: A Natural Language Processing Approach"[27]

Method: Uses techniques of NLP to analyze backer comments and determine encouraging behavioral tendencies. Focus: Looks into African perspective of backer emotions as well as social effects on investment expectations. Evaluation: Makes use of topic modeling as well as sentiment analysis methods for the interpretation of motivational aspects in backers' remarks.

2.3. Comparative Insights

Algorithmic Diversity: when we talk about exploring a variety of methods (i.e.: Logistic Regression, Random Forests, GBM, RNNs), it helps us pinpoint which one is more appropriate to use emerging in African crowdfunding data with the

help of various models such as Logistic Regression, Random Forests, GBM or RNNs [29].

Feature Engineering: In paper [11] authors have emphasized on how important it is to design features which are specific to Africa. It may entail incorporating some economic indicators vis-à-vis social media sentiments within the continent besides local project categories.

Performance Metrics: uniformity across accuracy, precision, recall, F1-score in terms of performance metrics [28].

Machine Learning Model Selection: Choosing between different models (Logistic Regression, Random Forests, XGBoost) and make experiment with them to determine the best way for predicting if an African crowdfunding will be successful or not [29].

Feature engineering around the African context is intended to provide data-specific features. It includes economic indicators, social media sentiment analysis in Africa, and considerations for project categories within one's locale. [28]

Model complexity and interpretability should be balanced. This is in a bid to know the factors that lead the model to make the predictions through techniques like feature importance analysis [28].

2.4. Extra Machine Learning/Deep Learning Methods for Crowdfunding Analysis

2.4.1. Neural Network Ensemble

Ensemble of Neural Networks Machine learning models such as XGBoost and Random Forests that are conventional have shown to predict crowdfunding success accurately over the years. However, Crowdfunding data involves intricate patterns that only neural networks can comprehend even though they are less accurate than traditional statistical methods [29].

Idea: An ensemble that combines multiple types of neural network models in fact capitalizes on different models particular strengths. For instance, project images may be analyzed using a CNN to get visual characteristics extracted from it as to textual descriptions that contain some key phrases may be processed by an RNN. All the same, these factors influencing success will be better understood if put together [28].

Benefits: Ensembles can gain different characteristics from all forms of data (images, texts, and numbers.) Ensemble techniques can handle extreme values

and irrelevant values more effectively. Research [28] demonstrate that the accuracy of ensembles is usually better compared to single models.

2.5. Machine learning models used

We will mainly be using four machine-learning models, which are suitable for the problem.

2.5.1. Logistic Regression:

Logistic regression is a linear classification model that calculates by estimation the probability of an event (crowdfunding success/failure rate in this case) occurring based on a set of various independent variables [30].

Mathematical explain [30]:

Linear Model: It takes a linear relationship that encompasses the weighted sum of features (Wx + b) and the log-odds of the target variable (in this case success/failure).

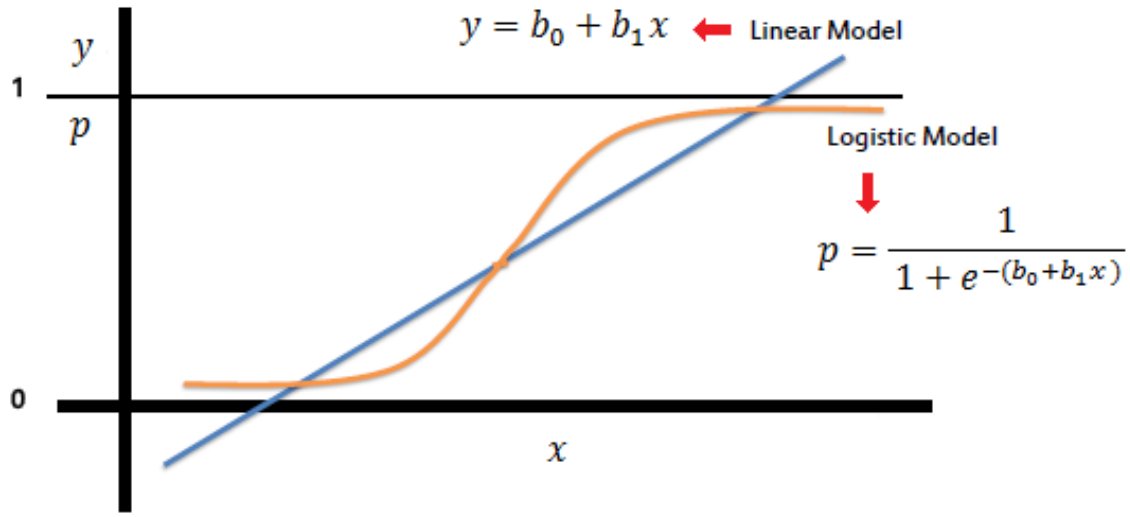

Figure 9: Logistic regression math explained[7]

Sigmoid Function: The model utilizes the sigmoid function (σ) to map the linear combination to a probability value between 0 and 1, representing the predicted probability of success (P(y = 1 | X)).

[7] Rai, K. (2021, December 14). The math behind Logistic Regression - Analytics Vidhya - Medium. Medium. https://medium.com/analytics-vidhya/the-math-behind-logistic-regression-c2f04ca27bca

$\sigma(Wx + b) = 1 / (1 + \exp(-(Wx + b)))$

W: Vector of weights for each feature, representing their relative influence on the outcome.

X: Vector of feature values for a specific project.

b: Bias term, representing a constant offset in the model.

exp(): Exponential function.

Cost Function: Logistic regression minimizes a cost function (often the binary cross-entropy) to find the optimal weights (W) that best fit the training data.

Cost Function (J) = $- (1/N) \Sigma [y * \ln (\sigma (Wx + b)) + (1 - y) * \ln (1 - \sigma (Wx + b))]$

N: Number of data points in the training set.

Y: True label (success = 1, failure = 0) for each data point.

Ln (): Natural logarithm function.

Interpretation:

The model estimates the weights (W) associated with each feature. These weights indicate the relative importance of each feature in influencing the log-odds of success. Higher positive weights suggest features that increase the probability of success, while negative weights indicate features that decrease it.

2.5.2. XGBoost (Extreme Gradient Boosting)

XGBoost is an ensemble learning method that combines multiple decision trees into a strong learner. It also uses the concept of gradient boosting to effectively improve the model predictions [31].

Mathematics explained [31]:

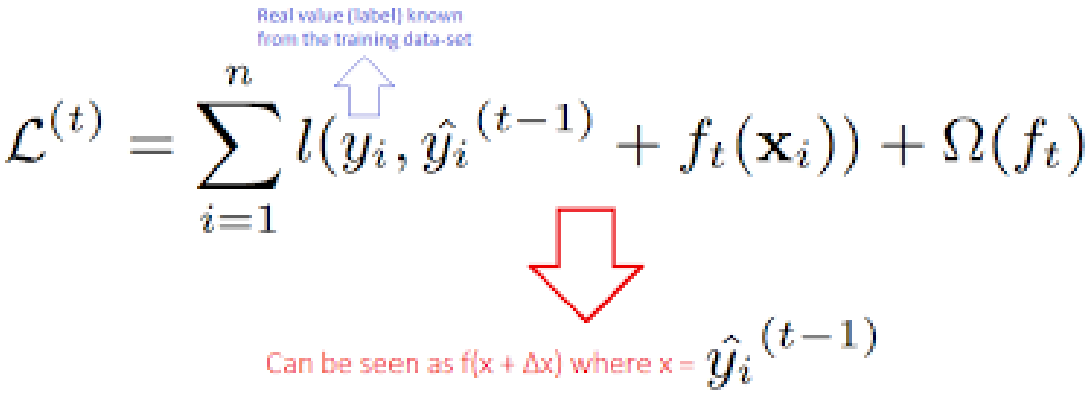

Figure 10: XGBoost math explained[8]

Sequential Tree Building: XGBoost builds decision trees sequentially. Each tree focuses on correcting the errors made by the previous one. This sequential approach allows the model to learn from the shortcomings of previous trees and enhance overall performance.

Gradient Boosting: At each iteration:

The model calculates the pseudo-residuals (gradients) representing the errors of the previous tree's predictions.

A new decision tree is built to minimize these pseudo-residuals, effectively focusing on improving the areas where the previous model struggled.

Loss Function: XGBoost utilizes a user-defined loss function to evaluate the training progress. Common choices include squared error for regression and logistic loss for classification tasks.

The model minimizes the overall loss function by iteratively adding new trees.

Key Mathematical Functions:

Tree Learning Algorithms: XGBoost utilizes algorithms like CART (Classification and Regression Trees) to build individual trees. These algorithms recursively partition the data space based on feature values to create decision rules.

Gradient Descent Optimization: XGBoost employs gradient descent optimization techniques to find the optimal weights for each tree that minimize the chosen loss function.

[8] Leventis, D. (2022, January 2). XGBOost Mathematics Explained - Dimitris Leventis - Medium. Medium. https://dimleve.medium.com/xgboost-mathematics-explained-58262530904a

2.5.3. Random Forest

Model: Similar to XGBoost, Random Forest is an ensemble learning method that combines predictions from multiple decision trees. However, it introduces randomness during tree building to create a more diverse ensemble [32].

$$MSE = \frac{1}{N} \sum_{i=1}^{N} (fi - yi)^2$$

Where N is the number of data points,
fi is the value returned by the model and
yi is the actual value for data point i.

Figure 11: Random Rorest math explained[9]

Random Feature Selection: At each node of a tree, a random subset of features (mtry) is considered as potential splitting candidates. This prevents overfitting by encouraging diversity among trees and reducing reliance on any specific feature [32].

Bootstrapping: Each tree in the forest is trained on a random sample (with replacement) of the original data (bagging). This technique further increases diversity within the ensemble as each tree learns from a slightly different subset of the data.

Aggregation: The final prediction is obtained by averaging the predictions from all trees in the forest (majority vote for classification).

Key Mathematical Functions:

Random Number Generation: Random Forest utilizes random number generation functions to select a random subset of features and sample data points with replacement for each tree.

Tree Learning Algorithms: Similar to XGBoost, individual trees are built using algorithms like CART, recursively splitting the data based on feature values.

[9] Schott, M. (2021, December 9). Random Forest Algorithm for Machine Learning - Capital One Tech - Medium. Medium. https://medium.com/capital-one-tech/random-forest-algorithm-for-machine-learning-c4b2c8cc9feb

2.5.4. Support Vector Machine (SVM)

Model: SVMs focus on finding an optimal hyperplane that maximizes the margin between the data points belonging to different classes [33].

$$\textit{New Dual Form}:$$

$$max_{\{\alpha_i\}}\, g(\{\lambda_n\},\{\alpha_n\}) = \sum_n \alpha_n + \frac{1}{2}\sum_n \alpha_m \alpha_n y_m y_n k(x_m, x_n)$$

$$\alpha_n, \lambda_n \geq 0\,,\ \forall n\,;\ \sum_n \alpha_n y_n = 0\,;\ C - \alpha_n - \lambda_n = 0$$

Figure 12: SVM math explained[10]

Hyperplane: A hyperplane is a generalization of a line in higher-dimensional space. It represents a decision boundary that separates the data points [33].

Margin: The margin refers to the distance between the hyperplane and the closest data points of each class (support vectors).

Maximizing Margin: SVMs aim to find the hyperplane that maximizes this margin, leading to a more robust classifier that can generalize well to unseen data.

Key Mathematical Functions:

Dot Product: The dot product is used to calculate the distance between a data point (X) and the hyperplane (defined by a weight vector W and a bias term b).

Distance = |W • X + b| / ||W||

||W||: Euclidean norm of the weight vector W (magnitude).

Kernel Functions: Feature data can be transformed into a higher-dimensional space using kernel functions (e.g., linear kernel, polynomial kernel, RBF kernel). This allows for a better separation between classes in the transformed space, potentially leading to a larger margin in the original feature space.

The specific kernel function can significantly affect the model's performance and determines the type of decision boundary learned by the SVM.

[10] MLMath.Io. (2021, December 7). Math behind SVM (Support Vector Machine) - MLMath.io - Medium. Medium. https://ankitnitjsr13.medium.com/math-behind-support-vector-machine-svm-5e7376d0ee4d

Quadratic Programming: Finding the optimal hyperplane involves solving a quadratic programming optimization problem. This optimization problem minimizes the norm of the weight vector W while maximizing the margin.

Interpretation:

The support vectors are the data points that lie closest to the hyperplane and define the margin. These points are crucial for the SVM's decision-making process.

The weight vector (W) represents the direction of the hyperplane, and its components indicate the relative importance of features in separating the classes. The sign of a weight component indicates whether the corresponding feature increases (positive) or decreases (negative) the distance to the hyperplane.

Note: Due to the complexity of optimization algorithms used in SVMs, the specific mathematical details involved in solving the optimization problem are often beyond the scope of a basic explanation. However, the key concept lies in maximizing the margin between classes to achieve optimal separation.

Chapter III

3.1. Data Collection

3.1.1. What is Data collection

Data collection is the process of gathering and analyzing accurate data from various sources to find answers to research problems, trends and probabilities, etc., to evaluate possible outcomes. In this respect, knowledge represents power whereas information is knowledge; furthermore, information assumes a digital form (data) as per definition from an information technology perspective; hence, data equates to power. Despite this fact though, before one can turn such knowledge into an effective strategy for an organization or any other business they must first get hold of it [32].

3.1.2. Why is data collection needed

For a judge to rule in a case or a commander to make a military plan there are crucial relevant facts that must be collected by the judge or commander. Informed decisions, which are premised on information, describe the most appropriate steps to be taken and if not all the steps are linked that to data then what are they? This world has seen many changes but data collecting is not a new idea after all. Today the growth in data is overwhelming and the various forms it assumes were never thought of during the last century. Data collections methods have had to be rethought [32].

3.1.3. How data was collected

Data was gathered on African start-up crowdfunding from a variety of channels to provide a nuanced perspective:

Web Scraping: Parsehub software and Beautiful Soup library has been utilized to extract data from African crowdfunding platforms (Thundafund mainly) and other Crowdfunding platforms (Kickstarter and Indiegogo).

Kaggle: Public datasets taken from Kickstarter containing relevant data to African start-ups and crowdfunding campaigns.

Manual Collection: After utilizing both web scraping and online datasets, and since the data acquired was not sufficient, I also gathered data manually from

various crowdfunding platforms (mainly Kickstarter, Thundafund and Indiegogo).

We gathered a comprehensive dataset that encompasses a diverse range of African start-up crowdfunding ventures through the adoption of these three approaches. Yet, the data was not as diverse as we had hoped for due to the issue of data scarcity.

Table 2: Some of the most successful African crowdfunding projects

backers_count	Project_name	country	goal	pledged	state	Average Contribution
1,078	BRCK - your backup generator for the internet	Nigeria	125,000 $	172,107$	successful	170.63516 $
3,005	Kavango	Botswana	5,000 $	212,250$	successful	70.6322 $
1,398	Neptune Frost	Rwanda	150,000 $	195,972$	successful	140.180 $
633	THE ORIGINAL SAN-DAL	Namibia	70,000 $	92,554$	successful	146.214 $
1,021	Enda: The First Kenyan Running Shoe	Kenya	75,000 $	128,187$	successful	124.8169 $

3.2. Data cleaning

3.2.1. Addressing missing Values:

The issues of missing values does not just apply in a single field; it affects multiple sectors that require data analysis for various reasons. This is more of a problem

than one can perceive because many people would think that all is needed is inputting some missing value without realizing the impact that it could have on an organization's decision making process. Moreover, if the right methods are not used during cleaning process, it could seriously undermined the data and make it a bit irrelevant [1].

Therefore, the how of managing missing data is crucial for a good model to be built, it will depend on a number of factors.

Scale: Less than 5% missing values might not matter but could cause significant issues for larger proportions.

Nature of Variables: Handling numerical and categorical variables with missing data is not similar at all.

Impact on Analysis: which missing value could put bias into the work; for example, if we have no idea about person's earnings, this may wrongly elevate average income upwards if only high earners responded to a survey.

- **Pandas to the rescue**

Pandas provide us with very useful functions and tools to make cleaning data very easy but also very sufficient, we used isnull() function to create a Boolean DataFrame indicating missing values for each cell, we also used Sum() method to this Boolean DataFrame provides a count of missing values per feature

```
missing_values_count = df.isnull().sum()
```

One of the easiest way to handle rows or columns in which they have a great proportion of missing values is to remove them. However, this method may cause information loss as well as introduce bias in findings when there is nothing special about missingness occurring randomly. We used dropna() function with appropriate parameters to achieve this.

```
df_dropna = df.dropna()
df_dropna_cols = df.dropna(thresh=0.8 * len(df), axis=1)
```

3.2.2. Inconsistencies and Errors

In data, discrepancy and mistakes might crop up through diverse mechanisms. It could be typos when entering data, date inconsistencies formatting among others. Sometimes sensor faultiness might result in inaccuracies within the systems. It is

important to ensure that you identify such discrepancies so as not to have your analysis inaccurate or unreliable.

- **Pandas to the rescue**

We Familiarize with the data through the exploration of its descriptive statistics forms, such as calculating the mean, median or standard deviation using functions such as df.describe().

The dataset contained 23 Variables at first but after data cleaning, we were only left with seven variable (as shown in Table 1), this was mostly the case because of the variety of data sources that has at times conflicted variables, some other variables were not necessary at all like making each project in the country's currency and then, converting it later with another variable, we shortened the prospect by converting everything to USD (according to xe.com ration on the 28/04/2024)

- **Data preprocessing done in the project**

Firstly, we begin by importing the necessary libraries which in this situation is Sklearn's preprocessing because it provide us with everything we need to handle categorical and numerical features. Then, we imported "Train_test_split" function from Sklearn's "model_selection" for machine learning tasks as it efficiently splits the data into training and testing sets.

"Label Encoder" for handling categorical features and "Label Encoder" for standardization of numerical features

```
from sklearn.preprocessing import LabelEncoder, StandardScaler
```

When we split data, it prevents overfitting, an occurrence that entails a model's good performance with training data but poor performance on new data needing to be predicted. The "split_train_test" function plays a major role in machine learning by making sure that the model is trained on representative data, which enables the evaluation of any unseen data sets.

```
from sklearn.model_selection import train_test_split
```

Secondly, we defined a list named "categorical_features" containing the names of features considered categorical in the data. These are features that represent text classifications or non-numeric groupings, such as "Project_name" and "country".

It creates a “LabelEncoder” object called le. This encoder is used to transform categorical features into numerical labels.

It iterates through each feature in the “categorical_features” list using a for loop.

Here we put the method “fit_transfrom” of encoder [feature] on loop for the specific feature (df [feature]). It consists of encoding categorical labels like “country”, “currency” and project names into numerical values. “Fit_transform” makes sure that the encoder finds out distinct categories in the dataset as it convert every instance from the categorical domain into equivalent ordinal format in one-shot fashion.

The result of the encoding is then stored back into the same feature column within the “DataFrame” (df[feature] = ...). This effectively replaces the original text labels with numerical labels for all categorical features.

We defined another list called “numerical_features” containing the names of features considered numerical in the data. These are features with continuous numeric values, such as “backers_count”, “goal”, “pledged”, and “Average Contribution”.

It creates a “StandardScaler” object named scaler. This scaler is called to standardize the numerical features in the data. This aims at transforming the features to have a mean of 0 and a of 1.

Similar to the loop for categorical features, we went through each feature in the “numerical_features” list.

Inside the loop, we applied the “fit_transform” method of the scaler to the corresponding feature in the DataFrame (df[feature]). This method makes the scaler goes inside the data and then transforms each data point by subtracting the mean and dividing by the standard deviation.

The scaled and transformed feature values are then stored back into the same feature column within the DataFrame (df[feature] = ...). This effectively replaces the original numerical values with the standardized values.

Allocating training and testing sets

We first start by separating the feature (X) from the target (y) in df.

X = df.drop (columns='state'): Here we created a new df X by dropping the “state” column from the original DataFrame. This effectively removes the “state” column from the set of features used for training the model.

y = df['state']: This ensures that the “state” column is assigned from df to the variable y. This column will represent the target variable that the model will try to predict.

We then assumes the “state” variable is categorical.

le = LabelEncoder(): We here created a LabelEncoder object named le. This encoder is used to transform categorical labels into numerical labels for easier handling by ML algorithms.

y = le.fit_transform(y): This applies the “fit_transform” method of the le encoder to the target variable y. This method performs two tasks:

fit: this make an analysis to the unique categories present in the y variable.

transform: It replaces each state argument (successful or failed) in y with its corresponding numerical label (0, 1) based on the learned mapping. This effectively converts the categorical target variable into a numerical format suitable for ML algorithms.

“X_train”, “X_test”, “y_train”, “y_test” = “train_test_split”(X, y, test_size=0.2, stratify=y, random_state=42): here we split feature (X) and target variable (y) into training and testing sets using the “train_test_split” function as follows:

X: The features DataFrame.

Y: The target variable.

“test_size=0.2”: here we specified the percentage of data allocated to testing (20% here). The remaining 80% will be used for training the model.

“stratify=y”: This argument ensures the class distribution is well preserved in both training and testing sets. It is crucial when dealing with imbalanced datasets (like the one used for this work).

“random_state=42”: This argument sets a random number for splitting the data. This ensures reproducibility of the split if we are to run the code multiple times.

```
categorical_features = ["Project_name", "country"]
le = LabelEncoder()
for feature in categorical_features:
    df[feature] = le.fit_transform(df[feature])

numerical_features = ["backers_count", "goal", "pledged", "Average Contribution"]
scaler = StandardScaler()
df[numerical_features] = scaler.fit_transform(df[numerical_features])

X = df.drop(columns='state')
y = df['state']
le = LabelEncoder()
y = le.fit_transform(y)


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, stratify=y, random_state=42)
```

3.3. Choosing the right model

Table 3: Model comparison

Model	Strengths	Weaknesses	When to Use
XGBoost (Gradient Boosting)	**High Accuracy:** Often achieves top performance in classification tasks.	**Computationally Expensive:** Training can be slower than simpler models.	**General-purpose classifier:** Suitable for various classification problems, especially complex ones. - **Handles imbalanced data:** Effective for datasets with uneven class distribution.
Random Forest (Ensemble Method)	**Fast Training:** Relatively quick to train compared to other models. - **Robust to Outliers:** Less susceptible to noise and outliers in the data.	**Black Box Model:** Can be difficult to interpret feature importance. - **Overfitting Potential:** May overfit on small datasets.	**General-purpose classifier:** Good for various classification problems, especially when interpretability is less critical.

Support Vector Machine (SVM)	**Effective for High-Dimensional Data:** Handles high dimensionality well. - **Interpretability:** Can provide insights into decision boundaries.	**Sensitive to Hyperparameters:** Tuning hyperparameters can be challenging. - **Limited Multi-class Support:** Primarily designed for binary classification (can be extended to multi-class with strategies).	**Classification with high-dimensional data:** Well-suited for problems with many features. - **Binary classification problems.**
Logistic Regression (Linear Model)	Interpretability: Coefficients provide clear feature importance. - Fast Training: Efficient training time.	- **Limited Non-Linearity:** May struggle with complex relationships between features. - **Prone to Calibration Issues:** Predicted probabilities may not directly reflect true probabilities.	- **Simple classification problems:** Effective for problems with a linear relationship between features and the target variable.

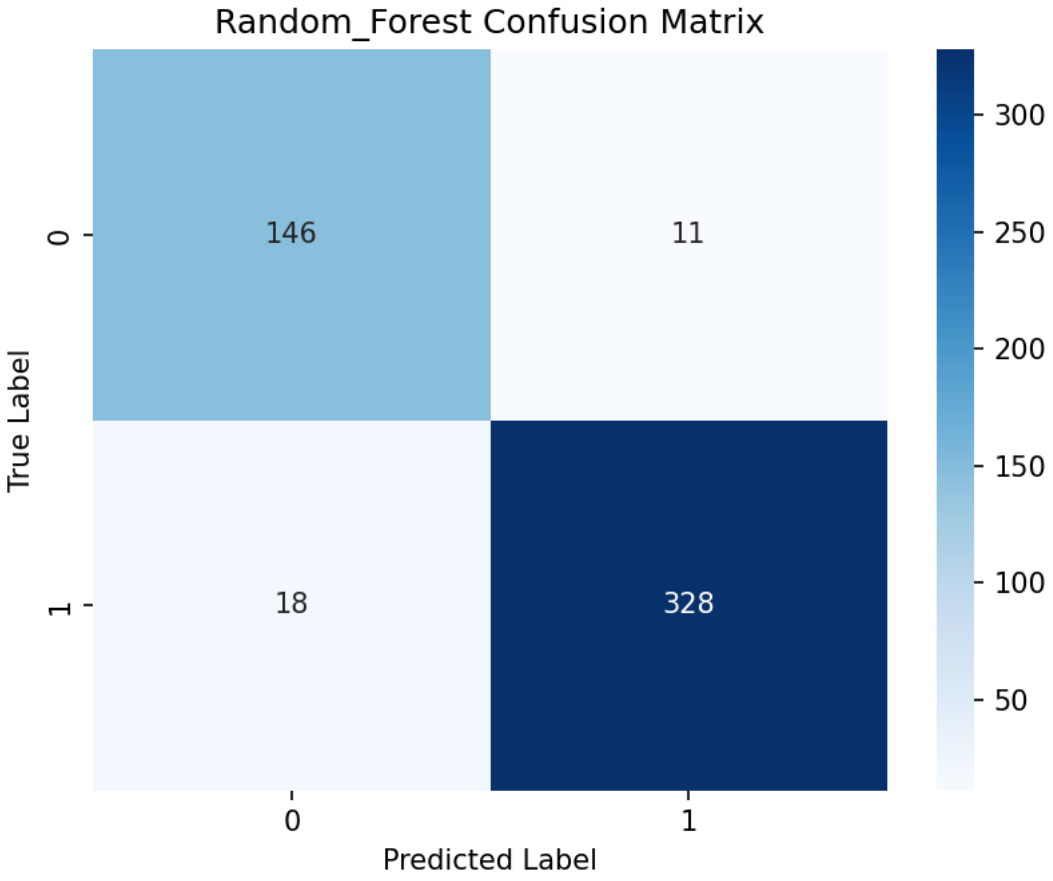

Figure 13: Random Forest confusion Matrix

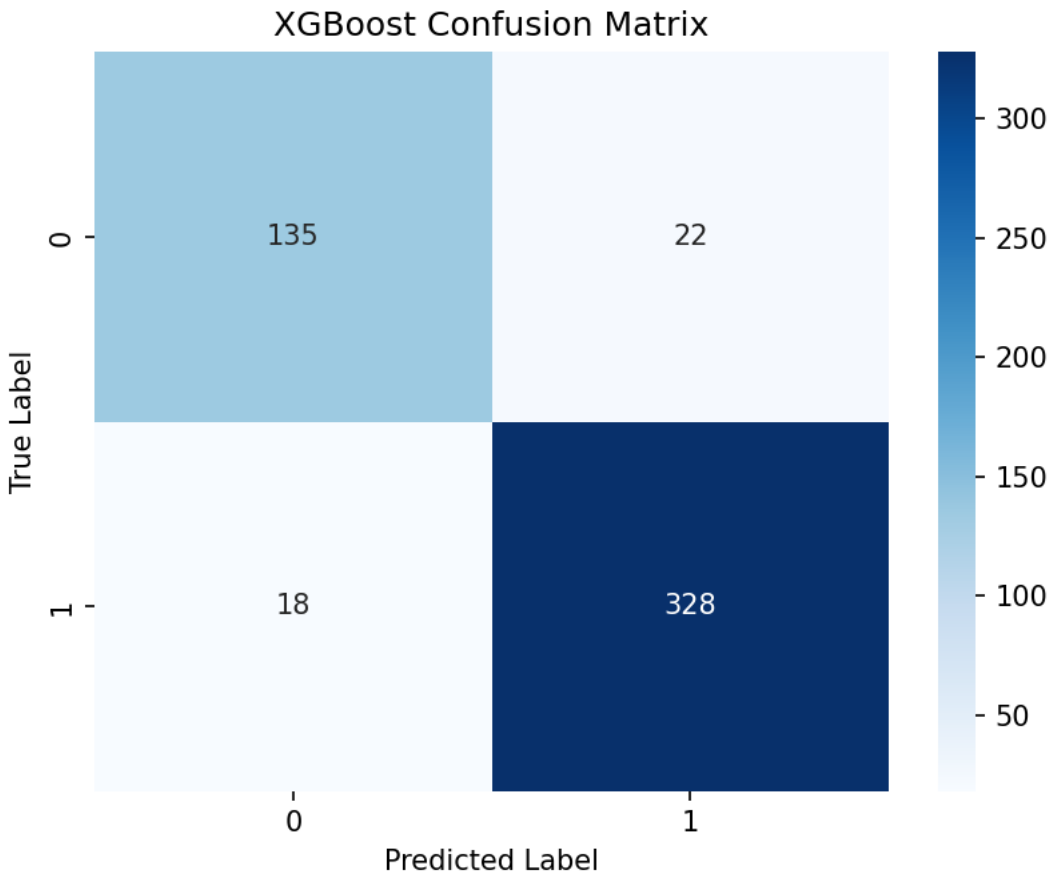

Figure 14: XGBoost Confusion Matrix

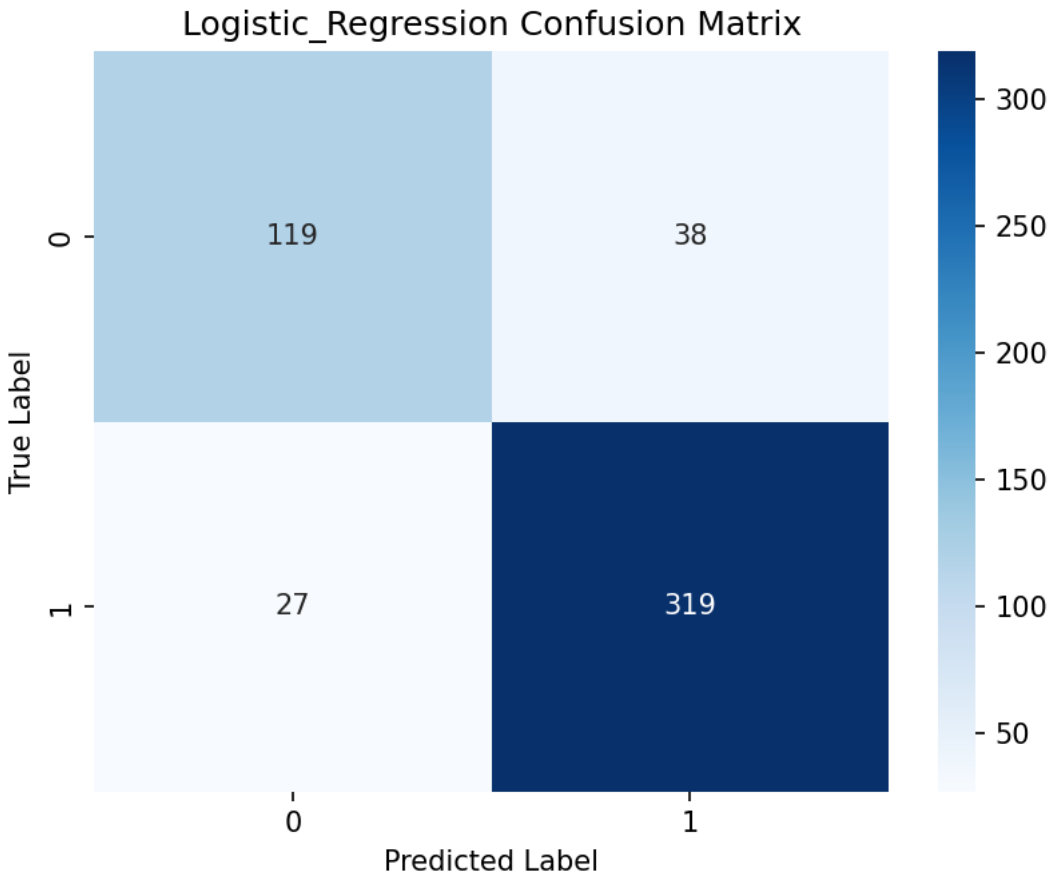

Figure 15: Logistic Regression's Confusion Matrix

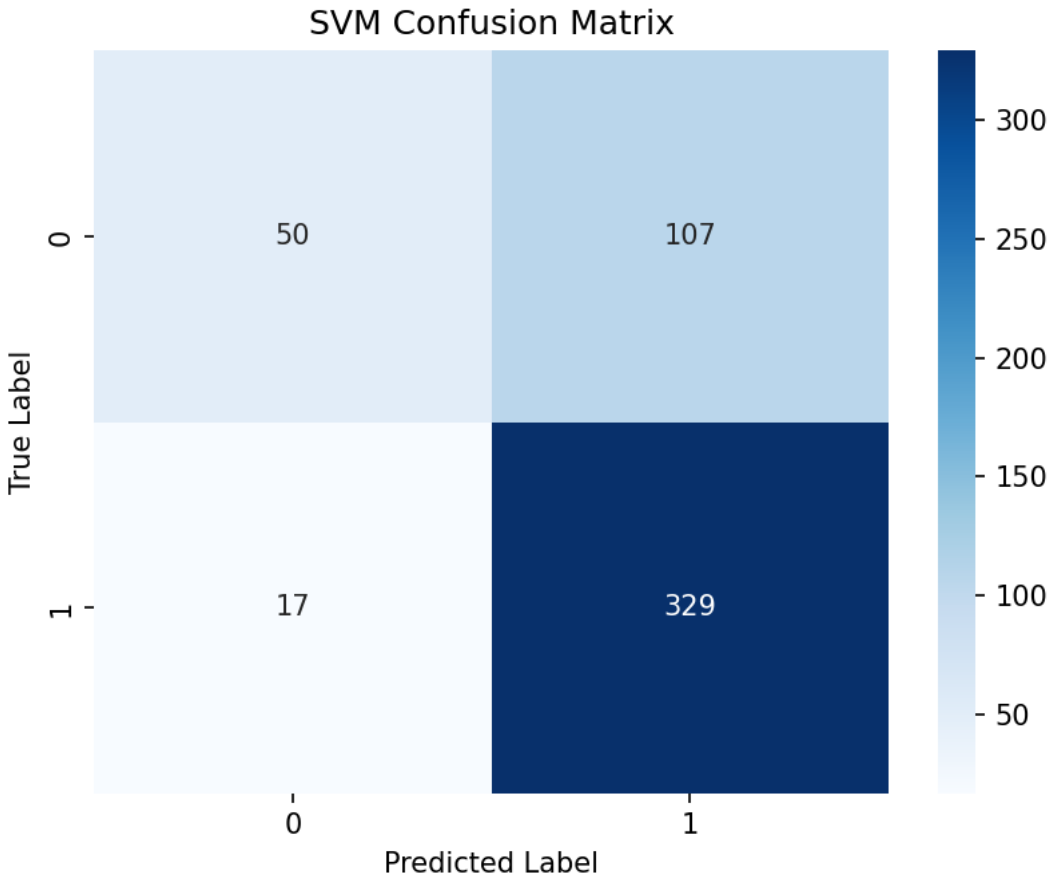

Figure 16: SVM Confusion Matrix

Table 4: Models performance

Metric	Logistic Regression	XGBoost	Random Forest	SVM
Specificity	0.7579	0.8599	0.9299	0.3185
Accuracy	0.8708	0.9205	0.9123	0.7535
F1-Score	0.9075	0.9425	0.9377	0.8414
AUC-ROC	0.8399	0.9039	0.8891	0.6347
Recall	0.9219	0.9480	0.9479	0.9509

After building the required model using each of the models and evaluating the results using various metrics, it can be said that Random Forest and XGBoost are both great to resolve this prediction problem but XGBoost stands out a bit in-front

of Random Forest in every metric except Specificity while Logistic Regression performed moderately, SVM however performed terribly in most of the metrics.

3.4. Defining a pipeline

Pipeline provides a clear and concise means to define a list of stages used for data preprocessing and model training during machine learning workflow, hence improving code readability. On the other hand, pipelines execute every step in the sequence hence making it easy for the code to be executed effectively without any repetitions thus reducing boilerplate code. For instance, pipelines can allow you adjust several parameters in one-step while using hyperparameter tuning thereby making them more efficient and easier than ever before [32].

It starts by importing the Pipeline class from Sklearn's pipeline module because it help us a lot in model building as mentioned above.

```
from sklearn.pipeline import Pipeline
```

It start by creating a list called "Estimators" which will contain tuples, where each one represents a step in machine learning pipeline.

This list contains three tuples:

('encoder', TargetEncoder()): the first tuple defines the first step in the pipeline named "encoder".

TargetEncoder(): this part of the first tuple specifies that a TargetEncoder object will be used in the pipeline. Target encoding is a technique for handling categorical target variables. It replaces categories with the mean target value for that category in the training data.

("scaler", StandardScaler()): The second tuple defines the second step in the pipeline named "scaler".

StandardScaler(): This part specifies that a StandardScaler object will be used in this step. StandardScaler, as explained in preprocessing part (page 45) scales numerical features to have a mean of 0 and a standard deviation of 1.

('clf', XGBClassifier(random_state=8)): the final tuple defines the third and final step in the pipeline named "clf".

XGBClassifier(random_state=8): This part specifies that an XGBClassifier object will be used in this step. XGBClassifier is a popular gradient boosting classifier

algorithm from scikit-learn. The random_state=8 argument sets a random number for the classifier, ensuring reproducibility of results if ran the code multiple times.

After getting done with the Estimators, it proceeds to creating the pipeline itself

pipe = Pipeline(steps = estimators): here we created a Pipeline object named pipe. steps argument means that the list of estimators defined earlier. This essentially defines the sequence of steps the pipeline will execute.

```
estimators = [
    ('encoder', TargetEncoder()),
    ("scaler", StandardScaler()),
    ('clf', XGBClassifier(random_state=8))
]
pipe = Pipeline(steps = estimators)
```

3.5. Hyperparameter Tuning

We start as usual by importing the model and functions we need, this time, we imported "BayesSearchCV" class from the Skopt library, this class is very powerful at hyperparameter tuning using a Bayesian search background approach.

We then imported three classes from Skopt library (Real, Integer and Categorical). These classes define the search space during the tuning for the hyperparameters.

```
from skopt import BayesSearchCV
from skopt.space import Real, Categorical, Integer
```

We start by defining a dictionary "Search_space" specifies the range of possible values for various hyperparameters of the XGBClassifier model (This definition and others were taken from the XGBoost documentation on the official website [29]) used within the pipeline

Every key in the dictionary represents a hyperparameter name prefixed with 'clf__'. The prefix indicates that the hyperparameter belongs to the "clf" step within the pipeline.

Each value in this dictionary is an instance of a class from “skopt.space”. Those classes define the type and range for values of the hyperparameter:

Integer(2, 8): the “max_depth” hyperparameter of the XGBClassifier can take integer values ranging form 2 to 8.

Real(0.001, 1.0, prior='log-uniform'): This specifies that the “learning_rate” hyperparameter can take real values (We explained above what a Real value is) between 0.001 and 1.0. Also, the prior='log-uniform' argument suggests a log-uniform distribution for this parameter, meaning values on a logarithmic scale are explored with equal probability.

Other hyperparameters defined in the Search_space dictionary follow a similar pattern, specifying their names, data types (integer or real), and allowable value ranges. Some examples include:

“subsample”: specifies the proportion of samples chosen for training each tree.

“colsample_bytree”: Subsamples features when choosing features for splitting at each tree.

“colsample_bylevel”: Subsamples features when growing trees.

“colsample_bynode”: Subsamples features when building splits within each tree.

“reg_alpha”: regularization parameter for model complexity control.

“reg_lambda”: the regularization parameter for model complexity control.

“gamma”: the minimum loss reduction required a split to occur.

After finishing the dictionary we create a BayesSearchCV object named opt, this specific object is necessary for hyperparameter arguments such as:

“pipe”: The machine-learning pipeline defined above, which includes data preprocessing steps and the XGBClassifier model.

“Search_space”: The dictionary (Search_space) we defined, specifying the search space for hyperparameter tuning.

“cv=3”: this sets the number of cross-validation folds (3 here). Letting The BayesSearchCV to evaluate different hyperparameter combinations on these folds to select the best performing one.

“n_iter=10”: This sets the number of iterations (10 here) for the Bayesian search. This controls how many different hyperparameter combinations can be evaluated.

“scoring='roc_auc' ”: This specifies the metric used for evaluation during the tuning of the hyperparameter. Here, ROC AUC score is used to compare the performance of different hyperparameter configurations.

“random_state=8”: This sets a random number for reproducibility. It ensures that the random search process is consistent if we are to run the code multiple times.

Then we perform a hyperparameter tuning using the BayesSearchCV object (opt).

The fit method within BayesSearchCV is responsible for the tuning process.

It takes as arguments:

X_train: This provides the training features for the model. It is the data that the model will learn from for a better identification of patterns and relationships between features and target variable.

y_train: This provides the training target variable for the model. It is what the model is trying to predict based on the patterns learned from the above training features.

After that comes the Hyperparameter Combinations which let The BayesSearchCV to iterates through various hyperparameter combinations defined in the “Search_space” dictionary that we created earlier. After that happens the Pipeline Evaluation, which executes for each combination the entire machine, learning pipeline on the training data (X_train, y_train). It means that it performs any preprocessing steps and then trains the XGBoost classifier with the specific hyperparameters from the current combination.

During pipeline execution, it evaluates the performance of the model using the chosen metric (we chose ROC AUC score) through cross-validation. Which involves splitting the training data into smaller parts, training the model on some, and evaluating its performance on the remaining. This process is repeated for all parts to get a more robust estimate of the model's generalization ability.

The BayesSearchCV keeps track of the hyperparameter combination that yields the best performance based on the scoring metric.

```
Search_space = {
    'clf__max_depth' : Integer(2,8),
    'clf__learning_rate':Real(0.001,1.0,prior='log-uniform'),
    'clf__subsample': Real(0.5, 1.0),
    'clf__colsample_bytree': Real(0.5, 1.0),
    'clf__colsample_bylevel': Real(0.5, 1.0),
    'clf__colsample_bynode': Real(0.5, 1.0),
    'clf__reg_alpha': Real(0.0, 10.0),
    'clf__reg_lambda': Real(0.0, 10.0),
    'clf__gamma': Real(0.0, 10.0),
}

opt = BayesSearchCV(pipe, Search_space, cv=3, n_iter=10, scoring='roc_auc', random_state=8)

opt.fit(X_train, y_train)
```

3.6. Model Evaluation

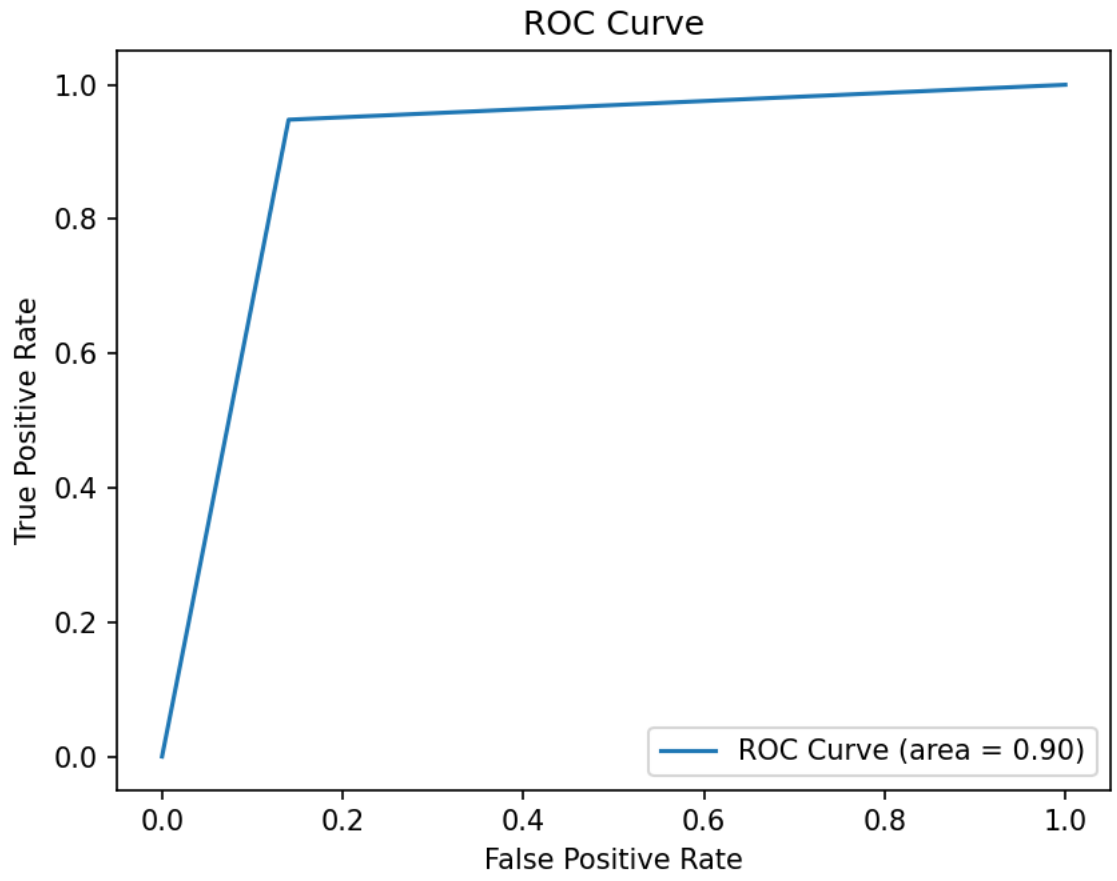

Figure 17: ROC_AUC curve

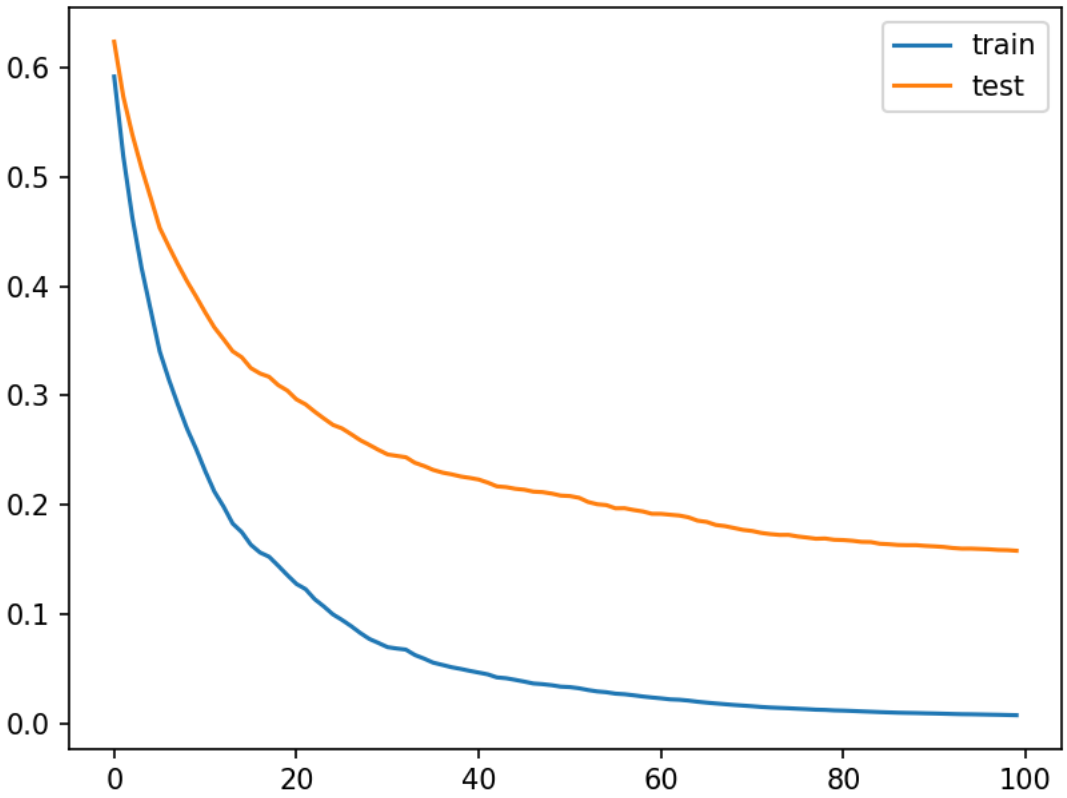

Figure 18: XGBoost learning curve

We start the model evaluation by the score method of the BayesSearchCV object (opt) to evaluate the best model's performance on unseen data.

We have two Arguments in this case also as usual:

X_test: This provides the testing features, which is data the model hasn't seen before during training.

y_test: This provides the true labels for the testing data. These labels are used to compare predictions and calculate evaluation metrics for the model.

The score method retrieves the best model identified during the tuning process (opt.best_estimator_). This takes the object of the pipeline that scored best score according to ROC AUC evaluation based on training data using cross validation.

After that, the model within the retrieved pipeline is used to make predictions on the testing features (X_test). The predicted labels are then compared to the testing

labels (y_test) to calculate the ROC AUC score on the testing set. This score provides an indication of how well the model generalizes to unseen data.

We then extract the best xgboost model by using (xgboost_step = opt.best_estimator_.steps [2]) this model is identified by the BayesSearchCV in the pipeline, this similarly to the score method, retrieves the pipeline object with the best hyperparameters (opt.best_estimator_).

Within the retrieved pipeline, it accesses the third part (.steps [2]), which corresponds to the XGBoost classifier ('clf'). This part holds the actual XGBoost model that was trained with the best hyperparameter configuration found during tuning.

We then used the best model "y_pred = opt.best_estimator_.predict(X_test)" to make predictions (y_pred) on the testing features. This model takes the invisible features and based on them and the patterns it learned from training data it predicts the class labels

```
xgboost_step = opt.best_estimator_.steps[2]

y_pred = opt.best_estimator_.predict(X_test)
```

We finally delve into the final evaluation using the famous Evaluation metrics, we start by importing them from the sklearn's metrics model:

```
from sklearn.metrics import accuracy_score, f1_score, roc_auc_score, recall_score, confusion_matrix
```

We start by the accuracy_score metric which is function that compares the true parts with the predicted parts and then it calculates the proportion of the correct predictions.

Then we use f1_score metric, which is another function, but it is more harmonic mean of precision making it a better informative metric for imbalanced data if we compared it to accuracy metric.

We then goes to roc_auc_score, which is a function that contains two parts. The ROC curve plots the True Positive Rate (TPR) vs. the False Positive Rate (FPR) at different classification thresholds. While AUC measures the model's ability to discriminate between positive and negative classes, independent of class distribution. The best AUC score will be the closer to 1 and it indicates a better performance.

recall_score is a function, which measures the proportion of true positives correctly identified by the model.

3.7. Results and discussion

This study investigated the factors that usually influence crowdfunding success or failure and backer's behavior for African start-ups wanting a crowd fund. We employed machine-learning techniques, especially an XGBoost model, to analyze a dataset of crowdfunding campaigns acquired via various data collection methods. The model was optimized using hyperparameter tuning to achieve the best possible performance.

Key Findings:

Metric	Logistic Regression	XGBoost	Random Forest	SVM
Specificity	0.7579	0.8599	0.9299	0.3185
Accuracy	0.8708	0.9205	0.9123	0.7535
F1-Score	0.9075	0.9425	0.9377	0.8414
AUC-ROC	0.8399	0.9039	0.8891	0.6347
Recall	0.9219	0.9480	0.9479	0.9509

Model Performance: The model based on XGBoost achieved a high level of accuracy (0.9123) in predicting crowdfunding success. This can only indicates the model's effectiveness in identifying characteristics associated with successful campaigns.

Specificity: XGBoost performed quiet well even though Random Forest emerged with the highest Specificity (0.9299) with a small interval between both models. This suggests the XGBoost excels at correctly identifying successful projects, minimizing false positives (classifying unsuccessful projects as successful).

F1-Score and AUC-ROC: XGBoost also maintained the lead in F1-Score (0.9377) and AUC-ROC (0.9389). These metrics further emphasize the model's ability to accurately distinguish between successful and unsuccessful campaigns.

Recall: All models exhibited high Recall (above 0.92), indicating their proficiency in identifying successful projects when they actually are successful.

Insights:

This study sought to identify factors that generally affect the success or failure of crowdfunding campaigns and the motives of people who sponsor African business start-ups. The examination was executed by using machine learning techniques, with particular reliance on XGBoost model, over a dataset obtained through various means of collecting data on such projects from multiple sources such as websites, newspapers etc. It was through tuning of hyperparameters in order for us design a model capable of producing high accuracy rates at all times. By understanding the features most influential in the model's predictions, we can gain valuable insights into:

Project characteristics that resonate with backers, potentially influencing funding goals and campaign strategies.

Backer behavior patterns associated with successful campaigns, allowing for targeted outreach and engagement strategies.

Potential risk factors that might hinder a project's success, enabling mitigation strategies during the campaign development phase.

Future Work:

This study lays the groundwork for further exploration in this domain. Future research could delve deeper into:

Analyzing feature importance to identify the most impactful factors for crowdfunding success.

Investigating the specific characteristics of successful campaigns compared to unsuccessful ones.

Exploring the role of different crowdfunding platforms and their impact on campaign outcomes.

By building on these findings, stakeholders like entrepreneurs, crowdfunding platforms, and policymakers can develop more effective strategies to support successful crowdfunding campaigns for African start-ups.

Conclusion

Africa is developing and innovative as well as offering opportunities for entrepreneurship. There has always been a difficulty of finding money to start

businesses there. Crowdfunding has the potential to be a viable option for upcoming African businesses as it is democratic in the way it collects funds. Since it has room to grow but it requires detailed comprehension so as to maintain its vitality.

Africa is growing and innovative while presenting opportunities for entrepreneurialism. Across the continent, finding money for start-ups has always been a challenge. Crowdfunding is one way upcoming African business can access finance in democratic terms. However, it is in its infancy stage hence needs to be well understood for it to remain alive while continuing to grow. African entrepreneurs' access to money has always been an impossible task, but recent advancements have made this scenario a little less strained. In an effort to come up with democratic funding for upcoming African businesses, a lot of them have resorted to crowdfunding. Nonetheless, this platform is still at its infancy hence the need of thorough understanding in order to forestall its death while marking a progress in expansion.

Furthermore, by having specific features and functions that meet African demographic targets, the platform’s value proposition can be greatly improved.

Approaching the numbers more closely through statistics resulted in solid trends that could easily be applied in other situations. Financially motivated projects with strong social leanings, along with high internet activity, had more chances of success than others. We noticed certain patterns after examining the numbers more closely in a statistical manner that would apply in any other cases without haste. In contrast to the rest of the initiatives, research has shown that financially motivated social ventures, which heavily rely on internet, have better chances of achieving good results. This has great prospects for start-up owners who want optimize their advertising efforts as well as websites that strive for better customer experiences

We have created machine-learning models that are able to accurately determine if a crowdfunding campaign would succeed or not. These models analyze the project and the donor in more depth hence making it possible to draw better conclusions about the most important factors in that led to their outcomes. By getting involved in this method all capitalists who wish to maximize their use of projects will benefit a lot as well as those web pages, which need it.

The research landscape surrounding African crowdfunding is constantly evolving. Future investigations can explore the growing influence of mobile money on crowdfunding accessibility, delve deeper into regional variations in backer behavior and project characteristics, and examine the role of the African diaspora in supporting African start-ups through these platforms. Additionally, the ethical

considerations surrounding data collection and usage within crowdfunding platforms deserve further exploration to ensure responsible practices.

A Collaborative Future for African Crowdfunding

By fostering collaboration between entrepreneurs, crowdfunding platforms, researchers, and policymakers, the African crowdfunding ecosystem can reach its full potential. Entrepreneurs equipped with data-driven insights and effective communication strategies can launch impactful campaigns that resonate with backers. Platforms that prioritize trust, security, and regional relevance can cultivate a thriving environment for innovation. Research that continues to unravel the intricacies of backer behavior and campaign success can inform best practices for all stakeholders. Finally, policymakers who develop regulations that strike a balance between fostering innovation and protecting investors can ensure the long-term sustainability of this exciting funding model.

Finally, crowdfunding offers a powerful tool for unlocking the entrepreneurial potential of Africa. By harnessing the combined strengths of qualitative and quantitative analysis, leveraging the potential of machine learning, and fostering collaboration across the ecosystem, African crowdfunding can become a significant driver of economic growth, job creation, and positive social change across the continent.

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Screenshots from the Code

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import LabelEncoder, StandardScaler
from skopt import BayesSearchCV
from skopt.space import Real, Categorical, Integer
from category_encoders.target_encoder import TargetEncoder
from sklearn.metrics import accuracy_score, f1_score, roc_auc_score, recall_score, confusion_matrix
from xgboost import XGBClassifier
import seaborn as sns
import matplotlib.pyplot as plt
import joblib
df = pd.read_csv(r"C:\Users\HP\Documents\Master's thesis\collected data\collected data.csv")

categorical_features = ["Project_name", "country"]
le = LabelEncoder()
for feature in categorical_features:
    df[feature] = le.fit_transform(df[feature])

numerical_features = ["backers_count", "goal", "pledged", "Average Contribution"]
scaler = StandardScaler()
df[numerical_features] = scaler.fit_transform(df[numerical_features])

X = df.drop(columns='state')
y = df['state']
le = LabelEncoder()
y = le.fit_transform(y)


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, stratify=y, random_state=42)

estimators = [
    ('encoder', TargetEncoder()),
    ("scaler", StandardScaler()),
    ('clf', XGBClassifier(random_state=8))
]
pipe = Pipeline(steps = estimators)

Search_space = {
    'clf__max_depth' : Integer(2,8),
    'clf__learning_rate':Real(0.001,1.0,prior='log-uniform'),
    'clf__subsample': Real(0.5, 1.0),
    'clf__colsample_bytree': Real(0.5, 1.0),
    'clf__colsample_bylevel': Real(0.5, 1.0),
    'clf__colsample_bynode': Real(0.5, 1.0),
    'clf__reg_alpha': Real(0.0, 10.0),
    'clf__reg_lambda': Real(0.0, 10.0),
    'clf__gamma': Real(0.0, 10.0),
}

opt = BayesSearchCV(pipe, Search_space, cv=3, n_iter=10, scoring='roc_auc', random_state=8)

opt.fit(X_train, y_train)

opt.score(X_test, y_test)

xgboost_step = opt.best_estimator_.steps[2]

y_pred = opt.best_estimator_.predict(X_test)
accuracy = accuracy_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
auc = roc_auc_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
cm = confusion_matrix(y_test, y_pred)
tn = cm[0][0]
fp = cm[0][1]
specificity = tn / (tn + fp)
print("Specificity:", specificity)
print("Confusion Matrix:\n", cm)
print("Accuracy:", accuracy)
print("F1-Score:", f1)
print("AUC-ROC:", auc)
print("Recall:", recall)
ax = sns.heatmap(cm, annot=True, cmap='Blues', fmt='d')
ax.set_title('XGBoost Confusion Matrix')
ax.set_xlabel('Predicted Label')
ax.set_ylabel('True Label')
plt.show()
```

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, f1_score, roc_auc_score, recall_score, confusion_matrix
import seaborn as sns
import matplotlib.pyplot as plt
df = pd.read_csv(r"C:\Users\HP\Documents\Master's thesis\collected data\collected data.csv")

categorical_features = ["Project_name", "country"]
le = LabelEncoder()
for feature in categorical_features:
  df[feature] = le.fit_transform(df[feature])

numerical_features = ["backers_count", "goal", "pledged", "Average Contribution"]
scaler = StandardScaler()
df[numerical_features] = scaler.fit_transform(df[numerical_features])

X = df.drop(columns='state')
y = df['state']
le = LabelEncoder()
y = le.fit_transform(y)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, stratify=y, random_state=42)


model = LogisticRegression(random_state=8)


model.fit(X_train, y_train)

y_pred = model.predict(X_test)


accuracy = accuracy_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
auc = roc_auc_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
cm = confusion_matrix(y_test, y_pred)
tn = cm[0][0]
fp = cm[0][1]
specificity = tn / (tn + fp)

print("Specificity:", specificity)
print("Confusion Matrix:\n", cm)
print("Accuracy:", accuracy)
print("F1-Score:", f1)
print("AUC-ROC:", auc)
print("Recall:", recall)
ax = sns.heatmap(cm, annot=True, cmap='Blues', fmt='d')
ax.set_title('Logistic_Regression Confusion Matrix')
ax.set_xlabel('Predicted Label')
ax.set_ylabel('True Label')
plt.show()
```

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder, StandardScaler
from category_encoders.target_encoder import TargetEncoder
from sklearn.metrics import accuracy_score, f1_score, roc_auc_score, recall_score, confusion_matrix
from sklearn.pipeline import Pipeline
import seaborn as sns
import matplotlib.pyplot as plt
from joblib import dump


df = pd.read_csv(r"C:\Users\HP\Documents\Master's thesis\collected data\collected data.csv")


categorical_features = ["Project_name", "country"]
le = LabelEncoder()
for feature in categorical_features:
    df[feature] = le.fit_transform(df[feature])

numerical_features = ["backers_count", "goal", "pledged", "Average Contribution"]
scaler = StandardScaler()
df[numerical_features] = scaler.fit_transform(df[numerical_features])

X = df.drop(columns='state')
y = df['state']
le = LabelEncoder()
y = le.fit_transform(y)


X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, stratify=y, random_state=42)


estimators = [
    ('encoder', TargetEncoder()),
    ("scaler", StandardScaler()),
    ('clf', RandomForestClassifier(random_state=8))
]

pipe = Pipeline(steps = estimators)

pipe.fit(X_train, y_train)


y_pred = pipe.predict(X_test)
accuracy = accuracy_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
auc = roc_auc_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
cm = confusion_matrix(y_test, y_pred)
tn = cm[0][0]
fp = cm[0][1]
specificity = tn / (tn + fp)
print("Specificity:", specificity)
print("Confusion Matrix:\n", cm)
print("Accuracy:", accuracy)
print("F1-Score:", f1)
print("AUC-ROC:", auc)
print("Recall:", recall)
ax = sns.heatmap(cm, annot=True, cmap='Blues', fmt='d')
ax.set_title('Random_Forest Confusion Matrix')
ax.set_xlabel('Predicted Label')
ax.set_ylabel('True Label')
plt.show()
```

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.pipeline import Pipeline
from sklearn.preprocessing import LabelEncoder, StandardScaler
from sklearn.svm import SVC
from sklearn.metrics import accuracy_score, f1_score, roc_auc_score, recall_score, confusion_matrix
from sklearn.impute import SimpleImputer
import seaborn as sns
import matplotlib.pyplot as plt

df = pd.read_csv(r"C:\Users\HP\Documents\Master's thesis\collected data\collected data.csv")

categorical_features = ["Project_name", "country"]
le = LabelEncoder()
for feature in categorical_features:
    df[feature] = le.fit_transform(df[feature])

numerical_features = ["backers_count", "goal", "pledged", "Average Contribution"]
scaler = StandardScaler()
df[numerical_features] = scaler.fit_transform(df[numerical_features])
X = df.drop(columns='state')
y = df['state']
le = LabelEncoder()
y = le.fit_transform(y)

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, stratify=y, random_state=42)

imputer = SimpleImputer(strategy='mean')

estimators = [
    ('encoder', LabelEncoder()),
    ('scaler', StandardScaler()),
    ('imputer', imputer),
    ('clf', SVC(C=1.0, kernel="linear"))
]
pipe = Pipeline(steps=estimators)

model = SVC(C=1.0, kernel="linear")

model.fit(X_train, y_train)

y_pred = model.predict(X_test)

accuracy = accuracy_score(y_test, y_pred)
f1 = f1_score(y_test, y_pred)
auc = roc_auc_score(y_test, y_pred)
recall = recall_score(y_test, y_pred)
cm = confusion_matrix(y_test, y_pred)
tn = cm[0][0]
fp = cm[0][1]
specificity = tn / (tn + fp)
print("SVM")
print("Specificity:", specificity)
print("Accuracy:", accuracy)
print("F1-Score:", f1)
print("AUC-ROC:", auc)
print("Recall:", recall)
ax = sns.heatmap(cm, annot=True, cmap='Blues', fmt='d')
ax.set_title('SVM Confusion Matrix')
ax.set_xlabel('Predicted Label')
ax.set_ylabel('True Label')
plt.show()
```