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Developing an MVP using React Native with the Best Practices in Startup

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Abstract

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In the dynamic era of technology and innovation with startups, Minimum Viable Product (MVP) is a key landmark, crucial in validating ideas, acquiring early traction, and refining based on user inputs. This thesis delves into investigating the hurdles and opportunities inherent in constructing an MVP (Minimum Viable Product) using React Native technology in the context of an early-stage startup. Through an extensive review of industrial best practices, utilizing action research alongside perspectives from the team, the thesis aims to formulate the industrial best practices framework aligning with unique obstacles and purpose in 'Startup A'.

At its heart, the thesis explores the pivotal role of MVP in the startup ecosystem, spotlighting the pertinence of swift experimentation, user-centeredness, and streamlining resources effectively in advancing product innovation and development. Furthermore, it analyses the finer points of utilizing React Native, a cross-platform framework, highlighting its effectiveness in expediting the process and accelerating the time to launch the product/MVP. Gaining perspectives from the startup team members, the thesis examines early-stage startups' common pitfalls, including budget constraints, manpower power, and time limitations. This thesis delves into the best approaches for efficient resource allocation, focusing on key functionalities, and encouraging iterative development, aiming to provide practical and effective pointers to navigate these obstacles and elevate the probability of MVP success.

In conclusion, the key findings extracted from the thesis highlight the crucial importance of integrating a scientific and systematic approach in MVP development with React Native. This approach should be deeply grounded in industrial best practices and enriched by invaluable insights acquired through practical experiences in the field. The thesis emphasizes the immense significance of comprehensive code documentation, proactive sharing of

knowledge, and a dedication to continuous improvement. These practices are essential and serve as milestones in fostering an ecosystem facilitative for sustainable growth and innovation for any startup organization.

Dynaamisen teknologian ja innovaatioiden aikakaudella startup-yritysten myötä Minimum Viable Product (MVP) on keskeinen maamerkki, joka on ratkaisevan tärkeä ideoiden validoinnissa, varhaisessa vetovoiman hankkimisessa ja käyttäjien panostuksiin perustuvassa jalostuksessa. Tässä opinnäytetyössä tutkitaan esteitä ja mahdollisuuksia, jotka liittyvät MVP:n (Minimum Viable Product) rakentamiseen React Native -teknologialla varhaisen vaiheen käynnistuksen yhteydessä. Teollisuuden parhaiden käytäntöjen laajan katsauksen kautta toimintatutkimusta ja ryhmän näkökulmia hyödyntäen opinnäytetyö pyrkii muotoilemaan teollisuuden parhaiden käytäntöjen viitekehyksen "Startup A:n" ainutlaatuisten esteiden ja tarkoituksen mukaisesti.

Opinnäytetyön ytimessä tutkitaan MVP:n keskeistä roolia startup-ekosysteemissä. Siinä korostetaan nopean kokeilun, käyttäjälähtöisyyden ja resurssien tehokkaan virtaviivaistamisen merkitystä tuoteinnovoinnin ja -kehityksen edistämisessä. Lisäksi se analysoi React Nativen, monialustaisen kehityksen, käytön hienoimpia kohtia ja korostaa sen tehokkuutta prosessin nopeuttamisessa ja tuotteen/MVP:n julkaisun nopeuttamisessa. Opinnäytetyössä tarkastellaan startup-tiimin jäsenten näkökulmia yleisiä sudenkuoppia, joita alkuvaiheen startupit kohtaavat, mukaan lukien budjettirajoitukset, ihmiskunnan voimat ja aikarajoitukset. Tässä opinnäytetyössä tarkastellaan parhaita tapoja tehokkaaseen resurssien allokointiin keskittyen avaintoimintoihin ja kannustamaan iteratiivista kehitystä. Tavoitteena on tarjota käytännöllisiä ja tehokkaita osoittimia näiden esteiden navigoimiseksi ja MVP:n onnistumisen todennäköisyyden lisäämiseksi.

Lopuksi opinnäytetyöstä poimitut keskeiset havainnot korostavat tieteellisen ja systemaattisen lähestymistavan integroimista MVP-kehitykseen React Nativen kanssa. Tämän lähestymistavan tulisi perustua syvästi teollisuuden parhaisiin käytäntöihin, ja sitä olisi täydennettävä alan käytännön kokemusten kautta hankituilla korvaamattomilla oivalluksilla. Opinnäytetyö korostaa kattavan koodidokumentation, ennakoivan tiedon jakamisen ja jatkuvaan parantamiseen sitoutumisen valtavaa merkitystä. Nämä käytännöt ovat välttämättömiä ja toimivat virstanpylväinä sellaisen ekosysteemin edistämisessä, joka edistää kestäväää kasvua ja innovaatioita kaikissa startup-organisaatioissa.

Keywords: Action Research, MVP, Lean Startup, Build-Measure-Loop, Mobile Applications, Cross-Platform Framework, React-Native, Best Practices, User-centric design, Agile Methodology, Test Driven Development

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List of Abbreviations

MVP: Minimum Viable Prototype

App: application/app/App

BML: Build-Measure-Loop

RN: React Native

PMF: Product-Market-Fit

CEO: Chief Executive Officer

CTO: Chief Technical Officer

TDD: Test Driven Development

1. Introduction

In the era of the digital world, bringing innovative ideas to solve real-life problems gives birth to new businesses. And here comes the term 'Start Up' which is the innovation in action. In modern business dynamics, a startup is not defined by its size but by its agility, business acumen, and commitment to addressing specific issues with innovative solutions. Nowadays, many startups prefer to develop their mobile applications for better growth by providing more features to the users and getting their attention. In other words, to increase the user's acquisition or retention period, mobile applications are the perfect choice. Making a mobile application is not an easy task and it might take a huge cost and well experienced team. The most straightforward way to deal with this situation is to go for 'MVP' in mobile app development, which brings down the cost of mobile application development to a marked degree. [2]

The thesis deals with the MVP development process covering the pitfalls in the process in a startup 'Startup A' and aims to provide the best practices of MVP development with React Native. The startup is an EdTech company building an MVP for its mobile application for learners who want to boost their learning progress in a particular field such as language, science, etc. In an early-stage startup, due to the scarcity of time and resources, the development process becomes overwhelming. Hence, building an MVP saves cost and time for development in the small ecosystem. This thesis covers the crucial role of MVP in the context of startup.

1.1 Background

In previous years, startups have drastically switched to building MVP as a planning strategy for developing their product, which helps startups validate their business idea in an early phase by gathering early feedback from the users and iterating for the product improvement for its product-market-fit (PMF) in an ecosystem where time and resources are insufficient. Often, startups need to develop themselves at a fast pace because of the dynamic world of technology and market where users' needs and requirements change frequently. Time is the only money for early-stage startups. To cater to this situation, startups are required to strictly follow the most powerful product development strategies such as market analysis, lean startup, Agile, and utilizing the latest trends in technology. [11] Due to their constraints and needs, startups are the most interesting subject for research and study. And this is the reason behind the Author's motivation for executing this research. The backdrop of the thesis comes from the Author's curiosity to conduct action research on an early-stage startup and conclude the best methodologies involved in creating an MVP with React Native and reduce the pitfalls of the development process in a startup ecosystem.

Choosing a technology or framework to build MVP again leaves a difficult question for a startup. There are two platforms 'Hybrid' and 'Native' for developing mobile applications which will be discussed in the thesis section 4. 'React Native' is gaining popularity among startups for developing MVP due to its ability to fix the challenges or pitfalls faced by early-stage startups for example financial constraints.

1.2 Research Questions

To address the objectives of the thesis, there are many key research questions have been raised to guide the investigation:

- How does an MVP impact the startup's success?
- How does the use of React Native contribute to the effectiveness or efficiency of developing an MVP in a startup?
- How can challenges be overcome using the best practices during the development of MVP with React Native?

1.3 Structure

The thesis targets proposing the best practice framework for developing an MVP using React Native in a startup environment. The thesis sets an introduction covering the purpose, background, structure, and limitations of the research. Following the introduction, a section literature review traverses through the previous research and findings relevant to developing MVP, React Native, and the best methods or practices used for developing MVP with React Native in the context of a startup ecosystem. Following this section, the next summarizes the section includes startups and their challenges. Moving forward the next section covers the Minimum Viable Product (MVP), its process of development, and benefits for a startup. The next section explores the most popular technology 'React Native' involved in the development of MVP when it comes to the startup ecosystem and its benefits. This section also includes the successful MVP example with React Native. Moving onto the next section includes the research methods used during the research.

The main part of the thesis delves into navigating the best practices of React Native in the development of MVP, covering key points such as, project management using the agile approach, implementing functional components, and user experience design, encouraged by the relevant facts based on the startup environment.

The efficiency of the best practices is evaluated, and results are optimized and gathered. Based on the key findings and results from the research, a development framework 'BPFMRN' for React Native MVP is developed, and it can be used for further research.

1.4 Limitations

This research is restricting itself to the startup business. It does not provide any recommendations and guidelines to the established businesses. The research does not consider the scenario when a business has no constraints on resources and timelines for launching a product in the market. This research does not expand itself to the end-to-end development of an application/product, but it limits the adoption of best methods and practices during the process of developing an MVP using React Native for an early-stage startup.

The thesis does not cover the application features in detail but here the main goal of this research is to find the industrial best practices for developing an MVP for 'Startup A' with React-Native technology.

There are various platforms in the market for developing mobile applications which are discussed in the thesis shortly. The focus is not on prioritizing a particular technology or framework for developing MVP, but the author's perspective is considering the stack that is utilized in the current startup (React Native), and the rationale for opting for the stack is covered in section 4 of the document.

2. Research Methods and Process

During this research, various academic literature relevant to Startups, and their processes, publications related to startup success and failures, articles, and books on MVP or lean startup methodology have been explored by the Author. The author is using *action research* as a research method for this research work. The reason behind choosing the action research is that the author is directly involved in developing MVP for 'Startup A'. Action research gives a better evaluation by conducting research with actions in a company or organization where improvisation in practices is required providing better solutions for a valid problem. Action research is based on reflecting on the actions involved in the research. Reflection includes the direct experiences the author or researcher gained during the development process. [15] In this research, the focus is limited to the 'Startup A' best practices. Hence, action research is found the most effective and efficient method to execute the research. The research process is accomplished with the cycles involved in action research. Every cycle of the research consists of planning, action, results, and reflection or learning from the actions to create an improvised practice for 'Startup A'. [15]

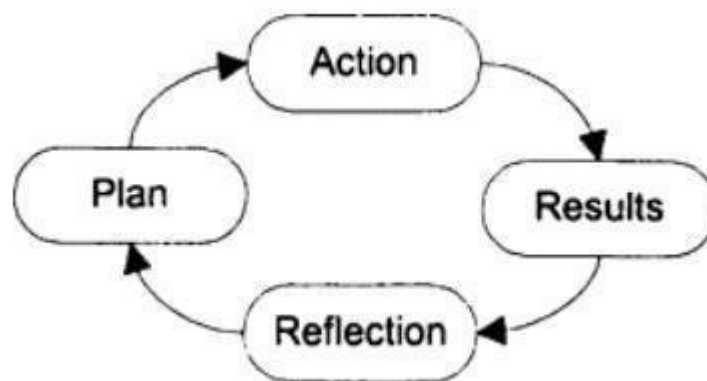


Figure 1 depicts the Action Research Cycle [15]

The research is driven by the facts and experiences of the team members of the startup. Discussions happened at every turn with the team members of 'Startup A'. The team members involve the Technical Lead, Designer, and Developer trainees. In the whole process of the research, the author iteratively hunched the research questions.[13]

3. Literature Review

This section explores the previous research related to startups, their development phases, product development in terms of MVP, and best practices or techniques involved successful execution of a startup. Startups are bringing disruptive innovation to the society. Going further, it is better to understand the definition of a startup. While traversing through several research papers and publications Author found the one and most accurate definition of the startup by Eric Ries. According to Ries, '*startup is a human constitution designed to create a new product or service under conditions of extreme uncertainty*'. [21, p.37]

Startups always struggle for their survival, especially in their early phase, and consist of a frequently changing and chaotic ecosystem. Applying efficient practices startups can increase their presence duration in the market and can cater to adverse conditions wisely. [20] These adverse conditions include time and resources, and it is more explained in section 4 of the thesis document. When developing a new product or service a startup steps through different stages such as

Discovery, Validation, Efficiency, Scale, Sustain, Conservation [20, p.4]

According to one survey, over 309 million startups are registered every year globally and many of them are not sustained in the market. 9 out of 10 startups fail in the first three phases of their journey.[23] The author explored past research and present market trends concerning the failures of startups and found the '*Lean Startup*' method impactful. The Lean Startup method provides Startups with better and faster ways to deal with the progress of developing a product using 'trial and error'. The concept originated in the 2000s and came up as a methodology in 2010. The theoretical aspects of this methodology are covered in section 5 (5.1) of the thesis. Parallel, fostering the practical implications of 'The Lean Startup' can be identified while building MVP for 'Startup A'. MVP is the core principle of the Lean Startup. MVP means

minimum viable product. In simpler terms, MVP is the sample of the product with minimum features for early customers.[22]

In the context of 'Startup A', the Author's primary vision is to explore and discover the past research or documentation related to the building of MVP in the field of mobile application development. The Author first collected data and stats related to the mobile application and their development platforms. Later, literature relevant to the technical stack for building MVP is being explored. The stats covered in this section are the results of searching about the possibilities of mobile app business globally and locally.

As per the report by LambdaTest, globally the mobile application business is booming and at its peak. We all rely on mobile applications in daily life in many ways. According to the Statista Digital Market Outlook, revenue across most segments of the mobile app industry is projected to reach approximately 613 billion U.S. dollars by 2025. In the third quarter of 2022, 3.55 million apps were available in the Google Play Store, making it the biggest available app. Also, The Apple Store, with 1.64 million iOS apps, makes it the second largest app store.[5]. According to Statista, in Finland, the total revenue from the application business is projected to reach 8.66% (2022- 2027) which results in a market volume of €672.80 million in 2027. [24]

The biggest challenge in mobile application development is the presence of various development platforms such as iOS by Apple, Android by Google, WindowsPhone by Microsoft, and others. The Author found the major players in the mobile market such as iOS, and Android. It becomes a tricky question for the startup while developing a mobile app for big platforms (iOS and Android) and the task involves a high budget and expertise relevant to each platform.[25] One reason is that each platform requires its own SDK, programming language, guidelines, recommendations, and code review process. Every business wants to expand and cover its application on at least the biggest platforms of the market. One reason is to cater to most of the people in the world as most of them are using either Android or Apple phones.

To cater to both platforms, it is important to deploy the app on both platforms. There are different technologies to launch mobile applications for both iOS and Android. Here, a brief overview comes from the academic literature and the blog posts belong to the technical experts. [25, 26]

Native Apps, dedicated to the specific platform. Either can make an iOS app, or Android app separately, but native apps do not cater both at the same time. Nowadays companies prefer *Kotlin* and *Java* technologies for Android mobile application development. *Objective C* and *Swift* are used for developing iOS mobile applications. [26]

Cross-Platform Apps, where one app can work dually or can work for both the platforms, iOS and Android. This is an interesting approach to cut the cost of development and reduce time and money. *React Native (Facebook)*, *Flutter (Google)*, *Ionic*, and *Xamarin (Microsoft)* technologies are for developing hybrid mobile apps.

[26]

For an early-stage startup, opting for technology for its mobile application MVP becomes critical where costs and time are the bigger constraints and should be reduced. Cross-platform technologies are among the best choice for startups. The most trending technology 'React Native' is tremendously changing the vision of startups, and small businesses regarding their mobile development strategies. [25] In the market, there are examples of many established companies that started as a startup and used React Native for their MVP development in their early phase. The examples include bigger names, such as

Instagram, Myntra, Airbnb, and Discord. [26]

4. Startup and 'the pain'

This section reminds one proverb 'No gain without pain'. And it is so true in the context of startup success. Often, startups face many challenges in their early phases. This section is covering briefly the most common challenges in front of the growth of the startup. Very few of the startups grow beyond all these difficulties and the rest give up and fail in their journey. Creating a new product requires strong finances, time management, and skills. The most challenging situation is raising funds or capital which is crucial to have to operate a startup successfully. Another difficult aspect is the lack of proper time management which results in delays in launching the product in the market. In this situation, it gets tricky to cater to the market trends and competition. [16] The other pain point is hiring skilled or expert team members as established businesses attract employees with good salaries and job perks. In this scenario, it gets challenging the retention of the team members, and this leads to frequent changes in the team and skills also. [16]

Communication with different stakeholders can also become a challenge in the early phases of a startup. Communication plays a critical role in the success or failure of a startup. Big companies are mature enough in their communication policies and good enough for sustainable development. This is the opposite in the case of the startup ecosystem because its arena is immature and young. Many startups in their early phases are not so famous in the market due to the lack of stakeholder engagement and weak marketing agendas and this results in decreasing their survival. The one reason behind this situation is the lack of communication. Before going into this, let's understand in brief about the stakeholders. *Stakeholders* are the ones who are directly involved in any company or organization and actively contribute to the growth or well-being of the company. Stakeholders in a startup can involve founders, investors, customers, employees/team members, and partners. [19]

Stakeholders' engagement or communication can be a great influencer for making the product strong and popular. This is the hidden key factor to

increasing their survival rate in the market. [20] We are not discussing elaboratively about this factor in the thesis. Moreover, a big picture is required to proceed with the research further.

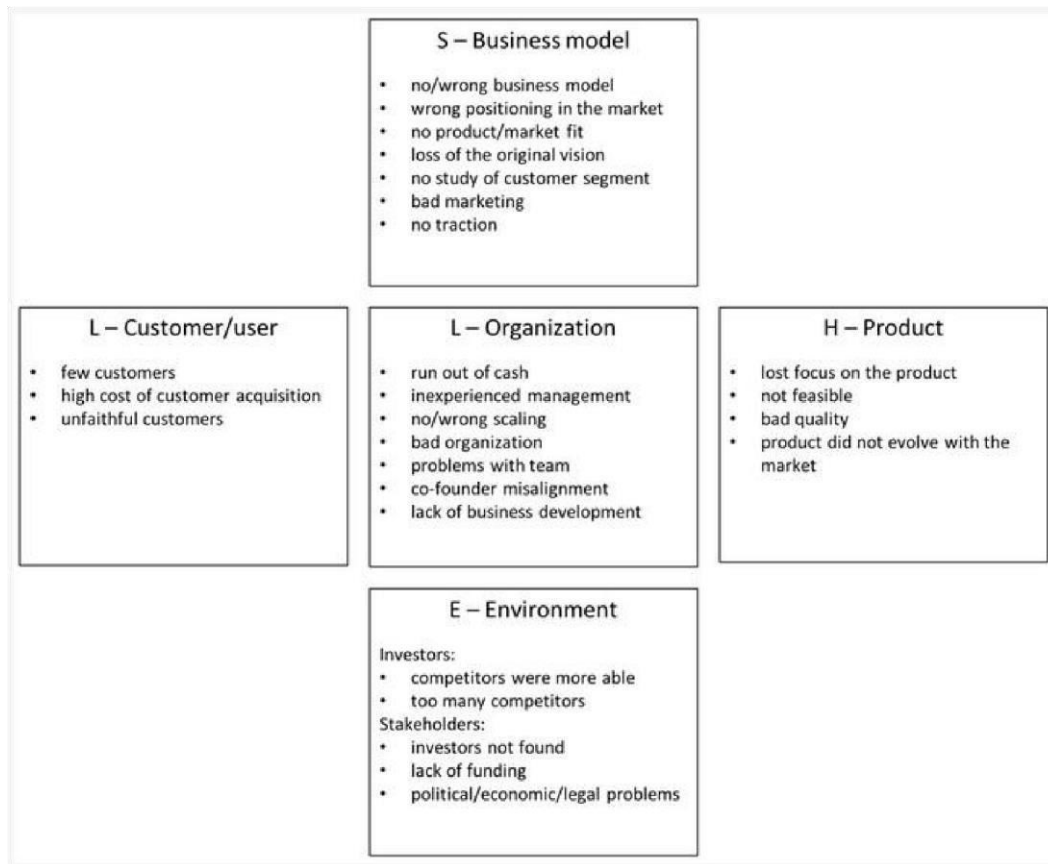


Figure 1 depicts the SHELL model showing Startup failure [18, p.5]

There is no single detriment causing the pain for the startup. There includes more such as having a weak business plan, lack of market research, no funds or investments, poor team coordination, and so on. [18, pp. 5-6]

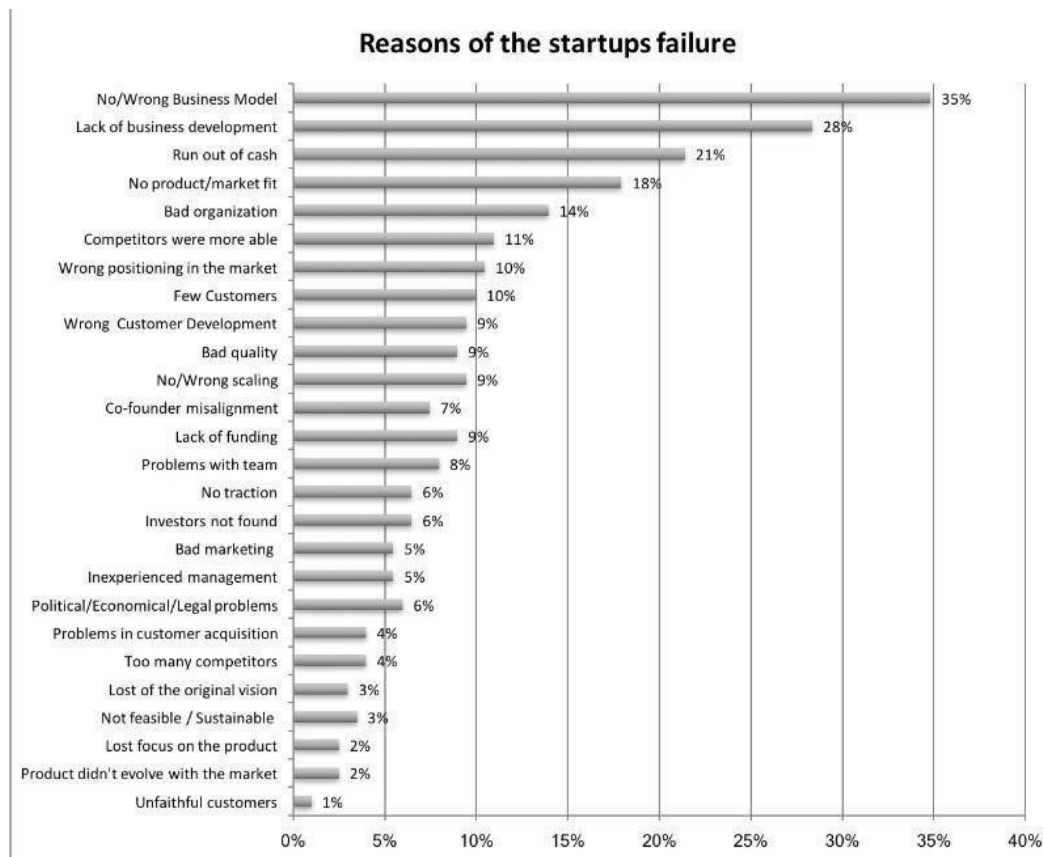


Figure 2 depicts the contribution % of individual factors of startups [18, p.10]

These factors can lead to major pain points for a startup. They may vary from one startup to another. It is important to optimize these pain points beforehand so that measures can also be taken effectively.

The author observed the synonymous situation in 'Startup A' where growth constraints are visible in funding, time management, and communications among teams and stakeholders. With the help of this research, the Author can identify the loopholes in the 'Startup A' process and development. This research explores the key pains of this startup in further sections and the lessons learned (8, 9).

'Don't lose hope'!

As startups follow the experimentation approach, and they follow 'learn by doing'. We cannot deny the fact that learning comes from failures.

According to David Mac Dougall (2023), sometimes it is okay to fail. Failure is important for success (Elon Musk). It is important to take a lesson learned from the mistakes and failures to avoid the repetition of the blunders.

5. Minimum Viable Product

Launching a new product in the market involves a big hassle for the startup company because it involves strong planning and validation of ideas. To ignore this hassle, startups are following the MVP approach to check their planning and validate their idea. The term 'MVP' was coined by Frank Robinson in 2001 and then introduced by Eric Ries in his book 'Lean Startup' (2011). Eric Ries defined the MVP as

'The version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort.' [10]

In simple words, MVP is a slimmed-down version of a mobile application. Building a mobile app from the ground can be terrifying for an early-stage team but starting with an MVP can become a milestone for the startup's success.

MVP is the pillar for developing a quality product. There are many factors behind the success of the biggest tech industries such as Google, Apple, and Netflix but the one common factor is adopting the MVP concept. MVP provides resilience to a product which is a significant character to hold the future growth of a startup in the frequent changes of the market.

The fundamental principle of MVP is *'learn, adapt, and iterate'*. Hence, it provides continuous improvement of the product, customer knowledge satisfaction, and simplicity. Nowadays in the market, some alternative terms are trending for MVP

such as Minimum Lovable Product, Minimum Testable Product, or Minimum Usable Product.

MVP constitutes a value proposition as its core feature, which not only consists of the features, but it must have a usable and reliable user-centric design to interact with users. The usability of MVP leads to the retention of users, and it gives feedback about the MVP adoption. Reliability is the consistency of the

MVP, and it evaluates the stability of the features of the MVP such as check of errors, or interruptions are not there. [9, 27]

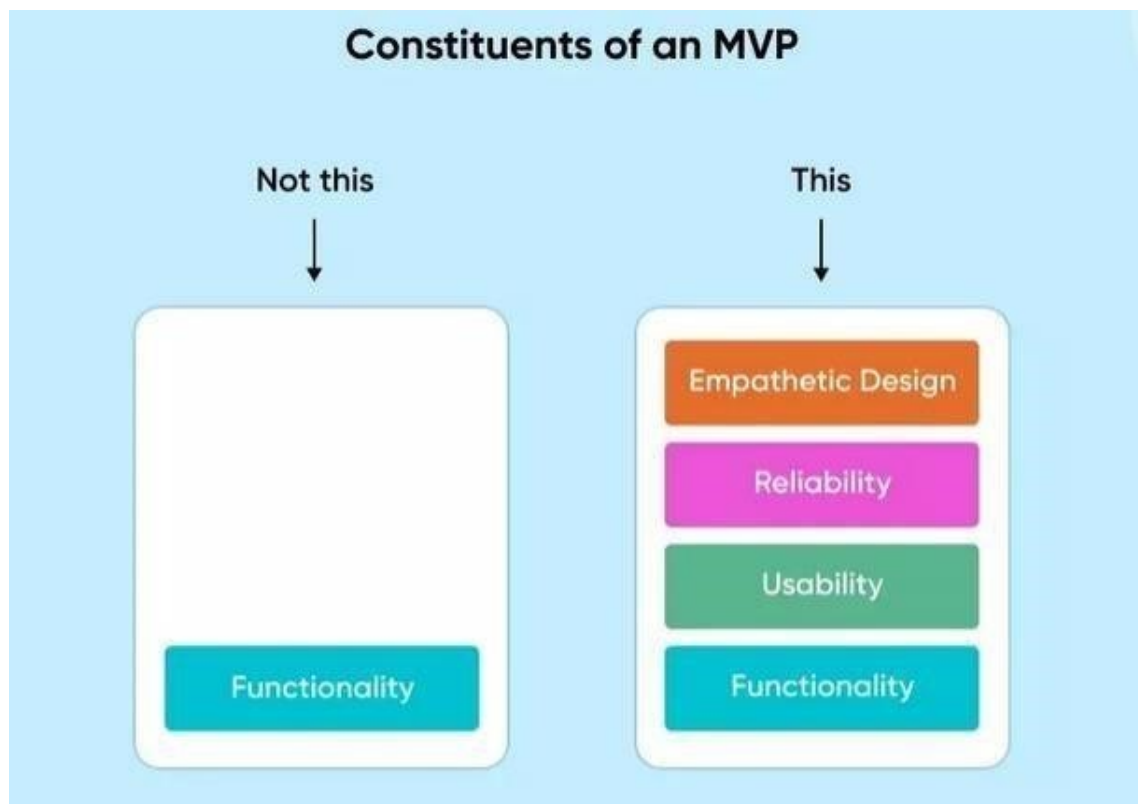


Figure 4 depicts the building constituents of an MVP [9]

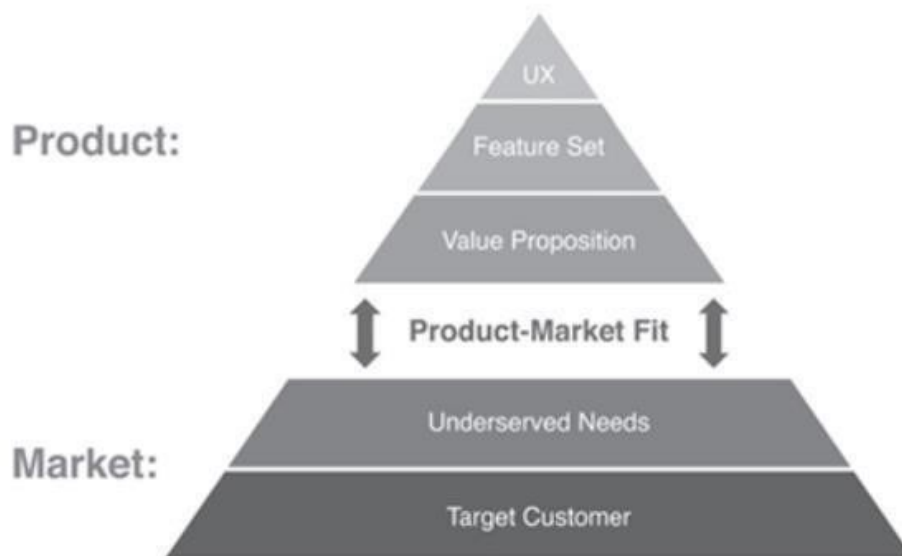


Figure 3 shows the Product-Market Fit Pyramid [27, Chapter 1]

MVP consisting of the value proposition leads to the product-market-fit in an early phase of the product. The product-market fit pyramid calculates how the product is suitable for the market. In simple words, how the product fulfills the customers' expectations. [27]

'Startup A' is in the early phase of its MVP development where iterations are completed in the first version of MVP which is tested on early users. After evaluating the results, a new user interface is designed by the UI/UX designer. Minimum features implemented with better interface and usability. The MVP is in the testing phase and the team is working on a reliable solution for the MVP. [27]

5.1 Lean Startup

This subsection provides a brief overview of the lean methodology. Adopting the 'lean startup' methodology has impacted startup development in a great way. The Lean Startup was first drawn by Eric Ries in September 2011. [21] The lean startup method emphasizes the experimentation approach. The process involves continuous user/customer feedback and an iterative way of implementing a design. The Lean Startup process consists of two major

process that creates a feedback loop which is an essential part of building a product suitable for the market needs. [13, 17]

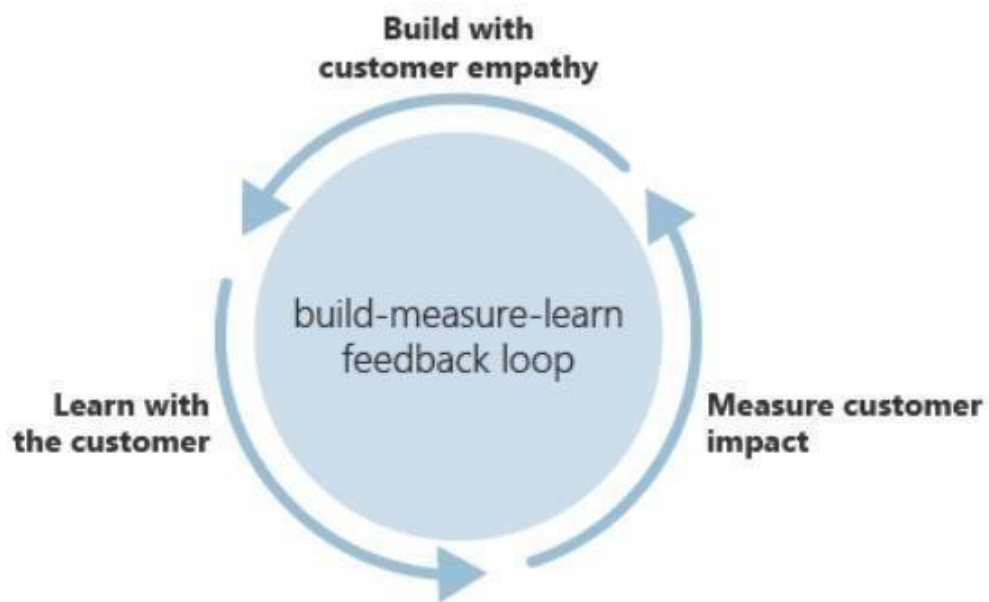


Figure 6 shows the Feedback Loop in the Lean Startup Process [4]

5.2 Steps involved in building MVP

MVP comes into the key role when a new business or product idea needs to be released in the market. This subsection includes a generic process of building MVP.

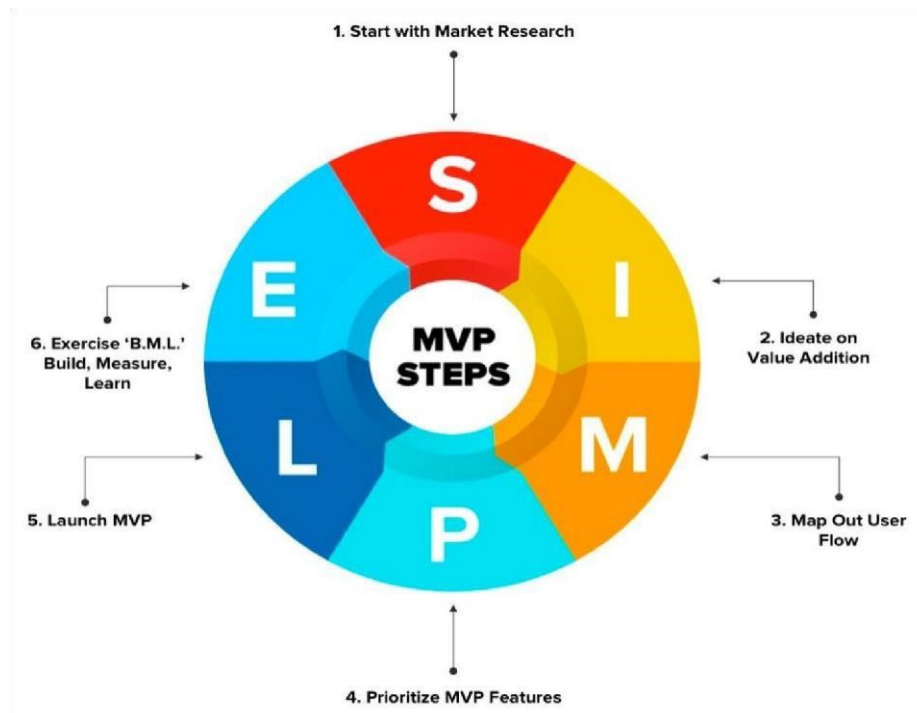


Figure 7 depicts the steps involved in building MVP [9]

Identify the Core Problem: Clearly define the problem of product aims to solve. It is the first step to understand the target audience and their pain points to address them effectively.

Define MVP Goals and Scope: Set clear goals for MVP. Focus on the minimum and mandatory features that directly address the core problem.

Market Research: Conduct market research to understand existing solutions, competitors, and user preferences.

Build a Prototype: Develop a basic prototype. It should demonstrate the core functionalities and the user interface, allowing stakeholders to visualize the concept.

Prioritise and Develop core features: The core and essential features for the initial UI should be considered.

Build the Minimum Viable Product: Develop the MVP by implementing the prioritized features.

Test and Iterate: Release the MVP to a selected group of users or adopters. Gather feedback and iterate based on user responses.

Launch and Monitor: Collect data and metrics from user interactions with the MVP.

Analyze this data to understand user behavior and areas for improvement.

Refine and Enhance: Use the insights gained from user feedback and analytics to refine the MVP. Add new features iteratively while ensuring they align with user needs and preferences.

5.3 Benefits of MVP

In the changing world of technology, it is important to validate product ideas quickly and efficiently. MVP plays a significant role in this scenario. This subsection covers the key benefits of building MVP.

There are various examples of successful MVPs but here to understand the major purpose of MVP let's take an example of the *Instagram* journey. MVP played a significant role in the success of Instagram. According to Investopedia,

Kevin Systrom, one of the founders of Instagram failed while developing a photo-based travel application. He first developed the MVP for his idea/application and after testing the application with early users he found a failure in launching the application. This trial-and-error journey made him develop an application like *Instagram* which everyone is using nowadays. With this, we can conclude that developing MVP for a new application or product is the crucial step in a startup to gather early feedback or criticism from the customers. [7]

MVP is an analysis of the market in the early stage, and it is beneficial to provide insights about the product's capabilities (mobile application in this research) according to the latest trends. It is the fastest way to make sure the idea is worth pursuing or following with less budget and effort by developing minimum features.

6. React Native for MVP Development

Early Cofounders are not aware of their product's final version. They have assumptions that need to be verified on time to attract investors. They do not want to invest a high amount of budget on products' early prototypes or MVPs. To address the challenges of lack of budget and the threat of time pressure, startups are using cross-platform frameworks that are open-source in the market. [31] Cross-platform technologies such as React-Native and Flutter are the best choices for startups. In 'Startup A', leverages are taken from React Native technology to develop the MVP. This section covers, in brief, the cross platform mobile app development and React-Native framework with its benefits for developing MVP. This research does not deal with other cross-platform frameworks throughout the process; hence Flutter is not covered in this section.

[28]

6.1 Cross-Platform Mobile Application Development: 'React-Native'

In today's era of the mobile world, new trends are evolving daily for developing mobile apps. A cross-platform technology or framework is a new paradigm for developing mobile applications. Cross-platform frameworks are platform agnostic and there is no need to write code for various platforms independently. Cross-platform development shares the feasibility of developing a single application for multiple platforms. Hence, developers can save their time and effort by not developing separate applications for iOS and Android. Many startups are taking benefits from cross-platform development practice and React-Native technology for building their MVPs or early-stage product prototypes to validate their business idea in the market. [31] React-Native is an open-source framework first created by Facebook in 2015. Developers can build native apps for both Android and iOS using React which is a JavaScript library to develop user interfaces. Using React-Native developers can target a wide range of viewers of their application. [32]

6.2 Benefits of React Native (RN) for MVP

React Native is the first choice for building MVP in startups. There are many reasons to opt for RN for the development of MVP. This subsection covers the benefits of RN:

- **Faster Development:** The hot reloading feature of React-native allows developers to see the changes that occurred in the code. It does not require reloading the entire application again and makes the development process fast.

```
// App.js
import { AppRegistry } from 'react-native';
import App from './App';
import { name as appName } from './app.json';

if (module.hot) {
  module.hot.accept(() => {
    const NextApp = require('./App').default;
    AppRegistry.registerComponent(appName, () => NextApp);
  });
}

AppRegistry.registerComponent(appName, () => App);
```

Figure 8 shows the Code of a React Native application's Root File

The above code checks the availability of Hot Module Replacement (HMR). If HMR is enabled, developers can make changes in the code with a reflection of the changes in the application with the reloading of the app. [28] One other feature to makes RN the best choice for fast development is its platform agnostic tendency that does not require setting up the SDK's for various mobile platforms.

- **Low Development Cost:** According to reports, React Native can reduce cost by 30% as compared to native technologies. [34] The development

team does not need to hire developers from individual platform technologies. The presence of web development skills can be utilized to develop RN MVP. This can lead to a significant reduction in the development cost and maintenance for developing MVP.[28]

- **Flexibility:** RN provides flexibility to developers in terms of using prebuilt UI components that can be used as per the requirements. These components give users a great look and feel of the UI. [33]
- **Performance:** RN utilizes third-party libraries to make its performance better.[33]
- **Modular Approach:** It is easy to manage a project while following a modular approach. A modular approach means breaking down the UI components into pieces that give the reusability of the components. This approach makes application easier to maintain and scale as each component is concerned with a specific purpose. This leads to an organized and clear codebase where developers can easily collaborate on the project. [33]

7. Pitfalls in MVP Development in 'Startup A'

It is explained briefly in section 3 about the common challenges faced by the early-stage startup. This section covers the specific challenges in front of the 'Startup A' for MVP development. The thesis does not elaborate on each limitation or constraint in depth. But sharing a brief view of the major challenges the author explored in the startup. The author recommends based on this, better and more efficient practices for 'Startup A'. The major pitfalls in 'Startup A':

- *Financial Constraints*: The most crucial part of a startup is its funding and investments. The CEO of 'Startup A' mentioned the impacts of funding and money in developing MVP. Lack of finances can lead to a slow development process. The author found a similar situation in 'Startup A' where founders invested some capital amount to develop the MVP. They are in the phase of attracting investors and to do so they have less time to launch the product in the market.
- *Human Resources*: Without mankind's power efficient development can never happen unless the founder has great and relevant technical skills to build the product. Developing an efficient, stable, and skilled team also demands a strong budget. For an early-stage startup like 'Startup A', attracting technical experts from every area such as development, marketing, and operations is a challenge. 'Startup A' has a small team of five members that consists of the CEO, CTO, and two developer trainees. A UI/UX designer has joined the team and left in just four months. The point to conclude here is that every team member plays different roles in an early-stage startup.

- *Communications*: Communication or sharing thoughts is one of the crucial elements for an effective and fast development process. Often, it lacks in an early-stage and immature startup. Before joining the CTO, there was no proper communication among the team members as there was not an official technical lead to share feedback and opinions about the tasks and their progress. The CTO provided a more technically ground and solid way of development in 'Startup A', and it led the startup in the correct direction of development.

8. Results and Outcomes

The outcome of the research is obtained in the form of the best methodologies involved while developing MVP with RN. The author noted that initially a small team of different developer trainees was engaged in building MVP Version 1 without following Agile principles and a user-centric approach. Later in the testing phase of Version 1, the team found usability issues and problems in the design of the UI. To improve the design iteration approach was adopted by the team. The Designer built a UI prototype in Figma and after the Figma testing with users, the team further started developing the MVP Version 2 focussing on implementing new designs and add-on features of user engagement.

While developing MVP Version 2, the team is guided by the newly appointed CTO in the company. The presence of the CTO overcomes the constraints related to best practices and technical outcomes. During implementing the second version of MVP, the Author found that industrial best practices are the key principles to achieve an efficient and fast development process. Incorporating the appropriate tools and technologies can make development faster and it leads to reducing the conflicts in the team.

Keeping in mind these key principles by taking the time-to-time feedback and having discussions with the team members, the Author integrated the best practices in a framework called 'Best Practice Framework for MVP with React Native'(BPFMRN). BPFMRN consists of the following techniques:

8.1 Lean Development Principles

The most essential element of a successful MVP is the integration of Lean principles in the development process of MVP. The key principles include Build- Measure-Loop, decision-making with validated learning, and pivoting/persevering. These principles lead to the rapid testing of MVP and fast learning from the tests. This helps to reduce the budget, time, and effort of the

team to work on features that are not acquired by the early users. By following this lean approach, the team (Startup A) can save resources. [21]

8.2 Project Management

Nowadays making the development process smooth and fast companies are adopting Agile methodology in project management. Agile provides continuous improvement and collaboration from the cross-functional teams in the project. Due to the scarcity of time and money, startups use agile approaches to make a project environment flexible and efficient for product development. 'Agile' means the ability to change and adapt quickly. By adopting this approach, teams can easily adapt to the changes faster. As user's requirements change frequently, agile provides a systematic and scientific way of tuning the product according to the needs of the users. Agile reduces the conflicts among the team members and gives transparency throughout the project development. Agile is one essential feature of the best practice framework for 'Startup A'. Agile methodology carries variations in its implementations. During the research process, the Author found the 'Kanban' and 'Scrum' approaches are appropriate for developing MVP in 'Startup A'. Other options are also available but as per the current requirements of the team, the CTO recommended adopting 'Kanban' and 'Scrum'. The author briefly mentions the recommended variations in the agile approach, 'Kanban' and 'Scrum'.

'Kanban' is a visual presentation of the tasks assigned to the team members. Many Kanban tools are available in the market, for example, Jira, Trello, Linear, etc. [35] In 'Startup A', while developing MVP Version 1, Trello was used as project workflow. Later, while seeing Linear having more automation features team switched to Linear and it is more effective for the MVP version 2 development.

'Scrum' provides an efficient and fast method for small teams like 'Startup A'. In 'Startup A' the technical lead plays the role of scrum master who holds scrum meetings once a week and the teamwork in a one-week sprint. While

developing the best practice framework, the agile approach positively and effectively changed MVP development. [35]

8.3 Technical Implementation Using React Native

In an early-stage startup, to reduce the waste of time and effort, it is important to have documentation of a standardized way of working on the technical part of the project. In Startup A, RN is used to develop MVP versions. The author noted successful results in integrating the best industrial practices of React Native while coding for the project. The author decided to develop a document for 'Startup A' containing these practices systematically so the new onboarding developers of the team can also start contributing and collaboration can be more effective and comprehensive. Integrating RN best practices improves the coding issues encountered by the team. The key best practices involve the following elements:

8.3.1 TypeScript: It is a superset of JavaScript developed by Microsoft that uses type definitions. It eliminates the Prop Types validation and makes development smooth providing errors and bugs on time. Prop Types validation happens only in a run-time environment. If a component takes a prop of incorrect type, the app will have bugs and without giving the props their types, these bugs can be unsolved. Defining the props with TypeScript helps when dealing with the component.

```
interface MyComponentProps {  
  message: string;  
}
```

Figure 9 shows the Props Types of a Component

8.3.2 Design System: It is one of the best practices to use a consistent design system for MVP/app development. Design system means the predefined set of rules to decide the style, look, and feel of the application. The most common designs include-

- **Typography:** Using a consistent styling defined in the design assets is a good practice keeping the code DRY and quickly being able to style components. This will reduce the number of custom styles needed to write per component and will make the styles easily changeable if needed without having to go through each component.

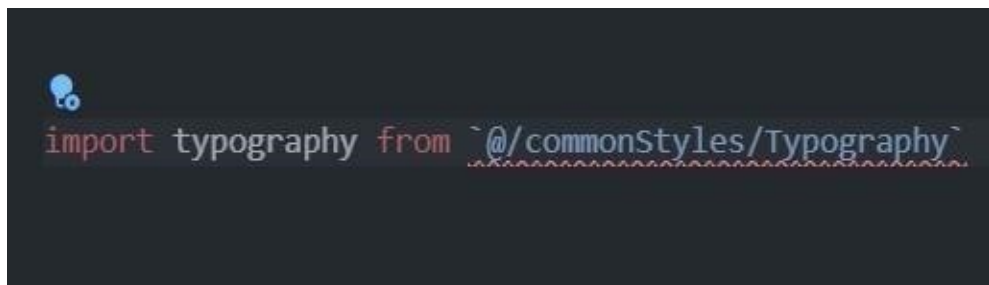


Figure 9 shows the Import of Typography

- **Spacing:** Spacing is the most used style in UI. Instead of having to write own custom magic numbers for padding and margin etc, the use of common styles is a good practice '@commonStyles/Spacing'.
- **Color:** Colors can also be defined as constants in @/Color.ts. Using constant colors instead of putting hex colors in the styles is better practice.

8.3.3 Use of Path alias: An alias always makes the imports simpler in the project consisting of many subfolders. It eliminates the issues of nested imports.

Path alias set up is '@'

With the `@` alias, you can reference components. For example, `import Button`

`from '@components/common/Button'` instead of `import Button from`

`'../../../../components/common/Button'` This also has the added benefit of

not having to change most of the references if your file location changes.

8.3.4 Reusable Components: Defining the common components used in the application is great practice to reduce the issues creating the same component again and again. For example, to use icons in the application, it is wise to create an icon component for each icon `<Icon name="AccountSelected" />`. Similar common styling components or hooks can also be defined for the application.

8.3.5 Unique Key for the Elements: It is good to use a unique key for a particular item to make the execution process fast. For example,

```
const todoItems = todos.map ((todo) =>

<li key={todo._id}>

{todo.text}

</li>

);
```

8.4 User-Centric Design

The biggest need for a business is the interest of customers or users in the product. Therefore, users' needs are the top priority for a company to serve the product as per user needs. The design of an application is dependent on the user experience (UX). In 'Startup A', the designer builds a basic prototype and after testing the prototype with users, the designer develops a user-centred

Figma design for the MVP. A user-centric design involves empathetic aspects of the design that attract users. It includes in-depth knowledge about user's thoughts, desires, and suggestions. The designer interacts with the users to gather their challenges, inspirations, and requirements. This leads to developing an MVP close to the user's needs. Every user belongs to a unique background in terms of needs and challenges, for this reason, a user-centric MVP design is a great practice.

8.5 Testing Methods

While developing MVP versions with React Native, the author found 'Test Driven Development (TDD)' an impactful strategy for understanding the requirements of each component in the MVP. In TDD, test cases are written before developing the functionalities in the MVP. During testing, various testing methodologies can be utilized for example, the Jest library is used to test the individual components of the MVP. In other words, it is called *Unit Testing*. To test the interaction among different components, integration testing is the best practice. By integrating this approach in MVP development, the team can deliver a quality product to the users efficiently.

9. Conclusions

This thesis explores the fine points of MVP development using RN in an early stage startup 'Startup A'. By gathering insights from a deep analysis of best industrial practices, action research on 'Startup A', discussions from the team members, and experiences taken from the hands-on over the project, many key learnings can be concluded.

It is an unnerving truth that many mobile applications fail to grow in the market. Statistics show that 80 –90% of mobile applications are deserted after first use. One of the reasons behind this not following and implementing the current industrial practices.[6] When it comes to an early-stage startup, it is becoming challenging to overcome the failure of mobile applications. To overcome this issue, startups are adopting the concept of 'MVP.' The significance of an MVP in a startup aura cannot be hyperbolized. By adopting the lean methodology for developing the product, startups can validate their product idea in an early phase, attract early users, and refine the product based on real feedback. RN stands out as an invaluable tool in developing MVP, providing a cost-efficient and expedient solution.

Moreover, the hurdles confronted by early-stage 'Startup A', including budget limitations, manpower limitations, and time constraints point to the necessity for specialized methodologies tailored to this unique ecosystem. Practices aimed at enhancing resource allocation, prioritization of crucial features, and fostering immediate iteration are imperative in navigating these challenges and optimizing the prospects of success.

Additionally, the incorporation of RN into MVP development unveils many benefits with some challenges. RN boasts advantages such as cross-platform compatibility, but startups encounter issues in technical aspects, performance concerns, and the environmental maturity to benefit from this technology efficiently.

Furthermore, the results drawn from this thesis reinforce the need for 'Startup A' to integrate a scientific and systematic method to develop MVP, anchored in best practices and rooted firmly in industrial standards. Through documenting valuable lessons, actively communicating with teams, sharing knowledge and opinions, and fostering the culture of adopting best methods and practices, like the 'Startup A' any startup can reduce the challenges and survive in the competitive market.

To sum up, the process of developing an MVP with React Native in a startup's early phase requires strategic foresight, a promise of continuous improvement, and a readiness for trial and error. By adhering to the best practices in the thesis, startups can enhance the quality of their product which can attract users, and investors, and engage stakeholders consistently.

In the end, the author appreciates the guidance and support received from the supervisor, Janne Salonen, and the 'Startup A' team members, providing direction and support while executing the thesis and ensuring cohesive progress. The learning from the research is invaluable for the Author's future perspectives and tomorrow's investigators interested in the startup ecosystem.

Thank you!

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