

UNIVERSITY OF GHANA

EXPLORING FACTORS THAT INFLUENCE MOBILE APPLICATION
DEVELOPMENT IN DEVELOPING COUNTRIES: EVIDENCE FROM
GHANA

BY

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DECLARATION

I do hereby declare that this work is the result of my own research and has not been presented by anyone for any academic award in this or any other university. All references used in this work have been fully acknowledged.

I therefore bear responsibility for any shortcomings.

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CERTIFICATION

I hereby certify that this thesis was supervised in accordance with procedures laid down by the University.

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DEDICATION



ACKNOWLEDGMENT

“One man may hit the mark, another blunder; but heed not these distinctions. Only from the alliance of the one, working with and through the other, are great things born.” – Antoine de Sainte-Exupery (1900 – 1944)

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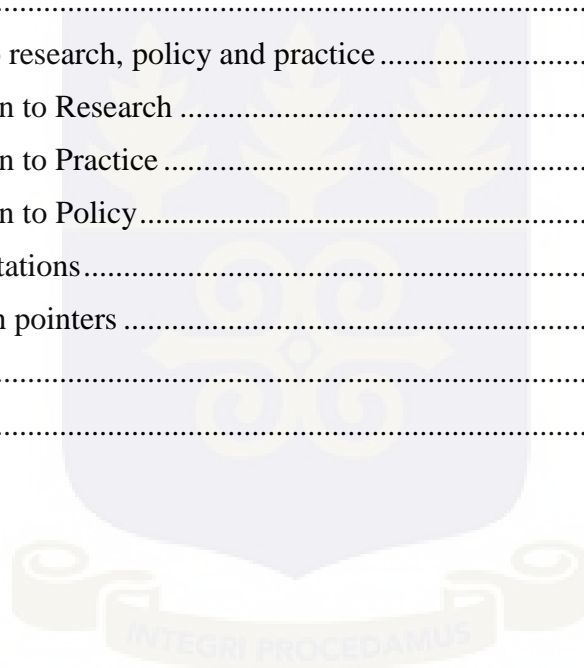
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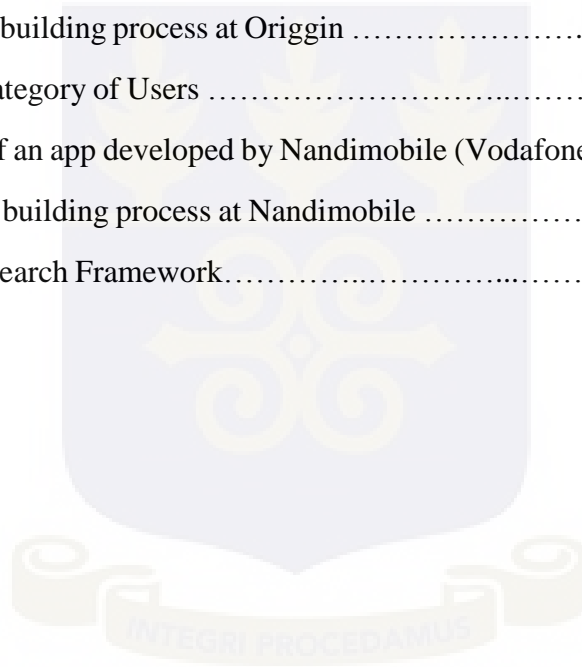


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ABBREVIATIONS

.apk	-	Android Application Package
.ipa	-	iPhone Applications
App	-	Application
SDK	-	Software Development Kit
API	-	Application Programming interface
MAD	-	Mobile Application Development
MADD	-	Mobile Application Development and Distribution
UI	-	User Interface
UX	-	User Experience
CTS	-	Compatibility Test Suite
OS	-	Operating System
iOS	-	iPhone Operating Systems
J2ME	-	Java 2 Platform Micro Edition
RIM	-	Research in Motion
MADLC	-	Mobile Application development Lifecycle
CEO	-	Chief Executive Officer
COO	-	Chief Operations Officer
CTO	-	Chief Technical Officer
BDM	-	Business Development Manager
IS	-	Information Systems

ABSTRACT

The purpose of this study is to explore factors that influence mobile application development among Ghanaian mobile application development (MAD) firms and to assess whether these factors pose as threats and/or opportunities to these firms. This research argues that in spite of the growth in popularity of portable devices in recent years, there is still lack of adequate research initiatives around mobile applications and its development processes.

This study therefore dwells on the tenets of critical realism and employs a qualitative methodological approach, to analyse the experiences of MAD firms in order to describe how they develop mobile applications amidst the constraints of their context. Further, in the quest to find answers to research questions raised, the study employed Miles and Huberman's transcendental realism data analysis approach to analyse a multiple case study conducted among two Ghanaian MAD firms (Origgin and Nandimobile Limited).

Eleven factors were identified through thorough mobile application development literature review; market trends, promoter and developer events, potential market demand, developer involvement, monetary rewards, intrinsic rewards and motivations, cross platform development and user convenience. However, fourteen factors including nine of the eleven aforementioned were realised after data collection, analysis and discussion. New factors that were found to be relevant constraints or enablers include smartphone adoption, data cost, competitive pressure, payment culture, native development and firm size thereby revealing ten propositions at the end of the study. For instance, as smartphone adoption by app users in Ghana continues to grow, this phenomenon interspersed with television commercials inciting people to *drop* basic/feature phones was found to be one of the motivations for application development among Ghanaian MAD firms. Secondly, Mobile application developing firms are skewed to develop free applications due to unavailability of trusted online payment infrastructures in Ghana. This factor from the discussion indicated that although the case firms

develop paid applications, they are developed on the basis of cash or cheque payments (contract applications) for organisations while individual consumption applications are therefore deployed as free applications with the plan of recouping financial gains through imbedded adverts.

This study fills gap of the paucity of research work done on mobile application development in Ghana and Africa as a whole. This study in relation to practice, opens wide the challenges and opportunities in the developer space for institutions aiming to branch into mobile applications development informing them of the complex interaction between technological, organisational and environmental factors. Considering that, the developer space in Ghana lacks regulation and governance, this research calls on government agencies to consider regulating the space for a fairer game specifically with respect to mobile internet cost.

The originality of this study lies in the researcher's adoption of the Technology, Organisation and Environment framework which has been widely used in quantitative terms to conduct a qualitative research and also within mobile application development.

It is recommended that future studies should consider the issue of cloud computing and mobile application development. Further, African higher educational institutions should consider incorporating mobile application development into their curricula since it is an emerging trend.

CHAPTER ONE

INTRODUCTION

1.1 Research Background

Mobile phones have evolved from basic or feature technology into a more sophisticated gadget. The number of consumers using mobile phones for purposes beyond personal communications is exploding worldwide (Taylor, Voelker & Pentina, 2011). This has therefore generated growing concern in the applications that run on these devices and an increased interest in their (applications) development in recent times. The migration from feature phones to smartphones can however largely be attributed to the fact that a number of trends co-exist in the global smartphone market but the steady decline in the average price has had a principal effect in driving the market growth of smartphones (International Data Corporation [IDC], 2013; infoDev, 2014). Relative to the International Data Corporation's report, smartphone shipment across the world in the fourth quarter of 2013 totalled 967,775.8, with 93 per cent of application developers globally targeting smartphones as of the first quarter of 2014 (Statista, 2014; Gartner, 2014). This gives a clear indication that globally, smartphone adoption is on the ascendancy.

Mobile applications are either pre-installed on mobile devices during manufacture, or downloaded by users from various mobile software distribution platforms (Hsieh & Hsieh, 2013). The applications are developed by either an organisation or an independent developer. They are then published on a portal for end-users to download. Some literature refer to the portal and the developing community as ecosystem; an interconnected system comprising `an orchestrator, mobile application developers, and mobile device owners, all of whom are connected through a marketplace platform (Hyrynsalmi, Seppänen & Suominen, 2013).

The development of mobile applications has generated more interest among the independent and freelance developer communities (Holzer & Ondrus, 2011). They are downloadable to specific platforms dependent on the type of mobile and its operating system (OS) one owns. With the recent emergence of Apple Applications Store, Google Play (previously known as Android Marketplace), Nokia Ovi Store, Windows Phone Marketplace and Amazon App Store open up a huge possibility for designers and developers alike (Wong, Khong & Chu, 2012). While the majority of these platforms remain active and in competition, others are quite sporadic to come about. For example, industry statistics as of July 2014 has it that Google Play (formerly Android Market) is leading the number of applications with a total of 1,300,000 followed by Apple Applications Store with 1,200,000, Windows Phone Store; 255,000, Amazon App Store, 244,000 and BlackBerry World 130,000 (Statista, 2014).

Recently in Africa, due to the lack of infrastructure in the field of health, education, agriculture, and banking and with a population of a little over one billion, the continent is gradually touting mobile application as one of the solutions (Apps World, 2011). For example, iCow is an SMS and voice-based mobile phone application for small-scale dairy farmers in Kenya. The app prompts farmers on vital days of cows gestation period; helps farmers find the nearest vet and artificial insemination (AI) providers; collects and stores farmer milk and breeding records and sends farmers best dairy practices (Forbes, 2011). In view of this, some institutions have begun setting up incubators that seek to train individuals in mobile application development. Comparatively, there are others that organize competitions for innovative ideas in mobile application development to help solve societal problems (Milam & Avery, 2012; Biztech Africa, 2013; Meltwater Entrepreneurial School of Technology [MEST], 2014). Further, there are also application

development competitions in most African countries with the same aim of harnessing potentials in app developers and also to promote local contents. For example, Jobonology Mobile App Challenge in Malawi, 9japplications Microsoft App Challenge and WITIN Opens Mobile Applications Challenge for Girls in Nigeria and in South Africa, MTN SA Foundation Community App Challenge.

The phenomenon of instituting incubators to train app developers is not too different in the case of Ghana as MEST is well established and has trained an appreciable number of mobile application developers. Likewise, there have also been a number of app development competitions to encourage mobile application developers to come out of their shells to develop problem solving applications. Such is the “MTN App Challenge” launched in 2011 in Ghana as well as Vodafone Applicationstar also launched in 2014 (Myjoyonline, 2014; Government of Ghana, 2013).

Considering the relative acceleration in ICT development and the rise in mobile telephony market in Ghana, mobile application development has a potential in helping towards achieving the urge to use information technology as a tool towards national development. For Instance, GSMA (2014) reports that Sub-Saharan Africa (SSA) has been the fastest growing region over the last five years, in terms of both unique subscribers and connections. By June 2014, there were 329 million unique subscribers, equivalent to a penetration rate of 38 per cent. With respect to Ghana therefore, mobile data penetration in March 2015 was 59.78 per cent (National Communciations Authority , 2015). This is indicative that, mobile users in the percentage bracket have transcended beyond basic or feature phones and require something more sophisticated. It has therefore become necessary to study the factors thus the facilitators and inhibitors that influence developers in this subject.

1.2 Research Problem

There has been some attention on MAD in information systems literature in developed countries. Themes discussed in the subject include but not limited to mobile application ecosystem and crowdsourcing (Hyrnsalmi, Seppänen & Suominen, 2013; Koch & Kerschbaum, 2014; Bergvall-Kåreborn & Howcroft, 2013; Hsieh & Hsieh, 2013), framework for development and usage (Yang, 2012; Wu, 2013), the developers perspective of the mobile application market and the challenges (Holzer & Ondrus, 2011; Joorabchi, Mesbah & Kruchten, 2013; Magrath & McCormick, 2013), the mobile gaming market (Kervenoael, Palmer & Hallsworth, 2013; Shih, Lin, Cheng, Chen & Chiu, 2012;) as well as mobile application adoption (Taylor, Voelker & Pentina, 2011; Liu, Zhu, Holroyd & Seng, 2011; Campbell, Altenhofen, Bellar & Cho, 2014).

Even though research conducted on mobile application development is substantial, extensive evaluation designate the need to come to terms with the challenges developers face as well as how they are able to address these challenges (Bergvall-Kåreborn & Howcroft, 2013; Holzer & Ondrus, 2011). It is also worth noting that intellectual works that have attempted to find answers to this phenomenon, take a more technical angle thus tackling the issue from the technically detailed development point of view. For example Joorabchi *et al.* (2013) in their study to gain an understanding of the main challenges developers face in practice when they build applications for different mobile devices highlighted that having to deal with multiple mobile platforms is one of the most challenging aspects of mobile development. They also identified that unit testing is not common within the mobile community and current testing frameworks do not provide the same level of support for different platforms. Further, Wasserman (2010) in his research studied software engineering issues for mobile application development, also indicated that, user

experience, non-functional requirements, processes, tools and Architecture are prevailing issues to address. The author finally explained that it's quite expensive to support multiple platforms, especially when there are multiple versions and variants of an app. However, though these studies were relevant, the researchers took into perspective more of the internal technological factors that developers face without taking into consideration the external socio-economic influences. There is therefore the need for a study that delves into factors that enable or constrain developers and firms. A research which will not favour one arena, but rather consider both technological and socio-economic dynamics.

Preliminary literature reviewed for this study indicated that only few considerations have been given in relation to conducting research on mobile application development in developing contexts like Africa. This includes a case study by Milam and Avery (2012) on mobile application development competition in Eastern African countries. In their study the authors indicated that Joshua Goldstein and Jon Gosier who were both workers at App4Africa while working in East Africa recognized that, mobile applications which were used primarily for entertainment and convenience in the United States and other industrialized nations, could serve a different, more socially conscious purpose in other parts of the world. Therefore, through partnership and support from donor agencies including the United States Department of States instituted the "Applications4Africa Contest". The contest invited East African citizens to share ideas about how technology can improve their lives, it also challenged technologists in the region to create applications to meet those needs. Another study on mobile phones in Africa was Boateng (2011) in which the author sought to investigate the impact of mobile phones on the micro-trading activities of traders in Ghana. In his conclusion, the author posited that regarding micro-trading,

traders use mobile phones primarily during-trade activities which include monitoring goods and pricing strategies, scheduling deliveries and addressing inquiries and complaints. Some traders, though few in number, innovatively used them to calculate purchases and send text messages to customers and trading partners. The author further made a recommendation that his work was not in any way exhaustive and that, findings and lessons in the study were stepping stones towards the mobiles for development movement, which is rapidly expanding.

Finally, another study with particular interest to Africa and mobile application development was Amanquah and Mzyece (2012) who researched into mobile application research and development in Africa. The authors in their study identified that for many in Africa, the mobile phone is their first and often primary means of connectivity. For this reason, the phenomenon presents significant opportunities for mobile application developers and researchers. However, this potential is obstructed by various factors such as language, literacy and the lack of trusted online payment support systems in Africa. The research further revealed that the African context presents numerous mobile application-related problems that are suitable for academic research.

With the exception of the three studies highlighted above, the rest of the literature reviewed pointed to the fact that mobile application development literature is far more advanced in developed countries than developing countries. This research will therefore attempt to fill this gap by exploring mobile application development among Ghanaian developing firms.

1.3 Research Purpose

The purpose of this study is to explore factors that influence mobile application development among Ghanaian MAD firms and to assess whether these factors pose as threats and/or opportunities to the firms.

1.4 Research Objectives

The following are the outlined objectives geared towards achieving the purpose for this study:

1. To evaluate the factors that enable or constrain mobile application development among Ghanaian MAD firms.
2. To examine how Ghanaian MAD firms address or take advantage of the opportunities posed by these factors.

1.5 Research Questions

1. What factors enable or constrain mobile application development among Ghanaian MAD firms?
2. How do Ghanaian MAD firms address these challenges or take advantage of the opportunities posed by these factors?

1.6 Significance of the study

The significance of the study can be viewed along three aspects: research, practice and policy.

It will be significant to research in the sense that, it will add up to the existing knowledge bank of mobile application development. It will also serve as reference base for students and researchers in the field of MAD.

In relation to practice, this research will open-up the opportunities and/or challenges that MAD firms face and as well offer guidelines of how their contemporaries take advantage of the opportunities while addressing their challenges.

To policy, this research can be beneficial to government agencies responsible for science and technology, for example the Ministry of Environment Science and Technology (MEST), giving them a practical view of the challenges mobile application developers are encountering and how best they can leverage them. Especially with the nationwide crusade on the national Science, Technology and Innovation (STI) Development Programme (STIPED I) nearing its end. The STI initiative seeks to build a strong capacity to support the social and economic development needs of a middle-income country (Ministry of Environment, Science and Technology, 2011).

1.7 Chapter Outline

Chapter One is the introduction of the research. In this chapter, the background of the research, research problem, and research purpose, objectives of the study, research questions and the organisation of the research were discussed.

Chapter Two presents a review of relevant literature on MAD as well as developing the research framework of the study by way of finding factors that influence mobile application development.

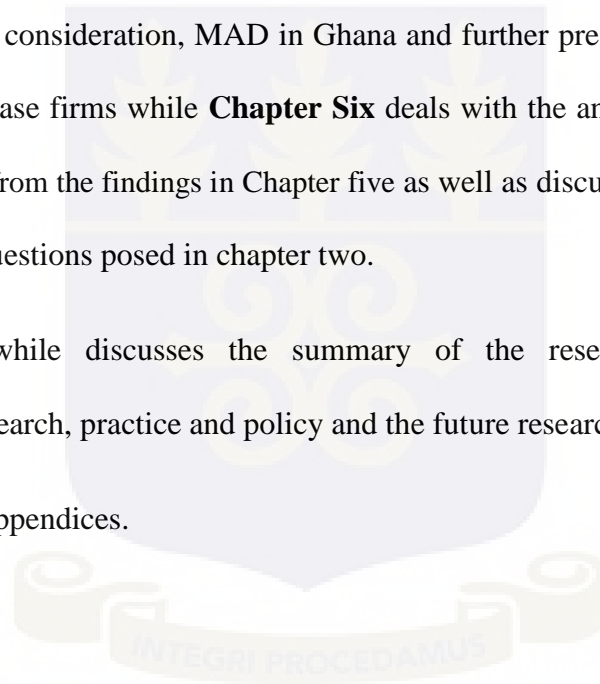
The theoretical foundation of this study is discussed in **Chapter Three** with the justification for the choice of using the Technology-Organisation-Environment Framework to conduct the research. The chapter also highlights instances where the framework has been used in IS research as a backbone for its selection.

Chapter Four discusses the research methodological approach which highlights the research strategy, paradigm and research design. The instrument for data collection and method used as well as data processing and analysis are expounded in the chapter.

Chapter Five takes into consideration, MAD in Ghana and further presents the finding of cases narrowing down to the case firms while **Chapter Six** deals with the analysis in order to exhume dominant themes arising from the findings in Chapter five as well as discussion of findings in order to answer the research questions posed in chapter two.

Chapter Seven meanwhile discusses the summary of the research, implications (and recommendations) to research, practice and policy and the future research directions.

Finally, references and appendices.



CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter seeks to undertake a review of literary works on MAD and to develop a conceptual model for assessing MAD readiness in a developing country. The chapter opens by taking an in-depth look into mobile application development; an overview, the actors and the categories. It then delves into reviewing past literature on MAD from 2008 to 2015 to expose the researcher to current research gaps for future research with special emphasis on the underpinning theories and frameworks for each research, methodologies and geographical locations the researches were conducted. Gaps for future research and summary then conclude the chapter.

2.2 Mobile Application Development: An Overview

Over the past decade, mobile phones, smartphones and tablets have managed their ways out as essential products in human lives (Wu, 2013; Humayoun, Hess & Ebert, 2014; Hsieh & Hsieh, 2013; Monarch Media, 2012; Zhu, Xiong, Ge & Chen, 2014). The mobile phone especially has developed from the ordinary call, response, send and receiving text messages to a multifunctional device that not only communicates but helps to learn and earn, called the smartphone (Godwin-Jones, 2011).

Even though MAD have enjoyed its fair share of literature in recent times, there has arguably not been a clear cut definition of the subject as most researchers on the theme in one way or the other relate it to desktop application development (Wasserman, 2010). This can be attributed to the fact that MAD has its roots in software development. However, they are written purposely to take

advantage of the unique features a particular device offers (Rouse, 2011). This research will therefore adopt the following definitions for mobile applications as they are deemed best related:

“Mobile applications are software packages that run on a feature and/or smartphone with an associated operating system (OS), such as Android, iOS, and so forth” (infoDev, 2014 p. 3).

“Mobile applications (applications) are software developed for use on mobile devices and made available through app stores” (Lim *et al.*, 2015 p.1).

Every mobile phone and for that matter smartphone is ran by an application. These applications are either native, web or hybrid. It can however be argued that, mobile applications are as old as the development of mobile phones themselves as there were algorithms that supported the full functioning of the phones.

Historically, Symbian was the first modern OS that was launched by Ericsson, but later on many competitors started emerging, namely BlackBerry, iOS and Android (Pandey & Nakra, 2014).

BlackBerry’s OS takeover started as a simple two-way pager (Hall & Anderson, 2009). The device then became an indispensable accessory of business executives, heads of state, and Hollywood celebrities (Gillette, Brady & Winter, 2013) due to its ability to send and receive email which solved some very important problems at the time.

However, Apple changed the face of mobile computing in 2007 when it introduced the first version of its iPhone series (Gurtner, Reinhardt & Soyez, 2014) which run on operating systems optimized for mobile devices (Koch & Kerschbaum, 2014). In 2008, Apple sought to bring developers on board hence releasing its software development kit (SDK) together with its App Store which will enable developers to create applications, initially for iPhone (Bergvall-Kåreborn & Howcroft, 2013) and upload them on Apple's portal for downloads. By 2011, over 70 million iPhones had been sold, and the seamless integration of the iPhone with the iTunes Music Store and Apple App Store had strengthened the iPhone's popularity, with over 15 billion songs and 14 billion applications downloaded as of June, 2011 (Na, 2011).

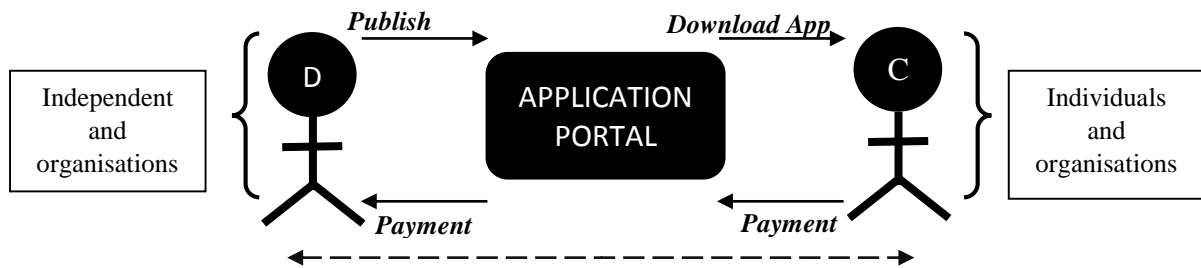
Android's entry into the mobile applications arena further transformed the mobile landscape and the way people see mobile applications. Android is based on an open-source license, and is designed explicitly to compete with the other mobile platforms developed by Microsoft, Apple, Nokia, Palm, Research in Motion, and Symbian operating systems for mobiles (Goggin, 2009). Pandey and Nakra (2014) argue that after its introduction, Android captured more than half of the market share of the OS market which was earlier held by Symbian, iOS and BlackBerry.

2.3 The Mobile Application Development Actors

Different actors come into play to form the MAD and distribution (MADD) landscape. Holzer and Ondrus (2011) analysed these actors from the perspective of the developer with respect to mobile applications distribution process. However, even though these actors are interdependent, they play

separate roles as far as the developer space is concerned but for the purpose of this study, the developer would be the focus of discussion.

Figure 2.1 The Mobile Application Distribution Process



Source: adopted and modified from Holzer and Ondrus (2011).

2.3.1 The Developer

Businesses are discovering that developers are modern-day channels that help them reach new consumers, discover new use cases and propel their growth. Since the release of the original iPhone in 2007 and the subsequent opening of the Apple App Store, content producers have had an ever-growing number of options for delivering their content to consumers (Monarch Media Inc., 2012). It is however not surprising that in the Internet era companies redefine their boundaries to incorporate online freelance workers to solve problems or gain competitive advantages (Hsieh & Hsieh, 2013).

With this as backbone, application developers can further be looked at as the front-liners of the application distribution process. Forward-thinking businesses today realize that developers are their innovation engine, their most promising affiliates, their evangelists or their fastest growing resellers (VisionMobile, 2014). The developer category of actors are made up of either independent (freelance) or organisational developers. Independent developers are individual developers who are motivated by several factors including monetary, pleasure, desire to create as

well as promotions and developer events put up by industry players. Such is the MTN Applications Challenge, Vodafone Applicationstar Competition both in Ghana and the Applications4Africa for East African Countries (Myjoyonline, 2014; Government of Ghana, 2013).

Organisational developers on the other hand are institutions that have either employed or hired the services of individual developers. A sharp contrast between this sub-category player and the freelancer is that, a freelancer may perform everything from coding to UI development while the organisation may employ individual expertise in each department of the development process. Barret (2001) however questions this idea as he suggests employing software developers is costly to firms and controlling their productivity is notoriously difficult.

To aid developers to come out with quality applications for the market, operating systems (OS) providers make available software development kits (SDK) to them in their respective environments. The SDKs provide the necessary tools and resources for the development, installation, and testing of the applications (Xanthopoulos & Xinogalos, 2013). These kits usually include libraries, debuggers, and handset emulators, among other useful development tools (Holzer & Ondrus, 2011). Android applications use java while iPhone operating system (iOS) employs objective-C, C++ or C (Koch & Kerschbaum, 2014).

Developers come up with applications based on customer specifications, requirements and needs and publish them on the application portal. The link between the developer and the customer may either be direct or indirect on condition that applications are not channelled through a portal hereafter called contract applications.

2.3.2 The Applications Portal

Comparative to trade, there is mostly an intermediary between the farmer and the final consumer even though this transition may be breached. Hence a farmer to consumer relationship. The application portal can in this sense be likened to the trader that acts as transit point of products from the farmer to the consumers.

The mobile applications are deployed through special distribution app stores, with or without fees. Prior to the launch of the Apple App Store in 2008 and subsequently the Android Market (Now Google Play), application developers used their own websites to get their applications to their customers (Holzer & Ondrus, 2011b). The mobile application portal is therefore an essential component in the mobile application distribution process. They play the role of intermediary between developers and consumers

2.3.3 The User / Consumer

Users are often the centre of mobile applications. Customers have high expectations and expect on-demand service and valuable experiences that are functionally, emotionally, and aesthetically satisfying (Noblis, 2011). This has therefore propelled organisations to continue to invest heavily in user experience (UX) to improve market positioning, build their brand, maintain customer loyalty, and increase customer satisfaction (Christ, 2011).

User research is therefore essential to help organisations surface unfamiliar user needs, perspectives, and goals to provide customers with an enriched experience.

2.4 Mobile Application Categories

Developing mobile applications is a challenging endeavour where technology and creativity are essential (Scharff & Verma, 2010). As discussed in the earlier paragraphs, Xanthopoulos and Xinogalos (2013) contend that each one of the platforms require a particular programming language, different development environments and programming models based on platform-specific application programming interface (API). On a broader perspective, prior to the evangelism for cross-platform development, mobile applications could be categorized under two main categories; native and web. However some researchers and developers propose the hybrid approach that infuses the strength of the two main categories. Each with its strengths and weaknesses.

Table 2. 1: Native Applications vs. Web Applications

	Native App	Web App
Hardware Access	Full	Limited (but growing)
Connectivity	Online and offline	Mostly Online but can be offline
Portability	Only on the same operating system and restricted by the supported version.	Can be used on any device with any operation system supporting web standards
Graphics	Can use all hardware capabilities to create graphical stunning applications like games.	Limited to the visualization supported by the browser
Look and Feel	Access to native controls allows creating standard applications.	With the use JavaScript frameworks, native controls can be simulated on the browser giving the user the feel of being using a native application

Source: Rodriguez et al. (2010).

2.4.1 Native

This is essentially how applications originally were meant to be developed. These are applications that are made specifically for a particular platform and have full access to the various functionalities of the respective devices. For example camera, contacts, GPS etc. that is to say, they are installed locally, extending the functionalities and developed for a specific OS (Koch & Kerschbaum, 2014). Using native approach, developers build applications for specific platforms with software development kits (SDK) and specific frameworks made for the platforms. More often than not, applications developed in native languages do not run on other platforms. For example, as discussed earlier, java applications for android will not run on an iPhone which requires object-C or C++ to run as they are popularly downloaded through their respective portals. This therefore raises questions on the possible stringency of the strength of developing native applications.

The typical process of developing native applications is the appropriate way of deploying mobile applications but has one major disadvantage: it is not possible to reuse the source code for another platform; the very same app must be redeveloped from scratch (Xanthopoulos & Xinogalos, 2013). They are more difficult to develop and require a high level of experience and technological know-how than other types of applications.

Native mobile applications can suffer from disadvantages that mobile web applications avoid, such as increased development and maintenance costs, hardware incompatibilities, and platform specific policies (Noblis, 2011).

2.4.2 Web based

The proliferation of devices (desktops, laptops, tablets, smartphones, and so on) necessitates data access that is independent of device and platform (Na, 2011). According to Subhi *et al.* (2014), web-based applications are those that function using the built-in web browser of the device. Heitkötter *et al.* (2013) reiterates this by defining web-based approach as applications that mainly deal with options of mobile device web browser. As a big part of web technologies are standardized, this approach allows developing applications which works on different platforms' web browsers. But it should be mentioned that such applications are not able to use certain hardware features of mobile device, for example cameras, GPS sensors etc.

Web-based app are practically applications in the category that seeks to leverage on the pitfalls of native applications and by publishing to the web. Organisations or individuals can avoid several obstacles that native applications typically encounter such that pushing updates is not contingent on user downloads and installations (Na, 2011). Developers and organisations need not simultaneously support several versions of the same application and can provide support independent of the device's OS (Christ, 2011).

Forward-thinking companies are already addressing the problems that will define the next market, such as focusing development on mobile web applications instead of increasingly restrictive native applications. Such organisations have successfully deployed mobile web applications over native applications (Noblis, 2011). For example, the Financial Times, according to Forrester Research implemented web-based applications that “lets Financial Times distribute a digital version of its

content to multiple devices and platforms while retaining control of the customer relationships (Na, 2011).

2.4.3 Hybrid

Gartner predicts that the increasing popularity of smartphones will lead to increase of mobile application development. Therefore in year 2016, 50per cent of available mobile applications in the market will be hybrid (Gartner, 2014).

Hybrid applications are packaged natively and thus can be (and have to be) installed on the device, unlike Web applications. While their look and feel mostly resembles that of Web applications, they have access to platform-specific features (Vitols, Smiths & Zacepins, 2014) hence hybrid applications try to combine the advantages of web and native applications (Xanthopoulos & Xinogalos, 2013; Christ, 2011) such that updates and installations are not entirely contingent on the user while the application is also able to access the full functionality of the device. However, the main benefits of hybrid approach are quick application development on multiple platforms.

2.5 Mobile Application Development Lifecycle (MADLC)

Designing the product to fulfil the requirements of the user based on the different standard development lifecycle models is a crucial aspect of the development process and therefore a pre-defined development process is of essence (Vithani, 2014). Inukollu *et al.* (2014) posits that mobile application is nothing but a software product with a different level of complexity and for that reason one can apply same conventional methods/methodologies (such as waterfall, iteration, agile

and scrum) which are primarily used for desktop software development along with different mobile app techniques and tools to design, develop, test and deploy a mobile application.

Particularly narrowing down to MADLC, Vithani (2014) proposes seven phases for mobile application development. This include; identification phase, design phase, development phase, prototyping phase, testing phase, deployment and maintenance phases.

2.5.1 Identification Phase

This phase marks the initiation stage where ideas are collected and categorised. According to Maycock (2012) the idea collection stage starts with capturing the initial idea which can be done by either the contracting company or the MAD firm. On the side of the developers, there is the need to brainstorm to come up with new applications. Filtered list of ideas are discussed by the mobile application idea team comprising of the business and IT representatives for the feasibility to launch a project around the idea (Vithani, 2014). At this stage the work done by the mobile application idea team is then documented and forwarded to the design team.

2.5.2 Design phase

Once the idea has moved into the project initiation phase and the essential elements have been organised, the design phase of the project should begin and the project initiation team will then be formed based on the scope and complexity of the project (Maycock, 2012). At this stage the team considers the category of app to be developed that is, native, web-based or hybrid, as well as whether the developed application is to be released as a free version or trial version with limited features or released only as a premium version (Vithani, 2014). Finally the team comes out with a phase document and forward it to the development team for coding.

2.5.3 Development Phase

In this phase, the application is coded. These include coding the UI as well as the core application. In coding the UI, Vithani (2014) cautions that, it is not a good practice to have a different look and feel for the same application on different platforms. The minimum set of interface components present in all mobile OS platforms should be used in the design. The documentation of the development phase is then forwarded to the prototyping phase team.

2.5.4 Prototyping Phase

Software prototypes are created in order to simulate the logical functionality of the app to the device (Bareiša *et al.*, 2008). In this phase, the functional requirements of each prototype are analysed; the prototypes are tested and sent to the client for feedback. After feedback is received from the client, the required changes are implemented through the development phase. The final prototype is sent to the client for a final feedback (Vithani, 2014). The work done in the prototyping phase is documented and then forwarded to the testing phase team.

2.5.5 Testing phase

Mobile app testing plays a vital role in determining the quality and performance of the app. In order to deliver superior quality applications, efficient techniques and testing tools have to be applied (Inukollu *et al.*, 2014). The testing of the prototype is performed on an emulator/simulator followed by testing on the real device. The emulator/simulator is often provided in the SDK. The testing on the real device, for example in the case of Android OS development, should be

performed on multiple OS versions, multiple models of handsets with variable screen sizes (Vithani, 2014). The test cases are documented and forwarded to the client for feedback.

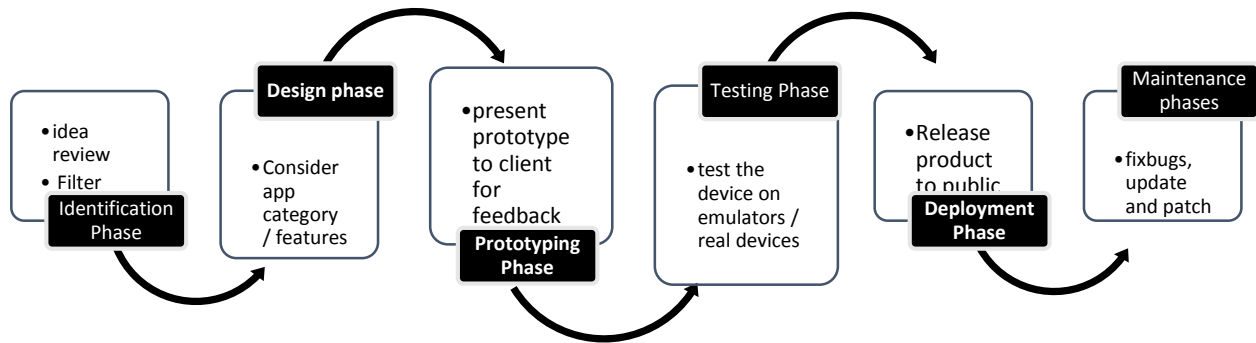
2.5.6 Deployment Phase

After the development and testing of the mobile app, vendors release the mobile app into the market for mobile users (Inukollu *et al.*, 2014). The marketing organization should be engaged to help determine the traditional advertising elements to help promote the application, as well as additional stakeholders throughout the company that are aligning their products or promotions with the release of the mobile application (Maycock, 2012). Vithani (2014) suggests that after the testing is completed and the final feedback is obtained from the client, the application is ready for the deployment. The application is uploaded to the appropriate application store/market for user consumption.

2.5.7 Maintenance phases.

Maintenance phase deals with fixing the issues that mobile users encounter and also involves developing/releasing new features, which can be implemented using MAD life cycle (Inukollu *et al.*, 2014). Integrating new requirements in the mobile use cases, projecting, developing and finally testing improves the overall caliber of the app when a systematic procedure is being implemented. Further, appropriate security patches, performances improvements, additional functionality, new user interfaces are provided at regular intervals in the form of updates to the application (Inukollu *et al.*, 2014; Vithani, 2014).

Fig. 2.2 Mobile Application Development Lifecycle (MADLC)



Sources: (Inukollu et al., 2014; Vithani, 2014; Maycock, 2012)

2.6 Review of Mobile Application Development Literature

Onwuegbuzie, Leech and Collins (2013) postulate that a thorough, sophisticated literature review is the foundation and inspiration for substantial, useful research. It is therefore helpful in two ways; thus, it does not only help researchers glean the ideas of others interested in a particular research question, but it also lets them read about the results of other (similar or related) studies (Fraenkel & Wallen 2006). The review for this study underwent five phases; categorisation of literature by factors relative to the research objectives, classification by issues, geographical distribution, methodological approaches and mapping and conceptual approaches used in MAD research. Considering the nascent nature of mobile application development in Africa and the focus of this research in perspective, literature selection for this study spanned between 2008 and 2015 (see appendix E). Further justification for the range is also to ensure that research gaps are recent.

2.6.1 Issues in Mobile application development Studies

Table 2. 2 Categorisation of Literature by Factors

Article	Theory	Sample & Methodology	Factors
Gurtner, Reinhardt and Soyez (2014)	Technology Acceptance Model	A cross sectional survey of 653 participants	<ul style="list-style-type: none"> • Convenience • Perceived quality • Enjoyment • Perceived ease of use • Perceived usefulness
Milam and Avery (2012)	<i>Not Considered</i>	Case Study	<ul style="list-style-type: none"> • Promotions and developer events
Zamfiroiu (2014b)	<i>Not Considered</i>		<ul style="list-style-type: none"> • The involvement of the developer level • Users expectations • Used technologies
Lim, Bentley, Kanakam, Ishikawa and Honiden (2015)	<i>Not Considered</i>	A cross sectional survey of 4,824 participants from USA, China, Japan, Germany, France, Brazil, UK, Italy, Russia, India, Canada, Spain, Australia, Mexico, and South Korea	<ul style="list-style-type: none"> • User adoption of the app store concept • App needs • Rationale for selecting or abandoning an app
Vitols, Smiths and Zacepins (2014)	<i>Not Considered</i>	case study of insurance mobile application development process	<ul style="list-style-type: none"> • Cross-platform solutions that will work on different mobile operating systems
Bergvall-Kåreborn and Howcroft (2013)	<i>Not Considered</i>	Sixty participants (55 Males and 5 Females) Face-to-face focus groups, semi-structured interview, open-ended questions	<ul style="list-style-type: none"> • Current challenges facing the mobile application development sector within the IT workforce
Holzer and Ondrus (2011)	<i>Not Considered</i>		<ul style="list-style-type: none"> • Implications that different market and technology trends have on the mobile application development market

Hsieh and Hsieh (2013)	Dual commitments framework	Email Interviews	<ul style="list-style-type: none"> • Monetary rewards • Potential market demand, • Perceived service quality, • Identification with the platform owner, • Intrinsic rewards
Koch and Kerschbaum (2014)	<i>Not Considered</i>	An electronic survey of 113 participants	<ul style="list-style-type: none"> • Intrinsic motivations • Acquisition of software development skills • Development of a new application • Financial motivations

Source: Author's Construction.

Table 2.2 above summarises studies conducted in MAD and outlines various factors that have been looked at either from the perspective of the developer or the consumer. The factors are further huddled into technological, organisational and environmental factors as follows.

2.6.1.1 Technological Factors

The technological context describes both the internal and external technologies relevant to the firm and include existing technologies inside the firm as well as the pool of available technologies in the market (Zhu, Kraemer, Xu & Dedrick, 2004; Picoto, Bélanger & Palma-dos-Reis, 2014). Review of articles in relation to the topic under study indicated that a number of researches have been conducted as far as the technological factors in MAD is concerned. These factors include Perceived quality, perceived ease of use, used technologies, user adoption of the app store concept, Cross-platform and technological trends (Gurtner, Reinhardt & Soyez, 2014; Zamfiroiu, 2014b; Lim, Bentley, Kanakam, Ishikawa & Honiden, 2015; Vitols, Smiths, & Zacepins, 2014; Holzer & Ondrus, 2011).

Gurtner *et al.* (2014) in their research to investigate influential drivers of adoption for mobile business applications came up with the finding that, perceived quality, perceived ease of use and convenience are factors that influence the adoption of business mobile applications by young people. This implies that users can have a relatively high intention to use a new mobile business application, but are unable to do so, if the system is not easy to use. They further found out that these users want to use mobile applications on different devices any time hence; convenience.

Vitols, Smiths and Zacepins' (2014) paper sought to identify problems that occur during developing hybrid applications with PhoneGap framework and to offer solutions on how to solve them. They concluded that considering the main characteristics of MAD approaches, it is seen that hybrid approach will have more and more applications and impact on future mobile application development. Main benefits of the hybrid approach as discussed (Section 2.4.3) are fast application development on multiple platforms. However, Phone Gap (Hybrid framework) will not perform well if there is a need for unique UI, complicated calculations and if the application is satiated with image, audio and video content.

Holzer and Ondrus (2011) argue that, the new entrants in the MAD industry have caused significant structural changes in the market by imposing and enforcing their own rules for the future of mobile application developments. As such these changes do not only concern the mobile phone manufacturers but also bring additional opportunities and constraints for current mobile application developers. They observed one trend as the entry of new platforms in the open-source community to lower their development costs and possibly extend their consumer market by lowering prices and as a consequence, increase their developer pool.

2.6.1.2 Organisational Factors

Previous studies have studied organisational factors in relation to the size of the firm and scope (Gibbs & Kraemer, 2004; Zhu *et al.*, 2002; Racherla & Hu, 2008) managerial structures available in a firm (Pan & Jang, 2008), the amount of slack resources available (Baker, 2012; Zhu *et al.* 2002). However, literature reviewed for this study with MAD in focus revealed six factors with the organisational context in perspective; Challenges facing the mobile app developers, the involvement of the developer, development of a new application, Acquisition of software development skills, Intrinsic motivations and Monetary rewards (Bergvall-Kåreborn & Howcroft, 2013; Koch & Kerschbaum, 2014; Hsieh & Hsieh, 2013).

Koch and Kerschbaum (2014) studied the motivation criteria for application developers of smartphone applications, with specific emphasis on their motivations and decision criteria for which platform they join. The study pointed out that, the highest rated motivations for smartphone developers are intrinsic motivations such as fun and intellectual stimulation experienced through the development process. The study also identified acquisition of software development skills and the development of a new application with previously unavailable functionalities were more important than financial motivations. Further, the authors' research which focused on only Apple and Android operating systems further found that developers prefer Apple's application portal to that of Android because of the perceived financial gains.

Also studying MAD on Apple and Google platforms, Bergvall-Kåreborn and Howcroft (2013) sought to examine the under-researched area of MAD and considers some of the current challenges facing this sector within the IT workforce. The outcome of the research indicated that some of the

problems developers face include working in a highly competitive and increasingly crowded market and problems associated with being in a position that reacts and responds to Apple and Google rather than one of greater influence and control. Secondly, the study revealed that many outsourcing firms are attracted to lower cost locations because labour regulations and human resource policies are comparatively lax. In their assessment, mobile application developers perceive employment contracts as immaterial as there is no alternative other than freelancing, in the hope that revenue will be generated.

2.6.1.3 Environmental Factors

The environmental context includes the size and structure of the industry, the firm's competitors, the macroeconomic context, and the regulatory environment (Tornatzky & Fleisher, 1990; Iacovou, Benbasat & Dexter, 1995; Zhu *et al.* 2002). Previous studies on environmental factors have looked at competitive pressure, regulatory environment, consumer readiness (Scott, 2007; Zhu, Kraemer, Xu, & Dedrick, 2004; Gibbs & Kraemer, 2004).

With this study in focus, literature reviewed under the environmental factors include market trends, promotions and developer events, App needs and potential market demand (Holzer & Ondrus, 2011; Milam & Avery, 2012; Lim *et al.*, 2015; Hsieh & Hsieh, 2013)

The smartphone market continues to grow, and no individual company currently dominates. This is according to Hsieh and Hsieh (2013) who also emphasize that greater market demand implies that developers can contact more users or earn more monetary rewards, which leads to positive evaluations. In their study, they identified that freelance developers consider different meridians

in their choice of platforms, reflecting the complex status and uncertainty of the smartphone market. According to Hsieh and Hsieh (2013), potential market demand could encourage developers to stay with their incumbent smartphone application marketplace or switch to another. Their research finally gave a proposition on potential market demand that, the greater the potential market demand that freelance developers perceive in the incumbent smartphone application marketplace, the greater their calculative commitment to that platform owner.

Narrowing down to application development competitions in Africa, Milam & Avery (2012) take a look into promotions and developer events that motivate developers to come up with applications that would help solve national issues such as health, education et cetera. The case study conducted by these authors revealed that even though application development is still nascent in Eastern Africa, an appreciable number of sixty applications were tendered in as a result of the competition.

Table 2.3 Categorisation of Factors

Factors Examined	Technology	Organisation	Environment
• Used technologies	✓		
• User adoption of the app store concept	✓		
• Market trends			✓
• Cross-platform	✓		
• technological trends	✓		
• Promotions and developer events			✓
• App needs			✓
• Challenges facing the mobile app developers		✓	
• The involvement of the developer		✓	
• Monetary rewards		✓	
• Intrinsic rewards and motivations		✓	
• Acquisition of software development skills		✓	
• Development of a new application		✓	
• Potential market demand			✓
• Convenience	✓		

Source: Author's Construction.

2.6.2 Conceptual approaches in mobile application development research

This section discusses conceptual approaches used in MAD in the literature reviewed. Under this section, it was observed that majority of the papers reviewed were not theoretically based which can largely be credited to the fact that, the subject has been studied from technical development perspective. As such frameworks used for the papers were sometimes primary frameworks for core development of applications which were practically deemed irrelevant for this study. However, the very few ones that were used and had a bearing on this study were the Technology Acceptance Model (TAM) (Gurtner *et al.*, 2014) for business applications. Wu (2013) on the other hand combined TAM and Technology Readiness to assess the contributing factors of mobile applications usage intention and how personal traits impact the actual mobile applications usage. Lastly, Hsieh and Hsieh (2013) used commitments and antecedents framework developed from a literature review in their study, stemming from the backdrop of mobile application portals to explore the antecedents of intentions to maintain a relationship with incumbent platforms.

2.6.2.1 The Technology Acceptance Model (TAM)

The TAM expands on the Theory of Reasoned Action (TRA) propounded by Fishbein and Ajzen, (1975) which also has its origins in social psychology and attempts to explain why individuals engage deliberate envisioned behaviours (Pinho & Soares, 2011). Davis (1989) proposed the Technology Acceptance Model (TAM) in order to explain the adoption and use of information technology. The model assumes that, perceived usefulness (PU) and perceived ease of use (PEOU) are the two key determinants of technology adoption. According to Lu *et al.* (2003), these two determinants serve as the basis for attitudes towards using a particular system, which in turn determines the intention to use, and then generates the actual usage behaviour. Perceived

usefulness according to Davis (1989) is the degree to which a person believes that using a particular system would enhance his or her job performance. Perceived ease of use on the other hand is defined as the degree to which a person believes that using a particular system would be free of effort.

The technology acceptance model is a robust but parsimonious theory and it is useful to explain a particular information system or technology (Chen, Li, & Li, 2011). In view of this, a number of studies have utilized the model for reviewing different forms of technologies and for that matter extending and proposing extended models. Taylor and Todd (1995) proposed the integrated model of TAM and TPB. Venkatesh and Davis (2000) proposed TAM2 as a new version of Technology Acceptance Model. Venkatesh *et al.* (2003) proposed the Unified Theory of Acceptance and Use of Technology. Chang (2008) proposed a combined model of Task-technology fit and Technology Acceptance Model. Lin *et al.* (2007) proposed the TRAM (i.e. integration of technology readiness and Technology Acceptance Model).

2.6.2.2 The Technology-Readiness (TR)

The technology-readiness construct refers to people's propensity to embrace and use new technologies for accomplishing goals in home life and at work (Parasuraman, 2000). The construct comprises four dimensions—innovativeness, optimism, discomfort and insecurity that represent the generalized beliefs and affects about technology- based products.

Optimism is defined as “a positive view of technology and a belief that offers people increased control, flexibility, and efficiency in their lives”. *Innovativeness* is defined as “a tendency to be a

technology pioneer and thought leader”. This dimension generally measures how forefront individuals perceive themselves (Parasuraman & Colby, 2001). These two generally capture positive feelings about technology and are the drivers of technology readiness. A high score on these dimensions will increase the overall technology readiness on the TR Scale.

Discomfort is defined as “a perceived lack of control over technology and a feeling of being overwhelmed by it” (Parasuraman, 2000). *Insecurity* is defined as “distrust of technology and scepticism about its ability to work properly” (Parasuraman & Colby, 2001). These dimensions are jointly looked at as negative feelings about technology. In other words they focus on concerns people may have with technology-based transactions.

Discomfort and insecurity are inhibitors of technology readiness. Thus, a high score on these will reduce the overall technology readiness. According to Rose and Fogarty (2010) consumers’ high on the other two TR dimensions, discomfort and security belong to either the Paranoids or Laggard segments. The paranoids believe in technology and are optimistic but lack the tendency to innovate. They therefore adopt technologies when growth begins to decline.

2.6.3 Geographical Issues in Mobile Application Development Research

This section delves into the distribution of articles according to their geographical regions of focus. Literature reviewed under this section was indicative of the fact that, most articles had no geographical linkage (76 per cent) as far as the subject of MAD is concerned. Of this figure, no geographic papers formed the majority with 33 papers. The remaining 24 per cent was shared among 5 regions; Asia (6.7 per cent), Americas (8 per cent), Europe (8 per cent). However, an issue of concern is the number of literature on the subject that directly or indirectly relates to Africa

(1.3 per cent) (Milam & Avery, 2012; Amanquah & Mzyece, 2012). Amanquah and Mzyece (2012) for instance hinted that the African context presents numerous mobile application-related problems that are suitable for academic research which requires a massive research attention. For example, the lack of text-to-speech and speech recognition technologies for indigenous African languages, most of which are tonal, whereas most Western languages are non-tonal. Another example is how to provide location-based services when most African towns and villages lack detailed annotated maps.

2.6.4 Research Gaps and Directions for Future Research

Evidence from the literature reviewed for this study indicated some few gaps which need attention. The findings revealed that, MAD has been extensively studied in technical viewpoints and requires a study that will involve the actors in the MAD landscape. Thus to study the subject from the developers' perspective and issues that enable or constrain MAD (Flora, Wang, & Chande, 2014; Holzer & Ondrus, 2011; Bergvall-Kåreborn & Howcroft, 2013). Flora *et al.* (2014) in a similar study indicated that there is still lack of research initiatives and insufficient understanding of real issues and challenges faced during the development of mobile applications. This to that effect exposes the mobile device to prospective attacks which need to be addressed promptly and require further work. The authors further reiterated that while there are large number of mobile applications, there remains a large number of complex issues where further work is needed.

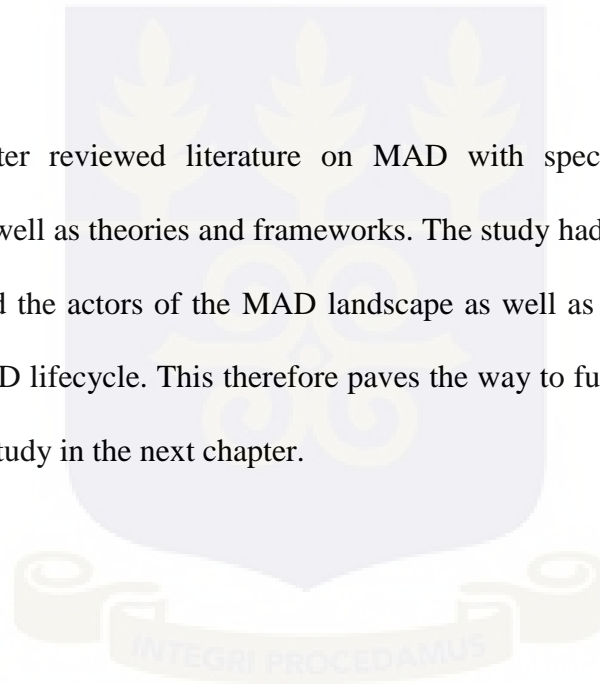
Furthermore, MAD is a global phenomenon and in that regard most articles reviewed were not country or regional specific but Africa still had less articles against other continents such as Asia (1:6), Americas (1:8) and Europe (1:8). This therefore endorses the need to up the study of mobile

applications in developing economies such as Africa's (Amanquah & Mzyece, 2012; Milam & Avery, 2012).

Finally, the review revealed that, studies on MAD lack adequate theoretical grounding. This therefore points out for the need to back or test MAD research findings with theories. It is against this backdrop that the researcher adopted the Technology-Organisation- Environment framework for this study.

2.7 Summary

To conclude, the chapter reviewed literature on MAD with special emphasis on issues, geographical regions as well as theories and frameworks. The study had earlier taken an in-depth look at the overview and the actors of the MAD landscape as well as the various categories of applications and the MAD lifecycle. This therefore paves the way to further discuss the research framework to back this study in the next chapter.



CHAPTER THREE

RESEARCH FRAMEWORK

3.1 Introduction

This chapter takes into consideration research framework that is deemed fit to help digest the subject having reviewed extant literature relative to MAD in the previous chapter. In the quest to find answers to the research questions under discussion, this chapter therefore discusses relevant literature that directly or indirectly relate to the selected research framework. To this effect, Technology, Organisation and Environment (TOE) framework was selected considering its parsimonious nature and the nascent nature of the phenomenon under study in the Ghanaian dispensation.

The TOE framework developed by Tornatzky and Fleisher (1990), assumes that the process by which a firm adopts and implements technological innovations is influenced by the technological, organisational and environmental contexts.

3.2 Technology – Organisation - Environment Framework – An Overview

To study the adoption of technological innovations in general, Tornatzky and Fleischer (1990) developed the technology-organisation-environment (TOE) framework to describe the organisational components that affect firms' adoption decisions. The TOE framework is an organisation-level framework that explains that three different elements of a firm's context influence adoption decisions. These three elements are the technological context, the organisational context, and the environmental context. All three are postulated to influence technological innovations (Baker, 2012). There are practically three elements that come into play

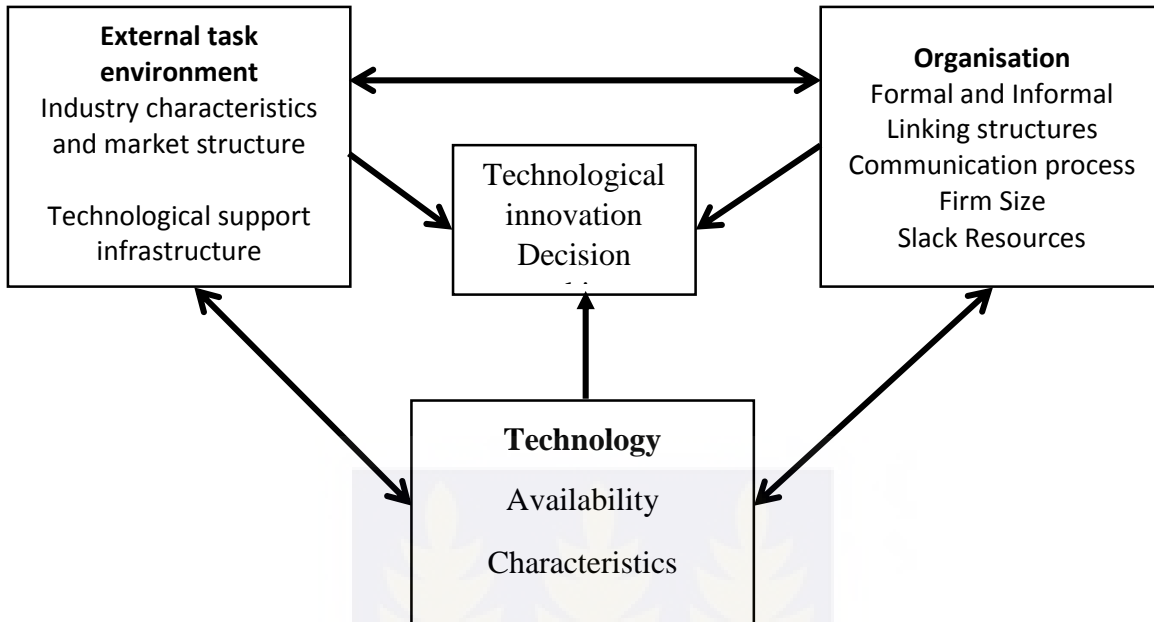
in this framework; Technology, Organisation and Environment. These three elements further pose as either opportunities or constraints. They, thus influence the way a firm sees the need for, searches for, and adopts new technology. The TOE framework asserts that the three principal contexts – technological, organisational, and environmental – influence the process by which an organisation adopts and accepts a new technology (Lippert & Govindarajulu, 2015).

Technological context contends that adoption depends on the pool of technologies inside and outside the firm as well as the organisation's perceived relative advantage (gains), compatibility (both technical and organisational), complexity (learning curve), trialability (pilot test/experimentation), and observability (visibility/imagination) (Awa, Ukoha, & Emecheta, 2012). The organisational context refers to the characteristics and resources of the firm, including linking structures between employees, intra-firm communication processes, firm size, and the amount of slack resources (Baker, 2012). Finally, the environment is the arena in which an organisation conducts its business (Scupola, 2009) which include the structure of the industry, the presence or absence of technology service providers, and the regulatory environment. Industry structure has been investigated in several ways (Baker, 2012).

3.3 The TOE Framework in Information Systems Research

The TOE as an adoption framework has been studied comprehensively in information Systems research with regards to factors that influence organisations' adoption decisions (Ortbach, Brockmann & Stieglitz, 2014). It has a solid theoretical basis, consistent empirical support and the potential for its application across various IS innovation domains (Oliveira & Martins, 2011).

Figure 3.1 Technology, Organisation and Environment Framework



Source: Tornatzky and Fleischer (1990).

The frameworks considering its rigorous nature has been used in studying IT-systems adoption in a wide area in IS as illustrated in table 3.1 adopted from Ortbach, Brockmann and Stieglitz (2014).

Table 3. 1 Comprehensive overview of TOE studies in the IS domain

Authors	Technology	Organisational Context	Environmental Context
Chau and Tam (1997)	Perceived benefits, perceived barriers, perceived importance of compliance to standards, interoperability, and interconnectivity	Complexity of IT infrastructure, satisfaction with existing systems, formalization on system development	Market uncertainty
Ifinedo (2011)	<i>(not considered)</i>	Management support, organisational IT competence	IS vendor support/pressure, financial resources availability, external pressure, firm size, industry type

Kuan and Chau (2001)	Perceived direct benefits, perceived indirect benefits,	Perceived financial costs, perceived technical competence	Perceived industry pressure, perceived government pressure
Lin (2013)	Perceived benefits, perceived costs	Firm size, top management support, absorptive capacity	Trading partner influence, competitive pressures
Lin and Lin (2008)	IS infrastructure, IS expertise	Organisational compatibility, expected benefits of e-business	Competitive pressure, trading partner readiness
Liu (2008)	Support from technology, human capital, potential support from technology	Management level for information, firm size	User satisfaction, ecommerce Security
Oliveira and Martins (2008)	Technology readiness, technology integration, security applications	Perceived benefits of electronic correspondence, IT training programmes, access to the IT system of the firm, internet and email norms	Web site competitive Pressure
Oliveira and Martins (2009)	Technology readiness, technology integration, security applications	Perceived benefits of electronic correspondence, IT training programmes, access to the IT system of the firm, internet and email norms	Website competitive pressure, e-commerce competitive pressure
Pan and Jang (2008)	IT infrastructure, technology readiness	Size, perceived barriers	Production and operation improvement, enhancement of products and services, competitive pressure, regulatory policy

Teo, Lin and Lai (2009)	Unresolved technical issues, lack of IT expertise and infrastructure, lack of interoperability	Difficulties in organisational change, problems in project management, lack of top management support, lack of e-commerce strategy, difficulties in cost-benefit assessment	Unresolved legal issues, fear and uncertainty
Zhu and Kraemer (2005)	Technology competence	Size, international scope, financial commitment	Competitive pressure, regulatory support
Zhu, Kraemer and Xu (2003)	Technological competence	Firm scope, firm size	Consumer readiness, competitive pressures, lack of trading partner resources
Zhu, Kraemer and Xu (2006)	Technological readiness, technological interaction	Firm size, global scope, managerial obstacles	Competition intensity, regulatory environment

Source: Ortbach, Brockmann, and Stieglitz (2014)

The TOE framework due to its explanatory power has been used in extant research across different contexts including technological, industrial, and national contexts. The TOE model has been used to explain the adoption of inter-organisational systems (Grover 1993; Mishra *et al.*, 2007), e-business (Zhu *et al.*, 2003; Zhu & Kraemer 2005; Zhu *et al.*, 2006; Zhu *et al.*, 2004), electronic data interchange (EDI) (Kuan & Chau 2001), open systems (Chau & Tam 1997), enterprise systems (Ramdani *et al.*, 2009), and a broad spectrum of general IS applications (Thong 1999). The TOE model has been utilized to explain the adoption of innovations in a host of industries,

including manufacturing (Mishra *et al.*, 2007; Zhu *et al.*, 2006), health care (Lee and Shim 2007), retail, wholesale, and financial services (Zhu *et al.*, 2006).

Coming from the backdrop of the instances cited above, Thong (1999) used theories from the technological innovation literature to develop an integrated model of information systems (IS) adoption in small businesses. His model specifies contextual variables such as decision-maker characteristics, IS characteristics, organisational characteristics, and environmental characteristics as primary determinants of IS adoption in small businesses. A questionnaire survey was conducted in 166 small businesses. Data analysis for the study demonstrated that small businesses with certain chief executive officer (CEO) characteristics (innovativeness and level of IS knowledge), innovation characteristics (relative advantage, compatibility, and complexity of IS), and organisational characteristics (business size and level of employees' IS knowledge) are more likely to adopt IS.

Similarly Oliveira and Martins' (2008) study compared the impact of different Technology-Organisation-Environment (TOE) factors on the web site adoption decision in small and large firms. A survey was undertaken on the use of Information Technologies (IT) by firms in Portugal and was used as the empirical basis for their study. The outcome of the study showed that, while large firms are mainly influenced by organisational and environmental factors, small firms are also concerned about the technological context.

3.4 Constructs of the TOE Framework

3.4.1 Technological Context

Technology readiness according to Oliveira and Martins (2008), can be defined as technology infrastructure and IT human resources. It also represents the pool of technologies available to a firm for adoption (Scupola, 2009) both the internal and external technologies that are relevant to the firm which may include both equipment as well as processes (Tornatzky & Fleisher, 1990).

Baker (2012), posits that Innovations that exist but are not yet in use at the firm also influence innovation both by demarcating the limits of what is possible as well as by showing firms ways in which technology can enable them to evolve and adapt.

3.4.2 Organisational Context

Organisational readiness is defined as “the availability of the needed organisational resources for adoption (Iacovou, Benbasat & Dexter, 1995). The context further refers to the characteristics and resources of the firm, including linking structures between employees, intra-firm communication processes, firm size, and the amount of slack resources.

Baker (2012) contends that communication processes within the organisational context can also promote or inhibit innovation. Top management leadership behaviours and communication processes include describing the role of innovation within the organisation’s overall strategy, indicating the importance of innovation to subordinates, rewarding innovation both formally and informally, emphasizing the history of innovation within a firm, and building a skilled executive team that is able to cast a compelling vision of the firm’s future.

3.4.3 Environmental Context

The environmental context includes the structure of the industry, the presence or absence of technology service providers, and the regulatory environment. Industry structure has been investigated in several ways (Baker, 2012). It also includes the size and structure of the industry, the firm's competitors, the macroeconomic context, and the regulatory environment (Tornatzky & Fleisher, 1990). Oliveira and Martins (2009) observed this context from the competitive pressure point of view; the degree of pressure felt by the firm from competitors within the industry. Similarly Thong (1999) in an agreement believed that competition increases the likelihood of innovation adoption in an industry.

3.5 Conceptual Framework

With particular reference to the previous chapter (literature review), there was a clear evidence that literature gathered could be categorized into technological, organisational and environmental factors in MAD studies. Further, some factors were identified that are most likely influential to the development choices of mobile application developers as outlined in Section 2.5.1.

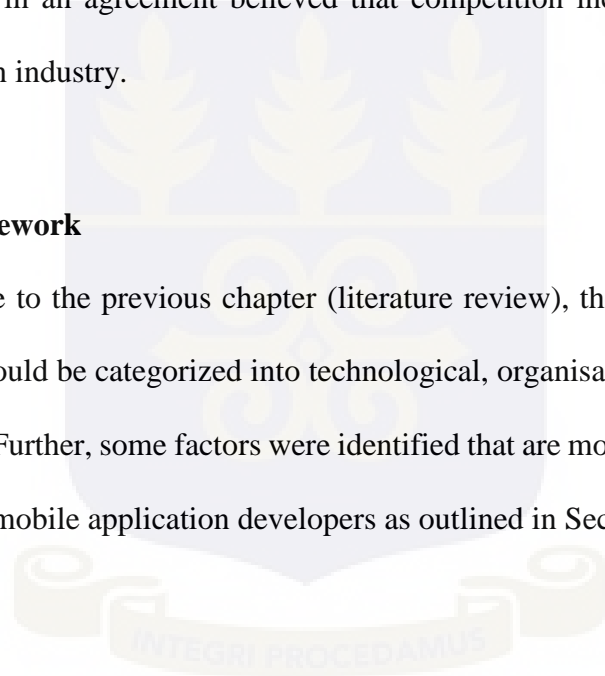
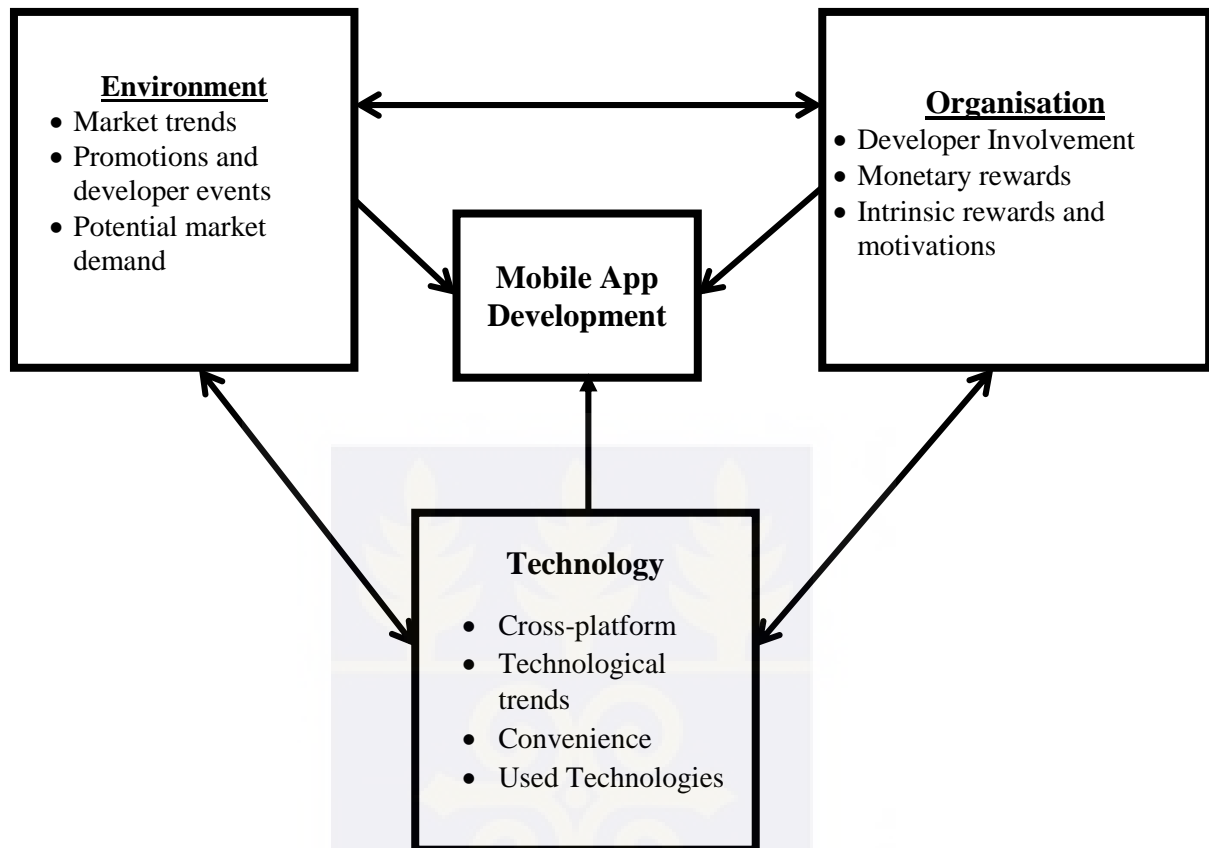


Figure 3.2 Conceptual framework of mobile application development



Source: Tornatzky and Fleischer (1990) and Factors identified in literature

3.5.1 Technological Factors

The technological context in this study does not deviate from the definitions made by scholars in previous literature. The context consists of both the internal and external technologies relevant to mobile application developing firms and include existing technologies inside the firms as well as the pool of available technologies in the market. Relative to factors retrieved from literature, cross platform, technological trends, used technologies and convenience were observed to have more influence on the MAD choice of developing firms (Gurtner *et al.*, 2014; Zamfiroiu, 2014; Lim, *et al.*, 2015; Vitols *et al.*, 2014; Holzer & Ondrus, 2011).

3.5.1.1 Cross platform

The alternative for developing application natively for every platform is in using mobile app development tools (MATs) that allow using shared codebase across all target platforms with little modifications (Khandozhenko, 2014). Cross-platform applications hinge on a single consistent codebase promising less development and maintenance effort, more focused development expertise and thus a more flexible approach for creating software products. Many researchers and MAD practitioners have argued that cross platform development is time saving and combines the strengths of both the native and web-based approaches in development.

As discussed in the previous chapter, cross platform applications dwell on the strengths of native and web-based application development to develop applications that need single command language across platforms. To better understand this phenomenon in the context of this study, the question of *how developing cross-platform applications enable or constrain the case organisations* emanate.

3.5.1.2 Technological trends

Mobile app development is currently progressing at a feverish pace (Godwin-Jones, 2011) and for that matter app developers must be well-informed on the technologies currently employed in its development. For example, the mobile applications development and distribution (MADD) mechanisms have changed over time. Previously app developers employed the walled garden approach where Mobile Network operators (MNOs) were in charge of being the interface between customers and service providers (Holzer & Ondrus, Mobile application market: A developer's perspective, 2011). However, Apple (iOS) and Google (Android) taking charge over their applications by establishing their own portals has ensured the decline of the walled garden

approach. In this sense the development trend of mobile applications is to improve the usability and for distributors to be closer to the users by rendering app support (Zamfiroiu & Despa, Reasons, Circumstances and Innovative Trends in Mobile Environments, 2013a). Another example is the drive towards developing context-aware applications; applications developed to stay aware of their contexts, aim to provide context-specific service for their users by automatically adapting to their changing contexts (Hong *et al.*, 2009). Context in this regard is defined by Dey (2001) as any information that can be used to characterize the situation of an entity, while an entity can be a person, place or object that is relevant to the interaction between users and applications, including location, time, activities, and the preferences of each entity. These dynamics in the app developer space therefore warrants the question of *what opportunities and/or threats this phenomenon pose to MAD firms.*

3.5.1.3 Used technologies

MAD like any other application development environment requires appropriate technologies that run at par with it to ensure that applications are developed to meet standards. For example, the programming language as well as the development methodology with which the applications are developed. According to Zamfiroiu, (2014) used technologies for application development occurs when old applications cannot be ran on mobile devices so new and fresh application will not be used by anyone. For instance, applications developed with android 4.2 users as core target means applications users using froyo or gingerbread (versions of Android OS) will not have the opportunity to use the app. This development therefore raises the question of *updates, patch and bug handling.*

3.5.1.4 User Convenience and expectation

As earlier indicated users are the core targets for applications developed and are vital actors in the MAD and distribution mechanism (Figure 2.1). There are factors that define the usability of an application which include the environment of usage as well as the users themselves. According to Treatanapon (2012), users can be categorised into experienced (expert, experienced and novice), demographics (age, gender, race, culture, knowledge, job, specific roles, income and location). In order to meet the expectations and experiences of users, Zamfiroiu (2014) posits that it is very important to take into account a highly targeted group during the development of the mobile application. This assertion therefore triggers the question of how MAD firms forecast the user convenience and experiences (platforms, usability and size of devices) of their target users/consumers before development.

3.5.2 Organisational Factors

This study operationalises organisational context in line with Pan and Jang (2008) as managerial structures available in a firm. That is, the amount of slack resources available and also the motivation and the commitment level of involvement of developers among developing firms. However, literature reviewed for this study with MAD in focus revealed six factors with the organisational context in perspective (Bergvall-Kåreborn & Howcroft, 2013; Koch & Kerschbaum, 2014; Hsieh & Hsieh, 2013).

3.5.2.1 Developer Involvement

In creating mobile applications and software development in general, the developers as highlighted in the previous chapter are the front-liners of the mobile application development and distribution process. This category of actors is an essential component of the mechanism, however, over immersion of this actor in the development process as argued by some researchers risk the quality of the applications and for that matter the users of the applications must also come into play (Muthig & Stupperich, 2005). On the other hand, other MAD researchers have also argued that, in creating robust applications with a high level of quality, if the developer is not interested in the quality of the mobile applications created, they will not meet quality standards and may have low quality applications (Zamfiroiu & Despa, 2013). To better understand this phenomenon within the context of this study therefore, it will be of significance to ask questions as to how many developers are involved within the application development chain of the case organisations as well as to what extent they involve potential users of the app.

3.5.2.2 Monetary rewards

Boudreau and Lakhani (2012) argue that it is reasonable for mobile application developers to emphasize monetary reward as motivations, because the marketplace is a business place designed to earn profits, however the paradox is that free applications currently account for about 60 per cent and 80 per cent of the total available applications in Apple's App Store and Google Play respectively (Gartner, 2013). These are greater than the number of applications that are on sale on the application portals. Further, a study by Koch and Kerschbaum (2014) pointed out that, a logical reason for monetary expectations for developing applications is the entry barriers to the development process for iOS developers which seem to be higher, since a specific programming

language and skills are required. For the group of application developers motivated by extrinsic factors, especially financial gain, the potential market size will be a more significant factor in selecting which smartphone platform ecosystem to join as compared to application developers motivated by intrinsic factors. However, with the context of this study put in focus as to the purchasing abilities and willingness of the app users, how do MAD firms monetize their applications?

3.5.2.3 Intrinsic rewards and motivations

Organisations are formed with the primary aim of helping solve problems identified in a particular setting while making profit. This is not different from organisations that develop mobile applications as they are set up to develop applications that meet the need of their targeted users. As indicated, application developers are categorised into organisation developers and freelancers (independent developers) (Holzer & Ondrus, Mobile application market: A developer's perspective, 2011). Koch and Kerschbaum (2014) in their study to examine application developers' motivations and decision criteria indicated that some motivations for smartphone developers are intrinsic motivations such as fun and intellectual stimulation experienced through the development process and the acquisition of software development skills. The author's study however took into consideration only independent developers, which warrants the need to assess the reasons behind application developing firms' decision to develop free applications if not paid applications with the context and purpose of this study in focus.

3.5.3 Environmental Factors

Finally the environmental context includes the size and structure of the industry, the firm's competitors and the macroeconomic context. This context include three elements; market trends, promotions and developer events and potential market demand (Holzer & Ondrus, 2011; Milam & Avery, 2012; Lim *et al.*, 2015; Hsieh & Hsieh, 2013). These factors have extensively been discussed in the previous chapter and emphasises the reasons a developer will stay with a platform rather than swing to the others with respect to market trend or potential market demand.

3.5.3.1 Market trends

The uncertainty surrounding technological trends in the developer space affects all facets of mobile application development. Such affected feature is the market trends which have advanced over the years. For instance, application developers initially used their websites to distribute applications however as earlier indicated this trend was further upgraded into the walled garden approach where mobile network operators (MNOs) became intermediaries (Holzer & Ondrus, Mobile application market: A developer's perspective, 2011). The current trend therefore which is the mechanism explained in figure 2.1 is being challenged by another strategy known as the multi-homing strategy; a strategy where a developer publishes products for multiple platforms (Hyrnsalmi, et al., 2012).

The question therefore is how application developers are able to adjust to the rampant changes in the developer space. It also wouldn't be far-fetched to ascertain the reasons Ghanaian MAD firms publish on application portals and how they have responded to the migration of the walled garden era to the app portals era.

3.5.3.2 Promotions and developer events

MAD is increasingly becoming a means of achieving several objectives which includes finding solutions to social and community problems. In Africa for instance, the lack of infrastructure in the field of health, education, agriculture, and banking and with a population of a little over one billion has compelled the continent to push mobile application as one of its solutions (Applications World, 2011). Relatively there has been an influx of organisations which as a means of encouraging app developers to develop local content applications organise app developer competitions.

Considering that the developer space is an open space (free entry), the question as to how these events pose as threats or opportunities would be relevant to achieve the purpose of this research.

3.5.3.3 Potential market demand

The proliferation of smartphones is driving the rapid growth of mobile application adoption and subsequently enlargement of mobile app stores. Hsieh and Hsieh (2013) define market demand as smartphone users' likely needs to download applications from smartphone application marketplaces. The authors further posit that greater market demand implies that developers can contact more users or earn more monetary rewards, which should lead to positive evaluations. In developing applications therefore, MAD firms need to assess cues presented by the market. For instance, Gartner (2011) reports that Google Android has the largest market share but iOS is the best-selling store currently. In order to measure the demand of app users the question to ask is how do MAD firms forecast and meet the demands of the app market?

3.6 Summary

The chapter began with justifying the reasons for embracing the TOE framework for this study as well as explaining the constructs of the framework. Again, the framework was chosen because of its conservative nature considering the nascent nature of MAD in Ghana. This in effect, allowed for the management of the factors to complement this research with respect to previous literature. In view of this, a conceptual framework was developed which will aid in answering the research questions as well as satisfying the objectives and purpose of this study.



CHAPTER FOUR

METHODOLOGY

4.1 Introduction

The previous chapter discussed the frameworks needed to undertake this study. It further presented the conceptual framework of the T-O-E to guide empirical testing of the concepts in the framework. This chapter presents a detailed discussion of the research methodology for this study. It also explains the research paradigm, research design, data collection and analysis methods used for this study.

4.2 Research Paradigm

There are variations in research because of the way various researchers view the world and how they interact with the setting around them. These are practically based on the set of beliefs the researcher has with respect to the phenomenon under study. Paradigms, according to Kuhn (1970), are the entire constellation of beliefs, values and techniques shared by members of a scientific community. Creswell (2009) refers to this as worldview; the general orientation about the world and the nature of research that a researcher holds. Although these beliefs usually remain implicit in most research, they affect the practice of the research.

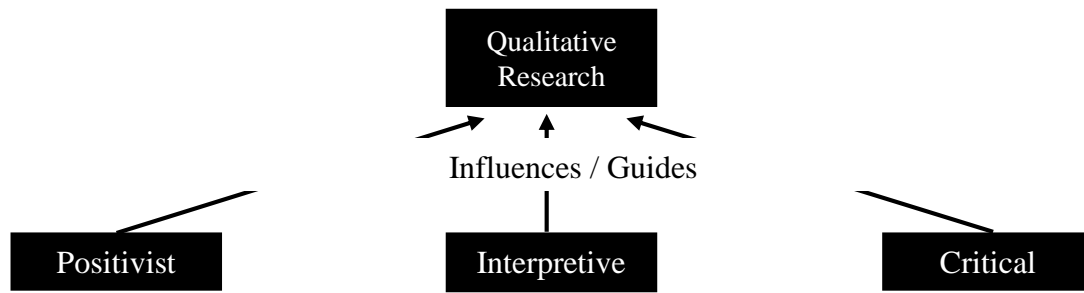
There are three dimensions of a research paradigm namely, ontology, epistemology and methodology. The epistemology dimension provides a philosophical background for deciding what kinds of knowledge are legitimate and adequate and it tries to understand what it means to know (Grey, 2014). Epistemology poses the following questions: *What is the relationship between the knower and what is known? How do we know what we know? What counts as knowledge?*

Epistemology is intimately related to ontology and methodology; as ontology involves the philosophy of reality and the view of how one perceives reality (Krauss, 2005; Wahyuni, 2012) whether it is external or a construct of our mind (Jonker & Pennink, 2010). Methodology meanwhile identifies the particular practices used to attain knowledge of the reality (Krauss, 2005; Wahyuni, 2012) that is, qualitative, quantitative or mixed methods.

In information systems, there exist three main paradigms and Myers and Avison (2002) discuss these as the positivist, interpretive and critical. Interpretive research seeks people's accounts of how they make sense of the world and the structures and processes within it (Fisher, 2010). Positivist studies generally attempt to test theory in an attempt to increase the predictive understanding of a phenomena (Myers & Avison, 2002). However, critical realism according to Mingers *et al.* (2013) offers a robust framework for the use of a variety of methods in order to gain a better understanding of the meaning and significance of information systems in the contemporary world.

Having looked at the above, this study therefore employed the critical realist stance to help achieve the purpose for which this research was conducted; to explore the factors that influence MAD among Ghanaian developing firms and to assess whether these factors pose as threats and/or opportunities to these firms (Section 1.3). The justification for selecting CR was based on the fact that it enables an information system's researcher to "get beneath the surface to understand and explain why things are as they are, to hypothesize the structures and mechanisms that shape observable events" (Mingers, 2004).

Figure 4.1 Underlying philosophical assumptions



Source: Myers and Avison (2002)

However, the pending question is how does critical realism help achieve the purpose of this research?

To help address this question, a critical realist needs to adopt a retrodution research strategy; where researchers take some unexplained phenomenon and propose hypothetical mechanisms that, if they existed, would generate or cause that which is to be explained. This in effect means moving from experiences in the empirical domain to possible structures in the real domain (Mingers, 2002; Easton, 2010). Retrodution enables the CR researcher to establish the basic conditions for a phenomenon, such as mobile applications development to exist. The phenomenon will not therefore exist if these conditions were not met.

According to Boateng (2014) the use of retrodution as a research strategy involves three main steps. The researcher begins first by examining the observed events and connections in a social phenomenon. Relative to this study, the prerequisite was met by first of all conducting a literature review on mobile applications development in chapter two to assess what has previously been done on the topic. Secondly, the researcher postulated the existence of real structures and mechanisms and how they would describe and explain relationships observed, if they existed (Easton, 2010).

Finally the third step was then to demonstrate the existence and processes of these structures and mechanisms proposed in the conceptual model (figure 3.4).

4.3 Research Design and Methods

Creswell (2009) viewed research design as plans and procedures for research that span the decision from broad assumptions to detailed methods of data collection and analysis. Creswell further advanced research design in three main components; quantitative, qualitative and the mixed approaches. Quantitative research primarily means in terms of ‘quantities’ implying the extent to which something either does or does not occur in terms of amount, number, frequency et cetera (Jonker & Pennink, 2010). Creswell (2009) further expatiates this as the means of testing objective theories by examining the relationship among variables. These variables, in turn, can be measured using statistical procedures.

Mixed method inquiry is an approach to investigating the world that ideally involves more than one methodological tradition and thus more than one way of knowing, along with more than one kind of technique for gathering, analysing and presenting human phenomena – all for the purpose of better understanding (Greene, 2006). The research method adapted for this study however was the qualitative method as it seeks to understand issues or particular situations by investigating the perspectives and behaviour of the people in situations and the context within which they act (Kaplan & Maxwell, 2005).

4.4 Case Study as a research method

The focus of this study was to explore factors influencing MAD among Ghanaian developing firms as either threats or challenges. With this as backbone, a case study research was deemed best method to carry out this research stemming from Yin's (2009) definition of case study research; a preferred strategy to study when "how" or "why" questions are being posed, when the investigator has little or no control over events and when the focus is a contemporary phenomenon within a real life context employing multiple methods of data collection to gather information from one or a few entities (people, groups, or organisations). The focus of a case study is on the in-depth understanding of the phenomenon and its context (Cavaye, 1996).

Case studies can however be a single- case design or multiple-case design. Researchers can adapt either of the two depending on the nature of the case under study. Single cases are employed in instances where there are no cases for replication. For example, Highland Towers in Kuala Lumpur in the 1990s (Zainal, 1997). Multiple-case design on the other hand allows cross-case analysis and comparison, and the investigation of a particular phenomenon in diverse settings (Darke, Shanks & Marianne, 1998). The goal is to replicate findings across cases. Because comparisons will be drawn, it is imperative that the cases are chosen carefully so that the researcher can predict similar results across cases, or predict contrasting results based on a theory. For the purpose of this study, a multiple study was adopted since the emphasis was to conduct two different case studies of the same phenomenon (Yin, 2009).

4.4.1 Case Study Design

A case study research is an accepted strategy in information systems research (Boateng, 2010; Cale & Kanter, 1998; Cavaye, 1996; Benbasat *et al.*, 1987). For example, Boateng (2010) employed the use of case study in his research to investigate the impact of mobile phones on the micro-trading activities of women traders in Ghana. This study is based on the descriptive case study approach which necessitates a theory to guide data collection and the theory should be clearly stated in advance and be reviewed to form the basis of the design of the descriptive case study (Yin, 2003; De Vaus, 2001). This approach was selected for this research due to its flexibility and the multiple sources from which data-gathering can be done.

Furthermore, a multiple-case approach was adopted for the study to help draw similarities or comparisons in case results. Multiple-case designs are desirable when the intent of the research is descriptive, theory building, or theory testing. The unit of analysis defines the boundaries of the case study research (Khalfan, 2004). These can be the individuals (employers or employees), events (decisions or programs) or entities (groups or organisations). The unit of analysis for this study ultimately focused on the three elements listed above in such order; entities, encompassing individuals and their events.

4.4.2 Selecting Case Mobile Application Development Firms

Research on organisation-level phenomena would require site selection based on the characteristics of firms (Benbasat *et al.*, 1987). This therefore required that only MAD firms were selected for this study. Additionally, with reference to Benbasat *et al.* (1987), development firms that shared similar characteristics formed the core sites for this research.

Further, organisations selected for the study were two years or older and are in continuous operations since their establishments. This was practically with compliance to Benbasat *et al.* (1987) cautions that site selection should be carefully thought out rather than opportunistic as well as ensuring there is adequate information to help pursue the objectives of this study.

For these reasons, only firms that met the requirements stated above were considered for selection to ensure that there were available data for the study. The author thence, listed application development companies in Ghana with the aid of Google Play and made phone contacts, personal visits, contact forms on website, emails in order to gain access to the firms. The case firms that agreed to participate in this research finally were Origgin and Nandimobile. Origgin accepted because the author had an introductory discussion with the CEO on the MTN App Challenge Road Show (a campaign by MTN to drive awareness of their app competition on university campuses in Ghana) at the University of Ghana Campus hence a reminder email was sent.

Nandimobile on the other hand agreed to participate on the first phone call and subsequent visit.

4.5 Data Collection Methods

Benbasat *et al.* (1987) postulate that ideally a case study must employ two or more sources to converge in order to support the research findings. Further, critical realism encourages the use of multiple data collection methods to enhance triangulation of perspectives and also unearth mechanisms and structures which underpin events which are readily observable. Evidence for case studies may come from six sources: documents, archival records, interviews, direct observation, participant-observation, and physical artefacts (Yin, 2009).

4.5.1 Interviews

The author used interview as a major source of data collection. In this venture, both structured and semi-structured questions were used. The questions (see Appendix A) were framed to gratify the objectives for which this study is carried out. This process underwent three reviews to make sure the right questions were asked with the assistance of the author's supervisors. Finally, a pilot interview was undertaken with five independent developers to evaluate the viability of the questions. The purpose of the interview guide was to direct the interviewer in the course of the interview so as not to deviate from the topic under discussion. The guide contained general questions which were later profiled along history documents provided by the companies. For example, firms' background, objectives and missions, management structure, start-up challenges and achievements, MAD projects.

At Origgin, the author conducted a general interview with the Chief Executive Officer (CEO), Chief Technical Officer (CTO), Chief Operating Officer (COO) and a member of the sales team. This was done in order to solicit how these people view the business from their angle of operations in the firm. Further, there was one extended interview with the CEO which aimed at pertaining to managerial questions that could best be answered by him. For example, "in your estimation, how many organisations or individuals has your organisation developed for? The CTO also granted a lengthier interview to cover aspects of the guide that could as well be best answered by him.

Similarly, at Nandimobile, There was one interview with the three personnel who were present and less busy at the time of the interview. They included the CEO who doubles as the CTO, Business Development Manager and one sales person. There were further one-on-one interviews

with the CEO and the Business Development Manager to answer sections of the interview guide that pertained to their respective offices.

4.5.1.1 Ethics for interview

The author upon gaining entry to the companies via phone calls, text messaging, personal visits and emails obtained introductory letters from the Departments of Operations and Management Information Systems (OMIS) to confirm the backing of the department for the research

With the consent of the interview respondents, the author used a Zoom H4N voice recording device to record all the interviews along with writing notes in a small book. The notes served as cues for follow up questions.

The interviews were held at the convenience of the respondents. The time frame for the interviews lasted between 45 minutes to 1 hour whereas other discussions lasted between 5 and 10 minutes. The group interviews lasted between 15 to 20 minutes.

4.5.2 Documents and Archival records

To match evidence to the facts collected during the interviews, documentation and archival records were collected. This category of data includes reports, customer specification documents, and web contents.

Table 4.1 Documents and Archival records examined

Document	Origgin	Nandimobile
Reports	To compare current practices to past application development practices. To assess case firms' past engagements with client companies.	To compare current practices to past application development practices. To assess case firms' past engagements with client companies.
Customer specification documents	To understand the customers' involvement in the development of applications and compare to post-development reports as to whether the specifications were met.	Not considered
Web contents	To assess additional information which were not collected during field interview. E.g. educational backgrounds, information on other services. Third-party websites were also accessed to back claims by respondents. E.g. NCA reports, myjoyonline, etc.	To assess additional information which were not collected during field interview. E.g. educational backgrounds, information on other services. Third-party websites were also accessed to back claims by respondents. E.g. NCA reports, myjoyonline, etc.
Fliers	Not considered	To access the extent of publicity initiatives the organisation engages in apart from their website.

Source: Author's Construction

4.5.3 Direct and Participant observations

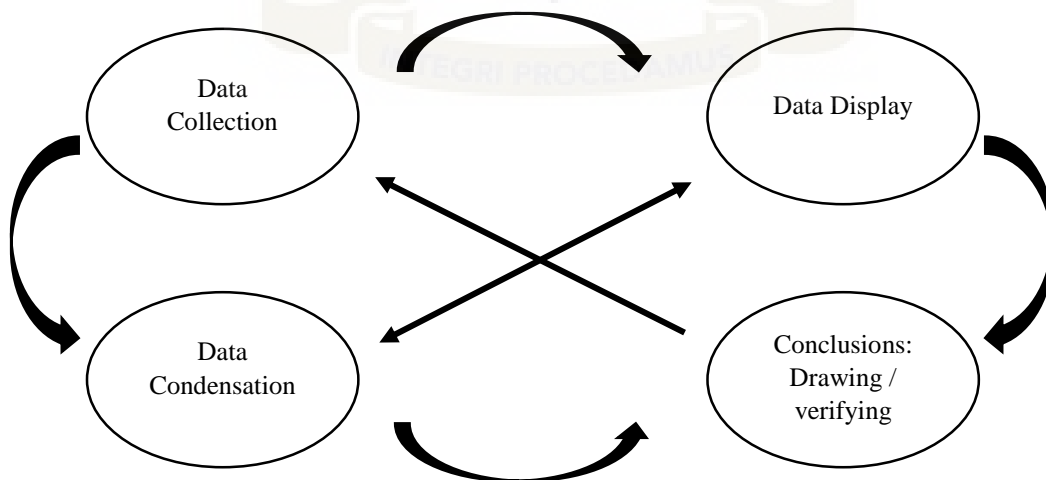
During the field study, the researcher was engaged with Origgin for a number of days. The organisation agreed that the author stays for a while at his wish to conduct his observation. The author then stayed for 2 hours per day for 3 consecutive days in order to align interviewed data to

practice. This also granted opportunities to ask questions and clarifications where needed. Questions asked during observations were not recorded as they were not prearranged. However, at Nandimobile, the environment wasn't conducive enough to undertake such a venture. This is largely attributed to the fact that the office space was shared though the firm had a room allocated to them. In view of this, the researcher strategically scheduled interviews with the CEO/CTO and the BDO for different days to enable him undertake observations during the said days.

4.6 Data Analysis

Data analysis is a systematic and essentially taxonomic process of sorting and classifying collected data (Greene, 2006). With the purpose of this study and the research framework as guides, the data analysis technique for the study was adopted from Miles and Huberman's (1994) transcendental realism technique which highlights three main components for analysis; data reduction, data display and drawing and verifying conclusions.

Figure 4.1 Miles and Huberman's Data Analysis Approach



Source: Miles and Huberman (2013)

4.7 Data Collection:

The first set of data collection for this research was conducted between 9th and 20th March, 2015. All data that were collected from the field were organised. Thus, interviews were transcribed, field notes well-arranged to make logical meaning. Further, the transcribed interviews were read over and over again to gain a general sense of the information and to reflect on its overall meaning. Boateng (2014) emphasises that, the researcher is encouraged to take notes and read through them to sort them out and categorise the data with respect to its relevance to the different respondents and to the research questions to be addressed.

4.7.1 Data Condensation

Miles and Huberman (2013) define data condensation as the process of selecting, focussing, simplifying, abstracting, and/or transforming the data that appear in the full corpus of written-up field notes, interview transcripts, documents and other empirical materials. According to Boateng (2014), data condensation is done in three stages and starts at the very initial research phase and continues throughout the analysis. Further, the process is characterised by three stages. Early stages, where the researcher edited, segmented and summarised collected data. At this stage, the researcher presented issues and conversations rather than the actual words used in the conversation. These were presented in series of statements to emphasise relevant points.

The next stage which is the middle stage is coding; the condensation of data into meaningful segments and assigning names (labels) to the segments (Boateng, 2014). With this research in focus, colour codes were used to distinguish between issues (see appendix B). For instance, challenges and opportunities were labelled in two different colours while another colour was used to highlight codes which were essential quotes from respondents. Finally, memoing; when

collected data in the form of sentence, paragraph or few pages find links with theory and previous literature discussion (Boateng, 2014). At his stage, field data that were found to have a linkage with literature either echoing or disproving were presented (see chapter 6).

4.7.2 Data Display

In order to emphasise and to make collected data simple for comprehension, the data were organised into tables, figures and diagrams. Miles and Huberman (2013) define data display as an organised, compressed assembly of information that allows conclusion drawing. Boateng (2014) emphasises that data display organises and summarises the data to help establish themes and also becomes the basis for future analysis.

4.7.3 Conclusions Drawing and Verification

Miles and Huberman (2013) designated that the reasons for reducing and displaying data are to assist in drawing conclusion. While drawing conclusions logically follows reduction and display of data. Inasmuch as possible conclusions were noted early in the analysis, those conclusions were vague and ill-informed and for that matter were held uncertain pending further review and were organised for presentation during analysis when all data were collected and analysed. Conclusions were finally presented in the form of propositions (see table 6.1).

4.8 Summary

This chapter began by discussing the research paradigm to be used for this study as well as the methodology to be employed. The critical realism paradigm, qualitative research approach and multiple case studies were identified to be used for this study.

The chapter further discussed the criteria for selecting case firms, data collection methods and the approaches for data analysis. With this firmly in place, the next chapter will present the findings of the study.



CHAPTER FIVE
RESEARCH FINDINGS

5.1 Introduction

As pointed out in chapter one (Section 1.3) the purpose of this research is to explore the factors that affect MAD among Ghanaian developing firms and to assess whether these factors pose as threats and/or opportunities to the firms. This chapter therefore presents the case findings for this research and also takes a look at the MAD landscape in Ghana.

5.2 Ghana Mobile Market - Overview

Ghana, a country with a population of about 25 million people, and a land area of 239,000 km², is West Africa's second largest economy after Nigeria, and Sub-Saharan Africa's twelve largest (African Development Bank, 2012). With respect to mobile phones and application development in Ghana, AITI (2014) reports that the country has seen a rapid increase in the use of mobile technology in recent years with penetration crossing the 100 per cent mark. However smartphone penetration in the country ranges between zero to five per cent and is expected to rise due to the low prices of android-based smart phones under \$70 (infoDev, 2014).

Mobile telephony in the country is currently dominated by six main telecommunication companies (telcos); Scancom (MTN), Millicom (Tigo), Vodafone, Airtel, Glo and Expresso and regulated by the National Communications Authority (NCA). The NCA (2015) reports that the mobile voice subscription penetration rate for the month as at March, 2015 was 115.64 per cent. The high penetration rate can however be linked to the Government of Ghana's efforts to increase smartphone penetration which is currently at 15 per cent as part of its policy of bridging the digital

divide (Biztech, 2015). Table 5.1 summarizes mobile market share subscription across networks in Ghana.

Table 5.1 Market Share for Mobile Data Operators

Scancom (MTN)	Vodafone	Millicom (TIGO)	Airtel	GLO	Expresso
48.30%	18.30	15.22	14.03%	3.91%	0.25%

Source: NCA, 2015

5.3 MAD Promotions and Developer Events in Ghana

The quest to boost the local MAD industry has received a good amount of support in Ghana (B&FT Online, 2015). Institutions as well as mobile network operators are on an extemporaneous campaign of helping raise the mobile applications standards in Ghana. The campaign is aimed at bringing to the developer space the need to develop local contents. Some of these institutions include the Meltwater Entrepreneurial School of Technology, Mobile Web Ghana, MTN Ghana and Vodafone Ghana.

Meltwater Entrepreneurial School of technology was established in Ghana in 2008 to offer aspiring African entrepreneurs a fully sponsored two year, intensive full-time program. The institution sources out for graduates from universities in both Ghana and Nigeria through aptitude tests and subsequent interviews to select the best 20 or more of Entrepreneurs-In-Training (EITs). The selected participants receive comprehensive training across the spectrum of skills required to build successful technology businesses, including computer programming, software development, product management, finance, marketing, sales and leadership best practices.

The Meltwater Entrepreneurial School of Technology (MEST) and the MEST Incubator program provide training, investment and mentoring for aspiring technology entrepreneurs with the goal of

creating globally successful companies that create wealth and jobs locally in Africa (Meltwater Entrepreneurial School of Technology, 2014).

After completion of the program, the EITs have the opportunity to pitch a concept. Winning teams then receive a seed funding from the MEST incubator to pursue their ideas. So far the success stories of Meltwater include Dropifi, Nandimobile and Saya – a disruptive technology that brings smartphone messaging functions to low end or dumb phones (B&FT Online, 2015).

MTN Ghana Limited, on the other hand as part of measures to support Ghanaians to develop relevant local content applications for the Ghanaian market (B&FT Online, 2014), organizes an annual application development challenge with the objective of harnessing local talents in application development, building strong affinity with the developer community and provide opportunity for developers to market their content via MTN platforms to deliver innovative services in Ghana (The Herald, 2014). Application categories for the competition include education, lifestyle and games. The applications must be unique, user friendly and relevant to the Ghanaian market (Graphic Online, 2014).

The Vodafone Applicationstar similarly, is an annual developer contest conducted by Vodafone for developers across several countries in African and Asian Continents, to promote local talent and bring them to the international stage (Vodafone, 2015). The competition is open to both individuals and start-ups that can develop applications for any of iOS, Android, J2ME or WP8. However, organisations that have developed applications for clients are ineligible to participate in the competition. According to Vodafone (2015) many people in Ghana are passionate about

information technology. Their dream is to design web or internet services that can be useful to their country or their community. Another dream that many Ghanaians share is to become entrepreneurs, own their own businesses and run them successfully.

Mobile Web Ghana which incidentally is managed by one of the case firms, started in December 2010, and developed as part of the World Wide Web Foundation's Mobile Entrepreneurship in Ghana program. Mobile Web Ghana is a non-profit organisation that aims to boost the uptake of mobile technology in Ghana.

The institution has two main focal points. First, to help passionate people become mobile-technology entrepreneurs, by teaching them to create applications accessible via mobile phones. Secondly, to help the trained personnel develop the business side of technology, and teach mobile business: start-ups, market research, business models, et cetera. The institution runs mobile entrepreneurship training sessions every 6 months. The training is followed by a period of mentorship and incubation, where promising projects are developed further and moved toward becoming commercial services.

5.4 Findings from Selected Cases

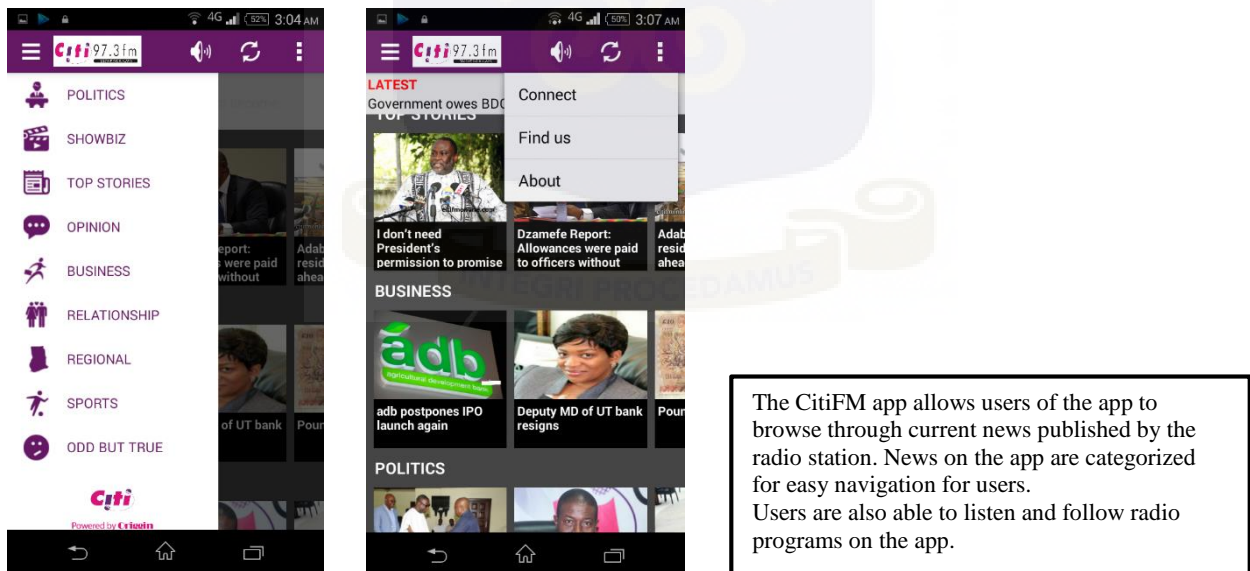
This subsection presents the findings of the case firms under study, the background history and organisation structure of each firm as well as current projects they are undertaking. The section also presents the constraining factors of each organisation guided by the T-O-E framework as well as the enabling factors that influence MAD among these two firms.

5.4.1 The case of Origgin

5.4.1.1 Brief Profile

Origgin is an indigenous Ghanaian consumer technology company founded in 2010 with the simple idea to leverage the power of technology to advance daily human living. The company designs and develops mobile application software for smartphones and tablets for end-users on android and iOS platforms only. The company has a firm size of about 15-20 workers. The website of the company speculates that *Origgin is one of few technology companies in Ghana building products and delivering services to challenge and meet up to international competitions.* Some popular applications of Origgin include Radio Gold, waakye locators, shopping mob, the Duncan William Ministries and Citi FM.

Figure 5. 1 Snapshots of an Origgin Developed App (Citi FM)



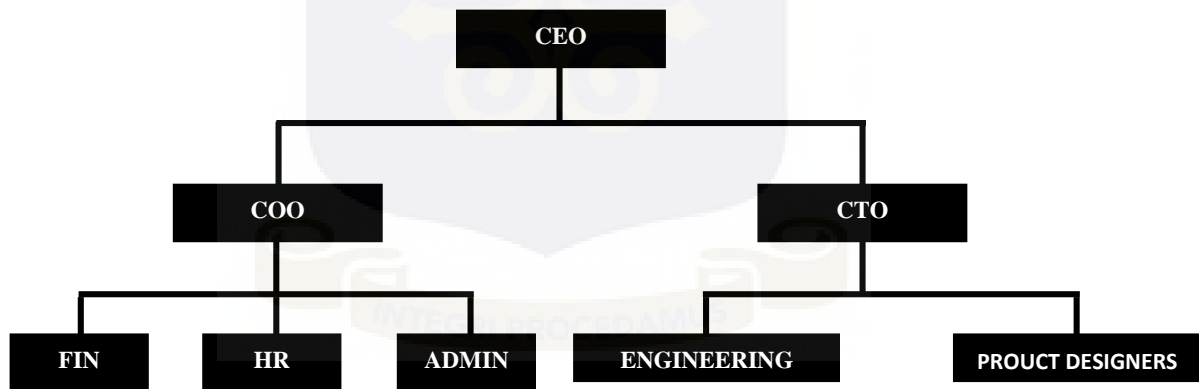
Source: Origgin Applications

Origgin operates with a team of fourteen comprising the Engineering team, Product team and the Business and Operations. The executive management is made up of three, the Chief Executive

Officer (Kane Mani), the Chief Operations Officer (Worlanyo Kojo Forster) and the Chief Technical Officer (Samdan Tettey Kudjodji).

The COO oversees the business division which is responsible for selling Origgin app services, waakye locator and other Origgin applications. He is also responsible to overseeing the finance department, the Human Resource department and the administrative team. The CTO on his part is also directly in charge of managing the engineering team (the engineers, mobile developers, web developers) and overseeing to all technical issues of the company. He is also directly responsible for supervising the product team. That is, the product designers and product managers. The Chief Technical and the Operation Officers report directly to the CEO who manages the top line of the organisation and also deals directly with investors and the Board of Directors.

Figure 5. 2 Organisational Structure of Origgin



Source: Field Interviews with Origgin Top Management

Kane (CEO) who studied film directing at the National Film and Television Institute (NAFTI) is a cofounder of Origgin. The company website reports that, Kane was recently named the entrepreneur of the month has featured on local and international fronts on his efforts in entrepreneurship and technology in Ghana (Trends & Rating Consult, 2015). Kane was swift at deflating the title of a developer ... *I am not a developer, I am an entrepreneur...*

Forster (COO) holds a BA in Economics from the Kwame Nkrumah University of Science and Technology (KNUST), Ghana and an MSc in Purchasing and Supply Chain Management from the Robert Gordon University, Scotland. He is also a member of the Chartered Institute of Purchasing and Supply (CIPS), United Kingdom. He joined the company in 2013 after prior working experiences in the public, educational, and private sectors in Ghana. Samdan (CTO) joined Origgin in February 2013 as a part-time technology consultant before fully joining in October, same year and assuming the role of CTO. He studied software engineering at BlueCrest College - Ghana. Origgin's business runs on two modules; applications that are pre-built for different category of industries (Bank applications, churches, airlines, hotel etc.) these are business applications and are sold at a flat fee to clients and secondly, customised applications which are individual focused.

5.4.2 Mobile Application Development Process

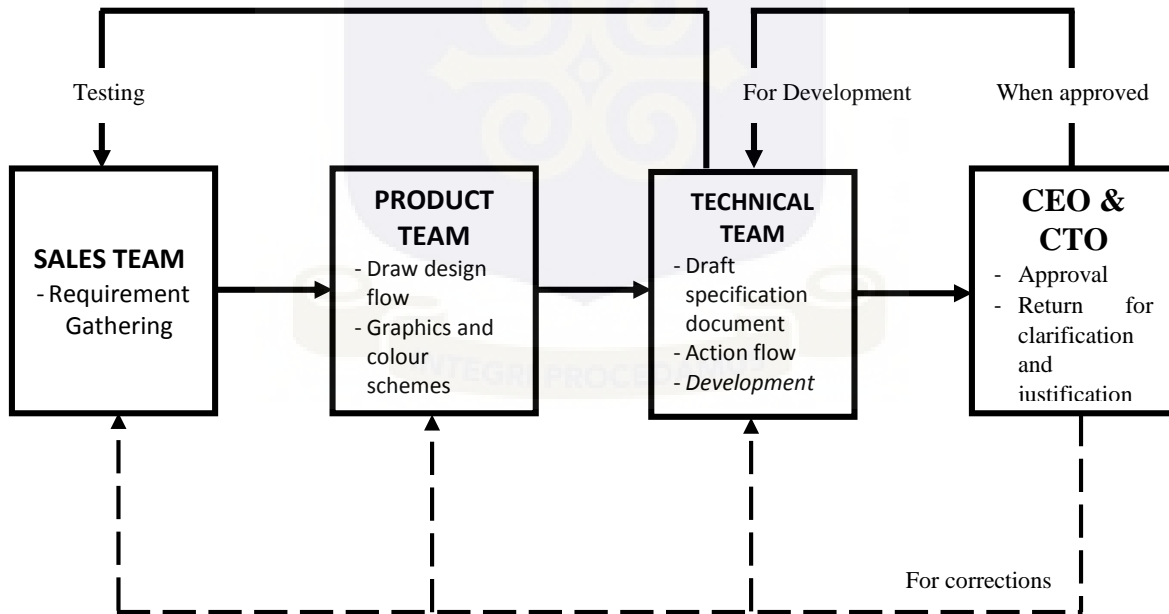
The organisation ensures a rigorous iterative process in building applications beginning with the sales team who makes contact with respective industries and sells the idea of the application to them. The sales team outlines all the activities of the contacted industry and then pushes the ideas down to the product team. The Product team at this stage comes up with the design flow and how they can fit the industry into their design. At the same stage, the graphic designers come up *with the colours, buttons and places they think icons can be well placed to trigger the intuition of the users.*

The product team then hands over to the technical team when the concept is fully developed. The technical team then drafts a full specification document of the activity flow of the project. Kane

explains, *this is done so that in case any of the team is not around and another team comes, they can pick up from where the previous team left off and begin to build upon it.*

The document is then forwarded to the CEO and the CTO who approves of it or returns it for correction and/or modifications. Upon approval, the document is then forwarded to the programmers who are also members of the technical and engineering team for development. After development, the application is then given to the sales team for testing before deployment. It is however worth noting that, though the process does not follow the MADLC entirely, the company ensures that, they use the available human capacity to ensure that they deploy an app of a good standard.

Figure 5. 3 Application building process at Origin



Source: Field Interviews at Origin

Origin’s combination of both entrepreneurial and technical skills safeguards the continuous positioning of IT and management in the firm. The organisation further aims at ensuring that the

company is au courant with contemporary trends in the developer space. For instance, the CEO reports that *at a point we had to fly one of our developers to Kenya to go and learn trends in app development and in turn come and replicate it.*

5.4.2.1 Constraining Factors

These sections present factors that constrain Origgin from developing mobile applications. Further in each subsection, the author presents steps or interventions the firm is taking to address those limitations.

5.4.2.1.1 Technological Constraining Factors

Origgin began with the business notion of building mobile applications across four platforms namely, Android, BlackBerry, iOS and Windows. However as the market grew, the company realised that, investing into BlackBerry and Windows was not a viable venture therefore, the organisation took a firm decision to build applications only for platforms that are dominant and had a larger global market share that is, Android and iOS. Origgin had the leverage of developing cross platform applications however, the CTO recommends that the organisation focuses solely on building native applications for each platform. This is because *the cross platform technology is not really robust and has a lot of security issues that comes with it. Hence you don't get to control the look and feel of the app.*

The organisation is constrained by the limited market opportunities of BlackBerry and Windows. Therefore developing cross platform applications which in turn is not robust is a problem to the organisation. Origgin further believes the quantum of people using BlackBerry and Windows as compared to those using Android and Apple devices are very few. The CEO to that effect posits

that *businesswise, it makes no sense in building applications that have relatively smaller market shares and only few people will use at the end of the day*

On used technologies, Origgin's main challenge came as a result of Apple's developing language (Objective C) not being a *universal language*. This therefore made it difficult for the organisation to commence developing on iOS from the onset. The organisation upon realising this challenge and how much it will cost them with respect to business and competition invested in their CTO to study the Objective C language. This challenge, though, at present solved has presented itself in another way as Apple has introduced *Swift*. But *making a switch to swift* according to Kane is not really a problem as the *technical team have begun learning the language to make way for the change and the trend as it is coming*.

Another factor that constrains Origgin is the handling of bugs, patches and update. Updates can be looked at from the supplier and also the consumer. Origgin pays its suppliers (Google and Apple) to keep the organisation updated on *latest* updates on Operating Systems. This according to the CEO is not a problem. However, managing updates on the consumer side poses a major threat to the business. *Managing updates and patches in our part of the world is very obscure...* Kane asserts. The attendant effect created by this is as a result of consumers using android versions such as Froyo and Gingerbread both released in 2010. The CTO shares a practical example of how they are constrained by this challenge

We built an app for Citi FM that has over 2000 users on it as at now.

We were getting a lot of crash issues but we at Origgin had used the app for over two months without any of such issue. This therefore

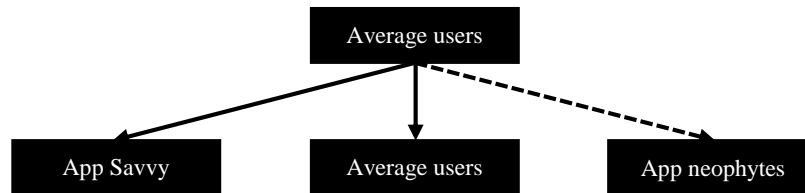
propelled us to go to our developer dashboard to track the source of these issues. We realised from the information on the dashboard that majority of the users who were complaining about the app were Froyo users and that the technology we had built on was more advanced than Froyo.

In such instances, the company has to take a decision to address the problem depending on the proportion of user complains to the number of active users. For example, if the number of users complaining is say, 1 per cent of the 2000 users, do we downgrade to please them or we leave them hoping they will upgrade or they get to buy advanced phones? The CTO asks. However if they had been the majority, the organisation would have brought the usage of the app down and developed a newer version using the information provided by the developer dashboard for the previous version. This according to him will kill your business branding and clients will lose trust in your service... it is really very challenging. The company eventually updated the app to meet the users' demands because the majority of the app users were using versions lower than the original design.

Finally, Origgin faces the challenge of anticipating the convenience of its customers. The firm therefore relies on the concept that there are three categories of users. Those who are *app savvy*; this category of *people know what an app is, know how to manipulate the user interface, how to 'click' and even know where to click without any tutorial*. The second category, *know not much as the first but are smart guys who know their basic clicks and can use intuition to use the app*. Lastly, the third group *who don't know anything at all about app who may be newbies in app usage*.

Origgin according to the CEO therefore focusses mainly on the first two set of users because *as a company, we can't serve everybody*.

Figure 5. 4 Origgin's Category of Users



Source: Field interview at Origgin

By so doing, the company does not lose sight of ensuring the UX of their customers. Consequent to this Origgin has two members of the product team whose core job is to make sure they come up with a complete design which would then be implemented by the programming team. Samdan (CTO) points out that user interface and experience (UI/UX) are the *key drivers in making applications successful*. *You can make a lot of noise about your app; it can have great functionalities and solve bigger need but if the technology behind it i.e. UI/UX does not match, you don't really get people engaged with your app.*

5.4.2.1.2 Organisational Constraining Factors

Organisation wise, one factor that constrains Origgin in the application development process is testing. Practically, the organisation uses its sales persons in testing their applications. However, to ensure the testing of the application is not Origgin bias, the organisation after using its sales persons in testing the applications for a week or two does random sampling of app users possibly in an institution like the University of Ghana where there possibly may be many app users to test the application and *pass conscious criticisms and feedbacks* as to where the app needs a second look.

Secondly, the organisation in its efforts to develop application is constrained by the fact that, they don't fully use their website in the distribution of applications. This is largely due to the reach of Origgin's websites in sharp contrast with the reach and popularity of the major mobile application development distribution (MADD) portals. Currently, Origgin publishes its applications on Google Play and iOS App Store which are owned by Google and Apple respectively. These portals in hosting the applications for distribution charges between 20 to 30 per cent on the total sales of the applications hence Origgin receives 70 to 80 per cent of the app sales they make on these portals. Kane Observed:

This is basically a threat because if Goggle decides to shut down their Play Store business right now, it means all the applications are dead likewise Apple and these are no new things. They happen as business grows and technology happens.

Origgin therefore has a long term goal of building its own application portal which will in turn host and distribute "African Content" mobile applications. The CEO notes that *in as much as we don't wish for the shutdown of Google Play or the App Store, in business anything can happen and in technology as well. So we have to create these backups.*

5.4.2.1.3 Environmental Constraining Factors

Mobile internet data usage among Ghanaians is one of the major external challenges facing Origgin in developing mobile applications as mobile app users prefer going for an offline app rather than applications that run on mobile data. Mobile internet data enables an app subscribers' mobile phone, tablet or mobile broadband modem to access the internet. This includes web surfing,

emailing, video and music streaming, downloading, uploading and using applications. Currently in Ghana, mobile app users access the internet by either subscribing to data bundles provided by the telcos or run on a pay as you go service. Table 5.2 illustrates data charges per megabyte across networks in Ghana.

Table 5. 2 Data charges by Telecommunication Companies in Ghana

	MTN	Tigo	Vodafone	Airtel	GLO	Expresso	Industry Average
Data/MB	¢0.1	¢0.2	¢0.2	¢0.1	¢0.08	¢0.0500	¢0.1217

Source: NCA, 2014

This phenomenon poses as a major constrain because Origgin applications that run on the framework of internet connectivity deter users from using the applications. In the words of the CTO *because most of our internet services are expensive and are slow too, most users are scared to use applications that have video content because it will consume much of their data.* Comparatively, with a minimum wage of GH¢7.00 (Osam, 2015) average users with internet moderated applications pay more than a double of their basic wage per day to browse a gigabyte of mobile data as illustrated below.

Table 5.3 Data Cost per gigabyte across networks in Ghana

	MTN	Tigo	Vodafone	Airtel	GLO	Expresso	Average across network	Minimum Wage
Cost/GB	¢20.00	¢12.50	¢20.00	¢20.00	¢12.50	¢15.00	¢16.67	¢7.00

Source: Telcos' websites

In line with efforts towards addressing this challenge, Origgin has signed up partnerships with MTN (Telco) and ISP (Surfline) for special data bundles that come with Origgin applications. In this regard, users of the applications do not necessarily use the applications at the full expense of their data rather, Origgin's partnership with the aforementioned organisations subsidise cost of

data consumption for users of Origgin applications at a 50 per cent discount. Users of the app on MTN therefore pay GH¢2.00 for 200mb.

Origin commenced operation in 2000 as one of the few institutions then offering MAD services in Ghana when all other organisations in similar industry were offering SMS and web services. Origgin currently faces a stiffer competitive pressure as more and more MAD organisations as well as independent developers enter the industry due to the free entry nature of the developer space. Further, institutions that formerly relied on mobile applications are gradually oscillating towards SMS and web services as a substitute means of maintaining constant interaction with their customer base. The CEO laments:

Currently, we are the leading company in Ghana doing this but people are seeing the opportunities in our space and entering there so now the space is becoming tighter. Also the SMS and web business are threats because most people think SMS and web are still the convenient way to do business online and to reach customers.

Further, Origgin faces the challenge of having to deal with the nature of the app market in Ghana. According to Kane, *the app market in Ghana is not ready for such things*. By his assertion, MAD is not a *country specific* phenomenon. It is a *global thing*. As such, several international developing firms have *flooded* the market with free applications which in a way have diluted the *notion* of buying applications among Ghanaian users.

In that regard the organisation believes in the *blue ocean strategy* as a means of building the app market in Ghana. The Chief Operations Officer explained the reason for this strategy as follows:

We can't wait for the market to get ripe. We can create the market. That has been one of our major goals; to create the market. There was never a smartphone until Apple created the market and now people are rushing into it.

5.4.2.2 Enabling Factors

This section presents key enabling factors that drive Origgin at developing mobile applications. These sections are further divided into the constructs of the T-O-E framework and as well in harmony with the interview data.

5.4.2.2.1 Technological Enabling Factors

Origgin's application development initiatives are driven by a number of technological factors. For example, the organisation develops hybrid applications (Section 2.4.3) for each platform. This initiative is driven by the unstable nature of the cross platform development frameworks irrespective of its ability to save the company time and monetary resources. The organisation has further trained their technicians in both Java and Objective C for android and iOS respectively. Since these are the only two application platforms Origgin develops for, the organisation finds it an *intelligent initiative* to develop only hybrid applications for these two platforms. In the words of the CTO: *We made a key decision that, we would be a native app development company even though it takes a longer time to build as compared to the cross platform applications.* The decision to invest time and resources into native applications *is to enable the company have control of the UI/UX, the design, the technology and build applications that we can for a long time be proud of.* Origgin at the moment takes advantage of Research in Motion's innovation of leveraging android applications to be installed on BlackBerry OS 10. BlackBerry 10 introduced an Android runtime

layer, which allows users to install Android application on their BlackBerry devices. In this regard, the CEO of Origgin says, *this is a good thing for us. It isn't a threat at all.*

This in effect means the company can continue to focus on the two platforms they develop for without having to develop specifically for BlackBerry. The assertion of the CEO was confirmed by the CTO: ... *There are die hard BlackBerry fans who will not use anything apart from BlackBerry. So I think the move to let BlackBerry turn to android is a smart move for BlackBerry because it will allow their people to use android and in turn will increase our market share and make our app distribution go wider.*

5.4.2.2.2 Organisational Enabling Factors

The firm size of the organisation is one of the major contributing factors towards application development in Origgin. The organisation has departments and individuals skilled in their respective positions which enable them to execute jobs in relatively lesser time periods. This is evident in Origgin's organogram (Figure 5.1) that the CEO performs a different role from the CTO and the COO which makes the respective heads of departments have complete supervision of their departments. For instance, the CEO is an entrepreneur so he sees to the everyday running of the organisation while the CTO is a developer who heads the technical team. In the words of the CEO, *our organisation size is an advantage to us because, the top management have complete oversight responsibility over their various department without interference.*

Another organisational enabling factor at Origgin is the seemingly boundary-less nature of mobile applications. The organisation tends to develop applications for Ghanaians while also believing that applications know no boundaries, some of the applications can be used in other countries unless they contain Ghanaian content that will relatively not make *sense* to a non-Ghanaian. For example, an application like Origgin's waakye locator will not make sense to someone outside Ghana however industry applications like hotel locators will appeal to a foreigner travelling to Ghana. This therefore puts no restriction on the development aspiration of the organisation but rather motivates them as application development is a global phenomenon.

5.4.2.2.3 Environmental Enabling Factors

Origgin believes that, the high rate of smartphone adoption in Ghana is one of the factors that drive the company to develop mobile applications. As application developers, the organisation's applications are developed with smartphones and tablets in mind. In that regard, the COO suggests that *one key opportunity we have gotten now is the "Drop that yam" tag*. According to him *Tigo's advert has caused a gigantic rise in smartphone adoption in Ghana over the past four months (December 2014 – March 2015)*. The Advert reproves users of feature or basic phones to opt for smartphone; Samsung galaxy young 2 (The Spectator, 2015).

Further, to Origgin, the proliferation of applications like WhatsApp, Viber, and Facebook just to mention a few have propelled most users of feature or basic phones to migrate to smartphones. This phenomenon together with the *"Drop that yam"* catchphrase in the public domain in the words of the CEO *have caused a rise in the arc of smartphone users and most businesses have come to realise that, building an app for their businesses is no more luxury but a necessity*.

Finally, Origgin's MAD choices are motivated by the dominance of android and iOS in the mobile app market. Even though the organisation began with the business idea of capturing the four major smartphone operating systems; iOS, BlackBerry, Windows and Android, the organisation is restricted to develop for iOS and android due to the large market share they possess.

In this regard, the technical division of the organisation is divided into two with respect to android and iOS hence the decision to develop only native applications and particularly focus on the two operating systems. The Head of the engineering team observes that *the focus on the two operating systems gives us enough time and puts us on top of issues in the respective operating systems.*

5.4.3 The Case of Nandimobile Limited

5.4.3.1 Brief Profile

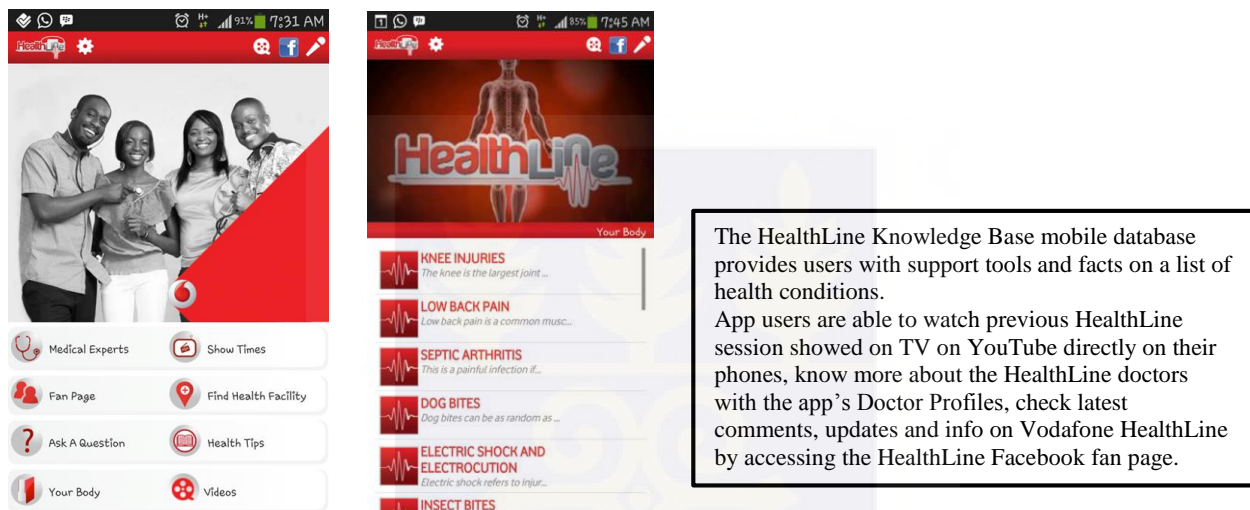
Nandimobile Limited is a software company which focuses on serving the technological needs of organisations and businesses in Ghana. The core business of the company is to leverage mobile phones for communications between businesses and their customers.

Nandimobile was founded by a team of three co-founder (Anne Amuzu, Edward Tagoe and Michael Dakwa) who graduated from the Meltwater Entrepreneurial School of Technology (Section 5.3) in 2010. The team got funded after pitching their idea to the Board of Directors of MEST and got incorporated on June 26, 2010. They are currently housed in the School's incubator in East Legon, Accra.

Anne, one of the three cofounders holds a degree in Computer Engineering from The Kwame Nkrumah University of Science and Technology (KNUST) and doubles as the Chief Executive and Technical Officer (CEO/CTO) of the organisation. Edward Tagoe was the Business

Development Manager and holds a first degree in Psychology and Michael holds a degree in building and technology and was also the Technical Manager of the organisation.

Figure 5. 5 Snapshots of an app developed by Nandimobile (Vodafone HealthLine)



Source: Nandimobile Applications

5.4.4 Mobile Application Development Process

Nandimobile develops both organisational and individual applications. Applications for organisations are usually developed at a fee paid by the respective organisation. However, applications meant for individuals are free applications and therefore attracts no monetary returns when a user downloads and uses them. That notwithstanding, Nandimobile needs another lens to look at ways to realise returns on investment from developing free applications. This they do by placing adverts on free applications of which organisations that advertise on them pay. Anne discloses:

It's like you develop the app and you realise someone will not pay for it so you make it free and find another way to get your money.

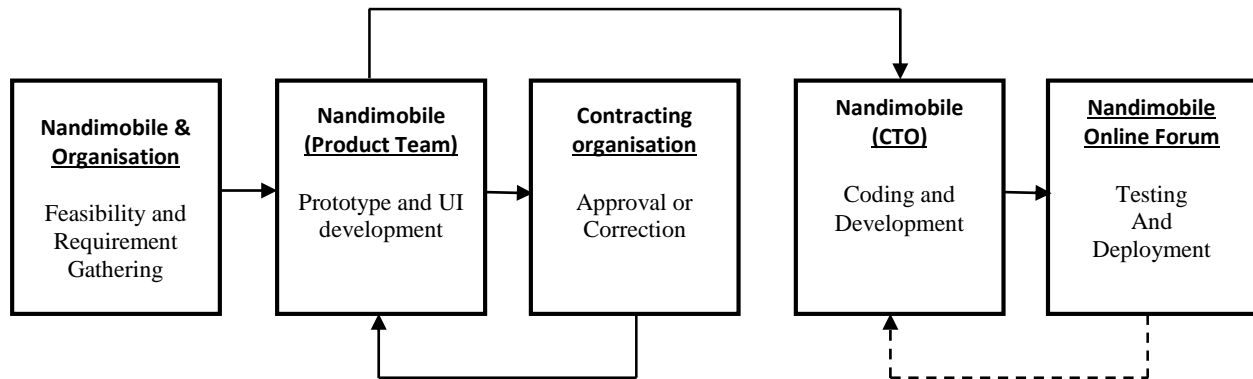
MAD in Nanadimobile with special emphasis on those developed for organisations go through a series of steps from feasibility study to deployment.

Nandimobile assumes, the contracting organisation has gone through its own feasibility study and has identified a problem that needs solution which required them to contact Nandimobile to develop an application to that effect. The organisation then together with Nandimobile come up with the requirements of the app.

Nandimobile upon helping the organisation come up with the app's requirement then develops a prototype UI for the organisation to determine whether the right colours and other related items are well employed. Coding and development then follow after all approvals are made by the organisation.

Testing is done to establish the stability and performance of the application. Nandimobile does this with the aid of independent app users who agree to test the application. Responses are then collected via email or on the forum in instances where online forums are used. *From there if everything is fixed then we can deploy it.* Anne concluded. Figure 5.1 illustrates the development process at Nanadimobile.

Figure 5. 1 Application building process at Nandimobile



Source: Field Interviews at Nandimobile

5.4.4.1 Constraining Factors

In spite of the enablers presented above, there are constraining factors that hamper Nandimobile in the quest to develop applications in Ghana. This section therefore presents these constrains and the interventions the organisation is taking towards addressing them.

5.4.4.1.1 Technology Constraining Factors

As discussed in earlier paragraphs, Nandimobile develops applications for Android and iOS devices. The organisation even though desires to develop cross platform applications is met with the challenge of having to deal with the instability of the frameworks (Xamarine, Phone Gap et cetera) for developing cross platform applications which compels the organisation to develop native applications for each operating system. However, developing native applications requires the organisation to commit more resources and time. The CEO/CTO summarizes, *developing for different platforms constrain us a bit because you need more time to do the same thing for the different platforms which is time consuming and financially demanding. Now there are some*

frameworks that enable you to develop across platforms but they are not as stable as compared to developing natively so they are not really the best.

In line with developing native applications, Nandimobile is also faced with the current challenge of having to switch from Objective C (*the primary language used in developing applications for OS X and iOS*) to Swift (*A new programming language for iOS and OS X applications that builds on Objective C*) as the new language for developing applications for Apple iOS. This technological trend poses as a constraint to the organisation because they perceive previous versions of the iPhones and iPads would not be able to run on the new language. It further means that the technicians in the organisation would have to learn the language in order to keep with time. Announcements: ... *So that means you have to learn a new programming language altogether to develop for iOS. That's not good though the new language might be better than the older one, it also means the existing persons have to learn the new programming language or if they can't, then we have to outsource.*

5.4.4.1.2 Organisation Constraining Factors

Nandimobile Limited runs on a similar module like Origin's. There are applications for organisations which are designed particularly for organisations at a fee and there are those that are developed for individual consumption and are free. Developing paid app (applications for organisations) do not pose much problems to Nandimobile however, having to deal with bureaucratic conditions when applications are developed for a respective organisation is a challenge. This happens especially when there are feature requests as every 'boss' at every level of the organisational hierarchy has a peculiar feature he/she requires in an app which sometimes

induces Nandimobile to develop the applications all over again. According to Selorm, *developing for organisations is sometimes hectic because everybody has feedbacks especially when it's a big organisation, the person you are talking to has a feedback, his boss has a feedback and the boss of his boss also has something different. At the end of the day you would come back to square one.*

Developing free applications however is not the wish of Nandimobile but by the organisation's perception, Ghanaians are not interested in paying for applications which makes Nandimobile develop free applications *not because we want to be charitable but it's because we don't have a choice* Anne laments. That notwithstanding, the organisation bypasses this constrain by delving into free applications by imbedding adverts in the applications. She concludes, *Ghanaians are not repulsive of ads in applications (Adverts in applications) yet but the threat is, they don't want to pay to download any app so it is difficult to monetise an app per download. You always have to look for other ways and means to monetise it.*

In order to reach a wider audience, Nandimobile uses their website to disseminate information, however, when it comes to application distribution, the organisation uses the application portals of the platforms they develop for (Android and iOS). Nandimobile prefers using their website for the distribution of applications however, they are constrained by the fact that their website do not reach a wider audience. Further, *the traffic on our website cannot be compared to that of the portals. So the prudent thing to do is to join them*, Selorm confesses.

Finally, the organisation has been constrained over the past year by the exodus of two co-founders. Michael Dakwa, the then Technical Manager left the company to pursue a personal profession in

photography and currently the manager of Team1000Words. Edward Amartey Tagoe who was also the then Business Development Manager is currently working with Blogging Ghana; a non-governmental organisation though he still works with Nandimobile on part time basis.

These adverse developments have had attendant effect on the way Nandimobile runs its operations. For instance, Anne now doubles as the CEO and the CTO and Selorm also doubling as the Business Development and Product Manager. In this regard, *requirement gathering is normally done by a different person from the one doing the coding in other organisations but here [Nandimobile] anybody can do the requirement gathering and could be the same person doing the UI/UX*. Selorm the current BDM says.

5.4.4.1.3 Environmental Constraining Factors

Culture plays a very important role when it comes to application development. Applications that may be well embraced in other jurisdictions may not have a fairly good reception in another jurisdiction. Per Nandimobile's judgment of the application development landscape of Ghana, Ghanaians have the culture of being 'spoon-fed' with applications hence the reluctance in paying for applications. In any case, app users in Ghana seem to find alternative for applications that require them to pay. Secondly, depending on the way Ghanaians use their phone, the organisation is restricted to developing certain types of applications. For example, Anne (CEO/CTO) explains that, *if you are building a payment platform, you should measure how far you would want to go because not every Ghanaian is comfortable with online business transactions*.

Relatively, paid applications on application portals require app users/downloaders to pay using electronic payment methods which are rare though not impossible in Ghana. Nandimobile finds

this as a major challenge as average Ghanaian users of a mobile app to their (Nandimobile's) estimation do not own a visa cards or MasterCard.

Finally, Nandimobile is constrained to develop particularly for android and iOS in the sense that, the other platforms; Windows and BlackBerry do not own a substantial portion of the market share. This therefore coerces Nandimobile to make do with the present market trend focussing on the top two. Anne Summarises ...*So the first platform we consider is android and secondly iOS. Windows is coming up so that will possibly be our third choice.*

5.4.4.2 Enabling Factors

Nandimobile's MAD choices are influenced by a number of factors. These factors are delineated in this section in terms of technology, environment and organisation.

5.4.4.2.1 Technological Enabling Factors

Nandimobile develops applications solely for Android and iOS operating systems even though the organisation in time past has developed J2ME applications; applications for feature or basic phones. Technologically, Nandimobile appreciates the roles played by the two giant operating systems in the provision of their SDKs. These motivation is further backed by the fact that there are more to application development than smartphones. For this reason, concentrating on Windows and BlackBerry would limit Nandimobile to developing just for smartphone when Android and iOS would give the organisation the leverage to optimise their applications for tablets as well. Anne says: *even though most of the platforms provide their SDKs, I think it is safer to develop for iOS and android considering the number of people using their tablets and iPads... it is not rare to*

see people with playbooks or windows tabs but how many? She questions. Consequently, this phenomenon defines the market and technological trends of the organisation.

To ensure that their applications are stable and do not pose security issues to users, Nandimobile opts to develop native applications for Android and iOS even though there is the availability of cross platform frameworks. Native app development enables the organisation to have command over the language instituting command lines and codes according to the respective operating system. Nandimobile for some time past has ventured into developing web-based applications (Section 2.4.2) but not without issues as some features in web-based applications did not always work on every OS hence the justification for native applications. Anne discloses: *to go around the multiple platform, sometimes we do mobile web but that also has its constraints. Some features might not work in mobile web so you might end up developing all over again so we only consider developing natively.*

5.4.4.2.2 Organisational Enabling Factors

Nandimobile as earlier noted got funded by MEST after pitching their business idea to the Board of Directors and subsequently housed in the institution's incubator. The incubator since its inception in 2010 houses a number of start-ups that came out of the MEST training program. According to MEST (2015) the incubator supports the overall mission of MEST by providing seed funding, office space and hands-on support for graduates.

In view of this shared office space, one key enabler to Nandimobile Limited is the close proximity to available expertise that may be readily available to them. The MEST incubator encourages knowledge sharing among pitched companies in the incubator hence Nandimobile's accessibility to the pool of available knowledge from the shared office space. Again, Nandimobile uses this platform of personnel to test their applications. In this regard, Nandimobile makes its applications available in testing mode to the other departments and personnel available in the incubator for assessment and suggestions barring any Nandimobile biasness.

Relatively, Nandimobile creates a virtual user platform for users outside of the incubator and have no relation to Nandimobile in the testing of their applications. This step taken by the organisation has enabled them to create a network of testers who are always ready and willing to test applications for Nandimobile.

5.4.4.2.3 Environmental Enabling Factors

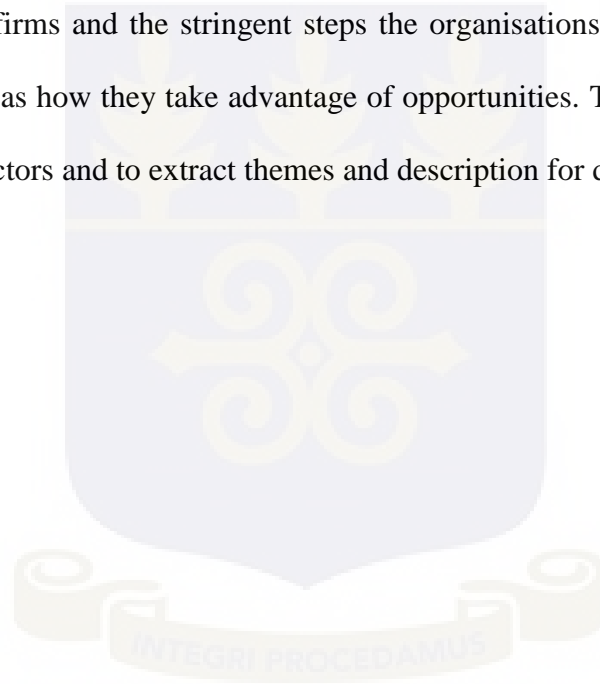
Nandimobile perceives the notion of developer and promoter events as opportunities to the organisation. This phenomenon does not have a direct influence on the application choices of the company but conversely, *'it helps us know what is going on in the app space in Ghana'*, Selorm claims. Additionally, the organisation feeds on participating or winning applications when they are announced, to project the trends in the app space.

To Nandimobile, government's decision to remove import duties on smartphones is a good step towards helping make smartphones affordable to all hence a rise in the penetration of smartphones in Ghana. Anne says: *We heard Government has intention to remove import duties on*

smartphones... that's a good thing for us. The organisation believes that application development in the current dispensation are meant for smartphones and tablets hence a prudent step for the Ghanaian Government to promote the adoption and use of smartphones (Biztech, 2015).

5.5 Summary

The case studies presented in this chapter suggested the presence of enabling and constraining factors among the case firms and the stringent steps the organisations are taking in addressing those challenges as well as how they take advantage of opportunities. The next chapter provides analysis of the related factors and to extract themes and description for discussion.



CHAPTER SIX

ANALYSIS AND DISCUSSION OF FINDINGS

6.1 Introduction

The purpose of the study is to explore factors that influence MAD among Ghanaian firms and to assess how these firms are taking advantage of opportunities and how they are addressing the threats in the Ghanaian developer space. Evidence from the field were presented in the previous chapter highlighting technological, organisational and environmental constraints and enablers among two similar firms and the intervening measures they are currently taking to address those challenges. This chapter therefore goes beyond the previous to analyse and discuss these factors with regards to the case firms guided by the research framework as discussed in chapter two.

6.2 Comparisons between the Two Case Firms

The case design for this research dwelled on a multiple-case approach (Section 4.4.1) intended to draw similarities and comparisons in case results in order to draw out key themes and analyse them for conclusions. Further, in order to satisfy section 4.4.2 this subsection presents the similarities between the case firms. The case selection as discussed in 4.4.2 indicated that organisations selected for this study were MAD firms who have been two years or more in continuous operation. Table 6.1 thus illustrates the similarities and differences between Origgin and Nandimobile as discussed in the findings.

Table 6. 1: Comparisons between the Two Case Firms

	Origgin	Nandimobile
Founded	2010	2010
Co-founders	2	3
Firm Size	15-20	7
Start-up funding	Self-funded	Sponsored
Core businesses	Web and mobile app development	SMS services and mobile app development
App Development	Paid applications	Paid and Free Applications
Target	Individual and Corporate	Individual and Corporate
Platforms	Android and iOS	Android and iOS
Applications	Native	Native
Distribution	Website, Google Play and App Store	Website, Google Play and App Store

Source: Author's Construction

6.3 Enabling factors

This section presents the enabling factors that influence the application development choices of the case firms. From the case findings, it was revealed that both Origgin and Nandimobile had similar key enabling factors that drive them to develop certain types of applications. In view of this, these enabling factors have been designated into the TOE framework discussed in chapter three.

6.3.1 Technological Enabling Factor

Table 6.1 Table of Technological Enabling Theme

Factor	Origgin	Nandimobile
Native Development	✓	✓

Source: Author's Construction

Technological readiness describes both the internal and external technologies relevant to the firm and includes existing technologies inside the firm as well as the pool of available technologies in the market as discussed in chapter three. From the findings, there was the indication that, native application development is a shared factor by both organisations as a major enabling factor.

In both organisations, the decision to develop native applications is as a result of the apparent unstable nature of the cross platform development frameworks. While Origgin, took a one-time decision to develop native applications as a way of going round the cross platform development constraint, Nandimobile tried developing web based applications but later switched to native applications because some features of the web based applications did not work on most mobile devices.

Despite the point that native application development is time consuming and financially demanding, both organisations develop natively due to the relatively few number of platforms they develop for that is iOS and Android as well as the desire to have control over the look and feel of the applications. This thus mean the market dominance of the two operating systems enable the organisation to restrict themselves to developing native applications for those two platforms while not losing sight of the need to have control over the functionalities of the applications.

6.3.2 Organisational Enabling Factor

Table 6.2 Table of Organisational Enabling Theme

Factor	Origgin	Nandimobile
Firm Size	✓	×

Source: Author's Construction

Iacovou *et al.* (1995) defined organisational readiness as the availability of the needed organisational resources for adoption. As discussed in chapter three, the context further refers to the characteristics and resources of the firm, including linking structures between employees, intra-firm communication processes, firm size and the amount of slack resources.

In relation to this study therefore, data collected from field interview revealed firm size with developer involvement as a relative enabling factor.

Evidence from the findings points to the fact that this factor plays a dual role with respect to MAD among the case firms. With the focus of this section being enabling factors, the emphasis hence will be based on Origgin as the organisation sees the size of its work force as an advantage rather than constraint.

The elaborate organisational structure (Figure 5.1) gives a clear indication of the subdivision and the roles played by each department in the organisation. Further, though some individuals in the organisation play multiple roles at some point in time, the specified roles of each department and key employees give them the propensity to focus on tasks until they are fully executed before moving to the next.

Analysis of the firm size with regards to testing of applications further indicates that, before applications are taken beyond the walls of Origgin for testing, they are pre-tested by the sales persons who are not developers so as to establish the views of non-developers before deployment. This is made possible because, the sales team becomes relatively quiescent when they finish their role as far as the development process is concerned.

6.3.3 Environmental Enabling Factors

Table 6.3 Table of Environmental Enabling Themes

Factors	Origgin	Nandimobile
Smartphone and Applications adoption	✓	✓
Potential Market Demand	✓	✓

Source: Author's Construction

According to Baker (2012) environmental context includes the structure of the industry; the presence or absence of technology service providers, and the regulatory environment. Analysis from the finding further revealed that three factors come into play as environmental factors that enable MAD in Ghana. This section thus presents these factors.

First, judging from the findings, the high rate of smartphone adoption among Ghanaians has served as a major boost to application development among the case firms. While Nandimobile claims that Government's waiver on the import duties of smartphones importations is a plus for them towards developing more for smartphones, Origgin on the other hand holds that Tigo's *drop that yam* advert has caused a bold rise in the smartphone adoption of Ghanaians and that advert in particular has rejuvenated them to develop more applications. The palpable reason for this is that,

both organisations do not anticipate a decline in the adoption of smartphones in Ghana anytime soon.

Relatively, both case firms attest to the fact that the proliferation of applications such as Facebook, Whatsapp, Instagram among others is also a factor for smartphones adoption in Ghana as such the organisations run on the back of this venture to develop application as users of smartphones do not only use the aforementioned applications but would like to explore more.

The case firms from the findings secondly indicated that, the dominance of operating s/systems such as android and iOS motivates them to most especially develop applications for those operating systems. Both organisations exhibited no trace of developing for either BlackBerry or Windows however Nandimobile during its business commencement developed J2ME applications but the decline in the adoption of feature phones in Ghana means the organisation had to focus solely on smartphones.

Further, the case firms take advantage of BlackBerry's initiative to allow .apk (Android Application Packages) to be installed on BlackBerry 10 and above to focus on developing for the two leading operating systems however, in any circumstance if Windows and BlackBerry become dominant, they (case firms) will not hesitate venturing into developing for them.

Finally, partnerships with third party organisations stemming from the findings indicate that, Origgin allies with MTN and Surflin as means of subsidising for Origgin app users who are on the networks to be able to use video and audio streaming applications. The partnership with MTN

started in 2010 with Origgin's MTN Yellow app which allowed iPad users on MTN to recharge their credits from their iPads using an app developed by Origgin. The organisation is enabled to develop applications that stream videos and audios due to the partnerships with these ISPs. Contracted applications are however not subsidised apart from Origgin applications. It is worth noting that, this enabling factor is also only implemented by Origgin as it does not apply to Nandimobile.

6.4 Constraining factors

From the case studies, there were evidence that both organisations were constrained by some factors that influenced their application development choices. Some of these factors are shared factors (Common to both organisations) while others are peculiar factors. In spite of these differences, the dynamics found in chapter five can be grouped under the constructs of the T-O-E framework.

6.4.1 Technological Constraining Factors

Analysis of this constraining factor indicates that there are three main technological factors influencing both companies. That is, cross platform development, technological trends and convenience.

Table 6.4 Table of Technological Constraining Themes

Factors	Origgin	Nandimobile
User Convenience	×	×
Technological trends	×	×
Cross Platform	×	×

Source: Author's Construction

Coming from the backdrop of the case findings, Origgin was set up to develop for the four main mobile application platforms (Android, iOS, Windows and BlackBerry) however, developing for these individual platforms is time consuming and financially demanding which will compel any application development firm to opt for cross platform development. In view of that, Origgin started developing cross platform applications however they were not published for distribution. Plausible reasons for the organisation's unwillingness to publish those applications were that, there were crash issues with the applications and the organisation further wanted to save face by not having to develop applications that would dissatisfy consumers.

Similarly, Nandimobile also initially but unsuccessfully started developing cross platforms which were also met with similar unstable issues just as Origgin's. Even though the reasons were not clearly stated by the respondents, a noticeable motivation may be that, the organisation considering the fact that they develop for just two platforms will put their full concentration on developing for those platforms than to focus on developing applications that will require constant emergency maintenance.

Secondly, both case firms had constraints with regard to the rapid change in technology as far as MAD is concerned. This phenomenon however has slightly diverging effects on both companies. For instance in the case of Origgin, Apple's switch from Objective C to Swift is not really seen as a problem because they believe Swift is an advancement of Objective C of which the latter will take a little while to fade off from the system.

At Nandimobile however, the switch is a threat because they have just one mobile app developer and in that instance, the developer would have to suspend everything in order to learn the new

language. The organisation therefore risks having to take time off application development or outsource until the current developer is done learning the new language.

User convenience have varying perspective from both organisations. Nandimobile sees UX from the perspective of a free app developer while Origgin views this from the angle of a paid app developer. Irrespective of that, both organisations perceive user convenience as a constraint as it is difficult to anticipate the users' previous experience with mobile applications. At Origgin for instance, this phenomenon constrains the organisation to the extent that they develop with two categories of people in mind (those who are app savvy and those that have the education and intuition to use applications with or without a little tutorial).

Relatively, Nandimobile develops with the idea that the app must be of importance to those who will download them however, the applications must be simple to the extent that an average smartphone or tablet user can use them without troubles.

6.4.2 Organisational Constraining Factor

Data collected from the fieldwork revealed that, organisational constraints can be grouped into developer involvement and monetary rewards and intrinsic motivations and firm size.

Table 6.5 Table of Organisational Constraining Themes

Factors	Origgin	Nandimobile
Monetary and intrinsic rewards	×	×
Firm Size	✓	×
Developer involvement	×	×

× - Constraint

✓ - Enabler

Source: Author's Construction

Both organisations from the findings faced the challenge of involving developers in the testing of applications. This manifests as a result of having to conceal applications from public view before the deployment dates of the applications. In view of this Origgin initially involved its sales persons in the testing of their applications however, the organisation moved further beyond the walls of Origgin to the streets sampling random app users to test and to give their views of the applications. A reason for going beyond the sales persons in the organisation is attributed to the notion that, they would be Origgin bias and the organisation risks the chance of having an open-minded critique of their applications. That notwithstanding, the organisation's move towards involving potential users also comes with a risk of releasing the idea of the app to the public.

Similarly, Nandimobile operates from a shared office space (MEST Incubator) and therefore have the leverage of engaging people from the incubator who are not necessarily Nandimobile personnel to test the applications. Nonetheless, the organisation does not feel safe with this venture due to familiarity complex in that, people they engage in testing applications may be bias and try to please them rather than make constructive suggestions.

With respect to rewards, both organisations develop paid applications however while Origgin chooses to focus solely on paid applications Nandimobile develops both paid and free applications as a means of getting around Ghanaians unwillingness to pay for applications by imbedding adverts in their applications. At Nandimobile, this venture takes a little while before the projected profit for projects are realised because advertising agreement and payments are based on the number of active users of the applications hence, the fewer the active users of the application the lesser the amount of money paid for advertisement and vice versa.

Finally, from the findings, it was realised that Anne plays double roles as both the CEO and the CTO of Nandimobile. Selorm on the other hand serves as the Business Development Manager as well as the Product Development Manager. Unlike Origgin, the firm size of Nandimobile is relatively smaller due to the departure of the two cofounders of the organisation. This situation causes the few key members in the organisation to perform multiple roles which in turn slows down the time taken to execute tasks. For instance, whereas at Origgin, the sales team does the requirement gathering and testing, at Nandimobile, any member of the team does the requirement gathering as of when the person is free to do so. On the same dais, Anne the CEO/CTO manages the daily affairs of the business in the position of the CEO while serving as the application developer as well in the position of the CTO of Nandimobile.

6.4.3 Environmental Constraining Factors

Environmental constraints from the data collected presented market trend, payment culture of app users, competitive pressure and data cost as key constraining factors as displayed in table 6.6.

Table 6.6: Table of Environmental Constraining Theme

Factors	Origgin	Nandimobile
Payment Culture	×	×
Market trend	×	×
Data Cost	×	×
Competitive Pressure	×	×

Source: Author's Construction

With regards to market trends both companies have the desire to develop natively for any platform. However, with android dominating the market share followed by Apple's iOS, both organisations are forced to develop for the two platforms aforementioned.

Further in that regard, even though the organisations could not readily quantify the number of applications developed for both android and iOS, Nandimobile asserted that, currently they do not have any of their free applications available on iOS due to the cumbersome nature of registering an app on Apple's PlayStore. Origgin however has applications available on both platforms but substantively have more applications on Google Play than on PlayStore. This is reflective of the trend on the global OS market as represented in table 6.2 below.

Table 6. 7: Worldwide Smartphone OS Market Share

Period	Android	iOS	Windows Phone	BlackBerry	Others
Q4 2014	76.6%	19.7	2.8	0.4	0.5

Source: IDC, 2014 Q4

Smartphone adoption, hence app usage in Ghana, is still nascent even though a substantive number of applications are evidently available on application portals. This phenomenon compels both organisations to develop certain kinds of applications. For instance, considering the fact that most Ghanaians are arguably not conversant with online payment systems, developing applications of such nature are likely to attract very low active users. To Nandimobile, the number of active users of their applications indicates the success of that app. In that regard, developing applications that will have thousands of users (users who have downloaded the applications but do not actively use them) and tens of active users is not a good business venture.

To the case firms, competitive pressure does not necessarily have a direct influence on the types of applications they develop however, the free entry nature of the developer space in Ghana is getting tighter and smaller. The competitive pressure put on these two companies have therefore

driven them to develop new business strategies in the app development business. For instance, Nandimobile looks beyond the applications they develop by imbedding adverts into their free applications hence generating revenue from a third party (companies that advertise in their applications). Origgin on the other hand is putting up efforts at maintaining their current customer (client) base while working assiduously at making new ones.

Another key factor that constrains the case firms in developing certain category of mobile applications is the high cost of mobile internet data imposed by telcos in Ghana. At Origgin, it was explicit that internet mobile data is a primary influence on the type of applications the company develops. Similarly, at Nandimobile even though not explicitly stated and for that matter no reason was given, data cost also influences the types of applications the company develops. Currently, the industry average for data per megabyte stands at ¢0.12 which means consumers pay an average of ¢1.20 for a 10mb data stream. This factor hence, constrains application developers to develop applications that require video or audio stream due to the high rate of data consumption they require.

6.5 Addressing challenges and taking advantage of opportunities

As highlighted in the research objectives (Section 1.4) this research seeks to examine how Ghanaian MAD firms address challenges posed by the factors in section 6.4. This section therefore in attempts to answer the second research question presents how the case firms address some of the challenges if not all posed by these factors.

6.5.1 Addressing Technological Challenges

Table 6.7 Themes of Strategic Technological Interventions

Factors	Origgin	Nandimobile	Solution
User Convenience	×	×	Simplify applications to enable all users use them with or without little tutorial.
Technological trends	×	×	Train current stuff in new languages and upgrades or outsource if the need be.
Cross Platform	×	×	Develop native applications for top 2 OS to ensure stability.

Source: Author's Construction

To both organisations, developing cross platform applications save time and financial resources however, the companies have no control over the look and feel of the applications. To Origgin, the frameworks are not robust and thus possess security issues, while to Nandimobile, they are not stable. In efforts to ensure a win-win instance in this situation, both organisations opted to develop native applications for the platforms they develop for. To the case firms, developing native applications ensure stability which further endorses excellent lasting relationships with their clientele.

Another constraining factor is the rapid rate of technological advancement. For instance, Apple's switch in programming language from Objective C to Swift requires that the developer begins learning the "what's new" in the upgrade. At a point in time at Origgin, the company flew their CTO to Kenya to learn new stuffs in android development and to replicate it to his supporting team in the organisation. In relation to swift, the CTO has started learning with the intention of training the technical team as well. At Nandimobile however, until the current CEO/CTO finishes learning the language, the company intends to outsource when there is a project that requires the swift language.

In efforts to find solutions to user convenience with their applications, Nandimobile is currently looking at ways to cut across the spectrum of user categories by developing applications that are intuitively simple and requires minimum or no user tutorial. At Origgin, however, the focus is on the top two app user categories; app savvy and the average user leaving the app neophytes with the conjecture that they learn along the way.

6.5.2 Addressing Organisational Challenges and Taking Advantage of Opportunities

Table 6.8: Themes of Strategic Organisational Interventions

Factors	Origgin	Nandimobile	Solution	Opportunity
Monetary and intrinsic rewards	×	×	Nandimobile imbeds ads in free applications to make profit. Origgin focuses on contract applications.	
Firm Size	✓	×	Top management at Nandimobile play multiple roles to hold the situation while they seek to recruit new stuff to fill vacant positions.	Top management roles are played by individual with sub teams at Origgin.
Developer involvement	×	×	Include potential users in the testing of applications or create online forums for application testing.	

Source: Author's Construction

Both organisations try as much as possible to reduce the developer involvement in the testing of applications in efforts to ascertain fair criticism without the element of familiarity and biasness. In this sense, Nandimobile involves other organisations in the incubator and further create an online testing forum for testing their applications by collecting emails of users who subscribe to be part

of the initiative. Similarly, Origgin first involves its sales persons who are typically not developers before moving on to the public for random selection of users in testing applications.

Both organisations develop paid applications and such applications stand the tendency of lower patronage in Ghana because most app users do not want to pay for the applications. In that regard, Nandimobile apart from contract applications develop free applications but imbeds advertisements in them. In this case the organisations that advertise in the applications pay for the service rendered to them by Nandimobile. In contrast, Origgin from its commencement had a business agenda of not developing free applications. In that respect most of the applications developed by this organisation are contract applications.

At Nandimobile, there is currently no solution to the issue with the firm size. However, the CEO and the BDM plays dual roles as CTO and PDM respectively to hold down the vacancies caused by two of the cofounders' resignation. That notwithstanding, the organisation has a short term plan of recruiting skilled personnel to fill the vacant positions.

Origgin on the contrary takes advantage of their firm size to divide labour and specify job roles. For instance, top management roles are specified and managed by individuals who have oversight responsibilities over their respective sub teams.

6.5.3 Addressing Environmental Challenges and Taking Advantage of Opportunities

Table 6.9: Themes of Strategic Environmental Interventions

Factors	Origgin	Nandimobile	Solution	Factors
Smartphone and Applications adoption	✓	✓		Develop simple applications that need little or no tutorial for new users.
Payment Culture	×	×	Both organisations develop applications that do not require online payment methods unless they are contract applications.	
Market trend	×	×	Both organisations focus on the top 2 OS (Android and iOS).	
Potential Market Demand	✓	✓		Both organisation take advantage of the few number of top OS to specialise and to train their personnel
Data Cost	×	×	Origgin has partnered MTN and Surfline to subsidise applications that require mobile internet data to run.	
Competitive Pressure	×	×	Origgin is currently creating a network of developers and client companies.	

Source: Author's Construction

As earlier indicated, both Nandimobile and Origgin develop according to the market trend. The organisations in that regard do not currently have Windows or BlackBerry applications but have a long term objectives of training their developers when the market trend swings in favour of Windows and BlackBerry.

Online payment is not popular in Ghana, therefore as efforts towards bypassing this constraining factor, both organisations restrain from developing applications that require online payment features. Here again, such features are only incorporated in contract application and is a customer requirement.

Both institutions admitted that, the developer space in Ghana is an open one. In other words, there is free entry hence open to competition. With respect to this challenge, Origgin, keeps a database of its clients and gives them constant reminders while they seek to build newer customer base. Further, the organisation relies on their lasting reputation with their current clients to network with new ones. Finally, Origgin organises a quarterly workshop for developers known as “a day in tech’. The organisation through this program seeks to build a network of app developers of which the organisation can rely on in times of difficulties.

To Nandimobile, competition is nothing new as their venture into MAD was initiated as a result of competition in the SMS and web business. Their approach to battling this constraint is by delving a step deeper in mobile app development by imbedding adverts into their applications. The companies may not be necessarily in need of the applications but the space for advertisement.

On the cost of data and app users' unwillingness to spend much data on applications, Nandimobile currently have no solution than to develop applications that requires not much data to enable users download and use their applications. Origgin on the other hand in their efforts has partnered MTN and Surfline to subsidise the cost of data that users of Origgin applications bear in their app usage.



6.6 Discussion of Findings

This section discusses the findings presented in the previous sections in line with literature reviewed so as to answer the research questions and draw propositions. This section further juxtaposes the literature findings from chapter two, the findings and analysis from chapters 5 and 6 respectively.

The discussion follows in two sections and subsequently reflect the two research questions:

- i. What factors enable or constrain MAD among Ghanaian MAD firms?
- ii. How do Ghanaian MAD firms address these challenges or take advantage of opportunities posed by these factors?

6.6.1 Technological Enabling Factors

This section presents the discussion of the technological wing of the research framework which also seeks to answer the first part of the first research question *factors that enable MAD among developing firms* and subsequently the second research question; *how mobile app developing firms take advantage of opportunities presented by technological innovations*.

From the analysis of the findings (sections 6.3.1.1 and 6.4.1.1), it is stated that MAD firms as a way of finding lasting solutions towards the instability of developing cross platform applications rather native application development to ensure stability and also to have control over the look and feel of the applications they develop. This finding can be lined along Vitols, Smiths and Zacepins' (2014) conclusion on a similar study on developing cross platform applications using Phone Gap. Thus, if the application is supposed to display extensive amount of data simultaneously and perform complicated calculations, native approach for development should be considered. It also

confirms Holzer and Ondrus' (2011) conclusion that currently, developers have to choose their preferred platforms and develop separate applications for each platform. Further, the findings of this study indicated that MAD organisations do not only develop native applications in order to have control over the look and feel of the applications but also to build applications that they will for a long time be proud of contrary to Heitkötter et. al.'s (2013) assertions that native application development is challenging and requires extreme efforts. The authors though in their study emphasised that native application development is not necessary when implementing mobile information systems, even if only a single platform is to be supported, a cross-platform approach may prove to be the most efficient method due to its low barriers. Analysis from the findings indicated that MAD firms in developing countries practice otherwise with genuine reasons pertaining to their environment even though building a different app for each platform is very expensive if written in each native language (Charland & Brian LeRoux, 2011).

Proposition 1: Native application development offer developing firms the ability to have control over the performance and functionalities of their applications.

6.6.2 Organisational Enabling Factors

This section discusses the organisational angle of the research framework. It also seeks to answer organisational *factors that enable MAD among developing firms and how the organisations leverage the organisational opportunities in mobile application development.*

Previous studies in technology adoption identified firm size as a factor in technology adoption (Low *et al.*, 2011; Pan & Jang, 2008; Baker, 2012; Thong, 1999; Oliveira & Martins, 2008;

Ibrahim, 1993). Even though, factors identified from literature reviewed in chapter two did not reveal firm size as a factor that influences mobile application development, it was however observed from the analysis of the findings for this study that firm size is an enabling factor and to a large extent a constraint (section 6.6.5). For instance, Ibrahim (1993) posits that firm size is a major influence on the selection of a competitive strategy. Past literature has also discovered that large firms tend to adopt more innovations, largely due to their greater flexibility and ability to take risk (Pan & Jang, 2008; Zhu *et al.*, 2004). This assertion is however contrary to the findings for this study thus even though Nandimobile is relatively a small-sized firm, they are able to take constructive decisions that sustains the business in building free applications. Oriffin on the other hand takes advantage of their firm size in taking strategic decisions thereby endorsing the claims of Pan and Jang, (2008) and Zhu *et al.* (2004).

Proposition 2: Mobile application developing firms with a larger firm size have the leverage of delegating responsibilities to departments and individuals without overstretching the human capacity of their firms

6.6.3 Environmental Enabling Factors

This section discusses the environmental factors derived from the findings and analysis.

Mobile phone adoption has been studied from a variety of perspectives, including sociology, demographics, computer-supported cooperative work and human-computer interaction (Biljon & Kotzé, 2007; Conci *et al.*, 2009).

Smartphone adoption by app users in Ghana continues to grow and this phenomenon interspersed with television commercials inciting people to *drop* basic/feature phones was found to be one of the motivations for application development among Ghanaian mobile application developing firms. This finding does not deviate from Silva *et al.*'s (2011) claim that the more people in one's circle who adopt a mobile phone, the greater the social influence or social pressure toward his or her adopting will be. Smartphone adoption even though is an added factor from those found in literature is also backed by the fact that Government's intention to remove import duties on smartphones importations at the time of this research (2014-2015) makes smartphone an affordable device for the Ghanaian populace. Additionally, the case firms in response to the rapid growth in smartphone adoption globally are propelled to develop applications to meet the growing demand.

Proposition 3: MAD firms in developing countries, in response to the constraints of development and rapid evolving nature of the mobile market globally, develop applications in response to technology and market trends.

Further to this, application developing firms depend on the potential market demand of operating systems ran on smartphones and tablets for application development. With particular reference to table 6.3, developing firms focus on Android and iOS because of their market dominance. This development is in tune with Hsieh and Hsieh's (2013) ascertainment that because the nascent smartphone industry will continue to grow, potential market demand is massive and has a great influence on developers' decisions to maintain their relationship with certain platforms.

Proposition 4: Potential market demand influences mobile app developing firms to stay with their incumbent platform, switch or consider venturing into other platforms.

6.6.4 Technological Constraints

This section relates to the Technological wing of the research framework and seeks to answer the second part of research question 1: *factors that constrain MAD among developing firms* and subsequently the second research question; *the interventions mobile app developing firms make towards addressing the challenges*.

Technological trends were key technological constraints that influenced MAD among the case firms from the analysis. As evident from the findings and subsequently the analysis, this factor has dual facets playing both enabling and constraining roles, however it is viewed more as a constraint than an enabler in this study. The factor sought to find out how the case firms react to the rampant change in the developer space. For instance, the switch from Objective C to Swift by Apple requires that organisations upgrade in their developing skills and even though one of the case firm have already positioned itself in terms of training its current staff in Objective C to forestall the challenges this phenomenon is likely to cause, the other is yet to but may opt for outsourcing if the need be.

Further, for most part of the analysis, technological trend was looked at from the point of view of technological changes however, looking at it from the perspective of mobile application development and distribution (MADD), the trend is that application portals are the fastest

pathways to distributing application. It was further evident from the findings that, both organisations do not employ the use of their websites for the full distribution of their applications with the basic reason that, application portals have wider audience than the websites of the case firms. These organisations however hyperlink their applications on the global portals to their websites to direct site visitors to the portals. This venture is also to avoid instances of users downloading the .apk or .ipa of the applications. This finding further confirms Cramer *et al.* (2010) claim that distribution has become increasingly simple due to the proliferation of app stores and the like. The authors' assertion that previously applications were installed manually or downloaded from individual portals, limiting the ability of the research community to test new applications with a wide audience was also confirmed by the findings.

Proposition 5: To ensure wider application distribution, mobile app developing firms use their incumbent operating systems' application portals

Another factor that constrains MAD among developing firms is user convenience. Again, both case organisations perceived this phenomenon from different perspectives thus, the paid and free app developer perspectives. From the analysis, it was observed that, it is a difficult venture perceiving categories of users and their user expectations of applications with respect to UI/UX. Whereas paid app developers have a particular category of users in mind at the time of development, free app developers develop with the motives that the app belongs everyone with a smart device. This finding runs contrary to Zamfiroiu (2014) claim that it is very important to take into account a highly targeted group during the development of the mobile application. A related study by Gurtner *et al.* (2014) indicated that considering the fact that mobile applications are usually designed for mobile phones, tablets and handhelds, user convenience is already inherent

in any mobile application however the difficulty lies in the level of convenience when demographics are introduced. In view of this, app developing firms in one way or the other try to involve users in their application developing processes but at a later stage of the development process.

Proposition 6: User research is essential to help mobile application developing firms to identify unfamiliar user needs, perspectives and goals to provide customers with enriched experience.

6.6.5 Organisational Constraints

This section discusses organisational constraints of the research framework and pursues to answer the second part of the research question 1: *factors that constrain MAD among developing firms* in union with the research question 2 *the interventions mobile app developing firms make towards addressing the challenges*.

As much as possible, mobile application developing firms try to minimize the level of developer influence in the testing and deployment of applications. Analysis from the findings designated that, the case firms do not solely rely on the resources in their organisations in testing applications rather, they resort to involving potential users in the testing phase. A plausible reason for this may be that, developers may be biased towards the applications or may exhibit half-hearted interest in instances where they are less interested in the application. This observation is in confirmation to Zamfiroiu's (2014) claim that if the developer is not interested in the quality of the mobile applications created, they will not meet quality standards. This finding further endorses Muthig and Stupperich's (2005) claim that, over immersion of a developer in the development process

risks the quality of the applications and for that matter the users of the applications must also be engaged. It is therefore against these backdrops that mobile app developing firms engage potential users in real life context to assess and to give their views on the quality of applications before deployment.

Proposition 7: MAD firms involve potential app user in the testing of their applications to minimise developer influence on their applications.

It was further shown from the analysis of the findings that, mobile application developing firms with relatively smaller firm size deposit pressure on the incumbent staff. For instance, the resignation of two co-founders of Nandimobile required that the CEO played a double role as CTO while the current BDM does same as PDM. Firm size and its implications to organisations have been cited in previous studies (Low, Chen & Wu, 2011; Pan & Jang, 2008) even though it did not form part of the factors identified in literature to influence mobile application development.

6.6.6 Environmental Constraints

This section discusses technological constrains related to the research framework and further answers the second part of the first research question: *factors that MAD among developing firms* and also highlights keys interventions taken by the organisations to resolve the challenge.

First, mobile application developing firms are constrained by the trend of the OS market. At the moment, iOS and Android are the leading operating systems with regards to smartphone shipment across the world. This therefore restricts mobile application developing firms to the two leading OS with long term objectives of developing applications for the other platforms when they begin

gaining substantial amount of the market share. This finding is confirmed by Bergvall-Kåreborn and Howcroft's (2013) study which focused on Google and Apple due to their relative large market share and also the market competition between different devices has been intense, iOS devices (such as iPhone, iPad, and iPod Touch) and Android devices (such as Galaxy Nexus, Motorola Droid, and Kindle Fire) are most popular today (Liu *et al.*, 2013).

Secondly, the rare availability of trusted online payment systems in Ghana was one constraining factor realised from the analysis of the findings. Mobile application developing firms are skewed to develop free applications because there is unavailability of an online payment infrastructure in Ghana. Although the case firms develop paid applications, they are developed on the basis of cash or cheque payments (contract applications) for organisations while individual consumption applications are therefore deployed as free applications with the plan of recouping financial gains through imbedded adverts. Lack of online payment systems has been cited in relative IS literature as a key constraining factor for e-commerce in developing countries (Effah, 2012; Panagariya, 2000; Cloete, Coutney & Flintz, 2002). This implies that until credible e-payment systems are put in place, mobile application developers would have to rely on developing free applications or would largely have to depend on Google Play and Play Store for the distribution of paid applications.

Proposition 8: Unavailability of trusted online payment systems makes it rather impossible for app developers to develop applications that require electronic payment functionalities

Further, one environmental factor that constrains mobile application developing firms is the open nature of the developer space. This factor even though does not have a direct influence on the core

applications developed by firms, the developer space is gradually becoming tighter with the invasion of freelance developers. This finding is in tune with Bergvall-Kåreborn and Howcroft's (2013) claim that, the creation of mobile application stores by Apple and Google effectively outsources product development as an open call to a global base of developers and amateurs that may wish to participate. They postulated that there are a number of drawbacks, which include working in a highly competitive and increasingly crowded market and problems associated with being in a position that reacts and responds to Apple and Google rather than one of greater influence and control. Competitive pressure has further been cited in other studies as a factor for technology adoption and innovation (Pan & Jang 2008; Oliveira & Martins, 2008; Low, Chen & Wu, 2011).

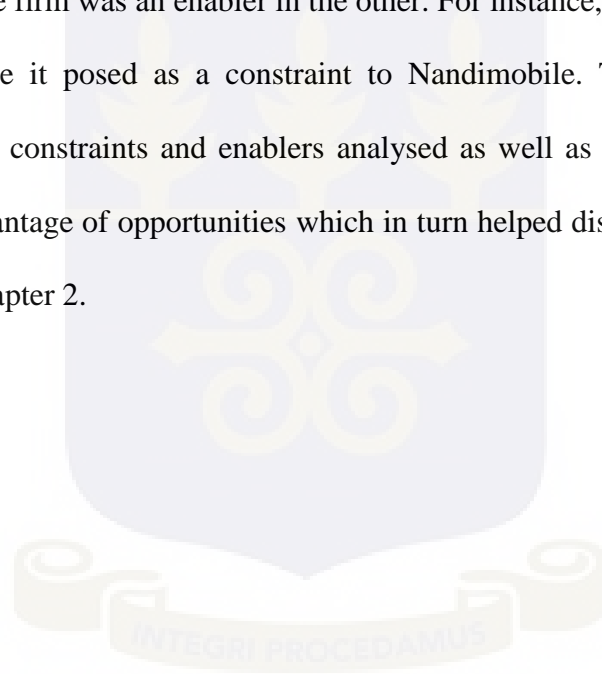
Proposition 9: Free entry and exit of mobile application firms and freelancers increase competition among developers.

Finally, a factor discovered from the data collection through analysis is the effect of data cost. Applications developed by firms are shaped by the notion that, app users do not find interest in applications that consume data and therefore are cost burden on users. This finding is contrary to Schmid's (2009) projection that broadband expansion in Africa will have a substantial impact across the economy in the form of decreasing communication cost and providing real-time access to data and important services such as telemedicine and tele-education (e-learning) on a large scale. This factor adds to the list of factors that were not found in literature perceived to affect mobile application development. From the analysis therefore, one of the case firms strategically aligns with a network operator and an ISP to subsidise data for their app users.

Proposition 10: Mobile Applications that require heavy mobile internet data attracts less active users due to expensive internet data cost.

6.7 Summary

The chapter set out to analyse the case findings of Chapter five with particular relation to the research questions. Outcome of the analysis indicated that there were similarities in both constraining factors and enablers for both firms. However, there were instances where a constraining factor in one firm was an enabler in the other. For instance, firm size was deemed an enabler at Origgin while it posed as a constraint to Nandimobile. The chapter presented a summarized table of the constraints and enablers analysed as well as how the firms addressed challenges and took advantage of opportunities which in turn helped discuss the factors vis-à-vis literature reviewed in chapter 2.



CHAPTER SEVEN

SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

The previous chapter discussed the analyses of the findings in relation to the literature reviewed in chapter 2 and 3. This chapter therefore presents the summary of the study, discusses research implications and presents the research limitation and overall conclusion.

7.2 Summary

The study began with an introductory section comprising of the research purpose to explore factors that influence MAD among Ghanaian developing firms and to assess whether these factors pose as threats and/or opportunities and how the case firms address the challenges and take advantage of opportunities presented.

The study further based on the research objectives to evaluate the factors that enable or constrain MAD among Ghanaian firms and to examine how Ghanaian firms address or take advantage of the opportunities posed by these factors.

Out of the objectives and the research purpose, two research questions were asked as follows:

1. What factors enable or constrain MAD among Ghanaian firms?
2. How do Ghanaian firms address these challenges or take advantage of opportunities posed by these factors?

These questions were therefore by first of all reviewing literature in Chapter 2. This chapter revealed that there was substantive literature on MAD focussing on the core development of application leaving just a few studies on the socio-economic aspect. It further revealed that, the subject has been studied more in developed countries than the developing and finally, due to the core development nature of the studies in mobile application development, IS theories that have been used in past literature are minimal.

This study therefore in chapter 3 found the Technology, Organisation and Environment Framework as the appropriate framework to answer the research questions from the backdrop of factors found in the literature reviewed in chapter 2.

Chapter 4 subsequently followed detailing the research methodology employed for this study. At this stance, the chapter, comprehensively discussed the three main research paradigms in IS (the positivist, interpretive and critical realism) from the standpoint of ontology, epistemology and methodology. In this regard, the critical realist's paradigm was selected as the ideal paradigm to undertake this study. The study further went on to discuss the three research methodologies; quantitative, qualitative and the mixed methods and also picked the qualitative method to aid the researcher to answer the questions posed in chapter 1. Finally, the chapter discussed how case firms were selected, the research design, data collection methods and analysis.

Having looked at the methods for data collection, chapter 5 presents the findings of the data collected from the field. The chapter based on the TOE framework narrated how each case firm is faced by technological, organisational and environmental constrains as well as the enabling factors

with the same construct. It was also realised from the findings that there were even more factors that enabled or constrained mobile application developing firms in Ghana compared to figure 3.2.

Chapter Six analysed the case findings of Chapter 5 in relation to the research questions and identified themes and description taking into consideration the constraining and the enabling factors with the aid of the T-O-E Framework. The chapter further discussed the analysis of the findings and specifically addressed the research questions in juxtaposition with the literature reviewed in chapter two, the research framework in chapter three and the findings in chapter five as well as the analysis of findings thereby suggesting ten Propositions (Table 7.1).

The findings also made way for a presentation of an empirically tested and revised research framework (Figure 7.2).

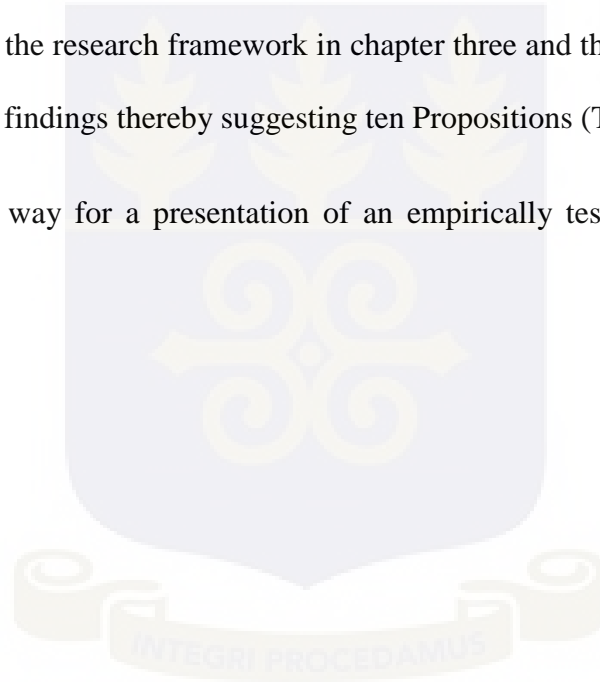
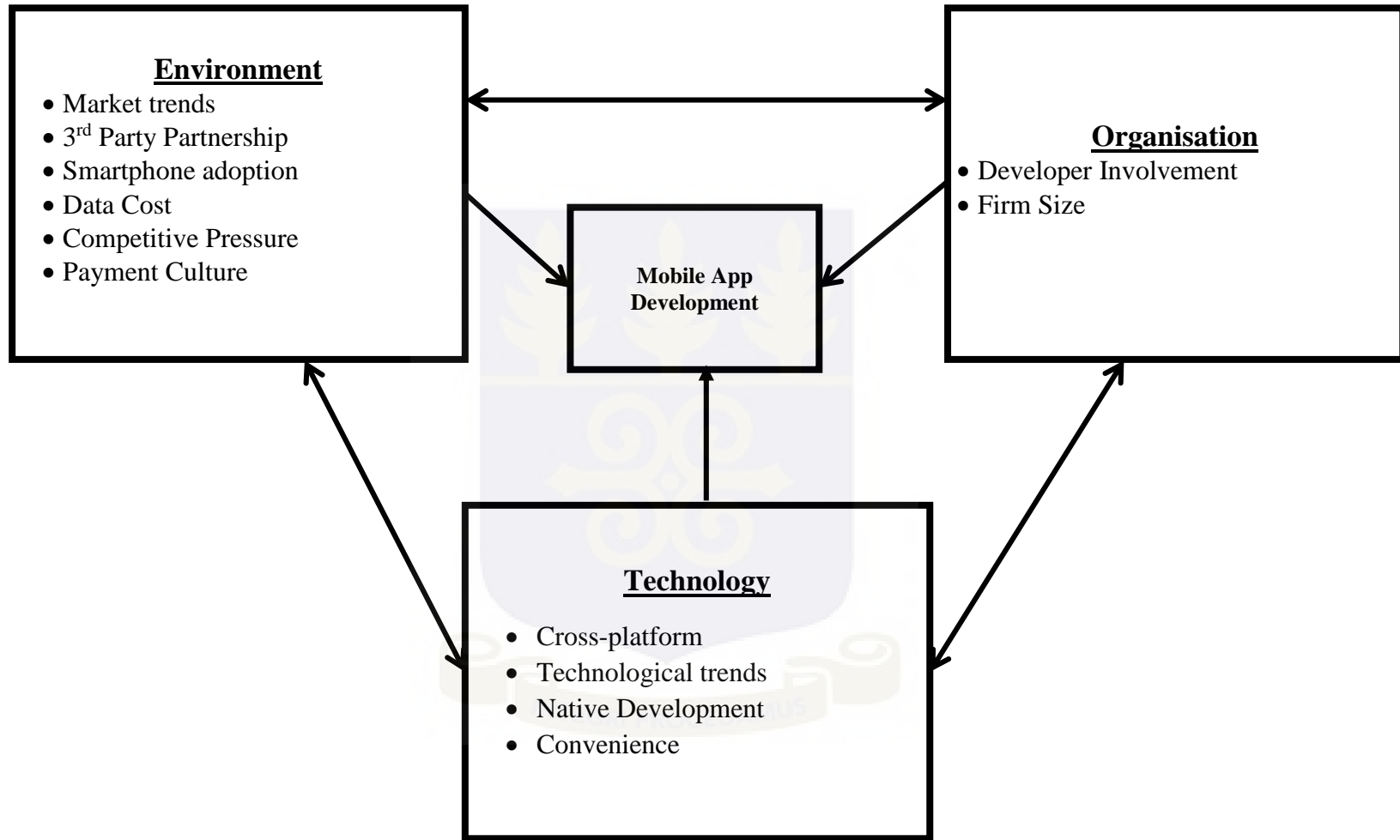


Figure 7. 1: Refined Research Framework



Source: Author's Construction

Table 7.1 PROPOSITIONS MADE FROM DISCUSSION

	PROPOSITIONS	Technology	Organisation	Environment
1	Native application development offers developing firms the ability to have control over the performance and functionalities of their applications.	✓		
2	Mobile application developing firms with a larger firm size have the leverage of delegating responsibilities to departments and individuals without overstretching the human capacity of their firms.		✓	
3	MAD firms in developing countries, in response to the constraints of development and rapid evolving nature of the mobile market globally, develop applications in response to technology and market trends.	✓		✓
4	Potential market demand influences mobile app developing firms to stay with their incumbent platform, switch or consider venturing into other platforms.	✓		✓
5	To ensure wider application distribution, mobile app developing firms use their incumbent operating systems' application portals	✓	✓	
6	User research is essential to help mobile application developing firms to identify unfamiliar user needs, perspectives and goals to provide customers with enriched experience.		✓	
7	MAD firms involve potential app user in the testing of their applications to minimise developer influence on their applications.			✓
8	Unavailability of trusted online payment systems makes it rather impossible for app developers to develop applications that require electronic payment functionalities.		✓	✓

9	Free entry and exit of mobile application firms and freelancers increase competition among developers.	✓
10	Mobile Applications that require heavy mobile internet data attract less active users due to expensive internet data cost.	✓

Source: Author's Construction



7.3 Implications to research, policy and practice

The significance of the study can be explored along three strands: research, practice and policy.

7.3.1 Implication to Research

To research, the study adds to the existing body of knowledge on MAD as well as responds to the research gaps considering the insufficiency of intellectual work conducted on MAD in Ghana and Africa as a whole.

This research also serves as a good source of reference for students and researchers who would want to further research in MAD not only in Ghana but also test the propositions of this research in other parts of the world. Further, on contribution to knowledge, this research employed the TOE framework which has widely been used in quantitative terms to conduct a qualitative research and introduced new factors in the area of mobile application development. This research therefore serves as a stepping stone for researchers who desire to use the framework qualitatively. Additionally, this research establishes factors for consideration for creating an enabling ecosystem for MAD in developing countries. Future researchers can therefore dwell on this to test their generalisability quantitatively.

7.3.2 Implication to Practice

In relation to practice, this research opens up the key enabling and constraining factors confronting mobile application developing firms not only from literature but also from fieldwork. The propositions of this study will further serve as strategic guidelines for all stakeholders in the mobile application developer space and as a reference for organisations venturing into MAD in Ghana to understand the playing field and that which constrains and enables industry players in their quest to make Ghana a hub for application development. Therefore organisations can take into consideration, their firm sizes and their developer involvement while venturing into this area.

7.3.3 Implication to Policy

Concerning policy, this research calls on Government agencies responsible for communication. For instance, the National Communications Authority (NCA) and the Central Bank with a practical view of the challenges mobile application developing firms encounter and how best they can leverage them with special emphasis on data cost and online payment systems.

Essentially, this research in relation to policy can also help top-management of developing firms to better prioritize challenges and to establish rigorous measures to addressing them.

7.4 Research Limitations

In the course of this study, some limitations were identified which called for the need to recommend direction for future research. This study focused on only two developing firms based in Accra and does not contain any element of an independent developer though the pilot study for the interview guide was tested with independent developers. The study did not also cover the application users and clients to assess client satisfaction of applications developed for them.

Further, even though quite a number of organisations were contacted for this project, only two agreed to be used for the study withholding information which were deemed private for public consumption even the researcher.

Finally, this research was limited by time as the researcher would have valued digging more into key issues that influenced MAD among the selected firms. Also appointments with the key respondents in the organisations were delayed due to their busy schedules and meetings.

7.5 Future research pointers

This study suggests several pointers for further research. Even though it is impracticable to outline all areas for further research, the following have been found principally relevant.

First, this study used qualitative method to study factors that influence MAD among particularly, developing firms. Quantitatively, the findings of this research might differ if tested among independent developers. It is therefore recommended that, this study is extended in a quantitative setting to give this study a generalisation in both respects.

Secondly, this research was conducted from the point of view of the developer which limits the scope of this study. It will therefore be an imperative venture to spread this study to encompass the users of applications. For example, a study to assess the app adoption among Ghanaian app users.

It is worth emphasising that, among the respondents for this study was one woman (Anne – CEO/CTO of Nandimobile). Future researchers can take into consideration gender issues in mobile application development.

Finally, a future research can interpolate both organisation developers and independent developers developing firms and draw comparative analysis between the two to find similarities and differences.

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APPENDICES

Appendix A - Interview guide

Introduction:

My name is Nii Barnor Jonathan, an MPhil student of the University of Ghana Business School pursuing Management Information Systems. I am conducting a study on the *factors that influence mobile applications development among Ghanaian firms*.

Overview of Research: Mobile applications development according to research is a nascent phenomenon in parts of the world. Nonetheless, there have been substantial number of applications developed and making ways among app users in Ghana. This research therefore seeks to

1. *Evaluate factors that enable or constrain mobile application development among Ghanaian firms*
2. *To examine how Ghanaian firms address or take advantage of the opportunities posed by these factors*

The interview will cover the following areas. You are however not under any onus to answer questions to which you feel uncomfortable with.

Thank you for your valuable contribution in advance. Your participation is vital to the success of this research. Information to be gathered from your firm is purely intended for academic purposes.

Background of Respondent

- 5) Kindly enlighten me on your position and unit within your organization.
- 6) Kindly enlighten me on your job details.
- 7) How long have you been working with this organization?
- 8) In your estimation, how many organisations or individuals have you developed for (as an organisation)?

Cross-platform

- 9) How does developing cross-platform applications enable or constrain your organisation?
- 10) Why do you develop particularly for that platform or why don't you specialise in one platform?

Technological trends

Technological trends are constantly on the rise...

- 11) What do you think are some of the opportunities posed by this phenomenon to your business?

12) What about threats?

Used technologies

13) Can you please enlighten me on some of the technologies employed in developing your applications?

14) How do you handle patches, updates etc.?

User Convenience

15) How do you forecast the convenience (platforms, usability and size of devices) of your users/consumers before development?

16) What are some of the importance of user interface/user experience (UI/UX) to the development of applications to your organisation?

Developer Involvement

17) Can you kindly enlighten me on the chain of development of an app in your organisation?

E.g. feasibility study → customer requirement → coding → etc.

18) How many people (developers) do you involve in the development process of an app?

19) How do you involve potential users in the testing of your applications?

20) Why do you involve them *if you do*?

Monetary rewards

21) How do you monetize the applications you develop?

22) What are your organisation's primary motivations for developing applications?

Intrinsic rewards and motivations

23) In what way do you measure the success of your applications?

24) What do you benefit in developing free applications (if you do)?

Market trend

25) Which of your applications are available on the application portals? (*E.g. Google Play, Blackberry World, Applicationstore, MTN play etc.*)

26) Why do you use that portal (in Q21) instead of your website?

Promotions and developer events

27) Could you please tell me where you obtained your training?

28) What do you make of promotions and developer events (Vodafone App star, MTN App Challenge etc.) with relation to mobile application development in Ghana?

29) Do you consider them as threats or opportunities to the application development landscape in Ghana

Potential market demand

- 30) Do you develop on customer specification (i.e. Contracted by company to develop) for a free market?
- 31) How do you know their specifications?
- 32) How do you forecast and meet the demands of the app market?

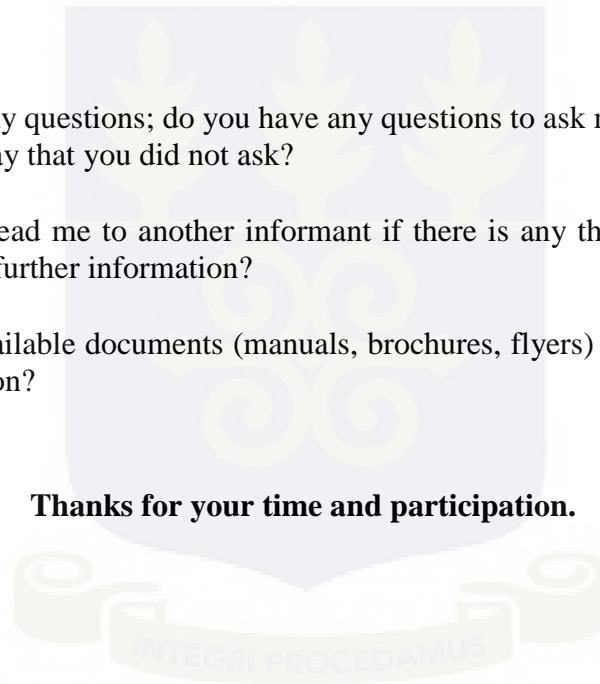
Research Questions

1. What are some of the factors that enable or constrain mobile application development in your organisation?
2. How do you address these challenges or take advantage of the opportunities posed by these factors?

Closure:

- 33) I am done with my questions; do you have any questions to ask me or anything you might have wanted to say that you did not ask?
- 34) Can you please lead me to another informant if there is any that you know of who can provide me with further information?
- 35) Are there any available documents (manuals, brochures, flyers) that can provide me with further information?

Thanks for your time and participation.



Appendix B – Colour codes for coding

Quote Threats / Constraints
Opportunities / Enablers

Background of Respondent

- 1) Kindly enlighten me on your position and unit within your organization.
- 2) Kindly enlighten me on your job details.
- 3) How long have you been working with this organization?
- 4) What is your firm size?
- 5) In your estimation, how many organisations or individuals have you developed for (as an organisation)?

Cross-platform

- 6) How does developing cross-platform applications enable or constrain your organisation to/from developing applications?
Developing across platform is a major challenge because you have to do the same thing for different platforms and it means that you need more resources for the same application. So developing an app for cross platform constrains us a bit. Because you need more time to do the same thing. Now there are some frameworks that enable you to develop across platform but they are not as stable as developing natively so they are not really the best.
- 7) Which brand of applications do you develop?
We normally develop for android and iOS. We have done blackberry and J2ME before but those platforms are dying right now so most people don't do those things again. So mostly now it's android and iOS.
- 8) Why do you develop particularly for that platform or why don't you specialise in one platform?
We develop for android and iOS because that is what people use nowadays. A lot of people don't use the feature phones (the J2ME is for the feature phones). Now we don't have a lot of that around. Most people have android so the first platform we consider is android and then secondly iOS. And then windows is also coming up so that will be our third choice possibly. If you want to have a lot of people on your platform, it will be good if you develop for the different platforms. So that is why we might not specialise in one. Maybe if everybody decides to use one platform, then we would. But to go around the multiple platform, sometimes we do mobile web but that also has its constraint; some features might not work in mobile web so you might end up developing the application [natively].

Technological trends
Technological trends are constantly on the rise...

- 9) What do you think are some of the opportunities posed by this phenomenon to your business?
Depending on what it is, it might either help or not help you. iOS decided to change the programming language from what it was. It was Objective C now they are saying swift so that means you have to learn a new programming language altogether to develop for iOS. That's

Appendix C - Email correspondence between researcher and a respondent.

https://mail.google.com/mail/u/0/#search/kane/14c292a2c787d1c9

Google kane

Click here to enable desktop notifications for Gmail. [Learn more](#) [Hide](#)

12 of 16

Nii Barnor Jonathan <niibarnorjonathan@gmail.com> Mar 17

to Kane

Dear Mr. Kane

Good evening,

After going through the transcription, i realized a lot of errors in spelling and constructions. i am currently working while i await your confirmation as well as the other documents to be used in my work.

Please i would also like to come over at your free time this week hopefully for a 5 to 10 minute follow ups on the following:

- How you are able to deal competitions
- How you are also able to deal with a market that is quiet new with electronic payments
- Determining the success of applications.

Thank you Sir and hoping to hear from you.

[Nii Barnor Jonathan Barnor](#)
[0243658601](#)

Kane Mani <kane@origginworld.com> Apr 2

to me

Nii

I trust you're doing well today.

My apologies for not responding earlier. I'll respond to your questions over the Easter Holidays.

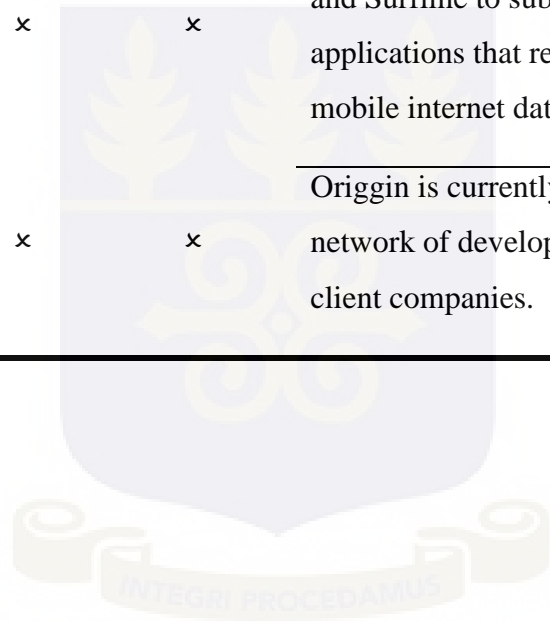
Thanks.

APPENDIX D – TABLES OF FACTORS AND STRATEGIC INTERVENTIONS

Factors		Origgin	Nandimobile	Solution	Opportunity
User Convenience	T	x	x	Simplify applications to enable all users use them with or without little tutorial.	
Technological trends	T	x	x	Train current stuff in new languages and upgrades or outsource if the need be.	
Cross Platform	T	x	x	Develop native applications for top 2 OS to ensure stability.	
Monetary and intrinsic rewards	O	x	x	Nandimobile imbeds ads in free applications to make profit. Origgin focusses on contract applications.	

Firm Size	O	✓	×	Top management at Nandimobile play multiple roles to hold the situation while they seek to recruit new stuff to fill vacant positions.	Top management roles are played by individual with sub teams at Origgin.
Developer involvement	O	×	×	Include potential users in the testing of applications or create online forums for application testing.	
Smartphone and Applications adoption	E	✓	✓		Develop simple applications that need little or no tutorial for new users.
Payment Culture	E	×	×	Both organisations develop applications that do not require online payment methods unless they are contract applications.	
Market trend	E	×	×	Both organisations focus on the top 2 OS i.e. Android and iOS.	

Potential Market Demand	E	✓	✓	Both organisation take advantage of the few number of top OS to specialise and to train their personnel
Data Cost	E	×	×	Origgin has partners MTN and Surfline to subsidise applications that require mobile internet data to run.
Competitive Pressure	E	×	×	Origgin is currently creating a network of developers and client companies.
<i>×</i> - Constraint <i>✓</i> - Enabler				<i>Source: Author's Construction</i>



APPENDIX E – YEARS OF LITERATURE PUBLICATION

