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# Analysis of market trends in mobility and possible next steps

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<p>Among the thousands of IT service providers in the world, application production is a primary service provided by most, if not all, IT-related businesses. This is because of the mushrooming number of mobile phone users and active internet service users. These users are always keen for more applications and services at the tip of their fingers. This is made possible either by websites or native applications installed on mobile devices. Thus, development, production and publishing of an application is a constant process, and an uphill battle with other performing applications to reach the top of the application rankings. However, the dilemma for a business is either build an application or stick with having a good looking website.</p> <p>The thesis investigated the market tendencies in the current application market, advising if an enterprise should choose either a native application or the traditional web application. The goal behind the research was to help an enterprise looking for the best return of investment to decide which technology is efficient and should be invested in. Various printed and online documents were provided and all the latest statistics and data was gathered from various statistical organizations. The data was studied and compiled into information which could be processed at the time of decision making. From the result it was concluded that Rapid Application Development and native applications are sustainable in the long run.</p>	
Keywords	mobility, mobile, app, applications, native, hybrid, web, market trends, Rapid Application Development

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For someone who never travelled to any country except for neighbours India and China, Finland was a new world to me. However, upon arrival, the green environment was similar to my home back in Nepal, except for tall hills and mountains of course. Adapting to a new culture with all strangers was hard for the first few weeks. However, the supportive nature of my newfound friends helped me adapt quickly. Choosing Metropolia was one of the better decisions, I realise, I had made. The teachers were friendly in and out of the classroom, which boosted my willingness to achieve my goals. Every hard situation was coped ease, be it not being to attend all lectures, or wanting to take more lectures than needed. The well-equipped campus of Metropolia provided every opportunity to learn using all the possible methods. Information Technology was one of the common choices of majority of my fellow Nepali classmates; hence the classes felt like back home.

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## 1 Introduction

Mobility refers to all the mobile devices and users. This includes mobile phones, tablets, and laptop computers. Among these mobile users, a majority are connected to the internet. The primary use of a mobile device is no more for telephone calls, but social media networking and leisure gaming. Secondary usage are numerous, such as mobile banking, ticketing, access keys, or tokens. All these activities or facilities are possible because of applications provided by their respective business owners. For example, Subway, the sandwich company, does not have a physical membership card, rather has an application which can be scanned. This facilitates consumers not to carry the bulky membership cards, and aids to the environment as well. This is the primary reason why most of the businesses have their independent applications. These are available in the respective Apple Store or Play Store. However, not all businesses have a running applications at their disposal. Thousands of retail companies do not have a native application because they already have a maintained website. This is where the division between the traditional and modern companies is created. A majority of mobile users prefer a mobile application to a website because native applications are easy to use, which creates competition between service providers on how to bring the best out of their businesses and be installed into a user's phone.

The project was aimed to analyse the state of mobility and what the preferred choices of consumers are in the mobile market. The study also aimed to find out what could be the method that would give the best return of investment to an organization. There were a few focus points such as how native application development can be brought into the web and how businesses can invest in the right platform and technology. The study was based on published statistics from various leading players in the mobility market. The reason to choose this topic was directed towards understanding the coherence of the requirements of consumers. The project itself played an important role in order to move an enterprise (Seattle App Lab) in the right direction and investigate what is necessary and important. It also aided in keeping track of the ongoing trend so as the enterprise can direct its path towards efficient and the latest trends in mobile development. Since the enterprise in itself is not large, the team working under it needs to be acquainted with the latest available technology and able to use it efficiently. Hence, this study helped realise which organ in the enterprise would need strengthening.



Application development is normal, but there is a serious lookout for rapid application development, and numerous challenges lying ahead of it. Thus, the goal was to research on the three major application types available; native, web and hybrid and find out a way to bring the native applications into the web.

## **2 About Seattle App Lab**

Seattle App Lab (SAL) is a mobile and web solutions provider which was established in 2012. It is based in Seattle, Washington. There are over 50 employees working in the SAL team. Yet, in the short span, it has served more than 80 customers worldwide. Some renowned customers include Microsoft, Unify Square, Macmillan Publishers and Media Cart.

SAL provides services based on the needs of the customer, be it media, public or private. Technology consultation is one of the services provided by SAL. Along with the help of its sister and partner organizations, it provides the best solution that can be offered. Not only the accumulation of data, but utilizing the acquired data into meaningful information is what SAL can offer its clients. The forms of data can be websites, mobile, social media, advertisements, or unstructured Big Data. Apart from that, cloud services are one of the primary services provided. The majority of IT consultation firms around the globe provide cloud services, and SAL is not different in that matter. Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) are the focal points of the cloud strategy provided. However, since SAL serves a wide variety of clients with a wide variety of requirements, there is no one basic template where the final result is moulded. Rather, custom development and execution over perfection are carried out within the given time and budget.

SAL is different from any other technology provider available because it has active and experienced service providing employees. Everyone tries to stay up to date, and is in a process of constant evolvement. The recruitment in its own is carried out using referrals and their own employment marketing platform. This helps in recruiting expertise according to the requirements, be it on a temporary or a permanent basis. Thus, apart from employing the best talent, SAL also provides with the best talent at disposal.

SAL has created numerous applications for numerous organisations, some of which are booking and ordering services for restaurants. Mobile CRM (Customer Response Management) is one of the popular tools used by various media outlets, and SAL offers CRM applications.

### **3 Mobility**

With today's availability of smartphones, employees can fully enjoy the benefits of mobile working, whenever at their convenience. They are given access to company networks. But, diversity in mobile devices means dealing with different OSes, making it harder for IT technicians to manage the system. This costs time and money. If everyone uses their private phones, the company network will be out in the open; The devices can get hacked, stolen or lost. This is hard to track and exclude.

The whole enterprise infrastructure is available through the development of cloud computing which provides the environment necessary to create a more interactive and powerful mobile app, very smart mobile device which have the ability to interconnect with sophisticated backend. There is an opportunity to create more competitive applications for the enterprise. The issue is getting to the enterprise data servers behind the firewall and tap into corporate data. Any enterprise wants faster and better decision making from the field without having to wait.

Mobility in the cloud, however, refers to managing and securing the devices and applications of the system. Once the system is connected to the cloud, profiles will be created for each level of employees. Levels of system access and applications will be assigned, and employees will be connected to profiles and selected devices. In case of any problems or bugs, the device will be wiped from the cloud. Mobility is not an add-on but a core to the business. Every enterprise has its own requirements. What works for one may not work for others. There is no clear winner among iOS or Android.

## 4 Strategies for Enterprise Mobility

To break the ice, it is necessary that a company strategizes. An organised strategy lays the foundation for a proper plan and aids in smooth execution. It might require proper analysis of what is required and a vision of what the final product will be. The starting point can be division of tasks, calculation of resources, implementation of a plan and scrutiny of the milestones achieved.

Apart from that, there are various challenges an enterprise faces, which can be economic, time-management or labour. Some of the potential challenges are analysed below:

### 4.1 Target Users

There are different types of users with different roles, admins, support staff, customers, resellers, contractors. The working principle of an application depends on what the audience demands. A one-size-fits-all policy might not work because of the same reason. Thus, the role of the user determines the level of access to the backend of the app, which, in general, is different from what can be downloaded from the Application Store.

A layered application with basic interaction with more checks may be a starting point. The type of the application can also depend on how the user requires it to be, how easy will the user interface be. Few approaches to consider can be as follows:

#### a. Understanding

The goal or the milestones of the organization should be clear. The main question should be; how will the application mature in the months or years to come? The vision and user demands should be the main point of focus and always be struck onto the day-to-day achievements.

#### b. Strategizing

Analysis is a good starting point for a strategy. The infrastructure that is at hand can help determine if the application should be built or bought. MEAP can be implemented in case the application requires a backend access. In this way, the total cost of ownership (TCO) can also be calculated easily. The mobile strategy should be divided accordingly, as

allocating the responsibility to a particular group or person. After the organizational farming is understood, then various factors can be planned as per the analysis and cultivated into a strategy and mapped and recommended to the organization so that they can process it in a very clear approach over a period of time to get a successful mobile strategy.

#### c. Recommendation

Implementation of roadmaps that are already available can be recommended. The recommendation of devices should be based on the user's preference. Hence, the required guidelines can be measured.

## 4.2 Security

Security is one of the key pillars of enterprise mobility. Real time analysis is implemented in most of the business and organizations in the current market. Hence, the flow of Big Data needs to be controlled, analysed, examined and utilised. Wireless or remote control such as WiFi, NFC and Bluetooth cannot be secure at all times, thus the requirement of possible safety measures and milestones are necessary. Some of which are discussed below:

#### a. Infrastructure

Integrating with the available share-point servers can be challenging for mobile devices. This is because of several aspects according to the role of the employee. Hence, the applications should be written with a different policy and access level. There can be restrictions of user information because the company policy might not allow access to it. On the other hand, there can be challenges in terms of finding extensions to the existing mobility. Challenges such as how a company can move along with the already existing infrastructure, but also be able to integrate it into the new mobility system.

#### b. Data management

An organization might have a vast amount of incoming data that needs to be processed. For an organization, everything is not necessarily hardwired into the enterprise, but can be controlled wirelessly remotely as well. Hence, there can be several steps that can be taken to process that data. However, if that incoming data is important, it will require

encryption since it will be transmitted over a network. It also depends on the organization if there is a requirement of a secure channel of transmission. In that case, permission should be granted to gain access to the sensitive secure systems at the backend of the application, behind the firewall in order for the application to work seamlessly. It would not be efficient if the requested data arrived after three minutes. A good example would be a directory search in a hospital.

#### c. Solutions

The solutions to most security issues can be dealt with the available resources with ease. Some are listed as follows:

- Encryption algorithms
- Token or code
- SSL/HTTPS
- Session Handlers
- Two-form authentication via 3<sup>rd</sup> party APIs
- Remote wipe, kill, lock

#### 4.3 Integration

An enterprise might work with different aspects of data source and processing. The question here would be how to handle multiple access to data sources, having to reach the servers in all the departments of the enterprise. How can it be interfaced, what business logic can be implemented? The solutions are analysed below:

##### a. Meta Data

One way to remedy some of the problems is reusing the metadata that the enterprise already possesses: the definition of files, names, equipment such as the nicknames for the employees, the name for infrastructures, the different types of files used by different branches of the enterprise.

##### b. MEAP integration

Mobile Enterprise Application Platform (MEAP), provides a path for all mobile applications to interface and integrate with clouds of different servers. It is a common interface for the enterprise to have a more consistent way of interfacing with multiple devices and applications that reach the backend, behind the firewall. As shown in figure 1, MEAP converges services from different platforms and is able to distribute to variety of devices.



Figure 1: Mobile Enterprise Application Platform visualized [1]

c. Provide data access

The data from multiple data sources, formats and locations such as the logistics and accounts can be provided into the integrated system. To fulfil this securely, user authentication, security usage, offline storage and synchronization measures can be implemented.

d. Enable service access

Enabling access to extract up-to-date content from multiple service end points is crucial for user based customized information. The workflow between the data and the business logic can be helpful to build a consistent mobile enterprise infrastructure.

Example:

A good example would be a mobile interactive sales briefcase. In basic terms, it is a tablet which acts like a sales booklet. A salesman does not need to flip through the pages or look for a particular item's availability by calling the inventory. All the data will be updated over the air (OTA) and the salesman can present real-time statistics to a potential customer. A final quote can also be calculated, which can include, but is not limited to, the shipping costs, the tax costs, time of arrival. This helps seal a deal quickly and efficiently, along with good customer interactive experiences. Some major points of a service access enabled device is:

- Tablet where all inventories are listed
- MEAP integration
- OTA updates, updated after change in stock or availability
- User reviews, photos, feedbacks on-the-go
- Act-on capability: customer sees-customer gets

#### 4.4 Platform

Mobile data and device management are the properties that are required to control the workflow of data from an input to a device. It refers to the control of device from a mobile location using remote access softwares which can monitor and control the devices in real time.

##### a. Mobile device management

In reference to the previous example, there can be cases when the sales device (tablet) is lost or stolen. There are multiple applications across multiple devices which need to be updated frequently. Will the user have to plug it into an enterprise PC and update it? The answers to these contingency can be simple. The device can be controlled remotely using Remote Access Tools (RATs). These RATs can lock, wipe or kill the device in the case of loss. Advantage can be taken from GPS aboard the device, in order to access the location of the device and its user. This can be useful to provide the required data to the device specific to the particular areas which makes it faster to access the data the user is looking for.

##### b. Mobile data management

By using RATs, the data on the device can be synchronized with the services in real time. The devices can be updated over the air (OTA). This will be efficient when the user is in the field either collecting data or providing data to the customer. The data can also be device-specific, which means the delivery of a high performance, data-rich application within the constraints of the device.

#### 4.5 Deployment

An application from a vendor's application store is easy to download. However, a business application store has a stricter standard from a security point of view. Each device works differently and might have a different operating system.

##### a. Platform diversity

A variation of the same application may be distributed according to the user based privilege and the purposes of the application. Regional difference also plays a role as the user may require access to more features than in a normal condition, for example, secure connection or encrypted data.

##### b. Enterprise application store

The enterprise application store is built around the specifications of the user devices. It takes into consideration the capability of the device. However, as the devices have diversity, a light version of the same application can be provided to some users and full-featured for some. This implies a different security policy or standard for the different versions of the same application across a range of multiple devices.

##### c. Application distribution

Careful consideration of a number of issues that impact the distribution of the application is required. Some of them are listed below:

- Strategy
- Software licencing
- Provisioning
- Usage management



- Remote control

## 5 Features of a good application

A definition of a good application can be gauged in a number of ways. The best and concrete way of determining is its performance in the application market. When an application crosses out all the qualitative aspects such as interface design, efficiency and sharpening, it can be deemed a quality application. According to Diego Miller, the founder of Livra, a survey company in America, the top 10% of applications are installed into 90% of smartphones. [2]

### 1. Ace of one, jack of none

An application should be able to do one primary task, and do the task splendidly. It can have other secondary tasks, but they are add-ons. A good example can be Flappy Bird, where the user taps the screen to play the game. There is no tilting or pinching the screen for better controls. This is the only job the application needs to do, and it does it very efficiently.

### 2. Simple interface

According to Yahoo CEO Marissa Mayer, an application should be able to do anything within two taps [3], which means a simple interface with all the available features should be available on-the-go. This helps users use the application efficiently and fast. Speed is the key. According to Mayer, a product should be designed in such a way that it would be used 98% of the time [3], which means that even though the product is capable of doing various tasks, a huge button should be placed so that the primary task would be done in a matter of seconds. An example is the weather app, which is simple as no clicks are required and it updates itself approximately every hour.

### 3. Offline capability

Even though most mobile phone users are connected to the internet via WiFi or a cellular network, there are potential users who do not have access to a constant internet connection. Hence, an application that can work offline and update itself once the user goes online can help extend the market further.

An example can be the Facebook application. The application downloads a chunk of data and displays the wall of the user even if s/he is offline. The user can upload pictures and post updates while offline, and all that data will be updated once the user is connected to the internet.

#### 4. Hardware access

Smartphones these days are not just phones. They are a heartbeat-monitor, thermometer, barometer and compass all-in-one. Hence, a good application should be able to utilize the available resources. It should work to the full potential of the OS to improve the user experience. This will ensure smooth and controlled running of the application.

#### 5. Audience

An application can target a specific group of audience and focus on the want of that specific user group. For example, a networking student might use the Subnet Calculator application very often. Hence, the company developing applications in the networking field can add a subnet calculator in their most popular application.

## 6 Native, Web and Hybrid

### 6.1 Overview

As predicted by Gartner, mobile phones have surpassed the number of desktops as the most common web access devices worldwide. [4] According to a report by Global Web Index (GWI), as shown in figure 2, 80% of users with access to the internet own a smartphone, and 47% own a tablet. [5] However, only about 20% of large resellers have a mobile-optimised site. M-commerce, on the other hand, has increased 99 folds in 6 years from £770 million to £77 billion.

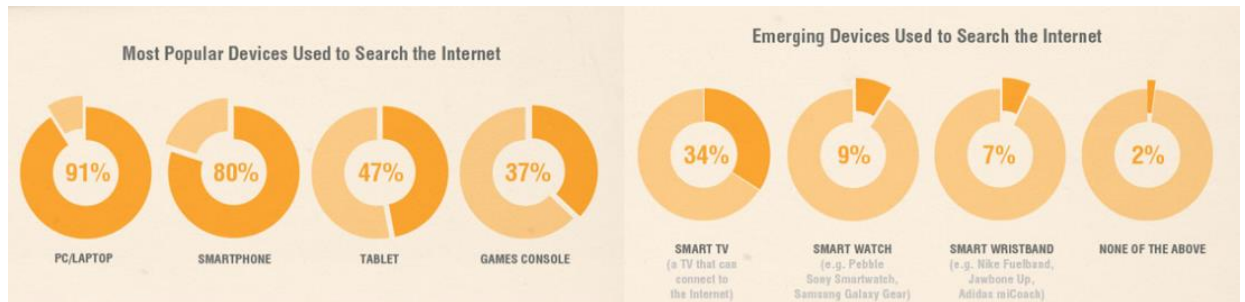


Figure 2: Popularity of mobile devices in 2015 [6]

A mobile statistics report by The Radicati Group predicted that there would be 5.9 billion mobile users worldwide by 2016. [7] However, other statistics from Statista, a static portal, show that the actual number of users is 4.6 billion in July 2016. This accounts for about 62% of the world population. As illustrated in figure 3, Samsung is the leading vendor followed by Apple.

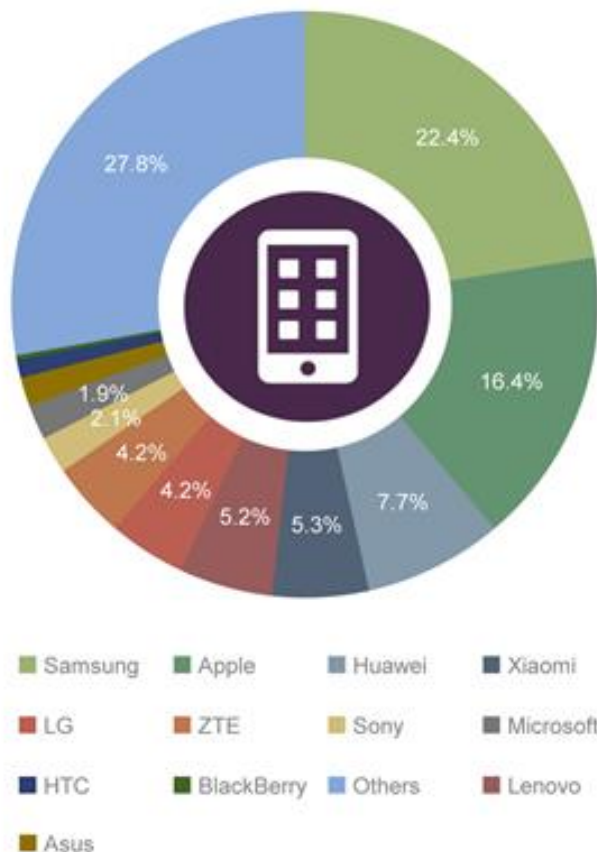


Figure 3: Global Smartphone Vendor Market Share 2015 [8]

On the web users' side, 1 in 7 searches are made using a smartphone. This accounts for 77% of the time spent by a user when s/he is not using it to browse a social networking site. Yet, only 30% of mobile web users are shoppers who make a purchase. The other 10% users use a tablet, and the vast majority of 70% still use a desktop for e-commerce, [9] which proves that mobile devices are primarily used for social networking and research rather than as a shopping platform. Surprisingly, Bing and Yahoo searches have a better conversion rate than Google, even though Google is the most visited website in the world.

## 6.2 Differences

Even though there are more than 1.4 billion smartphones sold annually, only 2 billion phones are browser-enabled. The reach for browser-based applications is higher, especially in less developed countries. Below is a comparison between native application and browser based app:

Table 1: Differences between native and web applications

Native	Browser
<b>Basics</b>	
A native application provides the best performance and enables access to all the underlying functionality of a device they run on; may use all the hardware resources, from the GPS of the device, to the accelerometer.	Since it is a web-browser based app, even though it may not utilize all the device hardware, functionalities such as GPS can also be used by a web application.
Provide offline access.	Does not function while offline.
Better design, better experience.	Made simple for minimum workload.
<b>Development</b>	
Multiple platforms	Easier to implement
More time and resources needed; a build from scratch is necessary for a custom application.	Various tools that require less time, even for custom pages.
Enclosed system; only developers are known to the working principle and codes.	Is an open system.

<b>Marketing</b>	
More than a million applications are available; hence the competition is high. A user is bound to use only one application for one purpose, for example one calculator.	More than 10 million webpages are available, but only a few of them are browser based applications. For example, one user can use multiple websites to search for a flight quote.
The cost of marketing is 3-5 times higher than development.	Marketing is relatively cheaper.
<b>Opportunities</b>	
Research shows that 66% of mobile phone users have a maximum of 7 applications installed on their phone. Hence, the rate of adoption is low.	A web application lies in a hit-or-miss situation. In the case the user searches for the right keywords in a search engine, it is only then the user will land on the webpage.
Since the application is built as per the customer necessity and with customer ease taken in mind, the billing can be done securely and easily.	The connection to a web application is not secure; hence the billing might not be safe. However, carrier or card billing can be taken as a safe method of billing.
In the case an application is what a user is looking for, or popular, it can stay on top of the application store for a long time, therefore generating revenue. A good example is Angry Birds, which reached 3 Billion downloads in July 2015. [10]	A web app, on the other hand, will eventually be integrated or transformed into a compact version into a native application. Facebook was a web-based application, which turned into one of the most downloaded native application.

### 6.3 Common Misconceptions

There are various words spoken about the usages, advantages and features of applications. Not all statements can be deemed as facts without proof. Hence, the discussion of the myths and facts have been debunked via some research carried out various survey companies around the globe. [11]

### 6.3.1 Myths

There always are advantages to disadvantages. The modern tools available such as Xcode for iOS and android studio for android are used to build native applications. Cordova or Xamarin are used to build hybrid applications. However, not all are perfect because of either lack of further development, or not widespread usage. Each set of developers working in different version of applications may not necessary have sufficient knowledge about the next version of application.

a. Hybrids applications are best overall

Hybrid applications are seen as the balance between web and native; however nothing can be a universal solution. With the availability of a custom-control and rich user interface, it is assumed that hybrid applications can work with any system or environment.

b. HTML5 is not ready

Even though the working draft is closed, HTML5 can be deemed ready. There is a fine tuning that is needed. No significant changes are left, and only minor tuning is required.

c. Web applications always need connectivity

Some of the applications built using HTML5 can store data by utilizing the local database. Factually, web applications do have less storage than native applications.

d. Only native applications give the best user experience

With the adequate knowledge of CSS, HTML, JavaScript, a hybrid application can be made better. Native applications may require more time and effort, but can be prepared.

e. Web applications are faster to develop

All the development boils down to the function abilities of the application. The design and development takes time when the application is high resource demanding. Comparatively, the effort is marginal.

### 6.3.2 Facts

The fact is that when an application is developed with the right set of tools, it can provide good user experience. The features can be utilised properly and development can be carried out according to the consumer demand. It is true that a web based application is

not able to utilise all the features of a mobile device, but it is also true that with the help of HTML5, more and more features of a mobile device are beginning to be utilised by the latest versions of web applications.

a. Reusability

Hybrid application with high content consumption has greater reusability. Dynamic content can be used to render multiple devices. It has greater control and workflow than imagined. However, it is heavily dependent on the content being delivered.

b. User experience and accessibility

Web applications are not far behind on user experience and accessibility. As stated earlier, more can be done with sufficient implementation of HTML, CSS and JS. The web applications also have the possibility to access the content from the camera and the phone.

c. Mobile development

The changing pace of mobile development has always been unpredictable. This may also be because of the fact that there is less room for improvement for perfection. Also, the market is already habituated to the same competition and same systems; hence a new competition is either a failure or a niche success after it is deemed uncompetitive.

## 7 Choosing The Right Application

The booming number of mobile devices also has led to the invention of cloud storage. Various service providers provide free cloud storage to some extent. This has also been a boon to hybrid applications since they can store all the data in the cloud and not rely on the local storage. By 2016, more than 50% of web applications have turned into hybrid applications since they bridge between native and web applications.

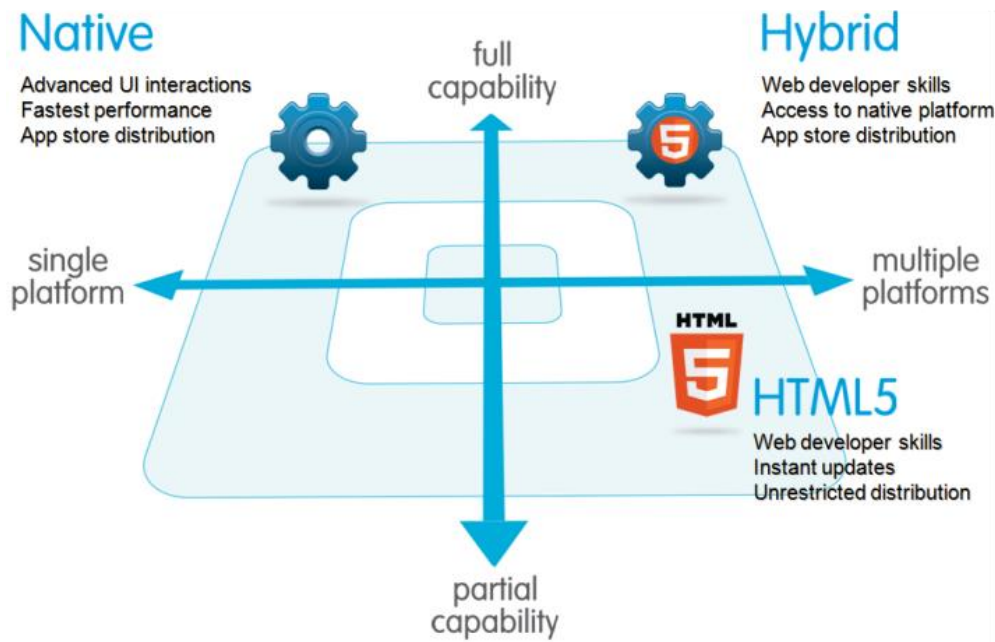


Figure 4: Native, Hybrid and Web applications compared [12]

As illustrated in figure 4, all three different type of applications have their own features. A native application is based on a single platform, but has a full capability whereas a native application has partial capability even though it supports almost all platforms.



Figure 5: Qualities of a good application



However, when choosing an application, there are various aspects that need to be kept in mind, such as, security, OS compatibility, performance and offline availability, which are shown graphically in figure 5.

### 7.1 Native applications

Native application are mobile resident applications which is specifically designed to be installed on the mobile operating system. They are generally downloaded via the OS's market store. The content comes from a local server; hence they have the ability to handle large amount of data locally within the device. The fluidity in the native application makes the navigation smooth. On the other hand, they can also fully utilize the SDK and allows more customization in terms of user interface control. The hardware-software integration means the camera, contacts, images, GPS, microphone and other hardware can be utilized with ease. However, hybrid applications are also able to do such to some extent. Regarding the security, since the data is accessed locally, the data is protected. Encryption can be handled without any influence on the performance. A Native application has a flawless performance and is more responsive when compared to the other applications. Features like push notification, history and in-app purchase help the user access all the required tools at ease. This is a huge boost to the application economics and helps increase the reach to the store directly.



Figure 6: Characteristics of a native app

As graphically shown in figure 6, a good native application has a strong security presence, device hardware control and usage, good performance and good overall user experience. Platform specific features such as back and menu buttons for iOS devices should also be available. Tracking of a purchase; from booking to delivery should be easy to monitor with touch of a button in a native application.

### Example

There are numerous applications in our daily drivers which are native applications. Facebook, Instagram, and Skype are few native applications that are most widely used.



Figure 7: LG TV remote control application (iOS on the left, Android on the right)

As shown below in figure 7, the LG TV Remote application is also native. It is controlling the connected television over WiFi. Since its sole purpose is to control the TV, it is responsive and fluid, which are the traits of a native application.

## 7.2 Web applications

Web applications are fine-tuned specifically to be run on a mobile browser. The traffic of data depends on the user request in HTTP. Thus, it works virtually in any smartphone. The downside is that it relies on an active internet connection. It is because of its open nature it does not require a custom SDK or OS, and will run on any device with a web browser. The same basecode can be used for multiple platform. The data is stored over the cloud and the rendering is done on the server side, and therefore is lightweight. Instant upgrades come as a bonus for lightweight applications. In general, web applications do not have custom look, and they are generic. This leads to limited capabilities on performance. Web applications also generally have a limited access or do not use the device hardware, but there are a few exceptions. It is thus easy to develop, maintain and distribute.



Figure 8: Characteristics of a Web app

Figure 8 depicts the features of a well-built web application. Since the same basecode can be used for multiple web applications, it can be written and deployed once, but run everywhere. There is no limit to customising software since web applications can be built using HTML, HTML5, CSS and JS. The main advantage of a web application over other types of applications is the wide coverage of different form factor of devices. It can run on android, or iOS or windows.

### Example

Since the booming growth of mobile devices, more and more web applications also have a supplementary native application for the same primary purpose. The same accounts are synchronised even though the user uses any one of the application.

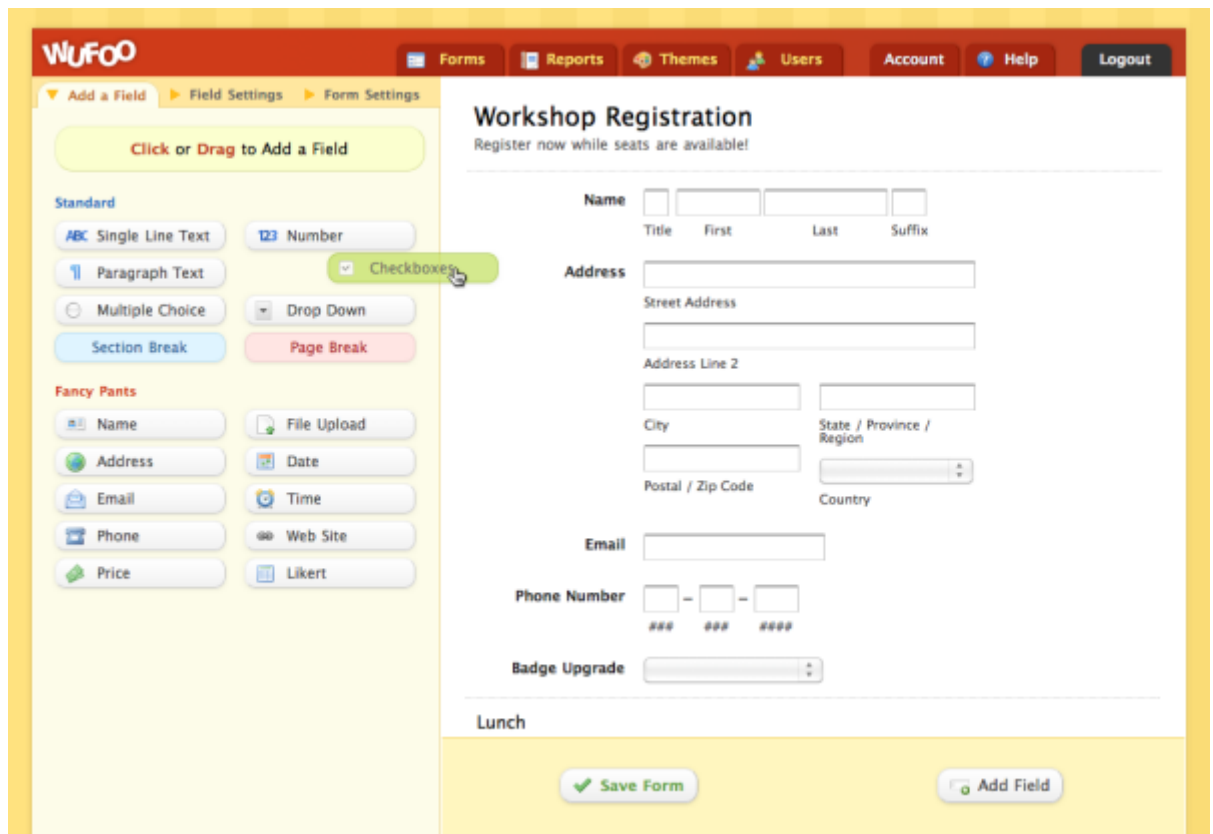


Figure 9: Wufoo, a web-based application is used to design online forms

Nonetheless, there are many examples of web applications, such as Dropbox and Wufoo. Dropbox is a cloud storage service whereas Wufoo, shown in figure 9, is a tool to design web forms used on websites. Usability is the primary factor when it comes to a web app, and this application is simple, well designed and easy to use.

### 7.3 Hybrid applications

A hybrid application is the marriage of web technology and native execution. It is a shell written as native, but screen and content are delivered dynamically. It is not a website in itself, instead portlets or templates delivered by HTML and XML by the backend. Hybrid application have access to native platform since they are hosted in a native container. They are built by cross platform application development and have the best and worst traits of both web and native applications.

Since hybrid applications are browser-based, they have the same vulnerabilities as the web applications. On the brighter side, the web portion can be downloaded or packaged within the app, like DLC in a game. All the benefits of a native application mean it has

full access to the API and application store complaint. It can work with or without an internet connection. The required data is utilized within the local storage and then later synchronised or downloaded when the internet is connected.

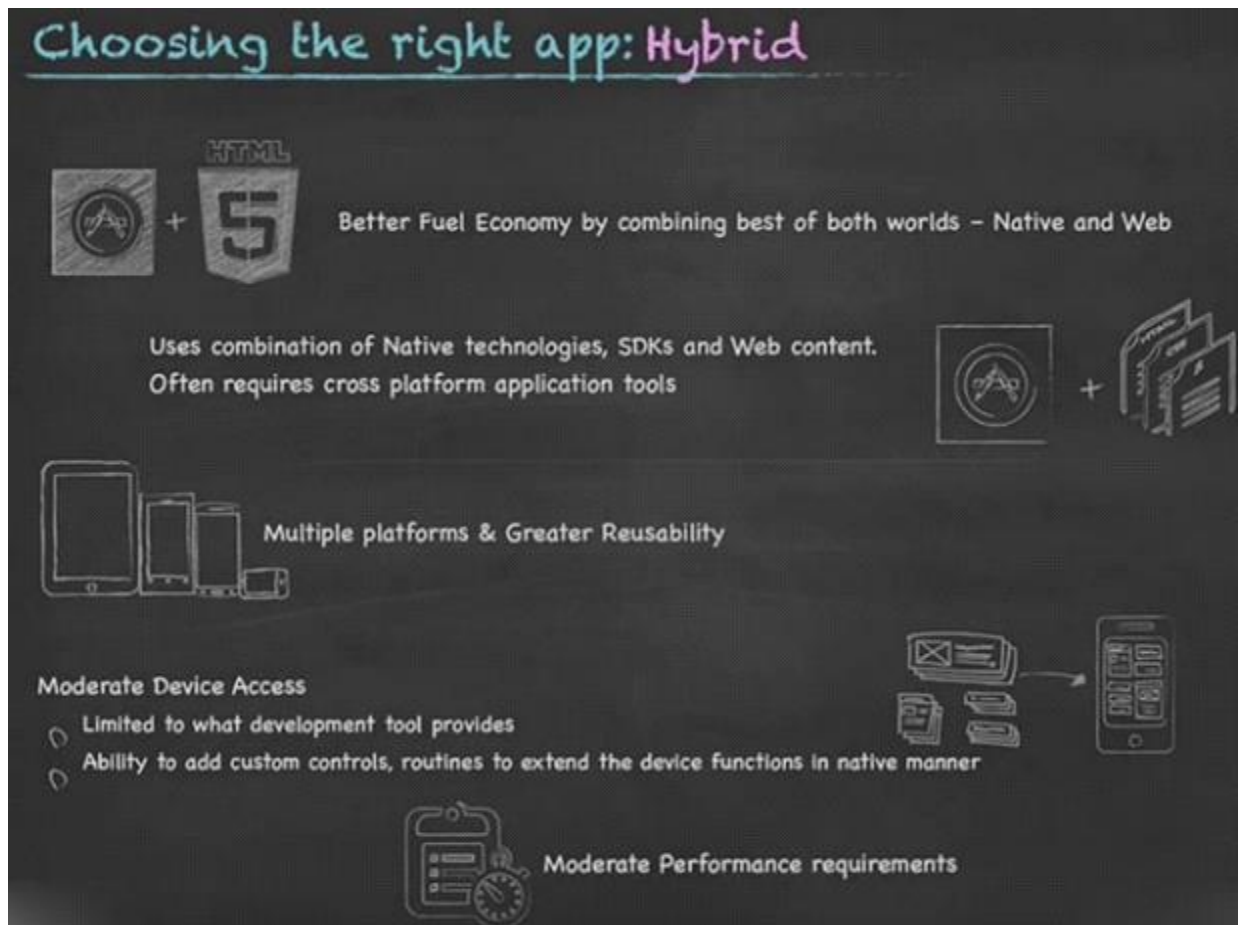


Figure 10: Characteristics of a hybrid application

The features of a well-built hybrid application are shown in figure 10. It is the fuel to both native and web application, with access to wider range of platforms with greater reusability.

### Example

Websites that already have many features available on their websites are the ones which have a hybrid application. They need not spend on native application because their hybrid application does the primary job. Some of the examples of hybrid applications are LinkedIn, Facebook and Flipboard. For instance, Facebook loads all the required content from the time it was online, and can store all the data locally. A status update can be updated without an internet connection, and will be updated when the device is online.

Table 2: Main features and differences between Native, Web and Hybrid applications

	Native	Web	Hybrid
High performance	√		
Rich UI/UE	√		√/x
Device features	√		√/x
Widget based applications		√	√/x
More than 2 platforms		√	
Games, Entertainment applications	√		
Less time to market		√	√
Instant Updates		√	
Subscription based		√	√

## 8 Possible Next Steps in Mobility

The convergence of mobile technology is making the world smaller day by day. It has transfigured the means and modes of communication. Augmented reality and virtualization have helped modes of interaction reach goals which were not believable. Therefore, what future does mobility hold in this advancement? It is useful that modern enterprises do not have an assigned workplace for each employee, but rather have a shared space which can be used by anyone at a given time. The employees no longer follow the pre-determined way, rather prefer to use their own mobile devices, which in turn saves the money and resources of the business. Thus the policy of bring-your-own-device (BYOD) is being implemented in the majority of startups around the globe. According to Gartner,

an optimised workplace can save a million dollars. Hence, the enterprise only needs to make the system secure. Management, control, security, context, collaboration, clarity are the steps that need to be bore into mind when taking the leap towards enterprise mobility.

The enterprise needs to have a stable connection, which means, the antenna should beam to all the corners of the workspace. Since there are very few devices that are connected via wire, the data encryption and a reliable connection are required. The wire-less network should be robust and incur no breakdown. On the other hand, the interface must be simple as the application will be addressing a broader workforce. This also leads to the requirement of a smart user interface, such that the application on its own can work according to the necessity of the user.



Figure 11: The breakdown and transformation of enterprise mobility

Transformation of all the tasks performed by the desktop into the mobile device, or a standalone application is the primary goal of the future as regards mobility. A part of modern mobility is Internet of Things (IoT), which is almost everywhere, which means they need a controlling device. A separate device to control each and every IoT enabled device is difficult; hence an application installed in the user's application is the answer. Here are a few advances that sees the future of mobility:

### 8.1 Convergence

Various desktop-based software have been trying hard to act like a mobile device, but have failed. A device, like the universal remote control, for an enterprise can only be a



mobile device. It has the capability to intake, analyse, process and output the given data in a short period of time on a simple interface. On the brighter side, it can also upload the real-time analytics into the database, all within the same device or application.

## 8.2 Centralization

Payment devices and signature pads are among many devices businesses like UPS or FedEx or DHL need to provide their employee in order to carry out a delivery. However, with the help of enterprise mobility, a simple application can take care of all this. NFC used for payment, stylus used as a pen and camera used as a barcode scanner are some features that can be utilized from one device to eliminate the use and maintenance of various devices.

## 8.3 Security

Due to the use of a private application within a private network, the chances of security leakage are low, especially within the enterprise. Multiple layers of login verification or assignment of different layers of access as per the user's needs are some features of mobile devices tuned with mobility.

## 8.4 Personalisation

From suits to mobile devices, everything in the modern time is personalised. This is the reason services sell in the market. Mobility has a bright future because the user can not only be able to personalise his work device, but also chose what type of device he wants, and what form factor. This helps the user get the work done in the easiest and most efficient way.

Due to these features, it is safe to say that mobility has a central role in the development of modern mobile devices. This provides the power to the user or employee, and increases the engagement time, in turn helping the work done on time.

## 9 Best Mobility Device Management Trends

Mobile device management (MDM) is basically a solution that one can put into the organization's network which will control the devices. With MDM, a device can be controlled off-location, and carry out remote wipe, install, monitor or control. The main service providers are Citrix, Microsoft and SAP, whereas the rising contenders are SOTI and AirWatch. [13]

User are central to any development. Their experience should be the intuitive strength to provide just the information they need, when it is needed, where it is needed, and preferably within two clicks. System-driven development tools process this task by trying to shoehorn entire solution built for PCs into smaller mobile devices which do not support this mind-set, which is why mobile solutions from big companies struggle to comprehend with the users. Everything needs to start from the needs of the end user, and work its way back.

Some of the characters of essential mobility management are:

a. Device diversity

A cross-platform is the answer to this feature. An organization is equipped with various types of mobile devices, hence management in the OS front is essential for mobility management.

b. Policy

An organization runs with the help of different employees with different levels of access to the enterprise resources. Hence, an enforced usage policy is the key to long-term security and workflow.

c. Security

One of the main issues with distributed devices across an enterprise is security. This is one of the primary management tasks required while planning for the next big change.

d. No/Zone leakage

Nothing is 100% efficient. Hence even though a company might employ the best application developer, but there can be backdoors and bugs. Like a cloud system,

the application can be run in Sand box or Containers, which will boost the security and help reduce leakage.

e. Inventory management

The resources of an organization might come from different geo locations, which is why an enterprise needs to monitor the geo change and filter what is connected.

f. Distribution of software

It is a difficult task to notify every application user about the change in the application. However, along with monitoring the devices and applications, the features such as push notifications and Over-the-Air (OTA) can be provided remotely. This saves time and money.

g. Administrative reporting

Along with constant monitoring of the system, a live feedback feature would improve the quality of output.

## 9.1 Mobile Enterprise Application Platform

Mobile Enterprise Application Platform (MEAP) is a category of software that allows the needs to build mobile applications in ways that are typically faster and cost effective than if they were built on their own from scratch. MEAP allows enterprises and businesses create application for their users, the benefit being able to create cross-platform applications without having to write the code from base. A very powerful tool some MEAP provide is to be agile in developing the process and make bracket changes to the application. It allows to gain control and standardise on a single platform to build all the mobile applications with internal and external features. It is a sustainable, supported and future proof where most of the work is done by the platform, which does the development, integration and management all in one place.

MEAP supports a broad range of devices and OSes, and can be run on the cloud. It incorporates an extensive range of applications, hence aids in workflow productivity, business intelligence, collaboration and knowledge management. MEAP offers future

scalability, sustainability, seamless integration, faster time to market, and lower development and management costs. The certain available application-making tools means that the tools act like plug-ins, but are often industry standard.

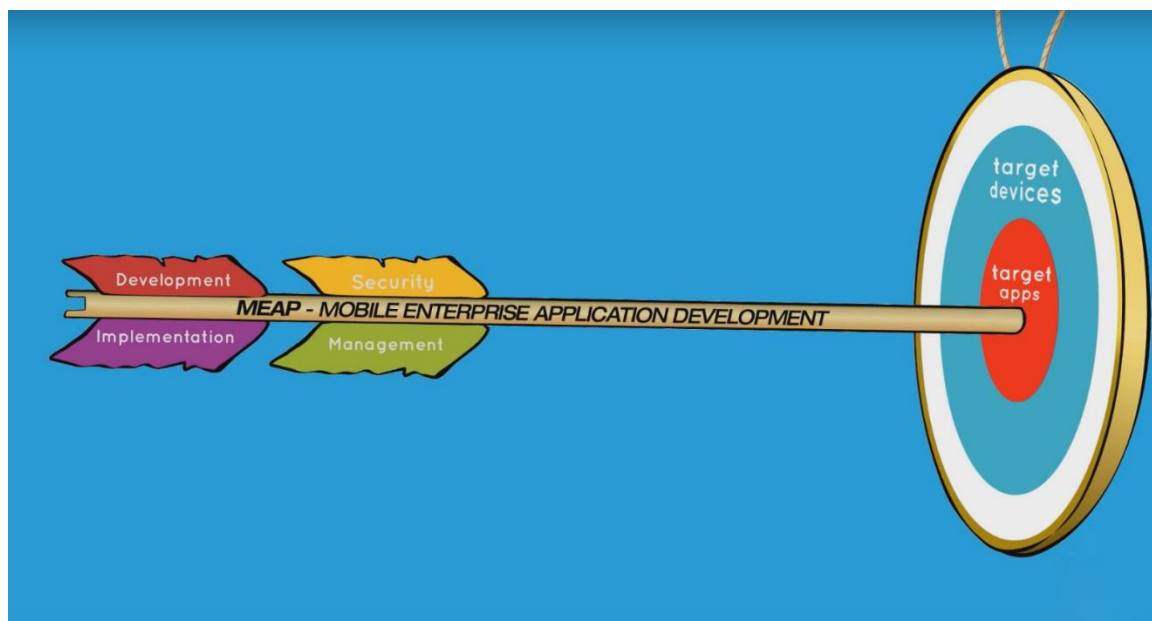


Figure 12: Mobile Enterprise Application Development (MEAP) targets

MEAP is considered one of the best and leading platforms. However, MEAP is changing into Mobile Application Development Platform (MADP). This is because it not only integrates the enterprise applications, but also rapid application development tools. This capability converges tasks such as development, implementation, management and security to mark the right target applications on the respective target device, as illustrated in figure 12.

## 9.2 Mobile Application Development Platform

Mobile Application Development Platform (MADP) is a refined version of MEAP, which is a hub of products and services used to develop an application. MADP aligns the three main entities of technology; the devices, the backend systems and the applications. These three variables are different from one another. Every 9-12 months, new devices and OS versions come into the market. On the other hand, the backend systems get an upgrade every 3-4 years. Also, applications are unstable. They can update every now and then. These systems run at the same time, but move at a different rate. Hence, there comes a requirement of a mobile platform that can chain these independent updates. The platform is built to leverage the SDK at immigration points in which enterprises can

chose to line these updates regardless of the lifecycle of the independent entities. Hence, when a platform is used, an application can be developed against the existing backend and chose the existing device that is available. However, by the time the application is done, the device may have been changed to a new OS or a form factor. In this case, the mobile platform protects the future changes that may incur so that one can insure that the whole development and integration process need not be done from scratch when the next change happens. This is when the platform has value and brings these three factors together during the complete lifespan of the system.

MADP automatically recognizes a device's property and installs a compatible version of the same application on different devices. Hence the same quality can be expected across different platforms of mobile devices.

An organisation is said to have fully utilized MADP if it meets the “Rule of Three”:

1. Supports three or more applications
2. Targets three or more operating systems
3. Integrates with three or more back-end sources of data



Figure 13: Gartner's magic quadrant for MADP [14]

Gartner's magic quadrant is a yearly publication of the key players in the technological world of mobility. Figure 13 clearly shows that IBM, Kony, Salesforce, Adobe and Microsoft are the leaders. The figure also demonstrates that the size of the business is not a factor. For example, Red Hat is lower than a newcomer Salesforce. Hence, the ability to execute and the completeness of vision are the factors determining the ranking on the enterprises.

## 10 Problem Statements

In order to tackle the problems, the primary problems should be listed out and the solutions sought. The three major problem statements when implementing mobility are as follows:

### 1. Mobility is expensive

According to the report 'The Global State of Enterprise Mobility: 2016', which surveyed 300 organizations globally, most enterprises have invested in mobility for the most part. The sum was estimated to be from €230,000 - €450,000 (\$250,000 - \$500,000), which is invested by 25.3% of the enterprises. [15] This is similar to the €250,000 (\$270,000) average of 2014. Another report claimed that €156,105 (\$171,450) was the average cost of an application in 2015. [16]

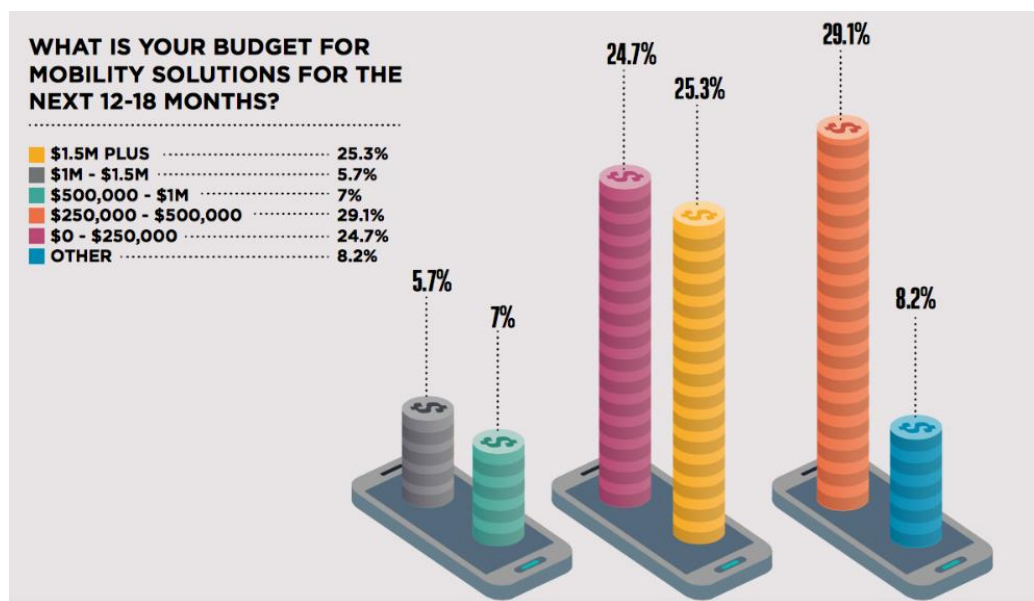


Figure 14: Investment distribution among 300 global organizations [15]

Referring to figure 14, it can be concluded that large-scale business tends to spend more on mobility, with the budget reaching as high as \$1.5 million.

## 2. Technical problem

Technical problems such as security, data leakage, getting the application up and running can be the most challenging of problems which can be handled with careful enterprise management and planning.

## 3. Hard to maintain

In reference to a 2015 report, it is estimated that the maintenance cost ranges from \$3000 to \$25000 for an enterprise application. [17] Apart from the cost, the commercial applications might face competition from other vendors with better and faster work rate. Updates and bug fixes are the core drivers that help maintain the application. Hence, work on the application is not finished after the launch of the application. Development means, there is constant change and advances necessary to keep the application up and running.

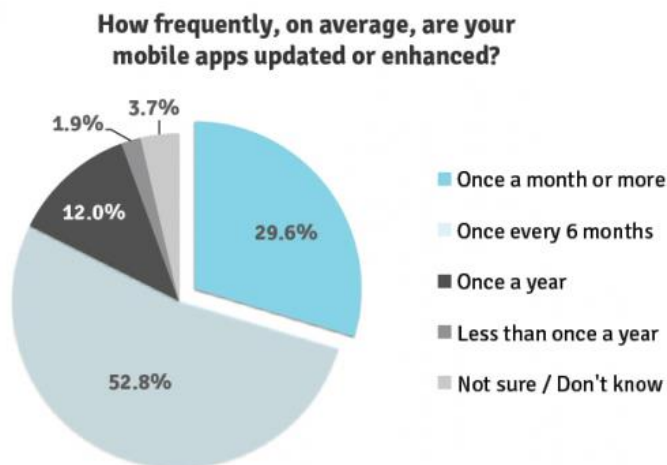


Figure 15: Pie chart on the update frequency of applications [18]

Figure 15 illustrated a 2016 survey, which concluded that more than half of the applications in the applications stores across all platforms are updated at least once every six

months. These are the applications ranked highest in their respective application stores. [18]

## 11 Solutions

The problems statements are basic and have at least one solution. Security, speed and real-time data access are the answers to most challenges that any organization faces. However, they have been discussed already. Here we discuss the solutions to enterprise mobility in the long term. These solutions help the company get a better return of interest (ROI).

### 11.1 Cross Platform Development

MADP is the ultimate tool in an application's lifespan, from designing to analysing after deployment. It helps to run the applications on a numerous range of mobile devices and works with the same efficiency across all platform and OSes. Applications like Appcelerator, Kony, Backbase which work via Arrow, NativeScript or CSS, be it native or hybrid, have MADP capabilities. MADP also supports open-sourcing for both iOS and Android technologies.



Figure 16: MADP cross platform frameworks

Cross-platform aids in better user experience and application performance. It provides access to the bare bones of the device and the underlying mobile operating system. The same code can be used for multiple platforms which makes it easier for the web devel-



opers, in turn reducing the development time and costs. However, it requires good programming knowledge and needs to be updated according to the platforms and OSes. Adding to it, since MADP is a tool in itself, its own IDE cannot be used.

## 11.2 Rapid Application Development

Rapid application development (RAD), it is a system development methodology that was developed to respond to the delivery system very fast. It was the merging of two interties; increased speed of business and powerful computing availability. Any project is only suitable for RAD if the decisions are taken quickly and by a smaller number of people. The project technical architecture needs to be defined clearly and the key technology component is in place and tested. There are no specific technical requirements since the enterprise aiming to use RAD usually has the capability.

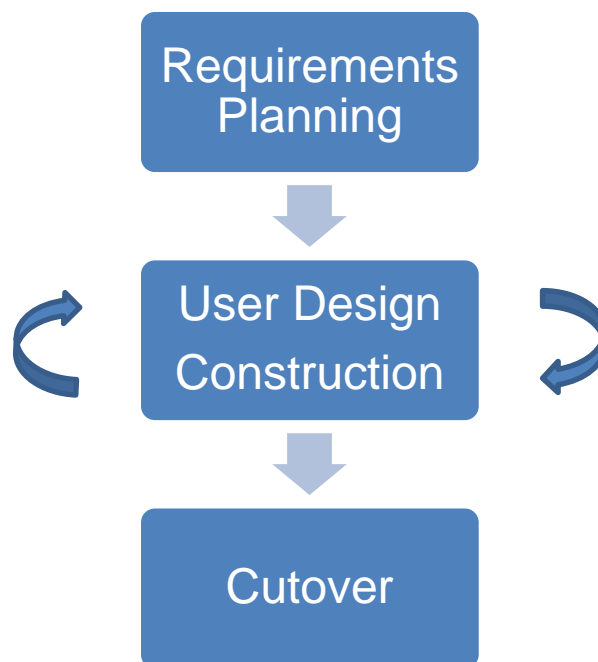


Figure 17: Phases in the James Martin approach in RAD [19]

Though the name suggests a rapid approach, the interaction time between the user and the developers means the development cycle spins more than required. Like a ping request, it requires approval from the user working along hand-in-hand. A project can only have RAD if it has more control in it, which is hanging on the balance that RAD is a

flexible and adaptable process. RAD is not suitable for a big group because of the hands on approach.

James Martin divides RAD into four phases [19],

1. Requirement planning

Rapid Application Development combines the elements of the system planning and the system analysis phases from the system development lifecycle (SDLC).

2. User design phase

RAD in itself is a method which lets the user go hand-in-hand with the developers. Hence, the system developers and end users work together in real time. Thus, in this phase, the users interact with system analysts and develop a prototype.

3. Construction phase

Users suggest changes or improvements as actual parts are developed.

4. Cutover phase

The final tasks and SDLC implementation. This is the concluding phase where the application is built, delivered, and placed in operation.

### 11.3 Native for the Best Experience

A native application is built for performance and subsequently does the task as required. High resource demanding applications can only be run on native applications. All of the device's features such as camera, GPS, accelerometer can be utilized by the native application, which is a difficult, if not impossible, task for a web application. A presence of a native application store means more users can be reached from a single place. A user looking for a particular application does not have to go elsewhere, rather type in the features, and download the application. From a user's point of view, mostly all native applications have the same layout of menu and features. This helps navigate the application swiftly and concisely. Hence, the user experience is better in native applications.



Figure 18: Mobile Applications vs HTML5 Web Applications

Figure 18 compares the features of native applications and web-based applications. It is clear that native applications have more features and utilization of resources.

#### 11.4 Migration of Native Application Development to Web

There are many web applications that have many features that can cost money if built from scratch as a native application. Hence, web applications are built as hybrid applications, which is the bridge between the two. However, the technology used in the development of native application is not the same as the web applications. It is simple for a web application to convert into a native application. The tools used are Objective C, Java or .NET according to the platform of the target, each have their own SDK: not just enterprise applications integration platform but rapid application development tools. They are then deployed in the application stores.

Table 3: An eight week plan from web developer to mobile developer [20]

Migration Path	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
<b>Java to Android</b>	Setup the development requirements.				Plan the structure	In reference to the proof of concept, construct a beta application.		Test and improve the beta application.
	Deploy virtual machines which supports .apk extensions, which is used by android devices.				Design for performance			
					Learn android devices and versions			
					Learn basic UI designs			
					Learn to improve the efficiency of the devices			
<b>.Net to iOS</b>	Setup the development requirements.				Plan the structure	In reference to the proof of concept, construct a beta application.		Test and improve the beta application.
	Learn softwares such as Xcode, Cocoa and Interface Builder to build iOS applications.				Design for performance			
					Learn android devices and versions			
					Learn basic UI designs			
					Learn to improve the efficiency of the devices			

## 12 Discussion

### 1. What does the market demand?

It is clear that the market is looking for on-demand mobility, IoT, 3D Printing and computing everywhere in general. In terms of enterprise mobility, there is demand for native applications for the organisation which is trying to reach a broader audience as a step up from a web application. The proportion of the demand for native applications over browser based applications was already surpassed in 2014.

### 2. How can businesses invest in the right technology?

It is not only the technology that a business needs, but the needs of a business that is technological. The business needs to understand what it is looking for, and what services it is offering via the technology used. Making a list of services provided and the means to meet those demands can be gauged and then the right technology can be introduced.

### 3. What is the strategy to solve the problem for the long term?

Any strategy needs to be well built before it can be executed. Hence, for a long term strategy, a business needs to look at itself in the mirror and prepare for it. Some of the strategies can be as follows:

#### a. Collaboration

The working and thinking minds of the organisation need to be working hand-in-hand.

#### b. Identification

What is required and what is available are two factors needed to be clear in order to set a clear goal and achieve it with efficiency.

#### c. Priority

Use of MADP will help in treating all devices in the same way.

#### d. Security

Security is one of the pillars of any enterprise strategy.

e. Approach

A one-way approach is as good as clapping with a single hand. Users and developers need to be in constant contact so that a multi-channel work world go on.

f. Milestones

Planning ahead and keeping goals in mind as the work follows helps in reaching the goal in time.

4. What metrics an organization should look for to get the best return of interest?

Enterprise mobility also requires a good Return of Interest (ROI) in order to help develop the organization further, like any other business. The main 3 Ps of an organization, Product, Process and People are the key figures to a better organization. A large number of people does not mean large productivity. Finnish game giant Supercell has 150 employees yet is one of the top game companies in the world with games like Clash of Clans, Boom Beach and Clash Royale which have 100 million daily players. [21]

To get the best ROI in mobility, an organization can use a few methods:

a. Revenue vs Costs

After finalizing the tools and technology required for enterprise mobility, an enterprise can compare the costs against the profits. This includes costs in development, launch, advertisement and maintenance against sales, performance and profitability.

b. Statistics

As soon as the application is available, the enterprise can collect raw data and analyse the market situation and get feedback right away. The availability of feedback section in application stores can be a stepping stone in the right direction. Every information is good information when it comes from a user of the enterprise's applications.

c. Adaptation

As stated earlier, MADP is one of the best path to organizational success with better utilization of resources. However, since it is a professional approach, the developers and employees need to adapt to the system and technology used. The

investment will only become an asset if it is being used, else it will become a liability and to balance it, more expenses can be expected.

d. User satisfaction

The rate of customer satisfaction is directly proportional to the image of the company. For example, few weeks back, nobody knew the company Niantic Labs, however within a month, its product Pokémon Go has been downloaded 75 million times. [22] Hence, it proves that hype plays a role and user satisfaction is the goal.

5. Hybrid or native?

Despite it being competitive to reach the top level, hybrid has not the same user experience as native. It has come a long way, which was a bridge between web and native. Hence, keeping in mind the number of mobile devices in the world, it is safe to say that native is the future.

6. Host or Install?

The deployment of an application depends on what the enterprise can offer. In the case the enterprise is small, a third-party solution is better, whereas for a large organization, installation would be better choice since it has a strong economic backing and can maintain the system on the long run. Cloud services like Amazon Cloud Service, Azure and VMware are very cheap and a subscription would cost lower than maintenance, save time and resource space.

### 13 Conclusion

The goal of this thesis was to analyse the mobile application market from a business point of view and conclude on which application is efficient to develop and maintain. Millions of applications are available in various application stores and hundreds are deployed every day. More and more mobile devices are produced around the world than any other mass produced devices. This sky rocketing of the demand for smartphones and mobile devices means a higher demand for content and applications. Pen and paper is not used by business anymore because using the policy of BYOD is resourceful and economical for the business and efficient to the user. The use of enterprise applications in these devices is the primary reason enterprise mobility has a good market in the future. The implementation of BOYD aids the enterprise in such a way that there is no requirement to train the new employee on how to use the resources. Time is money, and hence, time is saved in this process.

There can be no debate on the fact that native applications are far superior in terms of user experience, visual appearance, system utilization, and performance. Web applications and hybrid applications are trying to catch up with native applications but have not reached the same level. However, there is equal necessity of web applications because of the number of desktop devices still in use. Even though the number of potential buyers are mobile shoppers, desktop users need the bigger interface of a desktop. There are times when native application is not recommended. For example, it is not recommended when more than two platforms are targeted. Also, in case of instantaneous application updates requirements, native applications are going to be expensive. Even though it is easy to replicate and publish, the building can take time and time-to-market needs to be taken into consideration.

There is low investment and better productive results where mobility especially MADP is optimised. Optimisation aids in numerous ways such as scalability, usability and performance. MADP provides control to every drop of resources and full access of advanced devices and performance capabilities. The codes can be managed for each platform using a single interface and there is no limit in the user interface capabilities. Custom looks and feel can be provided to each client with a high level of security. If a better ROI is the main objective, then rapid application development (RAD) is the best in terms of low running costs. Once a skilled individual is employed to carry out the task, s/he can handle the rest of the process in accordance with the customer. Similarly, having an all-



in-one platform helps centralizing all the activities into one single hub. This makes maintenance, deployment and control easier.

Finally, the answer to the basic difficulties in the long term is mobility and the use of RAD and MADP. BOYD tackles the device and platform diversity among employees. Native applications provide secure, fast and efficient results. Cloud storage isolates the company network from open networks. More employees is not equal to more productivity. Rather, efficient employees equipped with the right devices is. Customer goals and interaction should be clear in the vision of the service provider. Mobility is the future, and the future is here.

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