ASSIGNMENT COVER PAGE

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Marker's Feedback

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Implementing a mobile based platform for higher education institutes in the Maldives

BIT 206 - FINAL YEAR PROJECT I

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Submitted to the

SCHOOL OF MULTIMEDIA (LIGHT SKY)

In partial fulfilment of the requirements

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COLLEGES MV

CYRYX COLLEGE

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ABSTRACT

This project is done as the assignment of our module BIT 206 (Project I), which is one of the module of our course (Bachelor of Information Technology). This is the Requirement Definition Report of the final project. Final project (Project II) will be implemented in next year (2018). This project was done by a group of three members. The final project also would be done by the same group. This document includes main four chapters. They are listed below:

- ✓ Chapter 1: Project Proposal
- ✓ Chapter 2: Project Management Plan
- ✓ Chapter 3: Requirement Analysis
- ✓ Chapter 4: Literature Review

As we mentioned before, title of the project is "Implementing a mobile based platform for higher education institutes in the Maldives". This would be an android mobile application and its name is "Colleges mv". This system will integrate all the higher education institutes in Maldives (especially those in Male') to a single platform. The key feature of this system is to display the courses and information of courses that is offered from different institutes.

Currently, there is such a system implemented in the Maldives. If anyone wants to look for a better course, they are having to access the websites of different institutes. Sometimes they have to come to Male also in order to apply for the course. This is a complicated system and we need to overcome the complication by implementing Colleges mv application. Users would be able to view all the courses offered from all the institutes in a single platform, so that, it would be very helpful for them to seek and to select a right course after comparing each other.

We hope this would be a very beneficial mobile application for the people who needs to look up for the courses in Maldives.

DECLARATION

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ACKNOWLEDGEMENT

This project will not be possible without the help of a number of people. We would like to express our deepest gratitude to those people who has devoted much of his/her time to us.

At first, we would like to thank Allah for giving us forte and providing us with good acquaintance to complete this assignment successfully and without whose grace and mercy we could not have come this far, even starting a bachelor of degree program.

We express my deep honest of appreciation to our lecturer (Abdulla Musthafa), for his treasured time endurance in delivering us with the all the necessary guidance and support throughout this project and module.

Finally, an honorable mention goes to all our classmates, family members and our group members for assisting us to complete the project and giving us a good support. Without helps of the particular that mentioned above, we would face many complications while doing this assessment. So once again thank you everyone from the core of our heart.

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LIST OF SYMBOLS AND ABBREVIATIONS

ACCA - Association of Certified Chartered Accountants

AMPS - Advanced Mobile Phone System

CDMA - Code-Division Multiple Access

CIM - Chartered Institute of Marketing

CSS - Cascading Styling Sheet

CSUN - California State University, Northbridge

DHE - Department of Higher Education

EDGE - Enhanced Data rates for GSM Evolution

FE - Faculty of Education

FET - Faculty of Engineering Technology

FHS - Faculty of Health Science

FHTS - The Faculty of Hospitality and Tourism Studies

FMC - The Faculty of Management and Computing

FSL - The Faculty of Shari'ah and Law

GER - Gross Enrolment Rate

GPRS - General Packet Radio Service

GPS - Global Position System

GSM - Global System for Mobile communication

HEI - Higher Education Institution

HSCSD - High-Speed Circuit-Switched Data

HTML - Hypertext Mark-up Language

IMA - Institute of Management and Administration

IUM - Islamic University of Maldives

IP - Internet Protocol

LBS	-	Location Based Service
MAPS	-	Modern Academy for Professional Studies
MCHE	-	Maldives College of Higher Education
MCMA	-	Maldives Centre for Management and Administration
MITE	-	Maldives Institute of Technical Education
MLS	-	Multiple Listing System
MNU	-	Maldives National University
MNQF	-	Maldives National Qualifications Framework
MOE	-	Ministry of Education
MP	-	Maldives Polytechnic
MQA	-	Maldives Qualification Authority
NMT	-	Nordic Mobile Telephone
OECD	-	Organization for Economic Co-operation and - Development
OS	-	Operating System
QoS	-	Quality of Service
SCHE	-	Short-duration vocational higher education
TACS	-	Total Access Communication Systems
UMTS	-	Universal Mobile Telecommunications System
US	-	United States
VTC	-	Vocational Training Centre
WAP	-	Wireless Application Protocol

CHAPTER 1: PROPOSAL

1.1. Introduction

After completing the school studies, everyone starts looking for the courses the further studies. There is no effective platform that they can search the accessible courses from different academies in the Republic of Maldives. They are having to access to websites of different academies distinctly in order to seek for an appropriate path. Our intention is to bring a solution for this burden via this project.

This project is a multi-college integrated online mobile application which will be developed for the Android operating systems. Colleges and universities which are located in the Maldives can take part in this platform in order to deliver the information of their courses to the public through the application. This application comprises colleges and universities, and all the relevant information about their offered courses.

Therefore, we can use this application to look for the available courses offered by several colleges and universities in the Maldives. We can get all the required information from several parties using this single application.

1.2. Company Background

This project involves colleges and universities located in the Maldives. Cyryx College will be the one of those that will be included in the application.

Cyryx College is the result of a small computer training center that commenced on 24th August 1993 with just 4 computers and 6 students. Cyryx is now matured college that provides to over 3000 students and employs over 60 academic and support staff members. Their amenities have grown to comprise tree campuses in Male' with several computer training labs, contemporary lecture rooms, and a library. In appreciation of service to the nation, Cyryx was granted the national Public Service Award by the president of Maldives in 2002. (Cyryx College, n.d.)

Their priority is to deliver a quality service. Their courses are considered to make sure that students collect relevant up-to-date knowledge and skills. Their lecturers are selected prudently by providing them further training. Their courses range from Certificates, Diplomas and Bachelors in Information Technology (IT), Management and Business Finance (Cyryx

College, n.d.). In addition, they also offer courses from Help University which is a private university in Malaysia. It is recognized for its excellent teaching-learning pedagogy and the quality of its programs. (HELP University, 2015)

1.3. Issues with Current System

Currently, there is no relaxed way of searching courses from different academies using a common platform. Calling to campuses or accessing to the website of all the academies and seeking is a complex system in this technologized world. Furthermore, this system makes it difficult to compare the courses of different conservatories. Due to this, there is no much competition between academies. We should bring a common stand for the colleges and universities to resolve this problem.

In addition, one of the most important facility that they should provide is 'online applying' for the courses. But it is a mislaid facility in most of the conservatories. In the present system, we are having to physically go to the particular campus of the college with all the required documents to apply for the course. Moreover, 'online payment' of course fee is another absent facility that most of the academies do not provide for their students. Students should be able to pay their course fee without presenting to the campus.

Lastly, there are numerous issues with current college-university system in the Maldives. It is a very time consuming, costly and complicated. system. Therefore, we should present a new appropriate system for an easy life.

1.4. Benefits and Constraints of Proposed System

We are proposing this system to overcome the issues and weakness in the present system. This application should be able to overwhelmed those matters. This application does not focus to online applying and online payment which may come bit later in a future version. But we focus to the main and most important issue that is assimilating of colleges with their courses. Anyone who have an android operating cell phone and internet access can see the courses from different academies with full details in a single application. This application helps to compare the courses, its fees, duration, etc, as we are presenting through a sole system.

However, as this is an online application, users need the internet access to use this system. Users those who does not have internet or Wi-Fi access are not able to practice this application. This might be a constraint of this system.

1.5. Project Description

This project is a multi-college integrated online mobile application which will be developed for the Android operating systems. Colleges and universities which are located in the Maldives can take part in this platform in order to deliver the information of their courses to the public through the application. This application comprises colleges and universities, and all the relevant information about their offered courses.

Main function of this application is viewing the courses and all the related details about them. Relevant details include following data:

- ✓ Colleges that the course offers
- ✓ Course overview
- ✓ Course fee
- ✓ Course duration
- ✓ Course level
- ✓ Course modules
- ✓ Course requirements
- ✓ Course timings and session
- ✓ Contact details of the academy

Users can see all the above-mentioned details in a systematic format. Courses will be categorized not by colleges, but by the courses such as Information Technology, Accounting, Finance, Shariah, etc. We have planned to add two extra functions of online application service and online payment service in the future.

Users can be direct users and indirect users. Users of the system include:

1.5.1. Direct Users

- ✓ Students who study in colleges or universities.
- ✓ Coordinators of colleges and universities.

✓ People who seek for courses or higher studies.

1.5.2. Project Description

✓ Other colleges and universities who do not take part.
✓ Ministry of Education.
✓ Parents or guardians.

As this is a mobile application, users can access the application using an Android running mobile handsets or tablets. In addition, they also need internet or Wi-fi connection as this is an online application. At first, user has to install the application from Google Play Store. It is the formal application store for Android applications. After installation, user can access to it freely with internet connection without any signup or login. Appropriate regular updates will be given and application can be updated from Google Pay Store.

1.5.3. Application architecture diagram
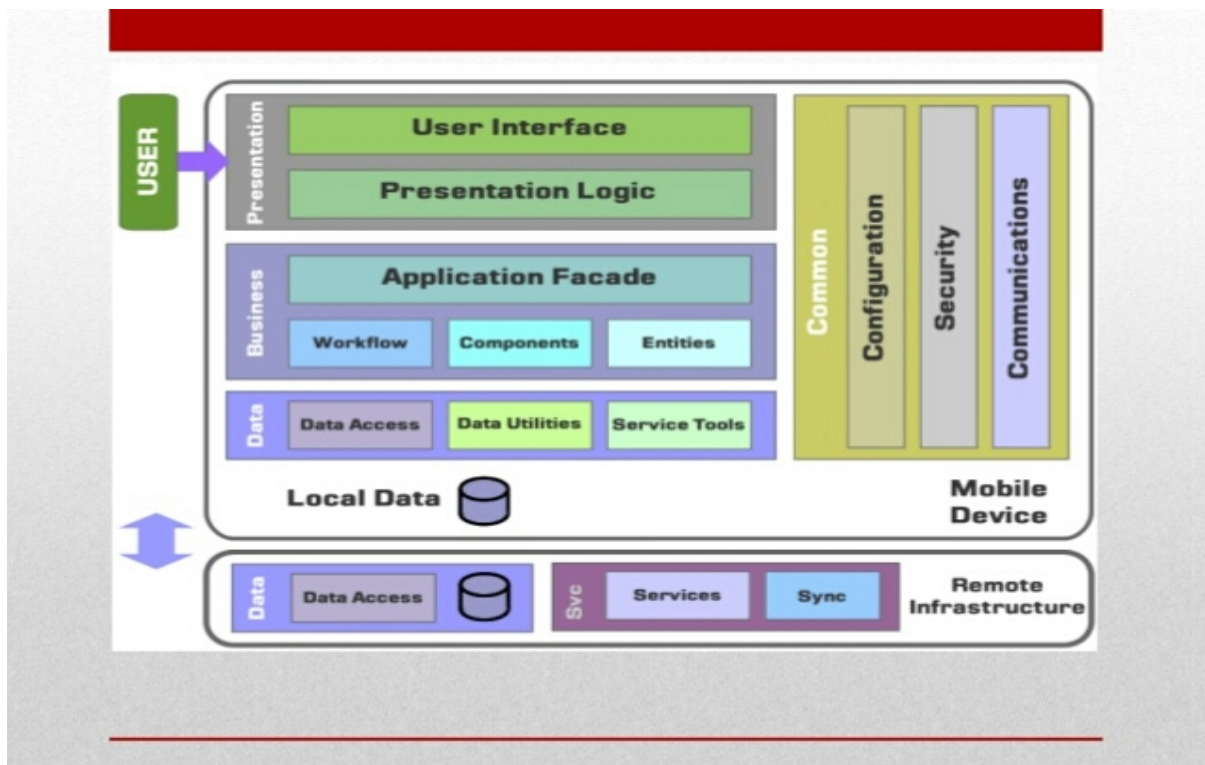
1.6. Project Aims and Objectives

The aim of the project is to overcome the issues with the current system and to provide an affective and reliable system to public. Our intention is to convert the current system to a competitive, effective and comfortable system by providing the required facilities.

1.6.1. Primary objectives of the project

- ✓ To integrate all the colleges and universities in the Maldives to a single platform.
- ✓ To avoid transporting difficulties by enabling seeking for the courses at any place.
- ✓ To deliver an easy way of searching the available courses.
- ✓ To increase the competition between academies.
- ✓ To help to choose the best appropriate course among all the academies by providing an easy way of comparing courses offered by different places.

1.6.2. Future objectives of the project

- ✓ To provide 'online applying' for the courses.
- ✓ To afford 'online payment' service of course fee.
- ✓ Seat availability.

1.7. Project Scope

Scope of this project is to provide the details of the courses offered by different colleges or universities form a single platform. Application provides all the details about courses. Users can easily compare the offers of different places. In future, this scope will be expanded as new functions are planned to add hopefully such as online application service and online payment service.

1.8. Software and Hardware Requirements

1.8.1. Software requirements

- ✓ Android Operating System

1.8.2. Hardware requirements

✓ Mobile Handset running Android Operating System or,

✓ Tablet running Android Operating System

1.9. Development Methodology

A system development methodology states to the framework that is used to structure, plan, and control the process of developing an informative system. A variety of such frameworks have grown over the years, each with its own standard strengths and weakness. One system development methodology is not unavoidably appropriate for use by all projects. Each of the accessible methodologies is the best matched to definite kinds of projects, based on several procedural, structural, mission and team contemplations. (Centers for Medicare & Medicaid Services, 2008)

Some of the acceptable system development methodologies are: (Centers for Medicare & Medicaid Services, 2008)

1. Waterfall Model
2. Prototyping Model
3. Incremental Model
4. Spiral Model
5. Rapid Application Development (RAD) Model

1.9.1. Waterfall Model
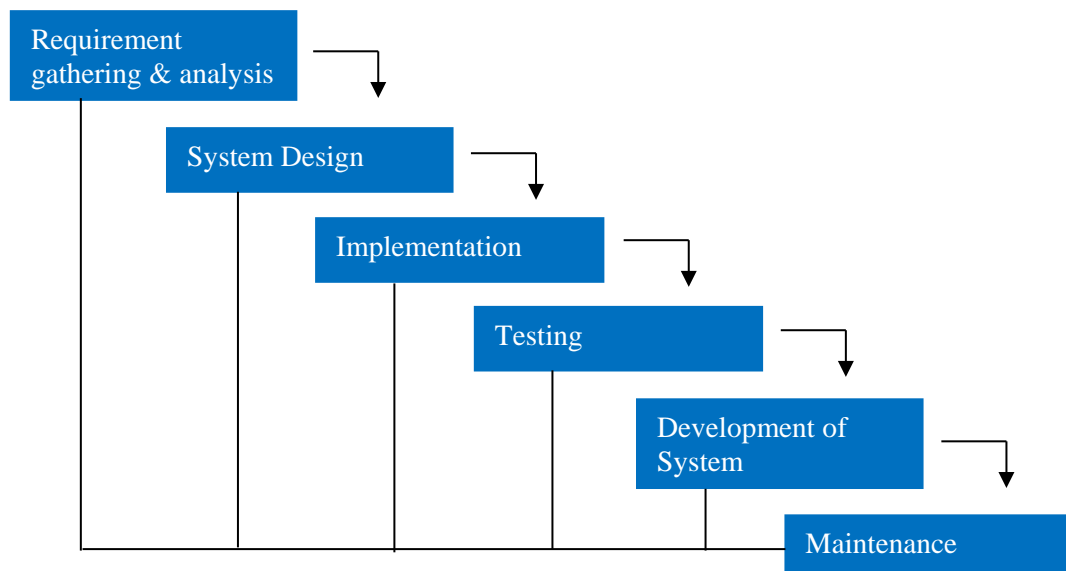
Framework Type: Linear

1.9.1.1. Basic Principles

- ✓ Project is divided into consecutive phases, with some overlap and splash back suitable between phases.
- ✓ Importance is on planning, time schedules, target dates, budgets and execution of an entire system at one time.
- ✓ Tight control is maintained over the life of the project through the use of extensive written documentation.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.1.2. Strengths

- ✓ Perfect for supporting less experienced project teams or project teams whose arrangement varies.
- ✓ Progress of system development is measurable.
- ✓ Conserves resources.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.1.3. Weaknesses

- ✓ Inflexible, slow, costly and awkward due to significant structure and tight controls.
- ✓ Project progresses forward, with only slight movement backward.
- ✓ Tiny room for use of iteration, which can diminish manageability if used.
- ✓ Depends upon premature identification and specification of requirements.
- ✓ Problems are frequently not revealed until system testing.
- ✓ System performance cannot be tested until the system is almost fully coded.
- ✓ Difficult to retort to changes. Changes that befall later in the life cycle are costlier and are thus discouraged.
- ✓ Written specifications are often difficult for users to read.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.1.4. Situations where most appropriate:

- ✓ Project is huge, expensive, and complicated.
- ✓ Project has pure objectives and solution.
- ✓ Resources need to be preserved.
- ✓ Project manager may not be fully experienced.
- ✓ Team members may be inexperienced.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.1.5. Situations where least appropriate

- ✓ Real-time systems.
- ✓ Event-driven systems.
- ✓ Leading-edge applications.
- ✓ Web Information Systems (WIS) primarily due to the pressure of implementing a WIS project quickly.
- ✓ Large projects where the requirements are not well understood.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.2. Prototyping Model
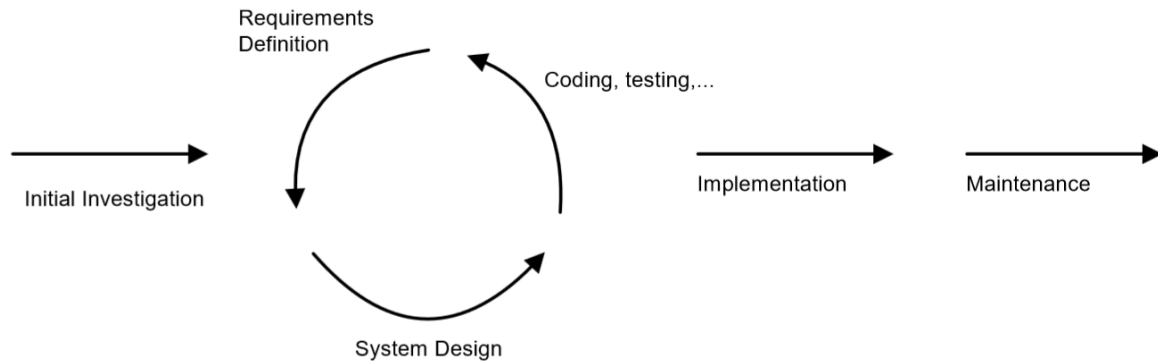
Framework Type: Iterative

1.9.2.1. Basic Principles

✓ Attempts to reduce inherent project risk by breaking a project into smaller segments.

✓ User is involved throughout the process, which increases the likelihood of user acceptance of the final implementation.

✓ Small-scale mock-ups of the system are developed following an iterative modification process until the prototype evolves to meet the users' requirements. (Centers for Medicare & Medicaid Services, 2008)

1.9.2.2. Strengths

✓ Improves both user participation in system development and communication among project stakeholders.

✓ Especially useful for resolving unclear objectives.

✓ Helps to easily identify confusing or difficult functions and missing functionality.

✓ May generate specifications for a production application.

✓ Encourages innovation and flexible designs.

✓ Provides quick implementation of an incomplete, but functional, application. (Centers for Medicare & Medicaid Services, 2008)

1.9.2.3. Weaknesses

✓ Approval process and control is not strict.

✓ Requirements may frequently change significantly.

✓ Identification of non-functional elements is difficult to document.

✓ Prototype may not have sufficient checks and balances incorporated.

(Centers for Medicare & Medicaid Services, 2008)

1.9.2.4. Situations where most appropriate

✓ Project is for development of an online system requiring extensive user dialog.

✓ Project is large with many users, interrelationships, and functions.

✓ Project objectives are unclear.

✓ User is not fully knowledgeable.

✓ Team members and managers are experienced.

✓ Flexible designs that will accommodate future changes are not critical.

(Centers for Medicare & Medicaid Services, 2008)

1.9.2.5. Situations where least appropriate

✓ Web-enabled e-business systems.

✓ Project team composition is unstable.

✓ Future scalability of design is critical.

✓ Project objectives are very clear.

(Centers for Medicare & Medicaid Services, 2008)

1.9.3. Incremental Model

Framework Type: Combination Linear and Iterative

1.9.3.1. Basic Principles

✓ A series of mini-Waterfalls are performed, where all phases of the Waterfall development model are completed for a small part of the system.
✓ Overall requirements are defined before proceeding to evolutionary.
✓ The initial software concept, requirements analysis, and design of architecture and system core are defined using the Waterfall approach, followed by iterative Prototyping.
(Centers for Medicare & Medicaid Services, 2008)

1.9.3.2. Strengths

✓ Helps to mitigate integration and architectural risks earlier in the project.
✓ Stakeholders can be given concrete evidence of project status throughout the life cycle.
✓ Gradual implementation provides the ability to monitor the effect of incremental changes, isolate issues and make adjustments before the organization is negatively impacted.
(Centers for Medicare & Medicaid Services, 2008)

1.9.3.3. Weaknesses

✓ Lack of overall consideration of the business problem and technical requirements for the overall system.
✓ Since some modules will be completed much earlier than others, well-defined interfaces are required.
✓ Difficult problems tend to be pushed to the future to demonstrate early success to management.
(Centers for Medicare & Medicaid Services, 2008)

1.9.3.4. Situations where most appropriate:

- ✓ Large projects where requirements are not well understood.
- ✓ Web Information Systems (WIS) and event-driven systems.
- ✓ Leading-edge applications.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.3.5. Situations where least appropriate:

- ✓ Very small projects of very short duration.
- ✓ Integration and architectural risks are very low.
- ✓ Highly interactive applications where the data for the project already exists and the project largely comprises analysis or reporting of the data.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.4. Spiral Model
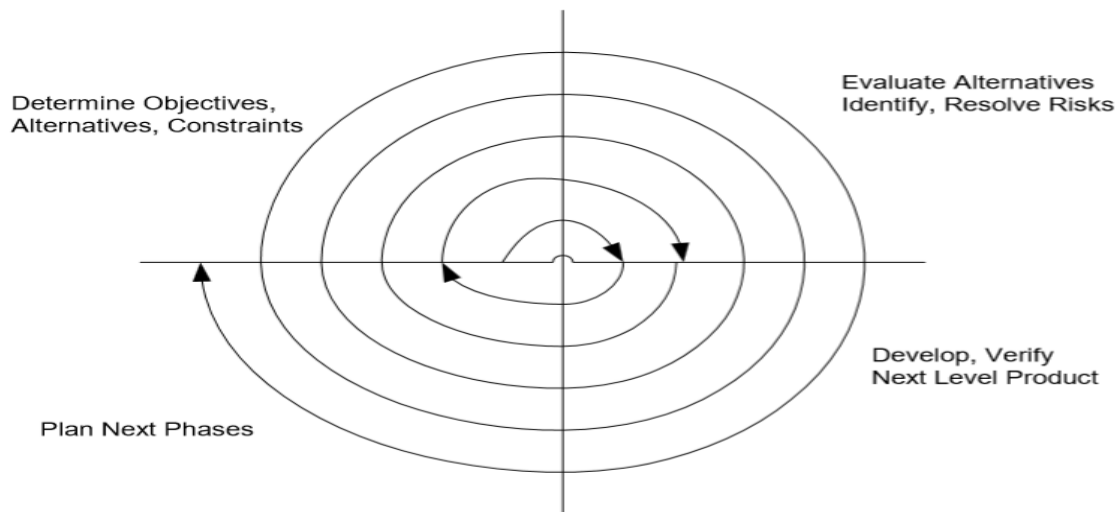
Framework Type: Combination Linear and Iterative

1.9.4.1. Basic principles

- ✓ Focus is on risk assessment and on minimizing project risk by breaking a project into smaller segments.
- ✓ Each trip around the spiral traverses four basic quadrants: (1) determine objectives, alternatives, and constraints of the iteration; (2) evaluate alternatives; identify and resolve risks; (3) develop and verify deliverables from the iteration; and (4) plan the next iteration.
- ✓ Begin each cycle with an identification of stakeholders and their win conditions, and end each cycle with review and commitment.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.4.2. Strengths

- ✓ Enhances risk avoidance.
- ✓ Can incorporate Waterfall, Prototyping, and Incremental methodologies as special cases in the framework.

  (Centers for Medicare & Medicaid Services, 2008)

1.9.4.3. Weaknesses

- ✓ Challenging to determine the exact composition of development methodologies to use for each iteration around the Spiral.
- ✓ Highly customized to each project, and thus is quite complex, limiting reusability.
- ✓ A skilled and experienced project manager is required to determine how to apply it to any given project.
- ✓ There are no firm deadlines. Cycles continue with no clear termination condition, s there is an inherent risk of not meeting budget or schedule.
  (Centers for Medicare & Medicaid Services, 2008)

1.9.4.4. Situations where most appropriate

- ✓ Real-time or safety-critical systems.
- ✓ Risk avoidance is a high priority.
- ✓ Minimizing resource consumption is not an absolute priority.
- ✓ Project manager is highly skilled and experienced.
- ✓ A high degree of accuracy is essential.
  (Centers for Medicare & Medicaid Services, 2008)

1.9.4.5. Situations where least appropriate

- ✓ Risk avoidance is a low priority.
- ✓ A high degree of accuracy is not essential.
- ✓ Functionality has priority over implementation.
- ✓ Minimizing resource consumption is an absolute priority.
  (Centers for Medicare & Medicaid Services, 2008)

1.9.5. Rapid Application Development (RAD)

Framework Type: Iterative

1.9.5.1. Basic Principles

✓ Key objective is for fast development and delivery of a high-quality system at a relatively low investment cost.

✓ Attempts to reduce inherent project risk by breaking a project into smaller segments.

✓ Aims to produce high quality systems quickly.

✓ Active user involvement is imperative.

✓ Produces documentation necessary to facilitate future development and maintenance.

(Centers for Medicare & Medicaid Services, 2008)

1.9.5.2. Strengths

✓ The operational version of an application is available much earlier than with Waterfall, Incremental, or Spiral frameworks.

✓ Concentrates on essential system elements from user viewpoint.

✓ Provides the ability to rapidly change system design as demanded by users.

✓ Saves time and money.

(Centers for Medicare & Medicaid Services, 2008)

1.9.5.3. Weaknesses

✓ More speed and lower cost may lead to lower overall system quality.

✓ Project may end up with more requirements than needed.

✓ Potential for inconsistent designs within and across systems.

✓ Difficulty with module reuse for future systems.

✓ Potential for designed system to lack scalability.

✓ High cost for commitment.

(Centers for Medicare & Medicaid Services, 2008)

1.9.5.4. Situations where most appropriate

- ✓ Project is of small-to-medium scale and of short duration.
- ✓ Project scope is focused.
- ✓ Functionality of the system is clearly visible at the user interface.
- ✓ Senior management.
- ✓ Requirements of the system are unknown.
- ✓ Team members are skilled.
- ✓ Team composition is stable.
- ✓ Developers are skilled.

    (Centers for Medicare & Medicaid Services, 2008)

1.9.5.5. Situations where least appropriate

- ✓ Large projects.
- ✓ Real-time or safety-critical systems.
- ✓ Computationally complex systems.
- ✓ Project scope is broad and the business objectives are obscure.
- ✓ The project team is large.

    (Centers for Medicare & Medicaid Services, 2008)

Rapid Application Development (RAD) model is the most suitable methodology to be used in this project as:

- ✓ This project is a small-scale project.
- ✓ Duration is short for the project.
- ✓ Project has a focused scope.
- ✓ Project team is minor.
- ✓ System is not complex.

These reasons are most appropriate for Rapid Application Development (RAD).

CHAPTER 2: PROJECT MANAGEMENT PLAN

2.1 Introduction

The purpose of this plan is to manage and organize the project well. In order to complete a project successfully with flexible service to users, the project is needed to be well achieved and fine planned. In addition, the purpose of the project management is to predict as many problems as possible, and to plan, organize and control activities so that the project is completed as successfully as possible in spite of all the risks.

The project is going to be managed by creating and monitoring the work breakdown structure, risk management plan and Gantt chart. Every day work will be monitored to ensure that works are going according to the scheduled Gantt chart and to ensure that broken down works are completed as plan.

2.1.1. Project team roles and responsibilities

Project manager plays a primary role in the project, and is responsible for its successful completion. The manager's job is to ensure that the project proceeds within the specified time frame and under the established budget, while achieving its objectives.

Project team members are the individuals who actively work on one or more phases of the project. Team member roles can vary according to each project.

Project team member duties may include:

- ✓ Contributing to overall project objectives
- ✓ Completing individual deliverables
- ✓ Providing expertise
- ✓ Working with users to establish and meet business needs
- ✓ Documenting the process

2.2. Work Breakdown Structure

A work breakdown structure (WBS) is a list of all the individual tasks that are required to complete the project. It is essential in planning and executing the project because it is the

foundation for developing the project schedule, for identifying milestones in the schedule. project works will breakdown into four months. It will start on 1st August 2018 and it will end at 30th November 2018.

Table 2.1 Work Breakdown Structure

Phases and Activities	Start Date	End Date	Duration in Days	Number of Resources
1. Define requirements 1.1 Define user requirements 1.2 Define system requirements 1.3 Define risks 1.4 Develop project plan	1 August 2018	31 August 2018	31 Days	6
2. Iteration1 2.1 Analysis 2.2 Design 2.3 Implementation 2.4 Design	1 September 2018	31 October 2018	61 Days	6
3. Iteration 2	1 November 2018	15 November 2018	15 Days	6
4. Iteration 3	16 November 2018	30 November 2018	14 Days	6

2.3. Risks Management

Project risk management is the art and science of identifying, analyzing and responding to risks throughout the life of a project. A risk management plan documents the procedures for managing risks throughout the project.

Table 2.2 Risks Management

Risk	Potential Impact on Project Success L/M/H	Likelihood of Occurrence L/M/H	Mitigation Plan
Inadequate performance	H	M	Benchmarking, prototyping
Server failure	H	L	Backup server
Human error on staff	H	L	Team formation, training
Unrealistic schedule	H	M	Modification of schedule
Idealistic budget	L	M	Modification of budget
Requirements do not match	M	M	Prototyping, application description in early phases
Overestimation of capabilities	H	M	Technical analysis, prototyping

2.4. Gantt Chart

Task Name	Start Date	End Date	Duration	August			September			October			November		
				Aug 01	Aug 15	Aug 31	Sep 01	Sep 15	Sep 30	Oct 01	Oct 15	Oct 31	Nov 01	Nov 15	Nov 30
1. Define requirements	1-Aug-18	31-Aug-18	31 days												
2. Iteration 1 (Analysis / Design / Implementation)	1-Sep-18	31-Oct-18	61 days												
3. Iteration 2	1-Nov-18	15-Nov-18	15 days												
4. Iteration 3	16-Nov-18	30-Nov-18	15 days												

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CHAPTER 3: REQUIREMENT ANALYSIS

</div>

3.1. Introduction

Requirements analysis is the process of creating a score for a systems effort. In other words, requirement analysis is the process of determining user expectations for a new or modified product. These features, called requirements, must be quantifiable, relevant and detailed. In software engineering, such requirements are often called functional specifications. Requirements analysis is an important aspect of project management. Requirement analysis is also called requirement engineering. (Rouse, 2007)

In this stage, project requirements will be explained in detail. This section includes requirement summary, functional requirements and non-functional requirements.

3.2. Functional Requirements

Functional requirements are functions of a system or its components. A function is defined as a set of inputs, the behavior and expected outputs of the system. In addition, it includes the activities operations that a system must be able to perform. (Ofni Systems, n.d.)

Users are divided into two categories. They are general users and administrators. General users would be the people who are the students of the college and people who wants to learn about the courses which is offered by various institutes. Administrators are the people who operate and manage this system. There are requirements by both group of users.

3.2.1. Requirements of the System by General Users

✓ **Download the application.**
   'Colleges MV' mobile application should be available in the trusted app stores such as Google Play Store. It is the most trusted and authorized app store for the Android applications. In addition, it should be installed smoothly to the Android devices that meet the requirements.

✓ **Access and search information.**
   Users should be able to access the application after installation and users must be enable to search the relevant and desired information. All the courses presented by

several HEIs, course overview, their cost or fee, duration, level, modules, requirements, session times and contact information should be information to be presented by the application to the users.

✓ **Do an easy comparison.**

This is one of an important objective of this system. Users should be able to compare the courses offered by various HEIs in term of cost, duration, modules, session timings and quality in order to select the most appropriate course for his/her carrier.

✓ **Get notifications for changes.**

Notifications or alerts are needed to be sent to the users if there is any change happened for the courses such as course and module modification, new course addition, and cost variations. Furthermore, if a new institute is included to the application, users will be notified about the alteration.

3.2.2. Requirements of the System by Administrators

✓ **Manage the contents.**

Administrators should be able to upload and modify contents, give alerts and notifications for the major updates, and provide relevant application changes to the users of this application.

3.3. Non-Functional Requirements

Non-functional requirements explain system attributes such as security, reliability, performance, maintainability, scalability and usability. Non-functional requirements specify qualities and it is also known as Quality Attributes. They assist as restraints on the design of the system athwart the unalike accumulations. In order to build a great application, we need to consider non-functional requirements for our work and it is important for mobile application too. (Scaled agile, n.d.)

3.3.1. Technical Requirements

Technical requirements describe the operational characteristics related to the environment, hardware and software. In order to run 'Colleges MV' application in the devices, an Android 4.0 running device is required. In addition, internet connection is required as this is an online mobile application.

3.3.2. Usability Requirements

The application that will be developing would have a user friendly and menu based interface. The application would be easy to interact and communicate with user, and it provides better user interface for ease of working and for better usability.

3.3.3. Performance Requirements

This mobile application that we are going to implement will be used as the chief performance system for providing assist to the users in learning about the courses which is available in Maldives. Therefore, it is expected that the database would perform functionally all the requirements that are specified.

- ✓ The application should be easy to handle
- ✓ Easy tracking of records and updating could be done.
- ✓ The system should give expected performance results.
- ✓ The load time and response time should be as less as possible.

3.3.4. Reliability Requirements

Reliability is theoretically defined as the probability of success. It describes the ability of a system or component to function under stated conditions for a specified period of time. The application should be reliable by performing well without failure over the duration of the usage of the user.

3.3.5. Security Requirements

We are going to implement a secured database. There are different categories of the users namely administrator, restricted users who will viewing either all or some specified

information from database. Depending upon the category of the user, the access rights are decided. If the user is an administrator, then he/she could be able to modify the data, append, etc. All other users have the rights to retrieve the information about database.

3.3.6. Availability Requirements

The application is an open platform for everyone who wants to use. However, the online payment service will be available to only authorized users who can access the system with username and password.

3.3.7. Proper Error Handling Requirements

The application shall handle expected and non-expected errors in ways that prevent loss in information and long downtime period.

3.3.8. Accuracy Requirements

The application should accurately provide real time information taking into consideration various concurrency users. The application would provide 99% access reliability.

CHAPTER 4: LITERATURE REVIEW

4.1. Introduction

This chapter is the literature review of the project of mobile based platform for higher educational institutes which we are going to implement. A literature review is a critical analysis of published sources, or literature, on a particular topic. It is an assessment of the literature and provides a summary, classification, comparison and evaluation (cite write, 2017). In other words, a literature review is a search and evaluation of the available literature in your given subject or chosen topic area. It documents the state of the art with respect to the subject or topic you are writing about. A literature review shows your readers that you have an in-depth grasp of your subject; and that you understand where your own research fits into and adds to an existing body of agreed knowledge. (Royal Literary Fund, 2017)

Literature review is a very important section for every project we do. It is vital to classify the problem of the study, which can be solved by collection of data. By undertaking a literature review you are able to critically summarize the current knowledge in the area under investigation, identifying any strengths and weaknesses in previous work, so helping you to identify them in your own research and thus eliminate the potential weaknesses, whilst bringing to the fore the potential strengths (health herts, n.d.).

In addition, it is very important to know that the work is doing by researcher in a research should not be repeated again. Literature review observes about the work that it is doing, is repeating unintentionally. It also helps to avoid the mistakes, which already done by another one. So, researcher can improve the research design and instrumentation, which was not successful at the last time. (Dissertation Writing Help Online Service, n.d.)

This document includes literature review of the following highlighted points:

- ✓ Maldives: This section includes about Maldives and data about the higher education system of the Maldives.
- ✓ How higher education system is organized in Maldives.
- ✓ Telecommunication service of Maldives.
- ✓ Mobile application environment.
- ✓ Implementation of mobile system.
- ✓ Current existing systems.

✓ Relationship between higher educational institutes and mobile technology.

4.2. The Maldives

The Maldives is a geological marvel consisting of 1,190 coral islands that form an archipelago of 26 major atolls stretching like a string of pearls across the Indian Ocean. The top of the chain of islands lies to the south west of India. The atolls stretch southwards from there and past the western side of Sri Lanka, ending just over the other side of the equator in the Southern Hemisphere. Each atoll is blessed with incredible biodiversity including an abundance of exotic corals and a rainbow spectrum of marine life. Only 192 islands are inhabited by its 300,000 inhabitants. More than 25 percent of the population live in Male', the capital, while the rest are distributed among just under 200 other inhabited islands. The rest of the islands remain Virgin Islands except for more than 100 islands that have been developed for the top end of the tourist market. (Ministry of Tourism, 2017)

4.3. Overview of Higher Education System in the Maldives

As our mobile application is based on the higher education of the Maldives, it is important to highlight about the higher education system.

The Maldives, an enlightened, market-friendly country, contains both public and private higher education institutions (HEIs). (The World Bank, 2011)

The Maldivian Government recognizes that increasing access to tertiary education is important for improving its human resource base - ultimately the nation's most important resource. If the basic and secondary education years provide the foundation for social development and for further learning, it is skills training and tertiary education that establish the knowledge and skills needed for economic development and competitiveness. (Department of Higher Education, 2009)

The rising social demand for higher education can be envisaged from the rapid increase in secondary enrolments over the past 10 years. The secondary enrolment has risen nearly threefold in the past 10 years as can be observed from Table 4.1. (Department of Higher Education, 2009)

Table 4.1: Secondary Student Enrolment 1998 – 2008

Year	Lower Secondary	Higher Secondary	Total
1998	11,845	436	12,281
1999	14,531	457	14,988
2000	18,254	638	18,892
2005	28,646	1,942	30,588
2007	29,417	2,486	31,903
2008	28,462	2,797	31,259

Higher education for secondary school leavers have been largely provided in the past through scholarships funded by the Government and through overseas donors including friendly countries. Overtime such assistance has declined while the secondary school leavers have rapidly increased. (Department of Higher Education, 2009)

Figure 4.1: Highest certificate achieved of resident Maldivian population 15 years of age and over by level (National Bureau of Statistics, 2014)
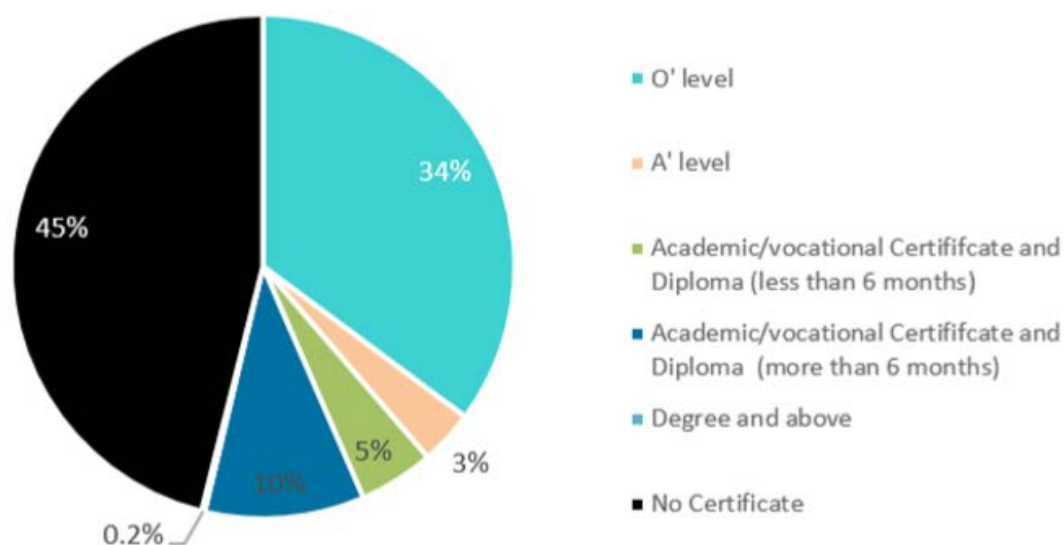
(National Bureau of Statistics, 2014)

Based on the highest certificate achieved, figure 4.1, shows that majority with 45% of the total population 15 years and above had not attained any formal certificate. Also, it shows that 34% had attained the O'Level qualification, followed by Diploma qualification with 15%, A'Level with 3% and Graduate Level with only 0.2%. (National Bureau of Statistics, 2014)

The overall education status of the population at Graduate level is very low, showing only 483 persons of the population had attained a degree and above certificate. Out of that, 66% were with Bachelor's degree, 30% with Master's degree and only 4% with a Doctoral degree. Out of the 15 years and above population who had not attained any certificate, 9% is the currently school attending population. (National Bureau of Statistics, 2014)

Figure 4.2. Achievement of certificate by resident Maldivian population 15 years of age and over (National Bureau of Statistics, 2014)

(National Bureau of Statistics, 2014)

Out of the total population who have achieved a certificate, figure 4.2, shows 65% had obtained O 'Level certificate, followed by 19% with Academic/Vocational Certificate and Diploma (more than 6 months duration in education), 9% with Academic/Vocational Certificate and Diploma (less than 6 months duration in education) and 6% with A 'Level certificate and only 0.4% with Degree and above. (National Bureau of Statistics, 2014)

Figure 4.3. Highest certificate achieved of resident Maldivian population 15 years of age and over who achieved a certificate by level (National Bureau of Statistics, 2014)
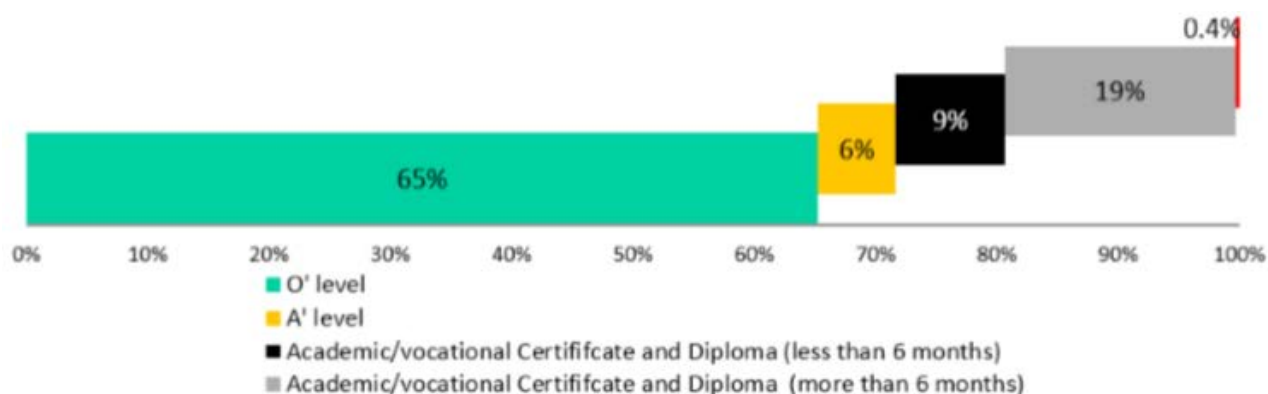
The table below shows the 15 years and above population who have achieved a certificate by age group and by the level of certificate achieved. Out of which 93% were below the age of 45 years. Among the 65 years and above population only 10% have achieved a certificate. (National Bureau of Statistics, 2014)

Table 4.2. Highest certificate achieved of resident Maldivian population 15 years of age and over who achieved a certificate by age group and level, 2014 (National Bureau of Statistics, 2014)

Age Group	O' Level	A' Level	Academic / vocational certificate and Diploma (less than 6 months)	Academic / vocational certificate and Diploma (more than 6 months)	Degree and above
15 – 18	11,730	548	266	344	-
19 – 24	24,535	4,680	2,000	4,932	27
25 – 34	33,623	2,178	3,863	9,259	123
35 – 44	8,148	394	2,657	5,046	131
45 – 54	1,709	114	1,416	2,474	126
55 – 64	331	21	550	973	56
65 – 74	74	9	175	261	16
75 +	18	2	72	74	4
Total	**80,168**	**7,946**	**10,999**	**23,363**	**483**

(National Bureau of Statistics, 2014)

Figure 4.4; below shows that among the population who have achieved a certificate, majority of the population below 45 years have obtained the O 'Level certificate, whereas majority of the population above 45 years have achieved Certificate / Diploma level. (National Bureau of Statistics, 2014)

Figure 4.4. Highest certificate achieved of resident Maldivian population 15 years of age and over who achieved a certificate by age and level (National Bureau of Statistics, 2014)
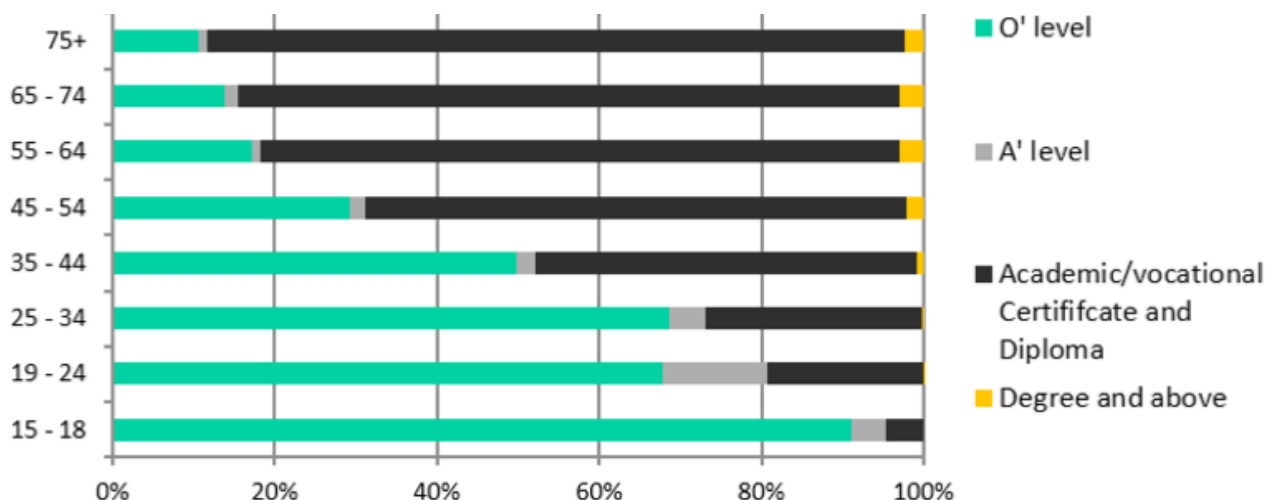
(National Bureau of Statistics, 2014)

There are significant differences between Male' and Atolls in the educational levels. According to table 4.3, the proportion of population who have achieved O 'Level as their highest attainment showed slightly higher at Atolls with 51% compared with Male'. However, it showed a higher difference at A 'Level with 60%, Bachelors Level with 74%, Masters Level with 76% and 90% at Doctoral level in Male' compared to Atolls. (National Bureau of Statistics, 2014)

Table 4.3. Highest certificate achieved of resident Maldivian population 15 years of age and over who ever attended education by locality (National Bureau of Statistics, 2014)

Education Level	Republic	Male'	Atolls
O'Level	80,168	39,185	40,983
A'Level	7,946	4,737	3,209
Diploma (less than 6 months)	10,999	5,574	5,425

Diploma (more than 6 months)	23,363	14,193	9,170
First Degree	320	237	83
Master's Degree	143	108	35
PHD	20	18	2
No Certificate	105,042	29,215	72, 827
Not Stated	5,319	1,792	3,527
Total	**233,320**	**95,095**	**138,261**

(National Bureau of Statistics, 2014)

Among the Atoll population 15 years and over who have achieved a certificate, majority with 80% had obtained O 'Level qualification, followed by Diploma level with 11% and 8% with A 'Level qualification. According to figure 4.5, within the Atolls also it shows that majority of the total population 15 years and above had attained the O 'Level qualification. (National Bureau of Statistics, 2014)

Figure 4.5. Percentage of resident Maldivian population 15 years of age and over who has achieved a certificate by level and locality, 2014 (National Bureau of Statistics, 2014)
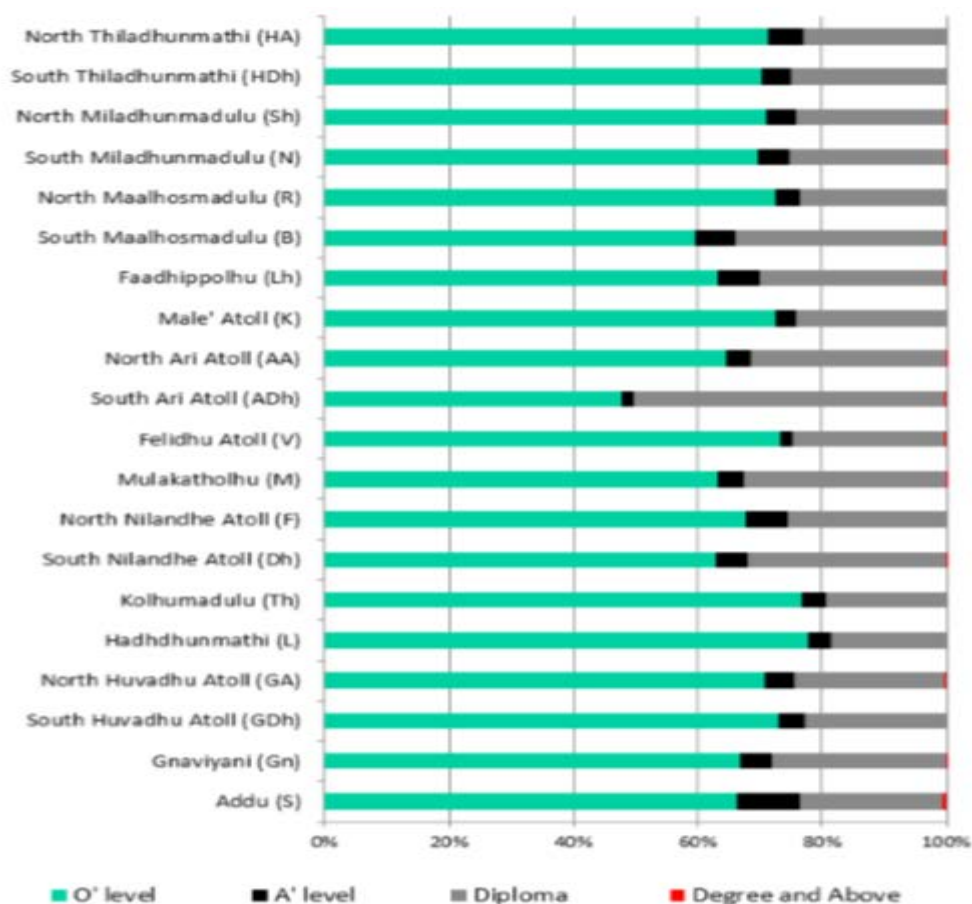
Within the Atolls the population who has obtained tertiary level qualification was very low. It showed that only 0.20% had obtained a tertiary level certificate, of which 0.14% with First Degree, 0.06% with Master's Degree and only 0.003% with a PHD qualification. (National Bureau of Statistics, 2014)

Figure 4.6. Highest certificate achieved of resident Maldivian population 15 years and over by sex and level (National Bureau of Statistics, 2014)
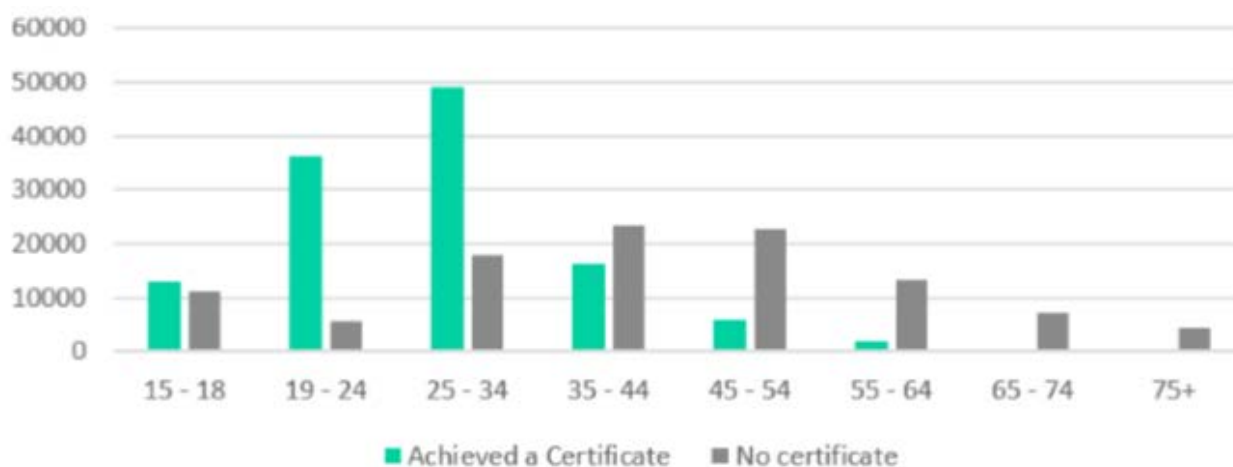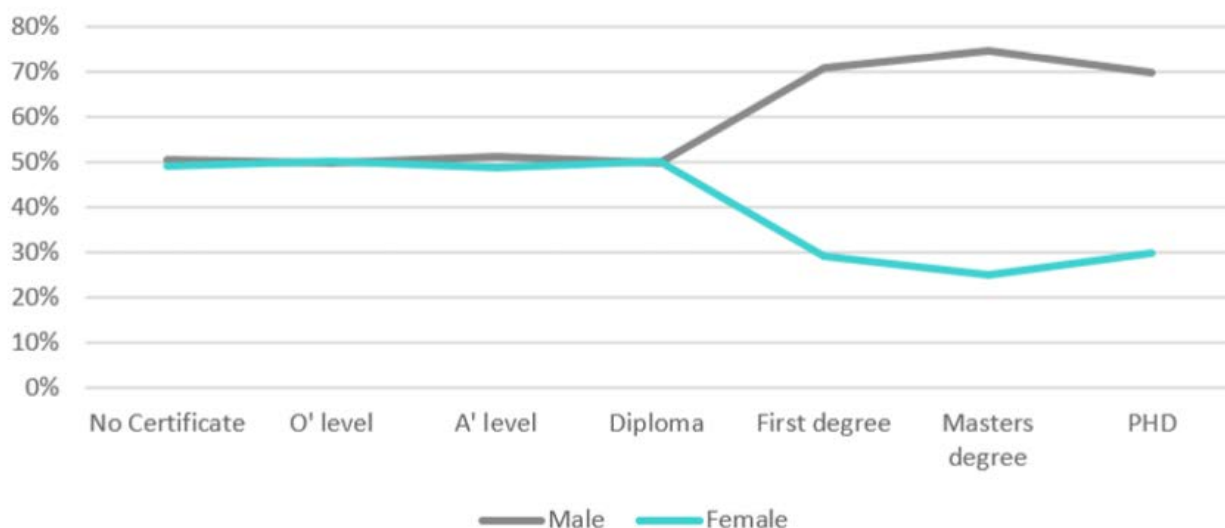
(National Bureau of Statistics, 2014)

As per Figure 4.6, among those with certified qualification showed similar distribution among the male and female up to the Diploma level and there on the gender gap widen showing male population advances in terms of achieving higher education certificate. For instance, the proportion males with Bachelor, Masters and Doctoral degree accounts for 71%, 75% and 70% respectively. (National Bureau of Statistics, 2014)

Looking into the resident foreign population 15 years and above, the overall education status of them was relatively low. Figure 3.7 below, shows that majority with 53% was who had not attained any certificate. This could be related to the bulk of population migrating for employment at unskilled jobs.

Figure 4.7. Highest certificate achieved of resident foreign population 15 years of age and over by level (National Bureau of Statistics, 2014)
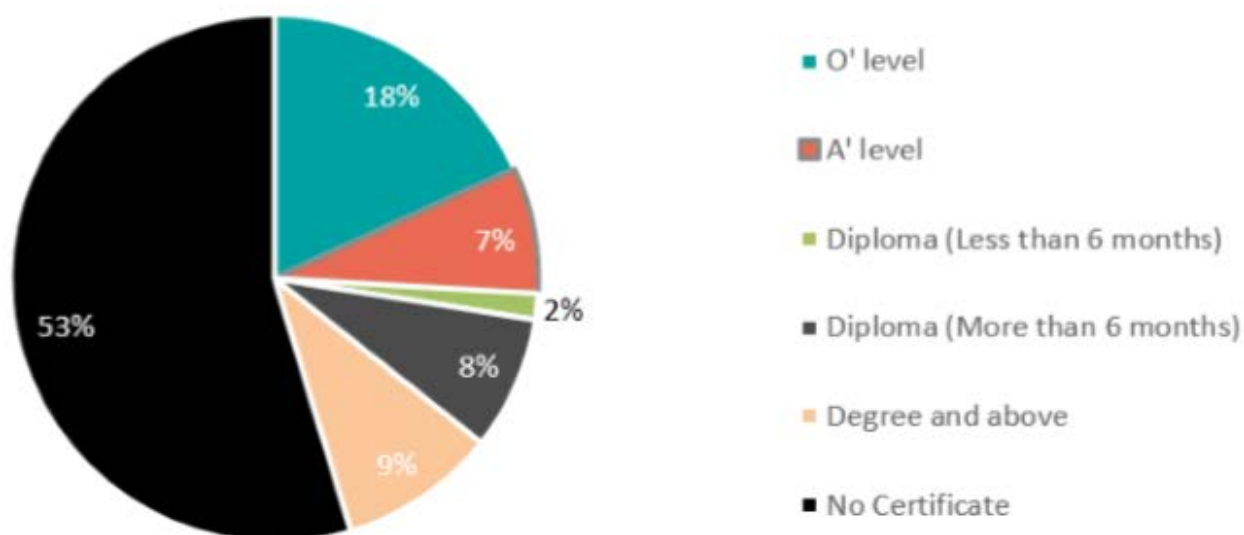
(National Bureau of Statistics, 2014)

Figures 4.7, also shows that 18% of the total population 15 years and above had attained the O'Level qualification, followed by Diploma Level with 10%, Degree and above level with 9%, and 7% with A'Level. (National Bureau of Statistics, 2014)

Table 4.4 provides a profile of the level of courses offered by government and the private institutions in 2008 (Department of Higher Education, 2009).

Institute	Certificate	Advanced Certificate	Diploma	Advanced Diploma	Bachelor Degree	Post Graduate
Government	6	24	23	2	8	4
Private	31	12	19	6	4	-

Participation rates in higher education among various socio-economic levels are unavailable. However, anecdotal evidence suggests that those from the outer islands are greatly disadvantaged in enrolling in tertiary education courses as they have to leave their residential islands. Living on the islands where tertiary institutions are located and travel between these and their home islands impose on them excessively high costs which most of them cannot bear. (Department of Higher Education, 2009)

4.4. Private Higher Education

There are a number of private providers of higher education programs in the Maldives. These providers offer courses leading to certificates, diplomas, and in few cases, to degrees. Although a comprehensive institutional classification system has yet to be established, the development of quality assurance guidelines has led to institutional differentiation among these providers; registration as an "Institute" or a "Centre" is less demanding and elaborate compared to a "College", which requires submission of a detailed proposal outlining the College's organizational and academic structures. (The World Bank, 2011)

Until recently, many of these providers were involved in providing language courses for adults and preparing youth and adults for local professional examinations. Lately, a number of these institutions have started offering computer literacy courses which are invariably short, generally lasting two weeks to three months. (Department of Higher Education, 2009)

The introduction of an external quality assurance mechanism after the establishment of the Maldives Accreditation Board, has paved way for providers to offer longer term courses in keeping with the qualifications framework. Although a comprehensive institutional classificatory system is not in place, the developments in quality assurance have led to differentiation among providers. An institute or a center registration is less elaborate than that for a college. In addition to meeting the basic guidelines of center and/or institute registration, college registration requires submission of a detailed proposal outlining the organizational and program structure. A panel appointed by the Department of Higher Education will assess and make recommendations accordingly. Centers and Institutes are authorized to award certificates up to Diploma level, while colleges can award undergraduate and postgraduate degrees. (Department of Higher Education, 2009)

Among the many private institutions registered, only a few offers long term (i.e. equal to or longer than one academic year) courses. The seven main private institutions that offer long term government approved programs are (Department of Higher Education, 2009):

- ✓ AVID College
- ✓ Clique College
- ✓ Cyryx College
- ✓ Mandhu College
- ✓ MAPS College

✓ MI College
✓ Villa College

Avid College has been successfully providing high quality education since 2005. Avid College is determined to cater to the existing needs and demands of students in Maldives by offering quality assured courses which are recognized by foreign colleges and universities. At the same time, we are in the process of introducing more courses and seeking foreign partnerships, which will pave way for Avid to offer value to those students who are seeking foreign qualifications at affordable prices. All courses offered at Avid College are approved by Maldives Qualification Authority (MQA). (Avid College, 2005)

Clique College received college status in September 2009 after nine years of delivering higher education and training programs as Clique Training Centre. Clique's institutional capacity has expanded with the establishment of a library, larger academic staff portfolio, and quality assurance mechanisms. The College is planning to offer full degree pathways in four specializations; Business Management, Marketing, Tourism, and Human Resource Management. In addition, Clique offers accounting courses at the certificate level, and a diploma in Information Technology approved by the Maldives Qualifications Authority (MQA). (The World Bank, 2011)

Cyrix College is a full-fledged college that caters to over 3000 students and employs over 60 academic and support staff members. Its facilities have grown to include two campuses in Male' with several computer training labs, modern lecture rooms, and a library. CC, which originated as a computer training center, was awarded the "college" status by the government in 2009. The courses are approved by the MQA. Cyrix College is also among the private education providers in the Maldives which has developed its courses following the Maldives National Qualifications Framework (MNQF). Cyrix College has degree completion agreements with several universities in Australia, India and Malaysia. (The World Bank, 2011)

Mandhu College, initially established as Mandhu Learning Centre in 1998, offers higher education and training programs to lower and upper secondary school leavers. Further the College has opened avenues for adults without conventional secondary qualifications to obtain diplomas and degrees through its carefully structured Foundation programs as a bridging alternative to fill up the increasing gap between the shortage of competent personnel in various

industries and the demand for these people. All programs offered by Mandhu College are approved by MQA. The Mandhu College programs include certificates, diplomas, advance diplomas and graduate diplomas in the following subjects: early childhood education, teaching primary and secondary education, business administration, and IT applications. MC also offers short courses at the level of Certificates I, II and III in wide range of applications. (The World Bank, 2011)

MAPS College portfolio includes also seven programs geared towards professional certification with associations such   as the Association of Chartered Certificate Accountants (ACCA), and the Association of Business Executive (ABE) of England. (The World Bank, 2011)

- ✓ Diploma in Business Management, Marketing Management, Business Management, Travel, Tourism and Hospitality Management, and Human Resource Management.
- ✓ Graduate and Post Graduate Diplomain Hospitality and Tourism Management.
- ✓ Certificates in Information Technology and Motion Graphics and Video Editing. (The World Bank, 2011)

In addition to the above institutions, there are more than 20 institutions that offer a variety of short courses. Most private providers are located in the capital, Male'. Some are beginning to offer selected programs in the atolls. (Department of Higher Education, 2009)

Most of the colleges offers the broadest range and profile of courses that include the following areas:

- ✓ Computing and Information Technology
- ✓ Business and Management
- ✓ Accounting and Finance
- ✓ Hospitality and Tourism Studies
- ✓ Education
- ✓ Marketing

Villa College is a full-fledged higher education and training institution belonging to the Villa Group. The colleges' programs include the following categories: (The World Bank, 2011)

✓ Foundation / Advanced Certificates in Information Technology, Teaching and Tourism Studies.

✓ Diplomas in Information Technology and Multimedia Technology.

✓ Bachelor Degrees in Information Technology, Multimedia Technology, Business Administration, Human Resources Management, Education (Education Administration, Mathematics and TESL) and Islamic Studies.

✓ Graduate Diploma in Teaching.

✓ Professional Certification Programs with CIM (Chartered Institute of Marketing) and ACCA (Association of Certified Chartered Accountants) in the UK.

✓ Post Graduate Studies: Master of Business Administration, Master of Education, Graduate Diploma of Teaching.

(The World Bank, 2011)

4.4.1. Higher Education Enrolment in Private HEIs

The enrollment numbers in the private HEIs are shown in Table 4.4. The shares of enrollment among these institutions are presented in Figure 4.8.

Figure 4.8. Enrolment Shares of the Private Higher Education Institutions, 2009/10
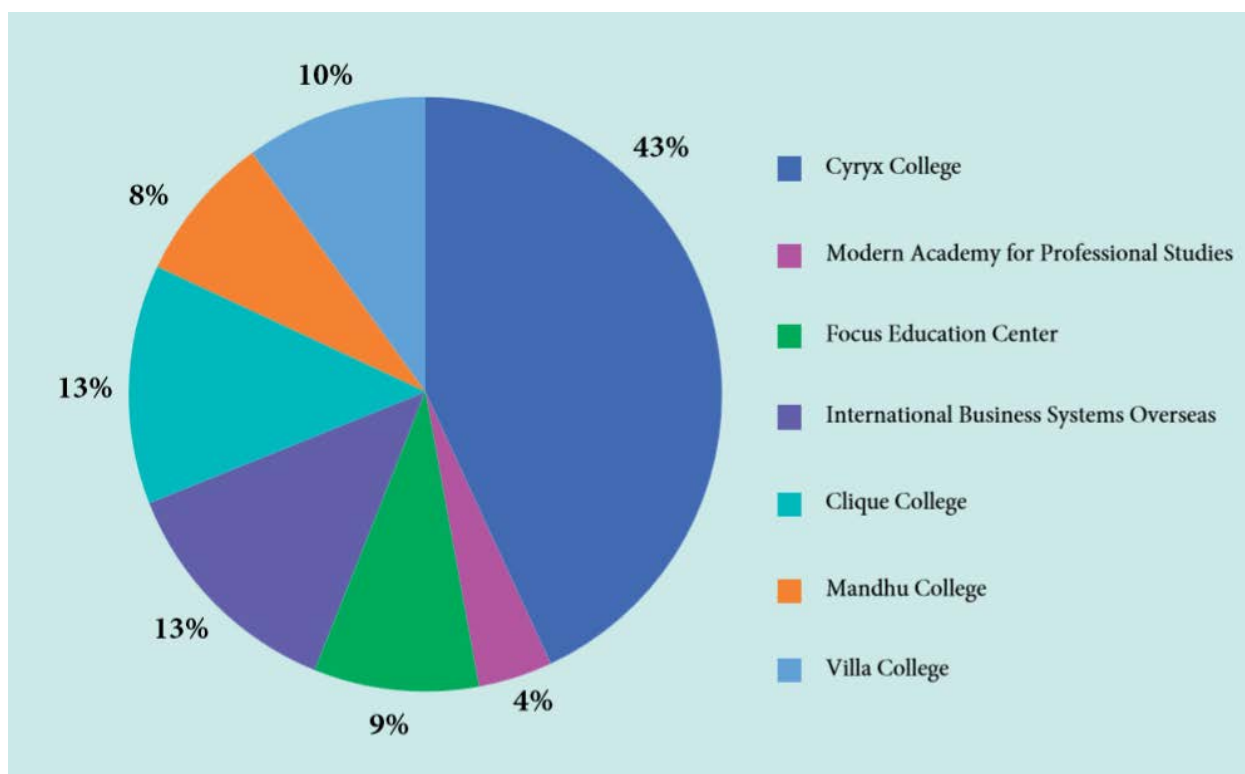
The information shows that the majority of enrollment is concentrated in professional, diploma and certificate courses. Degree level enrolment is very small, just 181 out of 5,935 students (3 percent). Cyryx College has the largest share of enrolment, about 43 percent. The next largest institutions are Clique College and International Business Systems Overseas (IBS). The courses and programs offered by these institutions generally fall within the categories of alternative higher education and are short-term vocational higher education (SVHE), typically lasting from six months to two years in duration [see Mazeran et al (2007) for a discussion of SVHE programs]. (The World Bank, 2011)

These private HEIs provide programs and courses in fields such as ICT, management and accounting, business administration, and English language. The focus is on job-oriented higher education. Many students are part-time, working during the day and following courses during the evenings. The institutions are all established in Male', although the government would like them to diversify into other parts of the country. Some private institutions have just begun to locate outside Male'. (The World Bank, 2011)

Table 4.5. Student Numbers in Private Higher Education Institutions (2009/10)

Private Colleges	Total	Degree Level	Diploma Level	Certificate Level
Villa College	608	181	263	164
Mandhu College	472		136	336
Cyryx College	2557		286	2,271
Maps College	237		237	0
Clique College	757		757	0
Total	**5,935**	**181**	**1,899**	**3,855**

(The World Bank, 2011)

4.5. Public Higher Education Institutes

Under the government, there are three institutes located in the Male' city. They are Maldives National University (MNU), Islamic University of Maldives (IUM) and Maldives Polytechnic (MP).

4.5.1. Maldives National University (MNU)

The Maldives National University (MNU) was set up in 2011 through new legislation which upgraded the MCHE to university status. The MCHE itself was established in 1998 to consolidate the existing institutions of post-secondary education in the Maldives, which evolved earlier from initiatives in a number of separate ministries including the Ministries of Education, Health, Tourism, Transport and Civil Aviation, and Planning to address their human resource and training needs. In the academic year 2008/2009, there are 4,550 total enrolments. The Maldives College of Higher Education (MCHE) was the main public sector HEI. Due to the cheapness of the courses, the priority of everyone is MNU. MNU has its campuses around the Maldives with local islands. The detailed patterns of enrolment and graduation by the various Faculties and Centers in the MNU (MCHE) are outlined below. (The World Bank, 2011)

4.5.2. Islamic University of Maldives (IUM)

The second institute under government is IUM which offers Islamic studies with a huge syllabus. It is the only Islamic institute located in the Maldives so far.

4.5.3. Maldives Polytechnic (MP)

MP is the public sector technical and vocational institute which offers most of the courses for free. The Maldives Polytechnic (MP) is an institution of higher education and training which offers a range of programs in engineering technology. These lead to the awards of certificates, advanced certificates, diplomas and advanced diplomas. The institution was established as a separate entity in 2010, by restructuring and renaming the Faculty of Engineering Technology (FET) of the Maldives College of Higher Education (MCHE) as the Maldives Polytechnic. The Faculty of Engineering Technology was originally established in 1975 as the Vocational Training Centre (VTC) under the Department of Electricity. (The World Bank, 2011)

In 1993, the center was renamed as Maldives Institute of Technical Education (MITE) under the Ministry of Planning, Human Resources and the Environment, and then finally as a constituent Faculty of MCHE in 1998. The MP has 614 student enrolments

in 2007/2008. A summary of the student enrolment and the number of graduates from the various disciplines and specialties is presented below. (The World Bank, 2011)

4.5.4. Enrolment and Graduation levels in The Maldives National University (former Maldives College of Higher Education [MCHE]) in 2008/2009

In the academic year 2008/2009, there are 4,550 total enrolments (See Table A1). The main distinguishing characteristics of the pattern of enrollment and graduation from MCHE9 are that: (a) about 60 percent of students are female; and (b) education, management and computing, and health sciences are the most popular subjects. The high rates of female enrollment are normal in education systems as they advance. In neighboring Sri Lanka, too, university enrollment is about 60 percent or more female. A similar pattern can be observed in many more developed countries, too. The popularity of subjects such as education and health sciences will also be related to high female enrollment, as these are sectors which are popular among female workers. (The World Bank, 2011)

Table 4.6. Enrolment Levels and Numbers of MCHE Graduates in the Academic Year 2008/2009 (The World Bank, 2011)

Faculty	Enrolment 2008-09			Graduates 2008-09		
	F	M	Total	F	M	Total
Centre for Maritime Studies	0	0	0	0	0	0
Centre for Open Learning	91	421	512	20	68	88
Faculty of Shari'ah and Law	117	138	255	2	4	6
Faculty of Hospitality and Tourism Studies	118	236	354	50	87	137
Faculty of Education	1170	405	1575	265	96	361
Faculty of Health Sciences	596	109	705	211	36	247
Faculty of Management and Computing	458	510	968	114	104	218
Foundation Studies	146	35	181	27	94	121
Total MCHE	**2696**	**1854**	**4550**	**689**	**489**	**1178**

(The World Bank, 2011)

Notes: F = female, M = male. The CMS delivers short courses only.

4.5.4.1. The Faculty of Education (FE)

The Faculty of Education, initially known as the Institute for Teacher Education is one of the key faculties at MCHE. Initial efforts at teacher education in the Maldives were aimed at training teachers in Dhivehi to provide basic education in primary schools. With universal primary education achieved, FE embarked on training teachers for secondary education in 1997. The provision of teacher education in the atolls is a major initiative of the Faculty of Education. (The World Bank, 2011)

The number of enrolled and graduating students in the Faculty of Education in the academic year 2008-2009 is outlined in Table 4.6. (The World Bank, 2011)

Table 4.7. The Number of Students and Graduates in the Faculty of Education in the Academic Year 2008-2009 (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09			Graduates 2008-09		
		F	M	Total	F	M	Total
Faculty of Education FE							
Applied Statistics	AD	7	10	17	1	0	1
School Management	D	10	12	22	4	6	10
Dhivehi Language	BA	57	34	91	0	0	0
Teaching English as a Foreign Language	D	45	6	51	19	3	22
Primary Education	BA	55	9	64	12	0	12
Dhivehi Language	D	93	54	147	47	36	83
Teaching English as a Foreign Language	BA	73	21	94	12	0	12
Teaching Primary Schools	AC	19	6	25	15	1	16
Teaching Middle Schools	D	128	29	157	26	8	34
Teaching Secondary	D	165	66	231	60	20	80

Schools							
Teaching Primary Schools	D	256	29	285	40	4	44
Teaching Secondary Schools	BA	262	129	391	29	18	47
Total Faculty of Education		**1170**	**405**	**1575**	**265**	**96**	**361**

(The World Bank, 2011)

4.5.4.2.The Faculty of Health Sciences (FHS)

The FHS was originally established as the Allied Health Services Training Centre (AHSTC) in 1973 under the Ministry of Health. Its status was upgraded to the Institute of Health Sciences (IHS) in 1991, and finally consolidated with other institutions with formation of the MCHE and renamed as the Faculty of Health Sciences (FHS) in 2001. The Faculty conducts a range of training programs in the field of primary care, nursing, pharmacy and medical lab technology to meet the health care demands in the Maldives. The FHS provides pre-service, and in-service education through workshops and seminars in the Male' and the atolls. (The World Bank, 2011)

Table 4.8. The Number of Students and Graduates in the Faculty of Health Sciences in the Academic Year 2008-2009 (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09			Graduates 2008-09		
		F	M	Total	F	M	Total
Faculty of Health Sciences							
Social Services Work	CIII	0	1	1	0	0	0
Primary Health	AC	47	39	86	17	9	26
Counselling	AC	20	2	22	7	1	8
Family Health	AC	14	3	17	12	3	15
Nursing	AC	151	0	151	66	0	66
Pharmacy	AC	16	0	16	4	0	4
Social Work Services	AC	32	3	35	22	5	27
Medical Lab Technology	D	42	8	50	10	2	12

Nursing	DN&ADN	147	1	148	31	1	32
Nursing (Conversion)	DN	13	0	13	11	0	11
Pharmacy	D	11	6	17	4	0	4
Primary Health Care	D	13	12	25	4	10	14
Primary Health Care	D	11	5	16	11	5	16
Primary Health Care	D	15	13	28	0	0	0
Midwifery	D	41	0	41	15	0	15
Health Services Management	BSc	22	16	38	0	0	0
Nursing	BN	1	0	1	1	0	1
Total Faculty of Health Sciences		**596**	**109**	**705**	**215**	**36**	**251**

(The World Bank, 2011)

4.5.4.3. The Faculty of Hospitality and Tourism Studies (FHTS)

The Faculty was originally established in 1987 as the School of Hotel and Catering Services under the Ministry of Tourism to develop trained personnel for the tourism sector. The school was transferred to MCHE and given its present name in 2001. FHTS was initially the only independent center in the Maldives offering programs of the Business and Technical Education Council (BTEC) qualifications by a Foundation in the UK. The Faculty is unique in that respect in its ability to offer these qualifications in the Maldives. (The World Bank, 2011)

Table 4.9. The Number of Students and Graduates in the Faculty of Hospitality and Tourism Studies in the Academic Year 2008-2009 (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09			Graduates 2008-09		
		F	M	Total	F	M	Total
Faculty of Hospitality and Tourism							
BTEC in Hotel Catering & Operations	ND	4	47	51	1	13	14
BTES in Travel & Tourism	ND	19	31	50	11	6	17

Accommodations & Operations	CIII	2	2	4	0	20	20
Food & Drink Service	CIII	3	31	34	1	15	16
Commercial Cookery	CIII	7	4	11	11	4	15
Front Office Operations	CIII	55	64	119	24	29	53
Pastry & Bakery	CIII	6	3	9	2	0	2
Total Faculty of Hospitality and Tourism		**96**	**182**	**278**	**50**	**87**	**137**

(The World Bank, 2011)

4.5.4.4. The Faculty of Management and Computing (FMC)

The Faculty of Management and Computing (FMC) was originally established in 1991 as the Maldives Centre for Management and Administration (MCMA). The center joined MCHE and its status was upgraded to an Institute and renamed the Institute of Management and Administration (IMA) in 1998. Finally, the IMA was given the status of a Faculty and renamed once again to its present name as the Faculty of Management and Computing in 2001. The Faculty offers a wide range of programs in business management and information technology and the certificate, diploma and degree levels. (The World Bank, 2011)

Table 4.10. The Number of Students and Graduates in the Faculty of Management and Computing in the Academic Year 2008-2009. (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09			Graduates 2008-09		
		F	M	Total	F	M	Total
Faculty of Management and Computing							
Island Administration	AC	5	24	29	15	51	66
Information Technology	AD	1	1	2	2	0	2
Accounting	AC	3	2	5	1	4	5
Management	AC	41	26	67	10	9	19
Accounting	AD	1	7	8	0	0	0
Business & Commerce	AD	1	1	2	0	0	0

Information Technology	AC	1	1	2	0	0	0
Information Technology	BA	11	31	42	2	8	10
Business Management	BA	33	10	43	15	4	19
Clerical Studies	CIII	37	10	47	31	4	35
Chartered Accountancy	ACCA2	0	8	8	0	0	0
Chartered Accountancy	ACCA1	29	39	68	0	0	0
CIMA	CIMA	2	3	5	0	0	0
Accounting	D	56	79	135	5	6	11
Business Management	D	75	48	123	24	10	34
Information Technology	D	45	85	130	9	8	17
Total Faculty of M&C		**341**	**375**	**716**	**114**	**104**	**218**

(The World Bank, 2011)

4.5.4.5. The Faculty of Shari'ah and Law (FSL)

The Faculty of Shari'ah and Law (FSL) previously known as the Institute of Shari'ah and Law was established in 1999 to strengthen the legal and judicial system of the Maldives by producing suitably qualified personnel qualified in legal and judicial affairs. The primary function of FSL is to design, develop and deliver courses in Shari'ah and Law at the certificate, diploma and degree levels. (The World Bank, 2011)

Table 4.11. The Number of Students and Graduates in the Faculty of Shari'ah and Law in the Academic Year 2008-2009. (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09			Graduates 2008-09		
		F	M	Total	F	M	Total
Faculty of Shari'ah & Law							
Shari'ah and Law	AC	53	35	88	14	17	31
Shari'ah and Law	AD	0	1	1	0	0	0
Law	BL-LLB	61	53	114	2	4	6

Justice Studies	D	2	43	45	0	0	0
Shari'ah and Law	MA	1	6	7	0	0	0
Total Faculty of Shari'ah & Law		**117**	**138**	**255**	**16**	**21**	**37**

(The World Bank, 2011)

4.5.5. Enrolment and Graduation levels in the Maldives Polytechnic

A summary of the student enrolment and the number of graduates from the various disciplines and specialties in engineering technology in the academic year 2007-2008 is presented in Table 4.11, which includes 30 distinct academic awards in four engineering and technology clusters:

- ✓ Mechanical engineering technology
- ✓ Civil engineering and built environment technology
- ✓ Electrical and electronic engineering technology
- ✓ Carpentry and boat building technology.

The most popular subjects are mechanical engineering and electrical and electronic engineering. The course which has the highest enrollment is engine repair and maintenance. (The World Bank, 2011)

Table 4.12. Enrolment and Number of Graduates from the MCHE Faculty of Engineering (now Polytechnic) in the Academic Year 2007-2008. (The World Bank, 2011)

Faculty	Award	Enrolment 2008-09		Graduates 2008-09	
		F	M	F	M
Mechanical Engineering					
Mechanical Engineering	AD	0	0	0	0
Mechanical Engineering	D	0	9	0	2
Machining& Mechanical Fitting	C III	1	5	0	0
Engine Repair and Maintenance	AC	2	167	0	41
Fluid Power	AC	0	0	0	0
Refrigeration and Air	AC	0	66	0	4

Conditioning					
Welding & Metal Fabrication	AC	0	11	0	0
Engine Repair and Maintenance	C III	1	5	0	0
Welding & Sheet Metal	C III	1	17	0	4
Total Mechanical Engineering		**5**	**280**	**0**	**51**
Civil Engineering & Built Environment					
Construction Management	AD	0	0	0	0
Civil Engineering	AD	1	10	0	1
Construction Management	D	0	0	0	0
Architecture	D	11	31	2	6
Civil Engineering	D	0	0	0	0
Building Construction	D	2	23	0	9
Desalination Sys O&M	AC	0	21	0	9
Total Civil Eng & Built Envrnmnt		**14**	**85**	**2**	**25**

Electrical & Electronic Engineering					
Electrical Engineering	AD	0	0	0	0
Electronic Engineering	AD	0	10	0	0
Electrical Engineering	D	0	0	0	0
Electronic Engineering	D	0	12	0	8
Electrical Engineering	AC	0	26	0	7
Electrical & Electronic Engineering	AC	1	105	0	23
Power System O&M	AC	0	41	0	6
Total Elec & Electronic Engineering		**1**	**194**	**0**	**44**
Carpentry					
Furniture Carpentry & Joinery	AC	0	0	0	9
Wooden & Fibre Glass Boat Building	AC	0	27	0	25
Furniture Carpentry & Joinery	C III	0	28	0	15
Furniture Carpentry & Wood Carving	C III	0	0		
Wooden & Fibre Glass Boat Building	C III	0	0	0	25
Total Carpentry		0	55	0	74
Total Engineering Technology		**20**	**614**	**2**	**194**

4.6. Higher Education Enrollment in country wise

The higher education system (degree or above and pre-degree level) has total enrollment of about 11,000-12,000 students. The Maldives National University (MNU) accounts for approximately 4,500-5,000 students, the Maldives Polytechnic (MP) has around 630 students, and the balance 6,000 or so students are in the various private HEIs. There are some students overseas, too, although the exact number is not known. Students follow a variety of types of programs and courses, including face-to-face instruction, on-line education, full-time courses and part-time courses. If the numbers enrolled in degree level and above or equivalent programs alone are considered, however, there are about 1,700 students in the Maldives. (The World Bank, 2011)

Table 4.13. Gross Enrolment in Higher Education, Maldives and Selected Countries

Country	Higher Education GER (%)	GNI per Capital (USD)
Maldives	3	5,790
Sri Lanka	21	1,990
India	13	1,220
Bangladesh	8	580
Pakistan	6	1,000
Nepal	6	440
Bhutan	7	2,020

Higher education enrolment in the Maldives is low for a middle-income country. If only university degree level or equivalent enrollment is considered, the gross higher education enrollment rate (GER) is about 3 percent [Table 1.4]. This is a low GER, and below the GER for countries such as Bangladesh, Nepal and Pakistan which are much poorer than the Maldives, and have less developed basic education systems. It is also about one-third the GER in India and well below the GER in Sri Lanka. The main reasons for the low enrollment in higher education are: (a) very limited access to higher education opportunities in the Maldives; and (b) poor access to and completion of higher secondary education in the country. Countries at the per capita income level of the Maldives would normally have a larger gross enrollment rate in higher education. For instance, among small, middle-income countries Cape Verde has a GER of 12 percent, St Lucia a GER of 15 percent, and Mauritius a GER of 26 percent. (The World Bank, 2011)

4.7. Tripartite System of Tertiary Education

Table 4.14. Tripartite System of Tertiary Education in Selected OECD Countries

Country	Tier I	Tier II	Tier III
Australia	8 research universities	32 new universities and some TAFE colleges	68 TAFE colleges
Canada	30 research and comprehensive universities	56 new universities, university colleges, polytechnic ITAL	145 community colleges and technical institutes

Finland	20 universities	31 polytechnics	Short-cycle programs in poly-technical education
Ireland	8 universities	13 technical institutes	Training centers
Korea	10 public universities 7 private universities	24 public universities 150 private universities	14 public junior colleges 144 private junior colleges
Mexico	10 federal and state universities 8 private universities	54 state and polytechnic universities 184 private teacher training (TT) colleges 249 public TT colleges	60 technical universities 211 technical institutes 995 private career colleges
Spain	Superior technical schools	University schools	Higher professional training schools
United States	690 Ivy League, public, and private research universities	1,760 polytechnic, colleges, and smaller state universities	1075 community colleges and institutes of technology

(The World Bank, 2011)

4.8. Structure of Higher Education

The HEIs do not specialize in degree level and postgraduate degree programs in small countries, as they do in large countries. Instead, these institutions offer a variety of courses and programs, at pre-degree certificate and diploma levels, as well as at degree and postgraduate degree level. All Maldivian higher education providers focus mainly on short-duration vocational higher education (SVHE) programs such as pre-degree certificates and diplomas [Table 4.3].

The majority of degree and postgraduate degree/diploma programs that are offered by the MNU and other colleges such as Cyryx, Mandhu and Villa, are accredited and/or awarded by overseas universities. The SVHE certificates and diplomas offered by the various institutions are awarded sometimes by the Maldivian HEIs themselves, and sometimes by overseas HEIs.

Table 4.15. Maldives Higher Education Institutions by Type of Courses and Programs

Programs	Public Sector	Private Sector
Postgraduate Degree or Diploma Level Programs	Maldives National University (MNU) (former MCHE)	Cyryx College Mandhu College Villa College
Degree Level Programs	Maldives National University (MNU) (former MCHE) Faculty of Islamic Studies	Cyryx College Villa College
Pre-Degree Diplomas and Certificates	Maldives National University (MNU) (former MCHE) Maldives Polytechnic (MP)	Clique College Cyryx College Focus Education Centre Mandhu College MAPS College Villa College

The shortage of degree level programs has compelled Maldivians who wish to study to degree and postgraduate degree levels to seek their university education overseas in a diverse range of countries, including Australia, England, Egypt, Lebanon, Malaysia, New Zealand, Pakistan, Scotland and Sri Lanka. An important advantage and benefit of this option is that university educated Maldivians are exposed to a rich variety of higher education systems, as well as societies and cultures. A major constraint, however, is that this is an expensive option, particularly if Maldivians are to travel to the high quality HEIs in developed countries such as Australia, England and New Zealand. In consequence, higher education opportunities are severely limited for Maldivians, and there is a shortage of well-educated Maldivians for professional and managerial positions in the economy. In consequence, the country is forced to rely, to a considerable extent, on expatriate workers to staff professional occupations in fields

such as medicine, engineering, and teaching, as well as in management positions in service sector operations in tourism, hospitality and leisure services, banking and finance, and transport. (The World Bank, 2011)

4.9. Governance of Higher Education

Governance and quality are the heart of higher education systems. Governance typically addresses such questions as the roles and responsibilities of the state and the private sector; the extent and nature of autonomy of institutions engaged in the delivery of higher education services; the protocols and processes for the accountability of the various agencies in the higher education sector; and the management and organization of higher education institutions (HEIs). Higher education quality focuses on the framework for quality assurance and accreditation, and the ingredients of quality, such as the quality of faculty programs, curricula, and teaching-learning activities. (The World Bank, 2011)

Under the Government's restructuring, higher education and training, which had fallen under the purview of the Department of Higher Education (DHE) which is a department of Ministry of Higher Education. DHE is responsible for overall development of the tertiary education system in the country. The Department is expected to undertake this task through policy formulation, planning and funding, registration and licensing, and quality assurance. (Department of Higher Education, 2009)

4.10.   Government Policy Framework

The government policy framework acknowledges that the private sector has a positive and significant contribution to make to national economic and social development. The MOE has drafted clauses for regulating private HEIs. Private HEIs are required to register with the MOE. However, the HEC and MOE have not yet defined a clear regulatory framework, nor a process for obtaining regular or complete information on the scale of the private HEIs. A special study in December 2010 by the MOE collected information on the numbers of students studying at public and private institutions and their mode of study. This shows the following approximate picture [Table 4.16]. (The World Bank, 2011)

Public Sector	
MNU	Certificate, diploma, undergraduate degree, BTEC, CIMA, ACCA, Microsoft.
Maldives Polytechnic	Certificate, diploma, CIMA.
Private Sector	
Clique College	Certificate, diploma, bachelor degree.
Cyryx College	Certificate, diploma, advanced diploma, degrees.
MAPS College	Certificate, short courses, diploma, degrees.
Mandhu College	Certificate, short courses, diploma, degrees, ACCA, CIMA, CIM.
Villa College	ACCA, ABE certificates and diplomas, Microsoft certificates. Certificate, diploma, undergraduate and Master's degrees.

(The World Bank, 2011)

Source: Handbooks of the various higher education institutions.

4.11. Quality Assurance

Quality assurance is increasingly seen as being central to efforts made to improve higher education and the trend for international collaborations and interactions. In the case of the Maldives, the need for ensuring quality was partly influenced by a set of local factors, in addition to some located outside the country. Those factors located outside the country were linked to the supply side of higher education. (Department of Higher Education, 2009)

A key element in an accountability framework is a process for ensuring the delivery of higher education to a standard of quality that is acknowledged internationally. Maldivian HEIs, both public and private, should have their awards recognized by universities and colleges throughout the world. One route to widespread recognition could be the adoption of the principles and practices of the Bologna process.

A growing number of institutions outside Europe are voluntarily accepting these as a means of enhancing the status of their higher education systems. The Maldives higher education system is based on the UK model, which means that the core element of the Bologna process (the

three-cycle system of higher education - bachelor's, master's and doctorate) is already in place. Further changes required now would be strengthening the quality assurance regime and the adoption of "Diploma Supplements" for all graduates so as to enhance their mobility into other higher education systems and provide some transparency on what they had achieved in their degree program. (The World Bank, 2011)

Maldives Qualification Authority (MQA) has the responsibility for the quality assurance of the higher education in Maldives. MQA's mandate is to assure the quality of post-secondary qualifications awarded in testimony of educational attainments. The (MQA) was created as a semi-autonomous body in May 2010 from the former Maldives Accreditation Board (MAB) with several functions. The overall intention of the Government in setting up the MQA can be summed up as being:

- ✓ To develop and then administer the Maldives National Qualifications Framework (MNQF).
- ✓ To accredit any new programs proposed by institutes.
- ✓ To ensure quality in local higher education.
- ✓ To authorize the entry into the Maldives of any foreign providers for tertiary education through an accreditation process.
- ✓ To guarantee recognition of local awards in an international labor market.
- ✓ To facilitate the articulation of awards, given within the Maldives, into educational programs in prestigious universities worldwide.
  (The World Bank, 2011)

The introduction of the Maldives National Qualification Framework (MNQF) in 2001 was a major milestone in quality assurance development in the Maldives. (Department of Higher Education, 2009)

The MQA has to be positioned to play a stronger monitoring role across the whole spectrum of postsecondary and technical and vocational education. This can be achieved through capacity building and strengthening its links with the industry, the education service providers and the accreditation authorities worldwide. (Department of Higher Education, 2009)

Figure 4.9. The Maldives National Qualification Framework
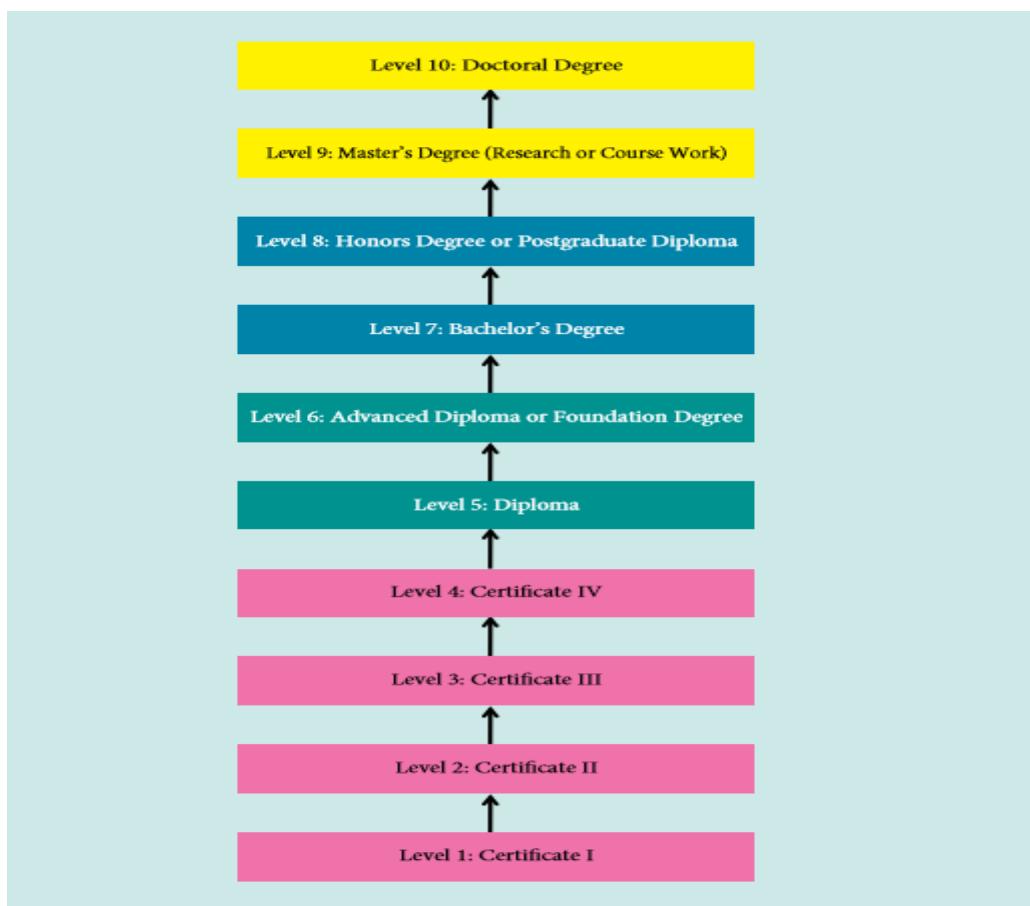
4.12. Challenges in Higher Education

The biggest challenge for the higher education sector is the formation of the Maldives islands. Islands are far away from each other. Due to this, people have to travel to the Male' which is the capital city of Maldives, to get higher education.

4.13. Solution

Our mobile application 'Colleges mv' would solve the problem of transporting to Male' city for looking up for the courses and applying to courses. By staying at the home island, anyone can seek for the courses from different institutes, can compare and select the best course, and can apply to the course without traveling to long distances.

4.14. Overview of Telecommunication Service in the Maldives

Maldives is a fully mobile service covered country. This would be a fantastic goal as we are going to build a mobile application to be used in the Maldives. Currently, there are two telecommunication service providers in the country. They are Dhivehi Raajjeyge Gulhun (Dhiraagu) and Ooredoo Maldives. (My Maldives, n.d.)

Although the Maldives has a population of only 348,000 the telecom market is bolstered by the considerable influx of tourists. Steady growth in recent years has attracted international investment, including the Qatar-based Ooredoo Group. The vibrant tourist sector helps to account for the unusually high mobile penetration rate, though multiple SIM card use is also widely adopted. In, addition a large number of expatriate workers require SIM cards on a semi-temporary basis. (Buddle, 2017)
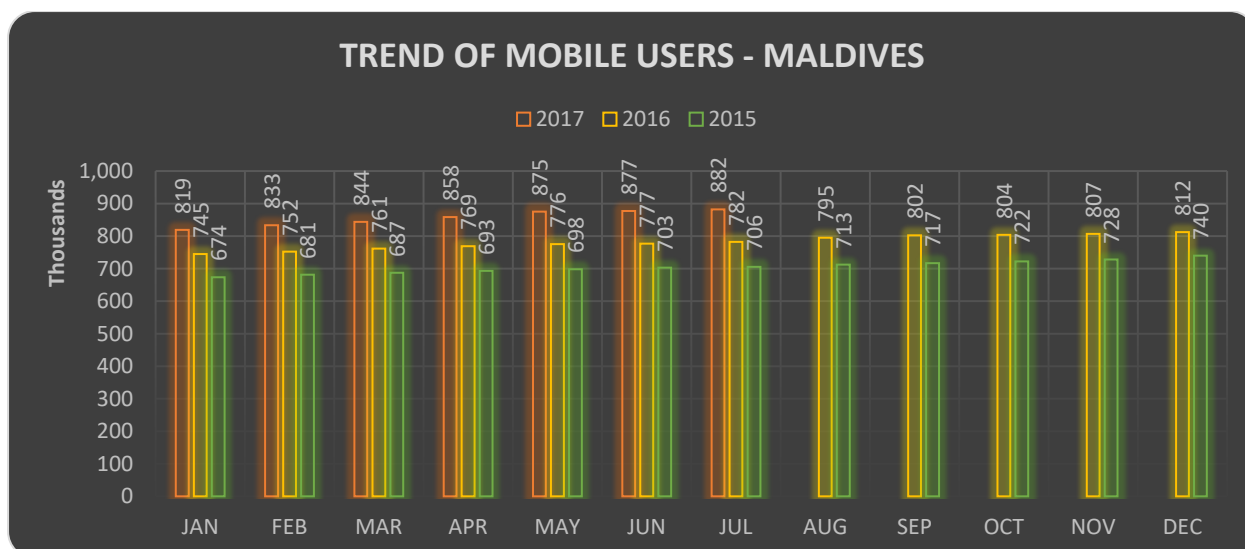
The two licensed operators, Dhiraagu and Ooredoo Maldives, have both invested in HSPA and LTE infrastructure, providing national coverage with the former and expecting to provide coverage with the latter to all populated islands by the end of 2017. This development has encouraged the take-up of mobile broadband services among subscribers. Both operators also provide fixed-line services. (Buddle, 2017)

The country has given priority to telecom infrastructure upgrades, with considerable success. There is a well-developed national network, though investment has been concentrated in the capital Malé as well as in the tourist resort islands. The submarine cable connection to Sri Lanka improved international bandwidth and helped reduce access pricing for end-users. A second submarine cable linked the archipelago to India in 2006. Additional cables linking the main atolls has substantially strengthened domestic connectivity. This was augmented by a new inter-island National Submarine Cable network contracted by Ooredoo Maldives: the 1,200km nationwide system, which came into service at the end of 2016, supports traffic demand arising from increased use of mobile broadband and fiber. In 2016 international internet bandwidth increased 37%. (Buddle, 2017)

The Communications Authority of Maldives has the mandate of regulating the communications sector, creating an environment conducive for promoting competition in communications services and developing these services in accordance with the national policies. The communications sector includes telecommunications, post and Information Technology. (Communications Authority of Maldives, n.d.)

The Authority is run by a Regulatory Board who is responsible for the administration and enforcement of the Maldives Telecommunications Regulation 2003 and any laws and regulations that are applicable to the sector. The Regulatory Board may delegate the powers and functions of the Authority to a division, section or person working for the Authority. (Communications Authority of Maldives, n.d.)

4.15. Mobile Usage in the Maldives

Figure 4.15.1. Usage of mobile, mobile internet and fixed telephone lines in 2017 in Maldives (Communication Authority of Maldives, 2017)

2017 MONTHLY FIGURES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mobile												
Total	819,333	833,337	843,549	858,384	875,149	877,134	882,058					
Postpaid	98,744	100,195	100,831	101,611	103,067	103,296	104,187					
Pre-Paid	720,589	733,142	742,718	756,773	772,082	773,838	777,871					
Teledensity	228.43	232.34	235.18	239.32	243.99	244.55	245.92					
Internet												
Broadband (fixed)	29,011	31,707	30,420	31,034	32,058	32,548	34,444					
Broadband (Mobile)	265,311	260,211	270,185	265,578	265,807	265,353	270,800					
Fixed Telephone Lines												
Total	21,137	21,020	21,082	21,041	20,941	20,816	20,796					
Male' Region	15,499	15,414	15,458	15,428	15,356	15,263	15,049					
Other Regions*	5,638	5,606	5,624	5,613	5,585	5,552	5,547					
Teledensity	5.89	5.86	5.88	5.87	5.84	5.80	5.80					

* including resorts & uninhabited islands

** Calculations based on projected mid-year population 2017, MPND Statistical Year Book 2012 and census figures. (358,679)

(Communication Authority of Maldives, 2017)

Figure 4.15.2. Trending of mobile users in the years of 2015, 2016 and 2017, in Maldives (Communication Authority of Maldives, 2017)

TREND OF MOBILE USERS - MALDIVES

☐2017 ☐2016 ☐2015

(Communication Authority of Maldives, 2017)

According to the figure 4.15.2, mobile users has increased month by month in every year. Maldives has a huge market for mobile and mobile apps. (Communication Authority of Maldives, 2017)

Figure 4.15.3. Usage of internet from mobile, fixed and broadband in Maldives between 2010 and 2014 (Communication Authority of Maldives, 2017)
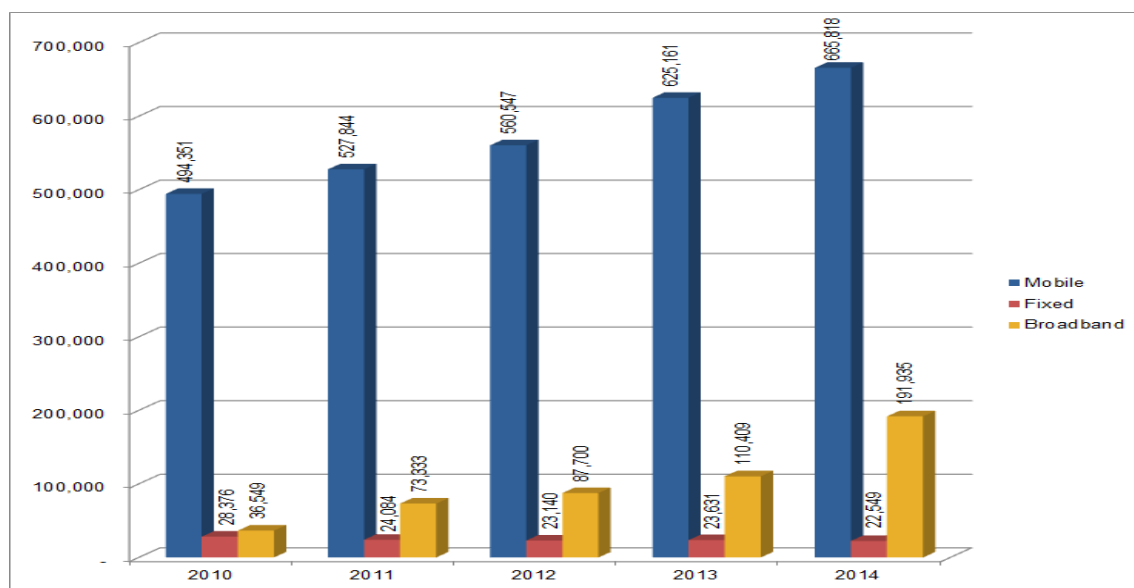
(Communication Authority of Maldives, 2017)

According to the figure 4.15.3, internet usage by mobile is higher than fixed and broadband. There is average difference of 300,000 between mobile and others. (Communication Authority of Maldives, 2017)

All these facts provide us the rapid increase in mobile communication usage around the globe, specially the use of internet via mobile devices. With all these facts we believe the need or demand for mobile applications will increase by 30% - 40% by year 2018. (Communication Authority of Maldives, 2017)

4.16. Mobile Technology

4.16.1. Overview of Mobile Technology

Mobile technology is a form of technology that is mostly used in cellular communication and other related aspects. It uses a form of platform where by many transmitters have the ability to send data at the same time on a single channel. This platform is called Code-Division Multiple Access (CDMA). This platform allows many users to make use of single frequencies because it restricts the likelihood of interference of frequencies from two or more sources. This channel has evolved over the years. (Macwan, 2017)

The mobile technology is rapidly evolving; over the years, its uses are becoming diverse and is gradually replacing some similar sources in the market that are also used for communication e.g. post office and land lines. The mobile technology has improved from a simple device used for phone call and messaging into a multi-tasking device used for GPS navigation, internet browsing, gaming, instant messaging tool etc. Professionals argue with the trend that the future of computer technology is rest on wireless networking and mobile computing. Mobile technology through tablet and portable computers are becoming more and more popular. (Macwan, 2017)

Mobile technology was mystery two decades ago but now, it has become something of necessity to both the rural and the urban areas. The mobile technology started as a remarkable achievement in the world of technology but now, it is transforming into user comfort technology due to its present diverse functionality. When the mobile was first introduced, it used to be basically for SMS, calls and games. But it has presently transformed into a digital world and has made life and business much easier; marketers

now have the ability to sell their products with ease through mobiles technology. (Macwan, 2017)

The mobile has made it possible for users to transfer files and other files through Bluetooth and Wi-Fi. The mobile is also equipped with internet connectivity, making it easy for the user to gain information and also to download files from the internet. Video call conferencing is another achievement that has come to reality through mobile technology. Business men and clients now have the channel to communicate even without seeing in person. With the use of mobile technology, it is now easy to catch up with every form of entertainment from the comfort of your home. (Macwan, 2017)

It has also made it possible for one to easily locate places on the globe using the Global Positioning System (GPS). Especially in the business world, the importance of mobile technology cannot be overemphasized; bankers depend solely on mobile technology on managing finances and stocks. Many business firms use the mobile technology to increase their earnings through providing customers easiness to patronize their product through apps and websites. For example, the Cinema may create an app for ticket booking; railway travel tickets can be purchased from the internet without having to queue up to purchase it. The evolvement of mobile technology has made our life easier and also saves us time and resources. (Macwan, 2017)

4.16.2. The Diversity of Mobile Technology

The diversity of mobile technology is due to the fact that that many mobile operating systems are available for smart phones all of which have their own unique characteristics. Some of these operating systems are: The Android, blackberry, web Operating System (OS), IOS, Symbian windows and Bada mobile some of which will be briefly discussed. The Android is an OS that is developed by google. The OS is designed basically for the touch screen mobile devices and it is based on a simple manipulation. It uses simple touch gestures that relates to the real-world situation. (Nield, 2016)

The Android is the first and only open source operating system; that means it has the ability to be ported to any cell phone. The blackberry is an operating system developed by the Blackberry limited. The OS was developed mainly for Blackberry smart phones. This system is most specialized for multitasking and also aids the use of some specific inputs

for the supports of some of its smart phones such as the track wheel, trackball, trackball, trackpad and touchscreen. The IOS is a mobile operating system that is made and developed by Apple. The system was developed for the use of the Apple hardware only such as iPhone, iPad and iPod Touch. (Nield, 2016)

Since 2008 the operating system customized their platforms, allowing the user to download any app he wishes to download like the gaming app, the utility apps, the GPS and other tools. Any user that have the knowledge to create an app and also wishes to create one can legally do so. The Web OS basically has the ability to support internet programming languages some of which are HTML, JavaScript and CSS. (Macwan, 2017)

The internet is now equipped with a 4G network. This network enables a high-speed data transmission in the channels, making surfing the internet to be easier. In the future, smart phones will be aware of their environment, they are going to be able to utilize the availability of physical inbuilt sensors and the ease with which data are exchanged. One of the way to achieve these trend is that the mobile phones will begin to keep track of the user's personal data, but also, they will be able to predict almost correctly the user intentions on what he wants to use or the information he is interested in getting. This will be accomplished by keeping track of the user earlier tasks. In the next generation of mobile technology, smart phones will be equipped with X-Ray tool that will be able to detect detail information about the location the phone is pointing to at that particular time. (Macwan, 2017)

Various companies are presently developing apps that will be able to accurately sense the exact location or present position of the phone or the user. Along with the future of mobile technology comes another device called Omni touch this is a device that makes it possible for application to be used on the hand, arm, desk, wall and every other plain surface. The device has a sensor touch interface which makes it possible for the user to access functions through the use of the finger touch. (Macwan, 2017)

Since the arrival of the mobile, it has helped humans in many ways; some of which are: mobile phones are very important in case of an emergency they safe lives in cases of accidents and other related issues. One of the most important use of smart phones is that they ensure safety. Families can easily communicate with each other while away. To cap it

up, mobile technology is here to stay and holds a lot more features in the future to meet even the most of our basic needs and to make life a lot easier. (Macwan, 2017)

4.16.3. Android verses iOS

If you're after a new phone, then deciding on Android or iOS is one of the biggest decisions you need to make (unless you opt for a niche option like Windows Phone or BlackBerry).

If you've spent most of your smartphone life on one platform or the other than you might not know much about the other - but we've spent plenty of time with both. Here are the key differences and similarities between Android and iOS.

4.16.3.1.   History

The first Android phone, the T-Mobile G1 (or the HTC Dream in the US) appeared in October 2008; the first iPhone was launched in June 2007. Since then, these operating systems have changed substantially - remember the iPhone didn't support third-party apps to begin with.

We've now on version 6 of Android (Marshmallow) and version 9 of iOS, with new versions due out by the end of the year (see below). Over the course of the last nine years we've seen these platforms become more alike in terms of the features they offer, the way they handle notifications, and the apps they support.

Of course, Samsung, LG, HTC, Sony and others all customize Android in their own way, and there's also the issue of fragmentation - only Google's Nexus devices are guaranteed to be running the most recent, unmodified version of the Android operating system.

Far more users are running iOS 9 than Android 6, though Android is on more phones overall. It's something Apple is proud of, though Google would point out its own OS is much more flexible and customizable - if you don't like the text messaging app, you can install another.

4.16.3.2.   Global Market Share 2017
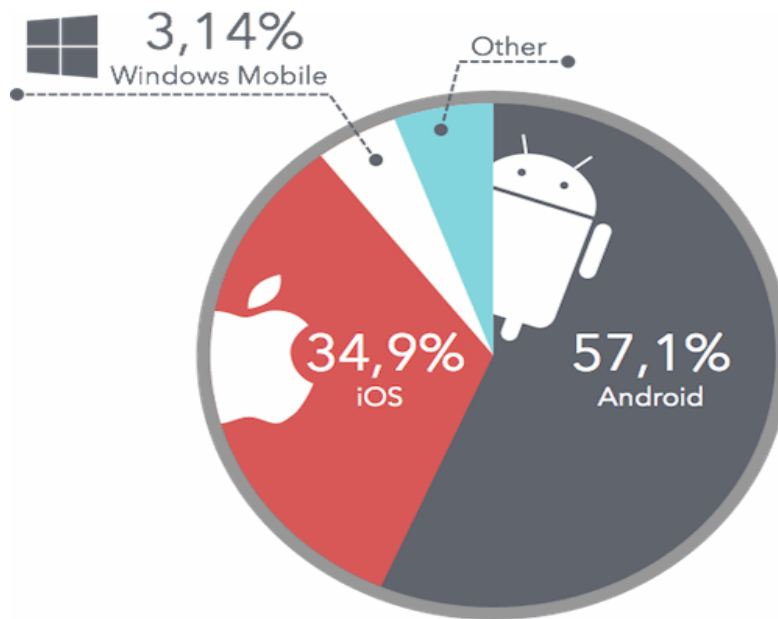
According to the figure above, majority of the market holds by Android with 57.1%. iOS has minority of 34.9%.

4.16.3.3.   Features

Since Google decided to spin its main apps out of Android, the mobile OS itself is essentially just the app launcher and the Settings screen. In contrast, iOS updates still include updates to Mail, Maps, Safari, Notes, News and all the other apps you get with the software.

As we've noted, Google gives users and app developers more flexibility in terms of editing the way the OS works (default apps, lock screens, widgets and so on) - on iOS, you're pretty much stuck with the way Apple wants to do things (which for many users is just fine).

Visually, Android's Material Design offers a more colorful, well-defined visual interface than iOS, which hasn't had a major overhaul since 2013. Apple's OS is all translucent shades and thin lines, Google's is blocky card shapes and bold headings and fonts.

Both OSes handle multitasking in similar ways and iOS has also added a back button of its own in recent times. Both have battery saving features, mobile payments support, digital assistants, and the ability to back up all of your precious data to the cloud automatically.

4.16.3.4. Ecosystem

Both Google and Apple want to lock you into their respective app ecosystems, but Apple is far more serious about it: you won't find support for iCloud or Apple Mail on Android, whereas all of Google's apps are available (and run very well) on iPhones and iPads.

Google's focus is more on the cloud whereas Apple prefers local devices and native apps. It's pretty much all or nothing with Apple: iPhones and iPads work very well with Macs and the Apple TV, but good luck trying to get your iTunes movies to play on an Android TV box.

If you love Apple's approach, that's no problem - but it's something to bear in mind. As you would expect from the company behind Chrome OS, accessing your Google stuff on the web is much more straightforward, though Apple does now have an iCloud web interface.

If everything you own is made by Apple then iOS becomes much more appealing, whether you're trying to get at your digital music and movies, switch between the same apps on various devices, or seamlessly sync your data between phones, tablets and computers.

4.16.3.5. Native and Third-Party Applications

As we've already said, Google's apps (Gmail, Google Maps, Google Keep and so on) are now updated independently from Android. These apps are all available on iOS too, though the versions for Google's own OS are usually slightly superior (and often updated first).

Trying to compare all of these apps against Apple's equivalents is no easy job: it's likely you've already got used to one set of apps or the other. Hangouts vs iMessage, Gmail

vs Mail, Google Maps vs Apple Maps... the features are similar and there are no clear winners.

iOS has long been the winner as far as third-party app support is concerned, though the gap has closed down the years: it's now rare to find a major app or game that doesn't eventually come to both Android and iOS, even though it might launch on one or the other first.

New, experimental apps usually appear on iOS before Android: due to the fragmentation issue mentioned above, it's easier for developers to code for iOS users (and they spend more money too). Apple's platform still has the edge as far as up and coming apps go.

4.16.3.6.   Google Now verses Siri

Going forward the biggest innovations in smartphone development are likely to come in the super-intelligent digital assistants: Google Now and Siri. Both give you voice-controlled access to your phone as well as smart prompts for travel and events when you need them.

Traditionally, Google Now has been more about surfacing the right info when you need it, though Apple has recently started to make Siri more proactive too. Google Now is also available on iOS in limited form, but Siri is restricted to iOS and the new Apple TV.

The apps also show the conflicting attitudes towards data privacy by these two companies: Google sweeps up as much data as it can about you across multiple platforms and services, supposedly giving Google Now a better idea of what information, you're going to need when.

Siri is more locked down: more private but more limited. Both are very capable at searching the web, finding information on your phone, and accessing supported mobile apps (typically the Apple ones in Siri's case and the Google ones as far as Google Now is concerned).

4.16.3.7. Android 7.0 Nougat verses iOS 10

In the next couple of months, we're going to see new OS releases from both Google and Apple - indeed if you're adventurous then you might have even installed the beta versions of these software packages, which can now be downloaded and tested free of charge.

iOS 10 isn't a huge upgrade, but it does bring with it cleaner notifications (and better lock screen access), smarter automatic tagging in Photos (like Google Photos), visual tweaks to Apple Music and Apple Maps, and more effects and emojis in iMessage (probably with WhatsApp in mind).

As for Android 7.0 Nougat, we're about to see native support for multiple windows, a dedicated VR mode, notification grouping, and the ability to run apps straight from the web without installing them first. There are several other tweaks too, including better battery performance.

Perhaps the bigger news from Google is the announcement of Allo and Duo, two apps to take on iMessage and FaceTime, though these aren't strictly linked to Android (and iOS versions will be available too). Like Apple, Google is committed to improving its behind-the-scenes AI as well.

In terms of Android vs iOS put head-to-head, this year's updates don't shift the needle in any major way, though Google looks far more committed to mobile VR at this point. Both tech titans are updating and refining their key apps, and enhancing the capabilities of their digital assistants.

As always, the question with Android is just how many devices will get Nougat and how quickly - this is part of the reason why apps like Gmail and Google Maps have been spun out of the core OS, so they can be updated separately.

4.16.3.8. Conclusion

Both these platforms are slick, stable and secure, with thousands of apps available. Android is undoubtedly more customizable; iOS, you might argue, is a little more

polished (especially on tablets). Visually they're quite distinctive too, taking different design approaches.

Customizations, ecosystem, apps, compatibility with other apps and devices - these are the key issues you should be weighing up when pitting Android against iOS. It's also worth considering the differences between Google Now and Siri and which one suits you best. (Nield, 2016)

4.16.4. The Evolution of Mobile Technology

4.16.4.1. Early History of Mobile Technology

In 1857, Clark Maxwell derived a theory of electromagnetic radiation, which Marconi used as a basis for the invention of radio transmission in 1901. This was a great achievement; however, it was unable to achieve reasonable data transmission rates for over a half-century. The first precursors to modern mobile telephony were introduced in the late 1940s in the United States and in the 1950s in Europe. These early "mobile" phones were heavily constrained by limited mobility and poor service. The devices were heavy and also extremely expensive.

4.16.4.2. 1G: First Generation Cellular Phones

In the 1970s, the First Generation, or 1G, mobile networks were introduced. These systems were referred to as cellular, which was later shortened to "cell", due to the method by which the signals were handed off between towers. Cell phone signals were based on analog system transmissions, and 1G devices were comparatively less heavy and expensive than prior devices. Some of the most popular standards deployed for 1G systems were Advanced Mobile Phone System (AMPS), Total Access Communication Systems (TACS) and Nordic Mobile Telephone (NMT). The global mobile phone market grew from 30 to 50 percent annually with the appearance of the 1G network, and the number of subscribers worldwide reached approximately 20 million by 1990.

4.16.4.3. 2G: Global System for Mobile (GSM) and General Packet Radio Service (GPRS) Networks

In the early 1990s, 2G phones deploying GSM technology were introduced. GSM uses digital modulation to improve voice quality but the network offers limited data service.

As demand drove uptake of cell phones, 2G carriers continued to improve transmission quality and coverage. The 2G carriers also began to offer additional services, such as paging, faxes, text messages and voicemail. The limited data services under 2G included WAP, HSCSD and MLS.

An intermediary phase, 2.5G was introduced in the late 1990s. It uses the GPRS standard, which delivers packet-switched data capabilities to existing GSM networks. It allows users to send graphics-rich data as packets. The importance for packet-switching increased with the rise of the Internet and the Internet Protocol, or IP. The EDGE network is an example of 2.5G mobile technology.

4.16.4.4. 3G Networks

The 3G revolution allowed mobile telephone customers to use audio, graphics and video applications. Over 3G it is possible to watch streaming video and engage in video telephony, although such activities are severely constrained by network bottlenecks and over-usage.

One of the main objectives behind 3G was to standardize on a single global network protocol instead of the different standards adopted previously in Europe, the U.S. and other regions. 3G phone speeds deliver up to 2 Mbps, but only under the best conditions and in stationary mode. Moving at a high speed can drop 3G bandwidth to a mere 145 Kbps.

3G cellular services, also known as UMTS, sustain higher data rates and open the way to Internet style applications. 3G technology supports both packet and circuit switched data transmission, and a single set of standards can be used worldwide with compatibility over a variety of mobile devices. UMTS delivers the first possibility of global roaming, with potential access to the Internet from any location.

3G Network Architecture
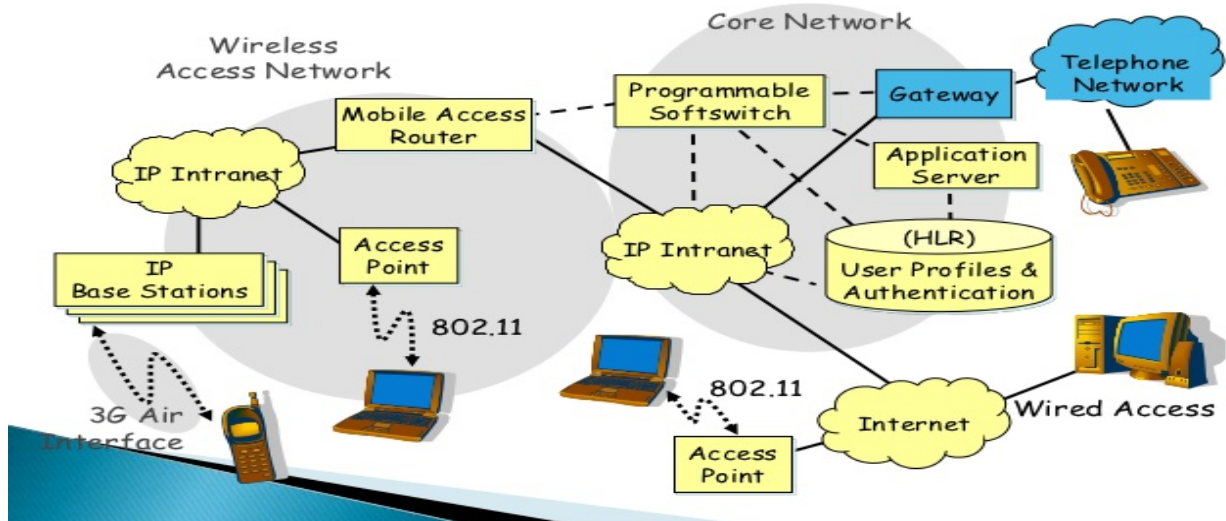
4.16.4.5. High-Speed 4G Mobile Networks

The current generation of mobile telephony, 4G has been developed with the aim of providing transmission rates up to 20 Mbps while simultaneously accommodating Quality of Service (QoS) features. QoS will allow you and your telephone carrier to prioritize traffic according to the type of application using your bandwidth and adjust between your different telephone needs at a moment's notice.

Only now are we beginning to see the potential of 4G applications. They are expected to include high-performance streaming of multimedia content. The deployment of 4G networks will also improve video conferencing functionality. It is also anticipated that 4G networks will deliver wider bandwidth to vehicles and devices moving at high speeds within the network area.

Right now, the telecom companies are working on implementing 5G Networks. In some countries 5G network is already implemented while the others are in testing phase. (Nubarrón, 2011)

4.16.5. Why Mobile Technology is More Important than Ever

Some observers would argue that we've just entered the "post-PC" era, where very few people access the Internet through traditional desktop or laptop computers – and that instead

we're soon going to be surfing almost exclusively on our smartphones and tablets. While the complete transition from PCs to mobile devices might take a while longer, it's hard to argue with how important those mobile devices have become to our daily lives.

Here are the top ten reasons why mobile technology is so important. Use this information to help you factor this technology into your marketing efforts for the coming year.

4.16.5.1. People are Increasingly Accessing the Internet Through Mobile Devices

It is estimated that the number of US consumers who access the Internet through traditional desktop and laptop personal computers will drop from 240 million in 2012 to 225 million by 2016. At the same time, the number of individuals who surf primarily through their mobile devices is expected to jump from 174 million to 265 million within that same time frame.

4.16.5.2. People Are Doing More E-Commerce Transactions through Mobile Devices

It is estimated that approximately 20% of all ecommerce sessions are now happening on smartphones and tablet computers. Market observers also believe that this rate will climb to more than 50% within the next three years. Unfortunately, not all ecommerce websites are well

designed to provide a quality shopping experience on mobile devices. Without a responsive website to display to users who visit using a mobile device, businesses are likely to see poor conversion rates for mobile shoppers.

4.16.5.3.   Mobile Technology is Changing the User's Web Surfing Habits

Individuals who surf the Internet through their smartphones or tablets are often much less likely trying to decipher a difficult to understand marketing message than someone on a PC. If something isn't immediately interesting or relevant to a mobile device user, they're likely to switch to a new app or web page right away.

4.16.5.4.   Social Media Has Gone Mobile

Some of the most popular apps on the iPhone and Android smartphones are those that allow users to access their social media accounts. This means that your marketing efforts should not only take the social media landscape into account, they must also do so with the understanding that many social media users will be accessing their accounts through mobile devices. This trend may become even more apparent as observers await the long-anticipated launch of a Facebook-branded smartphone.

4.16.5.5.   Mobile Technology Allows Location Based Marketing

Most smartphones and tablet computers incorporate location sensing technologies that allow apps to access the user's approximate location. For devices that include global positioning system (GPS) technology, these apps can pinpoint the user's location to within a few feet. These apps can then display targeted coupons or offers to nearby stores. Since people usually have their cell phones with them when they're outside of the home, this could be a huge opportunity for businesses.

4.16.5.6.   Smartphones and Tablets Remove Barriers to Mobile Marketing

Less than a decade ago, the promise of mobile marketing was mostly hype. Small screens, underpowered phones and lack of a mobile ecommerce infrastructure (and no corresponding consumer behavior) meant that people simply weren't ready to be

marketed to through their phones. We used our phones for talking and texting, and that was about it.

But the smartphones of today and the growing numbers of tablets are significantly more powerful, and let users do almost anything they'd do on their home computers.

4.16.5.7.   Mobile Technology is Replacing the Television and the Radio

Rather than listen to the radio, more and more users are logging into Pandora or Spotify for music. Case in point; most new automobiles these days come with iPod and iPhone connectivity options. And rather than watch movies and shows on television, more users are visiting network websites, Netflix and Hulu to watch programs on their own schedules. As these behaviors become more entrenched, marketers will need to come up with new and effective ways to get their messages in front of potential customers.

4.16.5.8.   The Most Valuable Demographics are Mobile

For many businesses, the most valuable demographic of potential customer is one who is young and educated and has disposable income. This demographic aligns almost perfectly with those who spend the most time on their iPads and smartphones. As a result, companies that want to get their messages in front of these individuals now have a straightforward way to do so. But don't be discouraged if your target market is older individuals – this demographic is currently experiencing some of the fastest growth rates in mobile device usage.

4.16.5.9.   Mobile Marketing can be Very Cost Effective

Marketing to potential customers through mobile devices still requires creativity, planning and skillful execution, but in many cases, this can all be done for less money than it would take to do through traditional media outlets. Being able to target potential customers more precisely, and to present your message only to those who you believe are the most likely to follow through and buy your products and services, means that your marketing dollars are spent more effectively.

4.16.5.10. Other Parts of the World are even More Mobile

Figure 4.16.1. Active mobile application users worldwide between 2012 and 2016
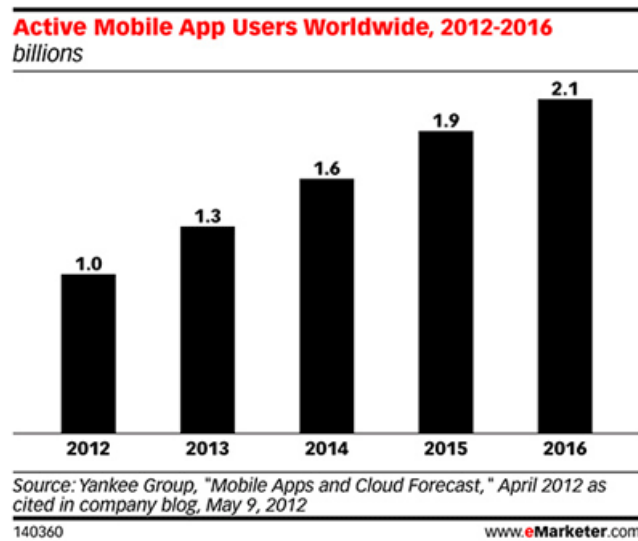
Depending on the nature of your business, if your market is truly worldwide then taking advantage of mobile technology is likely to be a significant aspect of your overall marketing strategy, and it might even be the primary channel through which you promote your business. In many countries, there hasn't been a gradual switch from PCs to smartphones because very few individuals ever owned a PC in the first place. In fact, within the next four years, it's estimated that the number of worldwide mobile app users will more than double; from 1.0 billion to 2.1 billion.

4.17. Mobile verses Desktop

Mobile apps are software applications designed to run on smartphones, tablets and other mobile devices. They are typically available through app stores which are operated by the owners of the mobile operating system. By 2020, mobile apps are forecast to generate around 189 billion U.S. dollars in revenues via app stores and in-app advertising. Some of the most popular operating system-native stores are Apple's App Store, Google Play, as well as Windows Phone Store and BlackBerry App World. As of March 2017, there were 2.8 million available apps at Google Play Store and 2.2 million apps available in the Apple's App Store, the two leading app stores in the world.

Figure 4.16.2. Number of global desktop and mobile users worldwide between 2007 and 2017
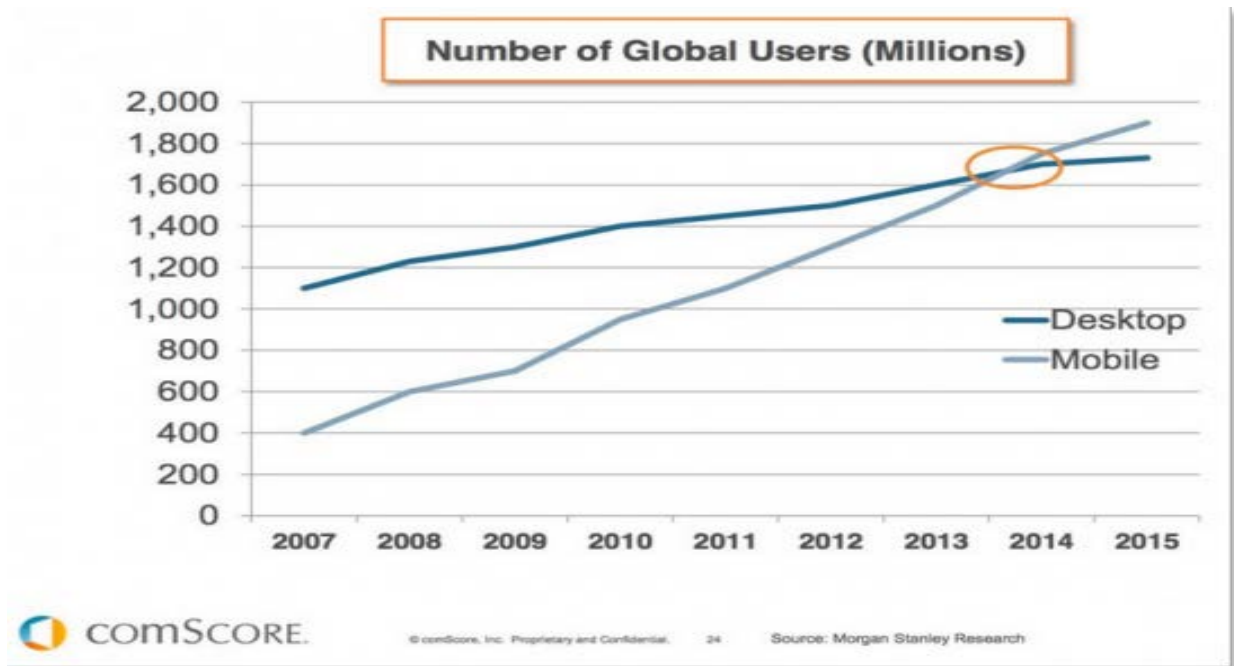
According to the figure 4.15.2, number of mobile user has increased than number of desktop uses, from the mid of 2013 onwards. It means market for mobile app is greater than market for web-based apps.

Figure 4.16.3. Internet usage worldwide by using desktop and, mobile and tablets
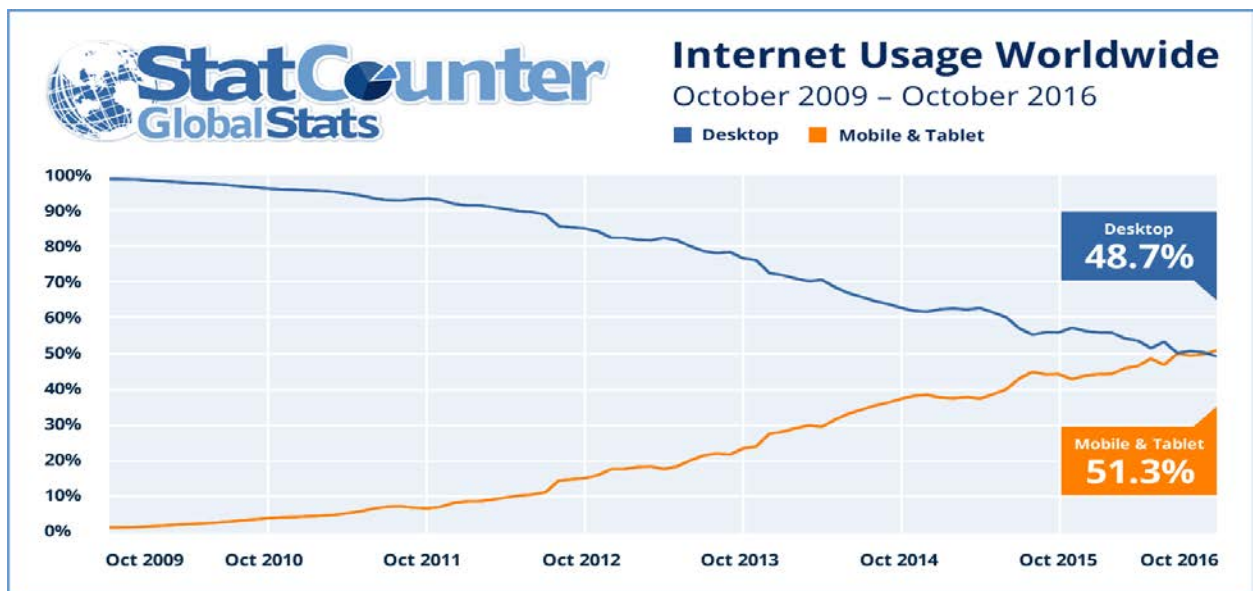
According to the figure 4.16.3, internet usage from mobile and tablets is increased a lot than internet usage from desktop. People started to use mobile devices for using internet. Therefore,

there is very small place for desktop or web based applications in the market. But, mobile apps are trending in the application market.

Figure 4.15.4. Percentage time spent on mobile apps 2016
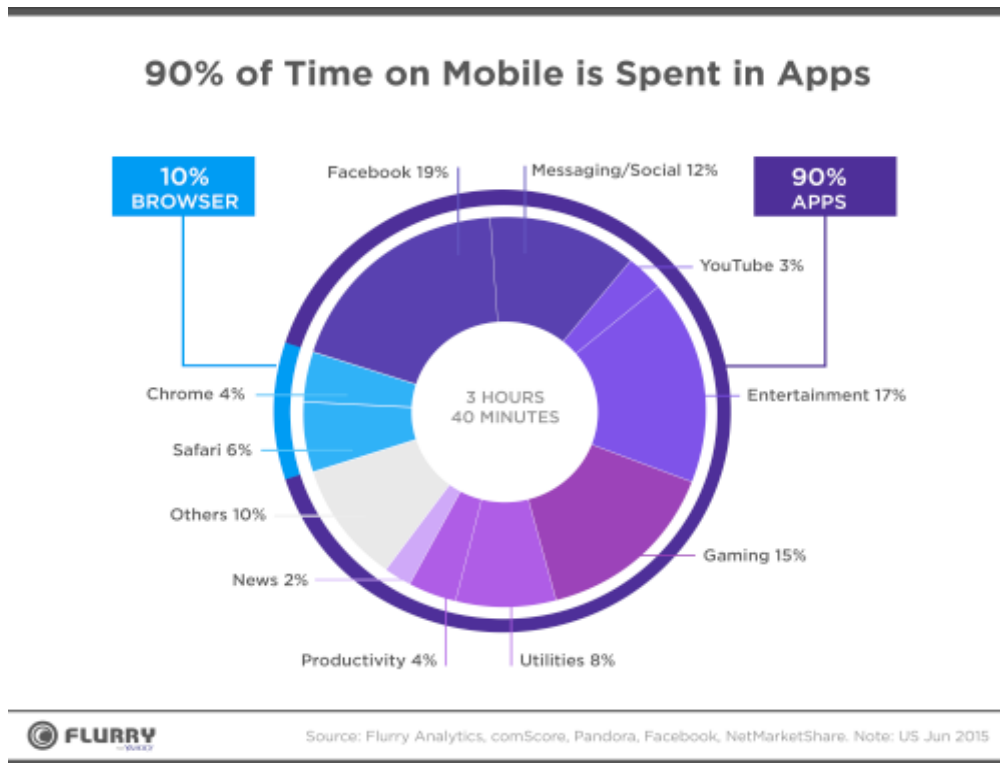
According to the figure 4.16.4, people spend 90% of time on mobile apps. Only 10% of time is spent on browser. This is a fact that market for web based and desktop apps are falling down rapidly, and market for mobile app is trending speedily. (Percent time spent on mobile apps 2016, 2016)

The increasing number of smartphone users in the global market has led to a tremendous increase in the number of apps that consumers use on their phones. The Apple App store boasts close to 2 million of these apps while Google play has over 2.2 million Apps. This number is expected to increase in the future.

The infographics that GO-Globe released also indicate that the overall usage of mobile apps is on the rise. Smartphone users understand the critical role that apps play in assisting clients to get access to essential information. According to these statistics, 52% of the time individuals spend on digital media is on mobile apps. This aspect clearly indicates that enterprises are generating a lot of revenue from the usage of mobile apps.

According to the comScore report, the number of mobile users surpassed desktop users in 2014. Gartner's prediction narrates that over 268 billion mobile downloads will generate an income of $77 billion in 2017. The estimated global mobile app revenue was $35 billion in 2014, $45 billion in 2015, $58 billion in 2016, and a predicted $77 billion in 2017, as stated above. The statistics indicate that people who fall in the age group of 18 to 24 years of age use more mobile apps than any other group. They are followed closely by 25 to 34 years, 35 to 44 years, 45 to 54 years, and then over 55 years, respectively. The implication is that businesses that use mobile applications will target the middle generation more than the younger and older generations.

According to these statistics, women spend more time on the mobile web and mobile apps than men. Additionally, the average time that people spend on apps increased by 20% from 2014 to 2015. The statistics further reveal that people spend 43% of their mobile app time on games, 26% on social networking, 10% on entertainment, 10% on utilities, 2% on news and productivity, 1% on health fitness and lifestyle, and 5% on others. It's no wonder the number of available mobile app games has been on the rise –85% of individuals prefer native apps to mobile websites.

When it comes to the growth in the time spent on mobile apps, music stands at 79%, health and fitness 51%, social networking 49%, travel 28%, entertainment 22%, sports 16%, games 15%, and news at 14%. The percentage of mobile apps that were only used once shrunk to 20% in 2015 after improving to 22% in 2014. The percentage of apps used more than 11 times increased by 39% in 2014. These statistics can now help us to determine the 2017 mobile app trends.

4.18. The Trend in Mobile Applications

There are several reasons for trending mobile apps in the world market. Following are some reasons:

4.18.1. Overview of Mobile Technology

The introduction of this concept may remind you of the Pokémon Craze that everyone was behind. It enabled humanity to witness the power of Reality apps. Currently, the number of apps that implement Virtual and Augmented Reality is on the rise. This increase is expected

to bring forth incredible outcomes in 2017 and the years to come. They will transform the way we interact with software systems and with each other.

4.18.2. Dominance of the Internet-of-Things

The IoT apps play a critical role in our day to day life. This aspect will continue to play a major role in the development of mobile apps in 2017. The profits and revenues of IoT have been on the rise and the trend is expected to continue in 2017. Most enterprises in the automobile, smart homes, education, security, and health industries are experimenting with IoT and have had very positive results. The implication of this trend is that IoT will be a great move in 2017.

4.18.3. A More Satisfying User Experience (UX)

The primary focus of mobile app development is user experience. This year will see the enhancement of this feature in a more innovative and practical manner. It's much easier to use mobile apps, and people tend to quit using any app that gives them an unpleasant experience. Therefore, development of mobile apps in 2017 will pay more attention to the user's point of view.

4.18.4. The Security and Privacy of Mobile Apps

The number of security attacks and threats have inevitably struck the mobile app industry given its tremendous growth. We expect a stronger growth of the inbuilt security features of both iPhone and Android applications. App developers will be focusing on including strong data encryption in the upcoming mobile apps. The security of mobile apps is at the center of attraction for the 2017 mobile app makers.

4.18.5. Continued Reign of Location Based Services (LBS)

Most mobile devices currently have GPS capabilities. There will be further evolution of LBS to provide users with real-time information in 2017. We expect the interest in location-based apps to flourish in 2017 more than ever before. Some of the key areas we will find an increased use of LBS include tourism and travel, navigation, security features, retail offers, location-specific payment portals, and indoor mapping, just to name a few. Leading

technological giants have made big purchases in the LBS space and the popularity of the Beacon technology is on the rise. Businesses and hardware developers may also flourish in this area given that this technology drains battery life.

4.18.6. The Trending of Chatbots

Most people view chat bots as a fun and easy way to help them with digital tasks. The most famous chatbots in the modern market include Allo, Alexa, and Siri. Most mobile app developers are striving to understand how chatbots work. In 2017 we will see most of them work towards making chatbots resemble human beings in the pattern of speech recognition and personalities, leading to smoother interactions.

4.18.7. Conclusion

According to statistics, the usage of mobile apps has been on the rise and2017 will continue to see an increase in the development of mobile apps in the global market. Some of the trends to watch out for in 2017 are the VR and AR chats, the dominance of the IoT, a more satisfying user experience, enhanced security and privacy of mobile apps, enhancement of LBS, and chatbots. These application trends will see mobile apps continue to generate a lot of revenue and profits all over the world.

4.19.   Implementation of Mobile Applications

A well-designed mobile app can inspire audiences and produce experiences they want to repeat and share with their community. It sounds simple, but the fact is implementing mobile application architecture that succeeds is not usually a job for the average businessperson. Rely on a professional and expect to work with them through these steps in implementing a successful mobile application. (Perry, 2017)

There are important seven steps for a successful implementation of a mobile application. Following are the stages of implementation: (Perry, 2017)

4.19.1. Identifying App Requirements

A meeting with a chosen industry leader in mobile design will result in the requirements needed for a successful business app. This meeting may take place in the form of live brainstorming, emails, Skype calls, or other online meeting formats. (Perry, 2017)

4.19.2. Design for Success

Design guidelines must be strategized and documented to include the structure for a mobile app that will complement your business brand and produce the results your customers are seeking. (Perry, 2017)

4.19.3. Development is Best Left in the Hands of an Expert

A solid mobile app will often include various layers: presentation, business, data access, service, and more. In this phase, key attributes, guidelines for performance, technology considerations, business issues, security, authentication, and more are discovered and built into the app architecture. (Perry, 2017)

4.19.4. Integration is an Important Consideration

The mobile app must integrate with existing web or legacy applications as needed, and some reliable backend work is usually required. (Perry, 2017)

4.19.5. Testing is Critical

Establishing a test site and calling on experienced teams to test the success of a mobile app is a critical phase. Apps require modifications to perfect the performance, the user experience, and the overall usage. (Perry, 2017)

4.19.6. Know Your Target Market

The deployment phase should include a successful release and a suitable marketing campaign to get the app off the ground and secure brand identity. (Perry, 2017)

4.19.7. Work with Experts

A mobile app is not much good without the technical expertise by a developer to manage and maintain it. Apps and the technical environments in which they perform are ever changing, and they will require modifications over time. (Perry, 2017)

An industry leader in mobile application architecture will deliver high value from start to finish. A streamlined user interface and superior mobile experience for every device will produce quality leads that are likely to return as loyal customers for more of the same. Mobile apps are a priority for companies that wish to deliver high-value solutions to their customers. (Perry, 2017)

4.20.   Current Existing Systems

Currently, there is no system or mobile application implemented for higher education institutes in the Maldives. Therefore, our system 'Colleges mv' would be the first mobile application implemented for higher education institutes in the Maldives. All the institutes have their websites and we have to use it to seek the data.

In abroad, there is no system implemented by integrating the higher education institutes. However, some universities have implemented their own mobile applications for their institute. Following are some universities that have their own mobile applications. (Modo Labs Team, 2015)

4.20.1. Harvard University
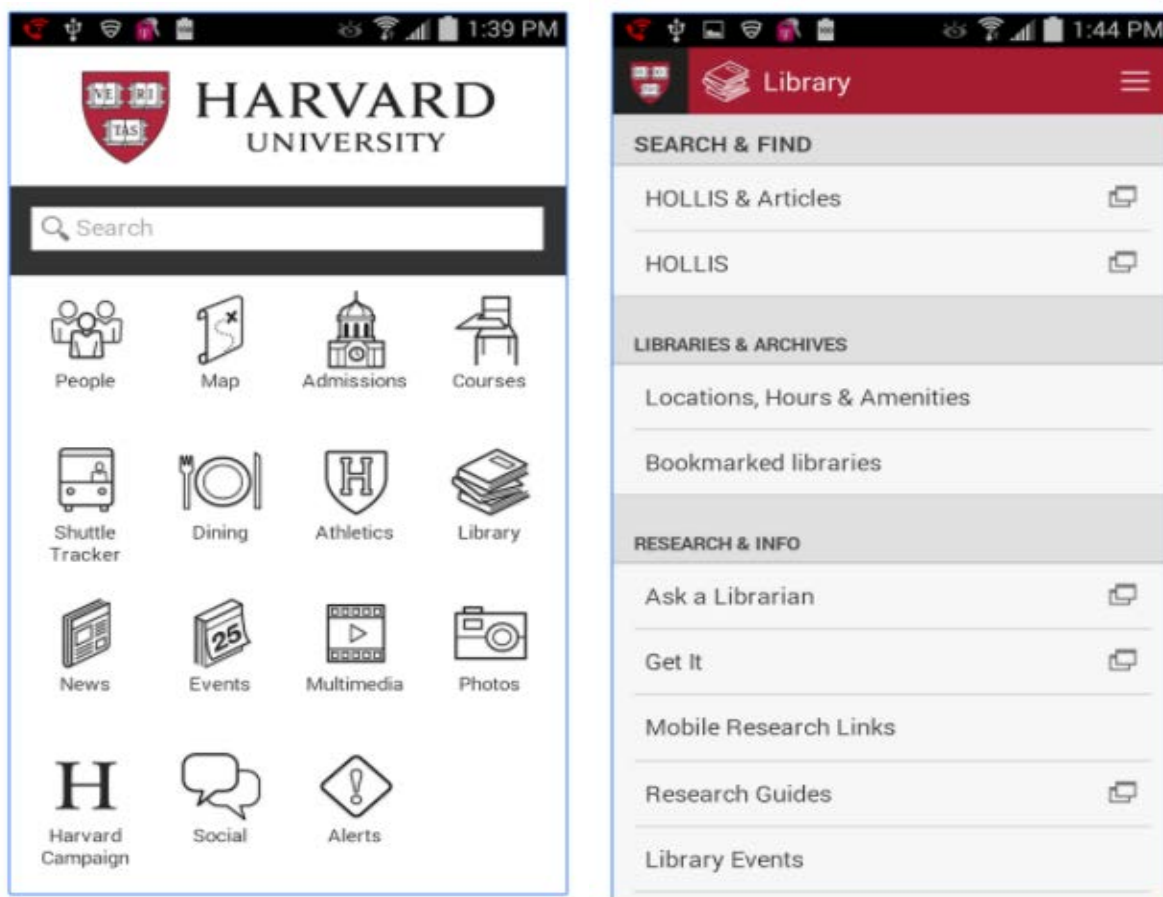
The Harvard Mobile app is a University-wide initiative to improve the mobile experience of students, faculty, staff, visitors, and neighbors who interact with Harvard's campus and community. Released in January 2013, Harvard Mobile 2.0 is the latest version of the application with a number of functional, design, and content enhancements. Harvard Mobile 2.0 now has native applications for Android and iOS operating systems, as well as a mobile web application accessible to any web-enabled smartphone. (Harvard University, n.d.)

### 4.20.2. California State University: CSUN Mobile App

This mobile uses a number of advanced features including searchable Indoor Maps with amenities, as well as PeopleSoft integration that allows students to add and drop classes. It also features dedicated Personas for students, faculty and alumni. This app also included guided campus tour with videos. (Modo Labs Team, 2015)

4.20.3. Fitchburg State University: Fitchburg State Mobile
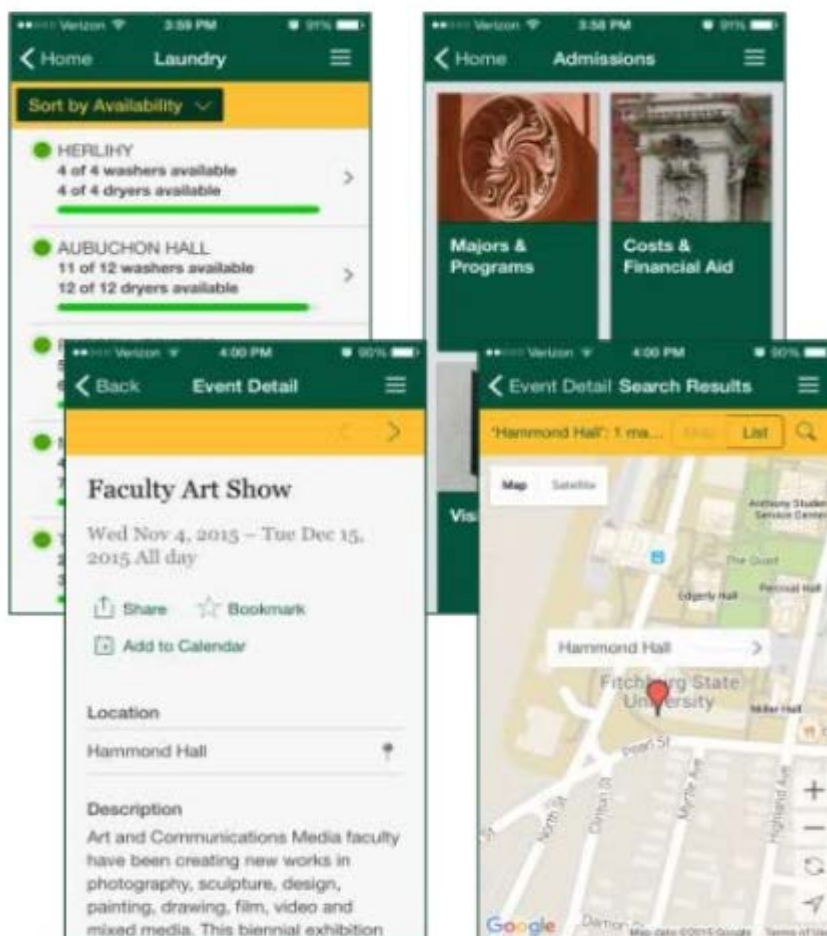
The Fitchburg State University app as a number of features that are extremely useful to their students such as laundry availability, and an option to chat with IT help. The app also features an admissions module with information for prospective students such as costs and how to visit, as well as an alumni module with details on how to get involved. (Modo Labs Team, 2015)

4.20.4. Qatar University: Qatar University Mobile
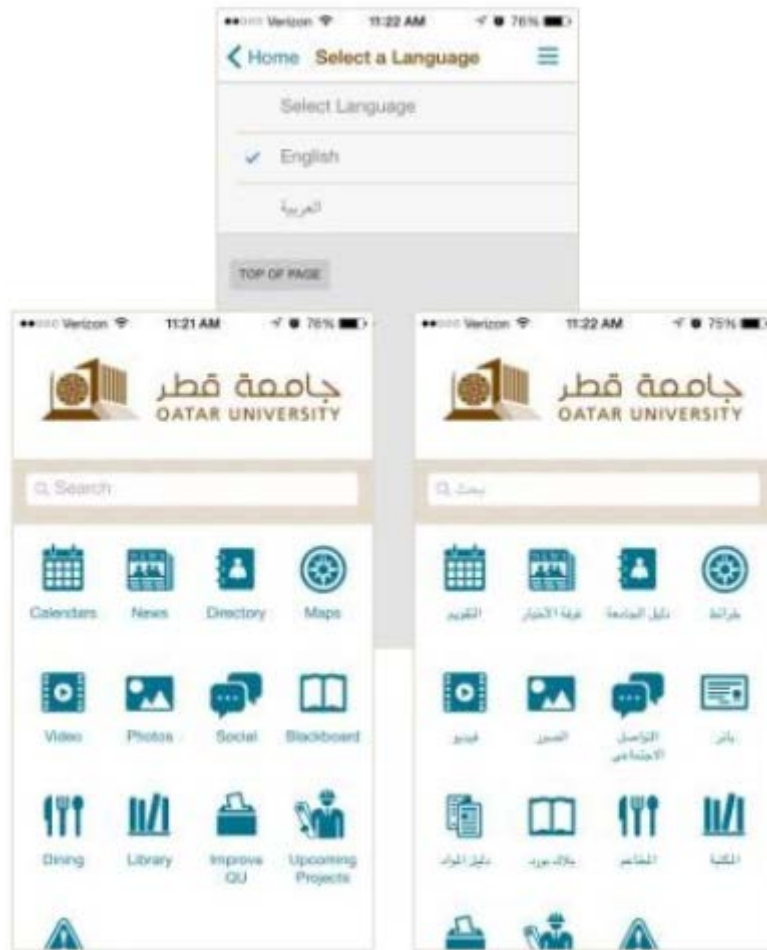
The Qatar University app includes all the basics of a great campus app, such as calendars, directories, maps, dining, integration with banner and blackboard. It goes one step further with special modules such as module with information about upcoming campus projects, as well as a module where students can submit ideas for campus improvements. This app exists in both languages, English and Arabic. Users can select their language preference. (Modo Labs Team, 2015)

4.21.   Relationship Between Higher Education and Mobile Technology

The success of any student engagement app is based on a number of factors. However, what ultimately defines the value of any app is ease-of-use. (Robinson, 2017)

Mobile technology is ubiquitous in the lives of today's college students. Although 83 percent of adults between the ages of 18 and 29 own a smartphone, mobile device ownership among

college students is even higher; according to a 2014 EDUCAUSE report, 86 percent of undergraduates owned a smartphone as of last year, and nearly half (47 percent) owned a tablet. (Baiyun Chen, 2015)

For millennials, mobile device usage has become second nature, and they are experts at home screen curation. comScore's Mobile App Report 2017 shares that millennials are most comfortable using their devices one-handed, and are likely to keep their apps in folders, helping them to organize the contents and offering them first-screen accessibility and hence, ease of use. (Robinson, 2017)

On the contrary, a student engagement app with a cumbersome design, too many steps and confusing presentation can lead to early user abandonment. In fact, easy on-boarding increases the user lifetime value by up to 500%. This simply points out the need to offer apps that offer ease of use and quick accessibility of desired content. (Robinson, 2017)

In case of Higher Education mobile apps, this could be achieved through a functional and compact student dashboard that shares all significant information in a single screen, offering one-touch access to associated content. (Robinson, 2017)

Considering this fact, a useful student engagement app should be able to aggregate assignments, course modules, notifications, and updates through the app dashboard by integrating SIS and LMS in one place. This offers students easy accessibility to required features, and a superior user experience, leading to better student mobile engagement. (Robinson, 2017)

According to the DubLabs survey, the next most important feature is 'Personalized Push Notifications'. 63% of millennials always agree to accept an app's push notification request, and interestingly, 71% of millennials also register annoyance for receiving too many push notifications. 'User experience' is likely to be a causal factor for this conflicting figure. Good user experience allows recipients to customize which categories of push notifications they receive. A study by Kahuna Mobile Marketing Index reflected that the average retention rate for users who opted in for Push Notifications more than doubled the rates for users who did not opt-in. (Robinson, 2017)

An effective user experience includes personalized notifications to provide timely and valuable updates to the user. In higher education, this means integrating SIS and LMS as well as allowing students to select which types of notifications they receive. This individualized UX lays the groundwork for better student engagement and retention, which is the ultimate aim of all higher education institutions. (Robinson, 2017)

4.21.1. Mobile Apps for Higher Education that Increase Student Engagement

Millennials are addicted to mobile technology, smart devices and apps, relying on them for communication, entertainment, navigation, banking, transportation; and the list goes on. Although Higher Ed institutions are looking beyond traditional communications methods, many haven't developed a mobile strategy that focuses on student engagement. Instead, many mobile apps for higher education are created daily without consideration to what will best support students' need and expectations. (Robinson, 2017)

Still other schools have limited technical resources and find it difficult to prioritize development of an effective mobile strategy. However, mobile-dependency is on the increase, with Being even more reliant than today's university students. Current mobile app usage statistics reflect that time spent with mobile apps will reach 19.9% of average daily total media time this year for a US adult. Similarly, Yahoo's Flurry Analytics shares that 90% of consumers' mobile time is spent in apps rather than in mobile web. Therefore, understanding the needs of students is the first step in creating effective mobile apps for higher education – ones that both engage students and support broad institutional goals. (Robinson, 2017)

Given these objectives, DubLabs has concentrated on helping schools to build effective mobile experiences to engage students through school-branded mobile apps. (Robinson, 2017)

- ✓ Native Integrations: DubLabs develops native integrations to your institution's SIS and LMS (using back-end system web services and APIs) to extract key information and present it to students in an intuitive mobile interface.

- ✓ Unique features deliver a quality experience to students: SIS/LMS integrated Courses; Chat Feature; Student Dashboard with all updates in a single screen; personalized push notifications, and the iOS Today Widget that lists daily activities.

✓ Students can check assignments, participate in course discussions, see grades and check calendars; pay tuition fees, and access campus maps, news, library, dining hall and campus information.

✓ Follett bookstore can be integrated into the campus mobile app, automatically showing all course materials pre-populated in the shopping cart. One click can purchase everything- what an easy way to buy course books and materials!!

✓ The App Management Portal simplifies branding and customizing individual school applications by offering multiple design templates, icons, and module types.

✓ The Push Notifications API allows linking to important campus systems. For instance, automated notifications can be set up for advisor appointments, reminders, emergency alert systems and more. These notifications inform individual students at the right time.

The objective is to provide students timely, personalized experiences that keeps them engaged, and enhances communication. In short, helping to drive student success. (Robinson, 2017)

4.22. Benefits of Mobile Technology for Higher Education

The utility and ubiquity of mobile devices, in combination with the digital aptitude of the students who use them, are transforming the educational landscape and bringing a host of new benefits to higher education. Mobile technologies are creating new ways for students to connect with their course materials, their classes and their colleagues, while also providing new ways to save money, while increasing access, productivity and flexibility. (Devine, 2013)

4.22.1. Solving the Higher Education Cost Conundrum

Current college students have been raised on mobile technology and expect higher education institutions and their instructors to continue integrating technology into the classroom for obvious reasons such as convenience; but the most significant benefit of mobile advancement in higher education is improved cost savings for both students and institutions. (Devine, 2013)

The cost of college continues to be a challenge with student debt reaching a shocking $1 trillion in 2012, proving the urgency of providing students with more economical solutions. Online courses are rapidly growing in popularity and certainly alleviate some of the challenge in solving this cost conundrum by eliminating institution costs related to infrastructure and amortizing costs across a much larger pool of students. (Devine, 2013)

Babson Survey Research Group released a study showing that 6.7 million students signed up for online learning in 2012, and at least 32 percent of students take an online course at some point during their college careers. These statistics validate growing student preference for the accessibility and affordability of the "mobile classroom" and many universities are beginning to recognize and expand their online offerings accordingly. (Devine, 2013)

An additional major expense addressed by mobile technology is the cost of textbooks. According to the U.S. Government Accountability Office's newly-released report on the Association of the American Publishers' website, textbook prices rose an average of 6 percent per year from 2002 to 2012. In addition to saving students money, digital textbooks also cater to the mobile nature of many students who prefer content at their fingertips, anywhere, anytime. (Devine, 2013)

4.22.2. Mobile Convenience and Efficiencies are Priceless

Online courses and digital textbooks clearly offer robust cost savings for students and institutions, but mobile learning also provides an unmatched level of convenience and productivity. Today's students are part of a digital generation that has grown accustomed to instant online access and information on demand. Last year, a Wakefield survey found that 40 percent of students could not go more than 10 minutes without using some sort of digital technology. This reliance on technology emphasizes the importance of mobile devices and augers for continued proliferation of tablets and smartphones across campuses. (Devine, 2013)

The "digital backpack" is an all-in-one resource, able to store a student's homework, notes and textbooks, without the hassle of physically carrying them around. Accessing content and materials on a digital device is a natural preference for these digitally savvy

students, allowing them access wherever and whenever they want, whether it's on the bus to campus or up late studying for a final in their dorm. (Devine, 2013)

4.22.3. The Future of Mobile Learning

According to the Financial Post, investment in U.S.- based education technology companies hit $930 million in 2011 and by 2015, 25 million post-secondary students in the United States will be taking classes online. Students have more mobile devices than computers and they certainly don't have a problem adapting to new delivery mechanisms, as long as the benefits are clear. (Devine, 2013)

Mobile has already proven its cost saving and convenience benefits, but it has the potential to truly transform the effectiveness of education by delivering it within the context of the student's life rather than in an abstract classroom. In order to successfully educate the digital generation, institutions must continue to evolve and further integrate innovative tools and digital resources into their learning models. (Devine, 2013)

Use of mobile technology for teaching and learning is still an emergent area for study, and more scholarly research must be conducted. Perhaps more importantly, individual experimentation is needed to understand what works, how, and why in both formal and informal learning environments. Practically, we need institutional changes that can facilitate and encourage students and instructors to integrate mobile technology into daily learning. At UCF, we continuously provide more support and resources for training our instructors. Because of these efforts, positive changes in the mobile landscape have become visible. (Baiyun Chen, 2015)

Following is a figure published by University of Central Florida after holding a survey on use of mobile devices in higher education by the students and lecturers.

Figure 4.22.1. Use of mobile devices in higher education by the students and lecturers (Baiyun Chen, 2015)
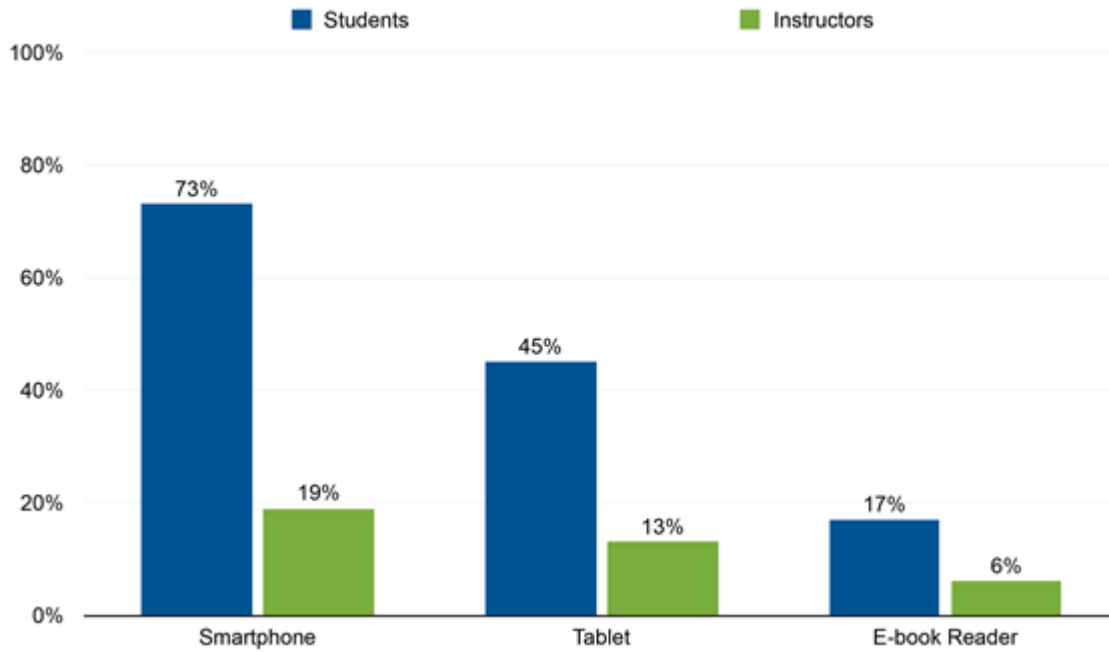
According to figure 4.22.1, we found a large difference between instructors requiring mobile device use in coursework and students using the devices for their own learning. (Baiyun Chen, 2015)

For learning on their own, students reported using smartphones (73 percent) more than tablets (45 percent) and e-books (17 percent). Furthermore, 66 percent of students ($n = 781$) reported using a mobile app for learning at least once each week. However, according to our participants, instructors rarely required mobile device use to complete assignments; respondents said only 19 percent of instructors required smartphone use, 13 percent required tablets, and 6 percent required book readers. Our open-ended questions to students supplemented the findings: students reported using devices to look up lecture topics during face-to-face class time; they use discipline-specific apps to access knowledge and other mobile apps to access course textbooks both during and outside of class. (Baiyun Chen, 2015)

4.23. Conclusion

The mobile application for higher education institutes would bring many benefits to the users as well as institutes. Currently, there is no such a system implemented in the Maldives. This mobile application would eliminate the use of coming to Male' city to seek the courses and to apply for the courses. Users can learn about the courses from all the colleges and universities in the Maldives through this platform. In addition, they can compare the courses with cost,

modules and duration. We hope it would be a useful mobile application for higher education institutes and users.

CONCLUSION

This was a very beneficial work for us. Furthermore, it was a fantastic experience we had for our current and future carrier of Information Technology. We learnt lots of new things from this project and some of us never had an experience in preparing such a project.

This is the documentation of the final project which it would be implemented in next year (2018). In this project, we have done main four chapters which is required for the final project. Project Proposal, Project Management Plan, Requirement Analysis and Literature Review is the four chapters we included in this document. This is one of a tough work we did in our Bachelor of Information Technology.

We faced lots of challenges and limitations in completing this project successfully. One of the main challenge we faced was lack of corporation from the group members. As a result, we could not be able to complete works on schedule and some works were delayed a lot. Due to this, we got a limited time to complete all the works. It was a big contest that we faced during this project work.

However, with all these challenges, we have completed the project successfully grace and mercy of Allah. In addition, our special thank goes to our lecturer Abdulla Musthafa for his assistance provided us in doing this work. Moreover, our group members did a great work. Therefore, we thank those members individually from the core of our heart.

Awareness and right information about courses is essential for selecting the best and most appropriate course. We hope this application would be an effective tool for the students and for those who wants to learn about the courses.

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APPENDIX A: GANTT CHART

Task Name	Start Date	End Date	Duration	August			September			October			November		
				Aug 01	Aug 15	Aug 31	Sep 01	Sep 15	Sep 30	Oct 01	Oct 15	Oct 31	Nov 01	Nov 15	Nov 30
1. Define requirements	1-Aug-18	31-Aug-18	31 days												
2. Iteration 1 (Analysis / Design / Implementation)	1-Sep-18	31-Oct-18	61 days												
3. Iteration 2	1-Nov-18	15-Nov-18	15 days												
4. Iteration 3	16-Nov-18	30-Nov-18	15 days												

APPENDIX B: PROGRESS REPORTS

SEPTEMBER 2017

MONTHLY PROJECT PROGRESS REPORT

1.   PROJECT TITLE

Implementing a mobile based platform for higher education institutes in the Maldives.

2.   STUDENT NAMES

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

3.   PERIOD COVERED

01 / September / 2017 to 30 / September / 2017

4.   KEY ACCOMPLISHMENTS

Project two chapters were completed during the month of September. They are Project Proposal and Project Management Plan.

5.   PROJECT STATUS

Mark as appropriate: on schedule ☐   ahead ☐   behind ■

6.   ISSUES / CONCERNS

The work was behind the schedule due to several reasons. One of the main reason was lack of corporation from the group members. To resolve the problem, advice has been given to members.

7.   Signatures

Student Names

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

Date: 30th September 2017

APPENDIX B: PROGRESS REPORTS

OCTOBER 2017

MONTHLY PROJECT PROGRESS REPORT

1.   PROJECT TITLE

Implementing a mobile based platform for higher education institutes in the Maldives.

2.   STUDENT NAMES

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

3.   PERIOD COVERED

01 / October / 2017 to 31 / October / 2017

4.   KEY ACCOMPLISHMENTS

Project main chapter (Literature Review) was completed in the month of October. It was completed on schedule.

5.   PROJECT STATUS

Mark as appropriate: on schedule ■   ahead ☐   behind ☐

6.   ISSUES / CONCERNS

Lack of corporation from the group members was the main problem faced us. To resolve the problem, advice has been given to members.

   6.   Signatures

Student Names

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

Date: 31st October 2017

APPENDIX B: PROGRESS REPORTS

NOVEMBER 2017

MONTHLY PROJECT PROGRESS REPORT

1.   PROJECT TITLE

Implementing a mobile based platform for higher education institutes in the Maldives.

2.   STUDENT NAMES

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

3.   PERIOD COVERED

01 / November / 2017 to 03 / November / 2017

4.   KEY ACCOMPLISHMENTS

Project Requirement Analysis Chapter was completed in the month of November. Moreover, with rest of the parts, the whole project was completed and finalized during this period.

5.   PROJECT STATUS

Mark as appropriate: on schedule ▇   ahead ☐   behind ☐

6.   ISSUES / CONCERNS

Lack of corporation from the group members was the main problem faced us. To resolve the problem, advice has been given to members.

7. Signatures

Student Names

Ahmed Afzal

Mahid Mohamed

Ahmed Nazim

Date: 03rd November 2017

APPENDIX C: MINUTES OF MEETINGS

We conducted several meetings to discuss about the project. Following are about some meetings and its minutes:

MEETING 1

Date: 01 / September / 2017

Time: 22:00 to 00:00 (2 hours)

Discussion:

> We were mainly discussing about the project proposal and project plan. Ideas by three members were shared each other.

Members Attendance:

> Ahmed Afzal　　　 - Present
>
> Mahid Mohamed　　 - Present
>
> Ahmed Nazim　　　 - Present

MEETING 2

Date: 01 / October / 2017

Time: 22:00 to 00:00 (2 hours)

Discussion:

> We were mainly discussing about the project Literature Review. Ideas by three members were shared each other and works were divided among three members.

Members Attendance:

> Ahmed Afzal　　　 - Present

Mahid Mohamed   - Present

Ahmed Nazim   - Present

Overall Corporation and Participation of Members

MEMBERS	PARTICIPATION
Ahmed Afzal	Good
Mahid Mohamed	Good
Ahmed Nazim	Poor

Attached CD of the Document