

**FEASIBILITY ANALYSIS OF AGILE METHODOLOGY
VERSUS TRADITIONAL WATERFALL MODEL FOR
TESTING IN THE AMS ENGAGEMENT**

**Internship Training
at
Deloitte Consulting India Pvt. Ltd.**

**By
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**Under the guidance of
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2013–15**


**Institute of Health Management Research
Jaipur
2015**

Internship Training

At

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model for testing in the AMS engagement**

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Post Graduate Diploma in Hospital and Health Management

2013-2015



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TO WHOMSOEVER MAY CONCERN

This is to certify that Dr. Swati Singh, student of MBA Hospital and Health Management from IIHMR University, Jaipur has undergone internship training at Deloitte Consulting USI, Bangalore from Feb 9, 2015 to May 15, 2015

The Candidate has successfully carried out the study designated to her during internship training and her approach to the study has been sincere, scientific and analytical. The Internship is in fulfillment of the course requirements.

I wish her all success in all his future endeavors.



Dr (Col) Ashok Kaushik

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We wish you the very best in your future endeavors.

Yours truly,

For Deloitte Consulting India Pvt. Ltd.

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Dr. Swati Singh

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Feasibility analysis of Agile Methodology versus traditional Waterfall model for testing in the AMS engagement

ABSTRACT

The Agile and Waterfall are two distinct methods of software development. The Waterfall model can essentially be described as a linear model of software design. Like its name suggests, waterfall employs a sequential design process. In contrast, the Agile method proposes an incremental and iterative approach to software design. The design process is broken into individual models that designers work on. This study is an attempt to study the effect of application of both these methods on testing process in the AMS engagement.

INTRODUCTION

Software testing is performed to verify that the completed software package functions according to the expectations defined by the requirements/specifications. The overall objective is not to find every software bug that exists, but to uncover situations that could negatively impact the customer, usability and/or maintainability.

Standard development methodologies describe a set of general testing mechanisms which must be incorporated in the product development lifecycle. These mechanisms start from testing very small of code piece by piece to testing the whole application functionality in the end.

The study was a descriptive one and data was collected through observation of the process and informal interviews of the project members over a period of two months. The study included two Update test cycles and the time taken to execute test cases of two markets was included in the study. The methodology applied in the first test cycle was the traditional

Waterfall model. The steps were broken down into sprints and prioritized with help of the project members for the second test cycle which provided the data for testing with Agile methodology. The cumulative time taken for execution of the test cases was recorded for each cycle and the difference in effectiveness achieved through both the applied methodologies was compared.

AIM

To ascertain if it is feasible to employ Agile methodology in the testing process and to know which methodology will provide the most effective results

OBJECTIVES

1. Getting a macroscopic overview of the process of EMR testing in the existing AMS engagement
2. Understanding the pros and cons of application of Agile and Waterfall models in EMR testing
3. Analysing the feasibility of implementing Agile methodology in the EMR Testing in the engagement

ANALYSIS

The total numbers of test cases included were 481; 239 test cases in market 1 and 242 in market 2. It was found that with application of Agile methodology, an efficiency of 16.38% in market 1 and an efficiency of 13.8 % in market 2 was achieved in application regression testing. The results of the study can be used for recommending the changes to be implemented in the testing process.

CONCLUSION

The testing team has been able to benefit by adopting Agile methodology that has resulted in the reduction in time taken in the testing process, ability to increase the test coverage and

increased productivity of the team members. This was accomplished by collaborating with the functional teams in the areas of better planning, prioritization of work and more effective communication within the members of the project.

To achieve the goals of improved test coverage, better utilization of the practitioners and high quality client service delivery which in turn would translate as optimal patient care delivery for health care organizations, Agile Methodology would be the right fit to drive the testing the enhancements and updates sent by the vendor.

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LIST OF ABBREVIATIONS

AMS-Application Management Services

EMR- Electronic Medical Records

ADT- Admission, Discharge, Transfer

OPD- Out Patient Department

IT-Information Technology

MNC- Multi National Corporation

1.1 ABOUT THE ORGANISATION

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DISSERTATION REPORT

Feasibility analysis of Agile Methodology versus traditional Waterfall model for testing in the AMS engagement

1.2 INTRODUCTION

Software testing is performed to verify that the completed software package functions according to the expectations defined by the requirements/specifications. The overall objective is not to find every software bug that exists, but to uncover situations that could negatively impact the customer, usability and/or maintainability.

Standard development methodologies describe a set of general testing mechanisms which must be incorporated in the product development lifecycle. These mechanisms start from testing very small of code piece by piece to testing the whole application functionality in the end.

1) Unit Testing

This is the most basic testing mechanism at the developer level. This covers very narrow and well defined scope. We isolate the code from any outside interaction or any dependency on any module. Unit tests focus on very small unit of functionality. They cover the interaction of the code with memory only and do not cover any interaction with network, database or file systems. They provide a simple way to check smallest units of code and prove that units can work perfectly in isolation. However, we need to check further that when these units are combined they work in a cohesive manner which leads us to further types of tests.

2) Integration Testing

Integration Test forms the next class of tests at the developer level. They provide a mechanism to test the interoperation of smaller units. Integration test involve testing the modules which access network, databases and file systems. They reveal out the issues with network modules or databases and more importantly in the connections between small units

of code. Often when the units are wired together there are issues. Unit A might not be giving data properly to the Unit B and these issues come up in the integration tests.

3) Functional Testing

After the integration tests are performed, higher level tests are used. Functional tests check for the correctness of the output with respect to the input defined in the specification. Not much emphasis is given on the intermediate values but more focus is given on the final output delivered.

4) Smoke Testing

Smoke Tests analogy comes from the electronics where a mistake means the circuit board giving out smoke. After functional tests are done a simple test is done from the start typically after a fresh installation and newer input values. Luckily there is no smoke in software industry but yeah, crashes are there to indicate trouble.

5) Regression Testing

Whenever complex bugs are patched in a system, typically which affect the core areas of the system, regression tests are used to re test all the modules of the system.

6) Acceptance Testing

These form the final level of test plan. Every feature is checked from the user's perspective by the testing team and the feature is marked accepted or rejected. These tests test the application from end user's perspective like detecting crashes after going through a certain

flow. The results of these tests are very subjective in nature and it takes a while to figure out the exact issue in the code.

Software methodology- A software development methodology or system development methodology in software engineering is a framework that is used to structure, plan, and control the process of developing an information system.

There are the following methodologies:

- Agile Software Development
- Crystal Methods
- Dynamic Systems Development Model (DSDM)
- Extreme Programming (XP)
- Feature Driven Development (FDD)
- Joint Application Development (JAD)
- Lean Development (LD)
- Rapid Application Development (RAD)
- Rational Unified Process (RUP)
- Scrum
- Spiral
- Systems Development Life Cycle (SDLC)
- Waterfall (a.k.a. Traditional)

The two basic, most popular methodologies are Waterfall or the “traditional” approach, and Agile. The fundamental principle of a waterfall approach is that development proceeds in stages and does not move from one stage to the next until each stage is considered complete. Thus, at the end of each stage, we either have a complete description of the system, at some level, or a complete system. This characteristic is often seen as making it easier to be compliant with regulations, because each complete description can be checked against its predecessors. There are two main advantages of the waterfall approach:

- It works well in a contractual environment, because the contract can be let against a well-defined set of requirements
- It avoids the problems of developers working without sufficient context to know whether they are creating something that is not maintainable or will prevent other needed functions being implemented

Agile development is a radically different approach. It recognizes that requirements will change as more is learned about the way that the proposed system will be used. It places the emphasis on working systems (typically software), rather than enforcing a process with strict deliverables.

If this approach is not carefully managed, it could degenerate into a process with all of the problems that the waterfall was designed to avoid, so various means are used to avoid this. In fact, agile approaches often require more discipline than waterfall methods.

The main control mechanism used in agile processes is to break the development up into a number of sprints. Each sprint aims either to deliver a well-defined subset of the overall required functionality or to perform well-defined restructuring of the architecture of the system. This is known as refactoring in agile terminology.

The main advantages of Agile methodology are:

- Customer satisfaction by rapid, continuous delivery of useful software.
- People and interactions are emphasized rather than process and tools. Customers, developers and testers constantly interact with each other.
- Working software is delivered frequently (weeks rather than months).
- Face-to-face conversation is the best form of communication.
- Close, daily cooperation between business people and developers.
- Continuous attention to technical excellence and good design.
- Regular adaptation to changing circumstances.
- Even late changes in requirements are welcomed

When new changes are needed to be implemented. The freedom agile gives to change is very important. New changes can be implemented at very little cost because of the frequency of new increments that are produced. Unlike the waterfall model in agile model very limited planning is required to get started with the project. Agile assumes that the end users' needs are ever changing in a dynamic business and IT world. Changes can be discussed and features can be newly effected or removed based on feedback. This effectively gives the customer the finished system they want or need. Both system developers and stakeholders alike, find they also get more freedom of time and options than if the software was developed in a more rigid sequential way. Having options gives them the ability to leave important decisions until more or better data or even entire hosting programs are available; meaning the project can continue to move forward without fear of reaching a sudden standstill.

1.3 REVIEW OF LITERATURE

According to study “Challenges in the transition from Waterfall to Scrum- a case study at port base”, by Sander Bannik, old sequential methods like the waterfall have proven ineffective. Many companies are making a switch from waterfall to scrum and there are significant challenges associated with it. In recent years, agile methods are an upcoming trend in project management. A survey conducted among 2252 companies in 2007 showed that 26 percent of them were using agile methodologies. In 2009, a survey confirmed that scrum was by far the most used agile methodology. A recent survey of nearly 500 companies showed that agile methodology is used by 40 percent of all software companies.

According to “International Journal of Advanced Research in Computer Science and software Engineering”, by Chavvi et al, one of the main challenges in transforming from waterfall to agile is the mindset of the people. The change is difficult to adapt and has to be started from the beginning of the process.

In the study, “How to Migrate from Waterfall Development Approach to Agile Approach”, (Master’s thesis) by FANGKUN YANG, in waterfall development approach, cost of change increases in a stable way until analysis and design phases (Janes and Succi, 2012). But when a change happens after that, it costs a lot of effort to fix and make sure that all related area such as code and documentation are modified accordingly. In the agile approach, cost of change is stable all through SDLC. In this approach, upfront planning and definition of customer requirements are given up until they are needed (Janes and Succi, 2012). For such

definition, cost is similar in all the development phases. This also lowers the cost of the modification.

Boehm and Turner (2005) think that “people issues are the heart of the Agile movement, and much of the paradigm change is aimed at empowering individuals by supporting reasonable goals, shorter feedback cycles, ownership, and flexibility” (Boehm and Turner, 2005, p.36). Thus it is the management of people that forms an important issue while transforming from waterfall to agile.

According to “Study on the Agile Software Applicability and implications” by Kuda Nageswara Rao, G. Kavita Naidu and Praneet Chakka, a number of projects indicate cost savings from the agile method. This was owing to the fact that less man hours were required while using the agile method leading to overall cost reduction of the project.

The study conducted by Kai Petersen and Claes Wohlin of School of Engineering, Blekinge Institute of Technology, Sweden, says that the implementation of Agile Methodology leads to better control and transparency. It is so because the work is divided into small and manageable tasks. In this methodology, the team members communicate intensively face-to-face as they have frequent meetings and are located physically together. Thus learning and understanding for each other is intensified.

According to the study, “Process of moving from Waterfall to Agile Project Management Model” by Sanja Vucicevic and Drazen Draskovic, the basic problems encountered while using the traditional model are failing to meet deadlines, abandoning the projects mostly

after failing to meet the deadlines and lot of pile up in the projects. However, using Agile methods

Contributes to diminishing these problems. Here, the individuals and interactions are more important than processes and tools; customer collaboration is more important than contract negotiation and quick responding to change is more important than following a plan.

1.4 PROBLEM STATEMENT

The testing process forms an essential process of EMR software maintenance. However, it has been found that the process of regression testing does not get over within the determined timelines which leads to delay in completion of test cycles.

1.5 RESEARCH QUESTION

Is it feasible to transition the existing traditional Waterfall methodology to Agile for testing process in AMS engagement?

1.6 RATIONALE OF THE STUDY

1. To give suggestions to improvise the testing process and provide better client service and customer value
2. This study aims to understand which methodology will yield the most efficient and effective results when applied to testing in the AMS engagement

1.7 AIM OF THE STUDY

To ascertain if it is feasible to employ Agile methodology in the testing process and to know which methodology will provide the most effective results

1.8 OBJECTIVES OF THE STUDY

1. Getting a macroscopic overview of the process of EMR testing in the existing AMS engagement

2. Understanding the pros and cons of application of Agile and Waterfall models in EMR testing

3. Analysing the feasibility of implementing Agile methodology in the EMR Testing in the engagement

1.9 METHODOLOGY

The study was conducted over a span of two months from March 10, 2015 to April 30, 2015 in an EMR support project.

Study Design

This was a descriptive cross sectional study.

Sample size-481

The data with respect to two different markets was collected with 239 test cases in market 1 and 242 test cases in market 2

Sampling technique

Non probability Convenience sampling

Methods and Instruments of Data Gathering

1. Primary data was collected through informal interviews of the project members
2. Secondary data was collected through observation of the process and documentation available on testing process

1.10 MAPPING THE EXISTING PROCESS

Electronic Medical Records form a major part of the Health IT transformation and are extremely dynamic in nature. They require changes from time to time and thus depending on the end user's input there are certain updates that have to be pushed in to the system from time to time.

The updates are small packages of code, each containing a discrete fix to address a critical patient safety, data integrity, or workflow issue. These updates are created by the EMR vendor after validation from the Application Management Services (AMS) team on the provider side. Once the updates are approved by the client, the EMR vendor installs them into a test environment for the AMS team to start the review process. The AMS application and testing teams review each and every update, analyze its impact on the application, identify workflows effected, test all functionalities identify integrated test scripts and do end to end testing for the application. This process is done on a bi-monthly basis over a span of seven weeks.

The following are the activities involved in the process:

Week 1

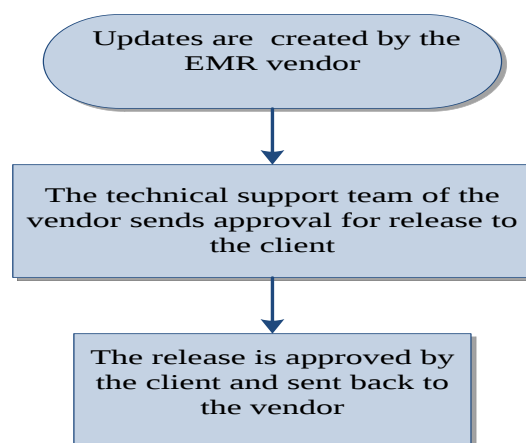


Fig 1.1: Update Process: week 1

Week 2-3

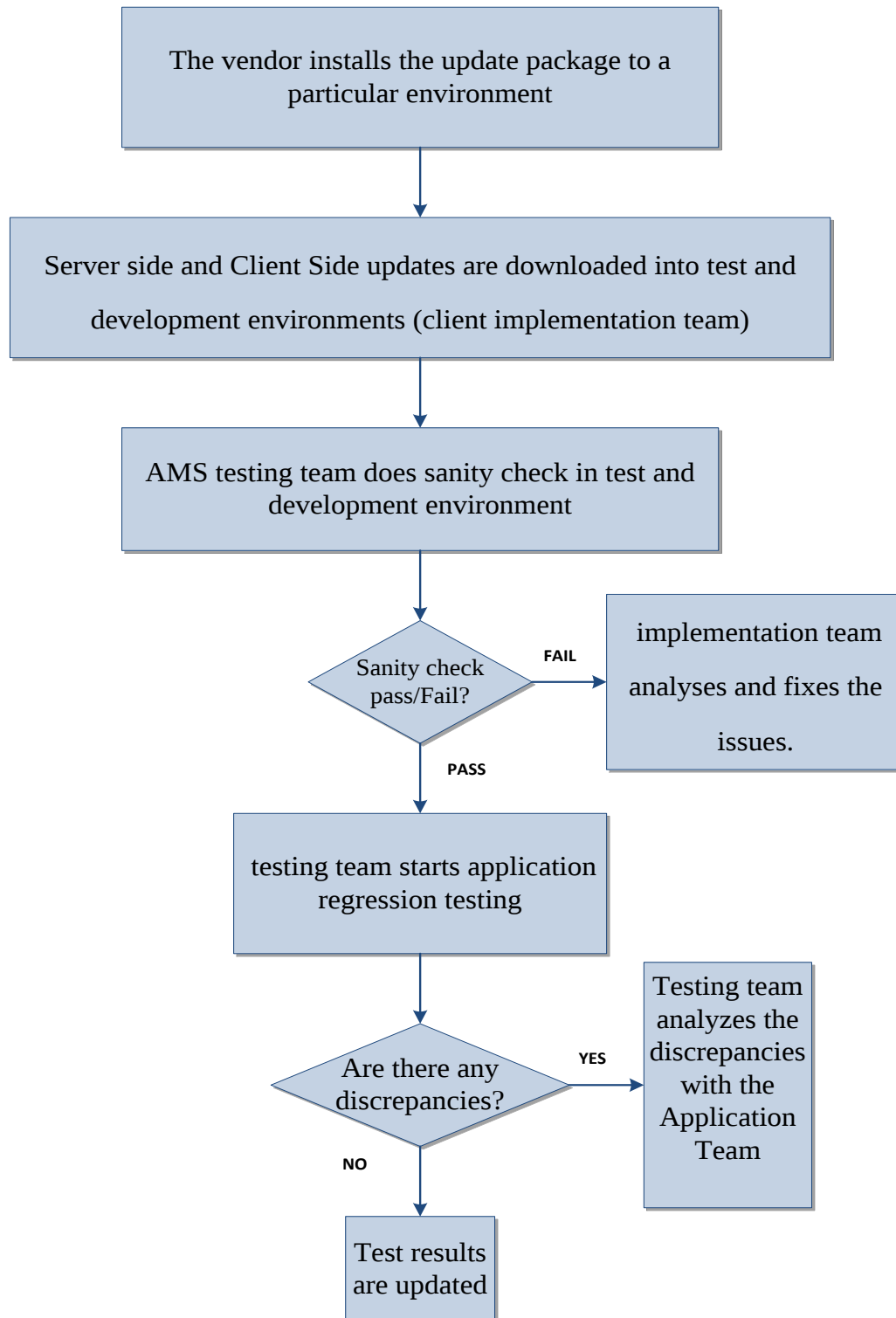


Fig 1.2: Update process: week 2-3

END OF WEEK 3 – WEEK 6

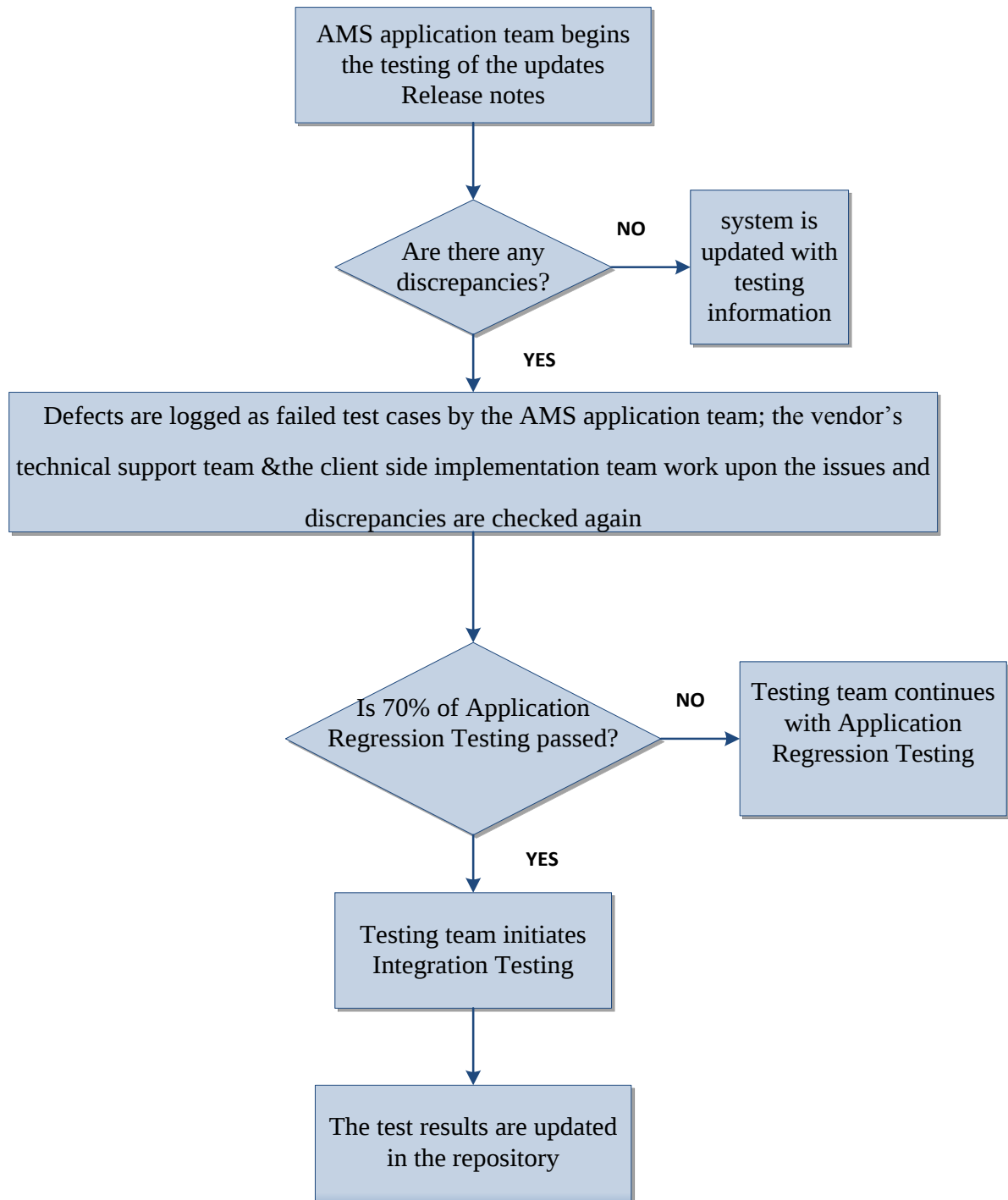


Fig 1.3: Update process: week 3-6

WEEK 7

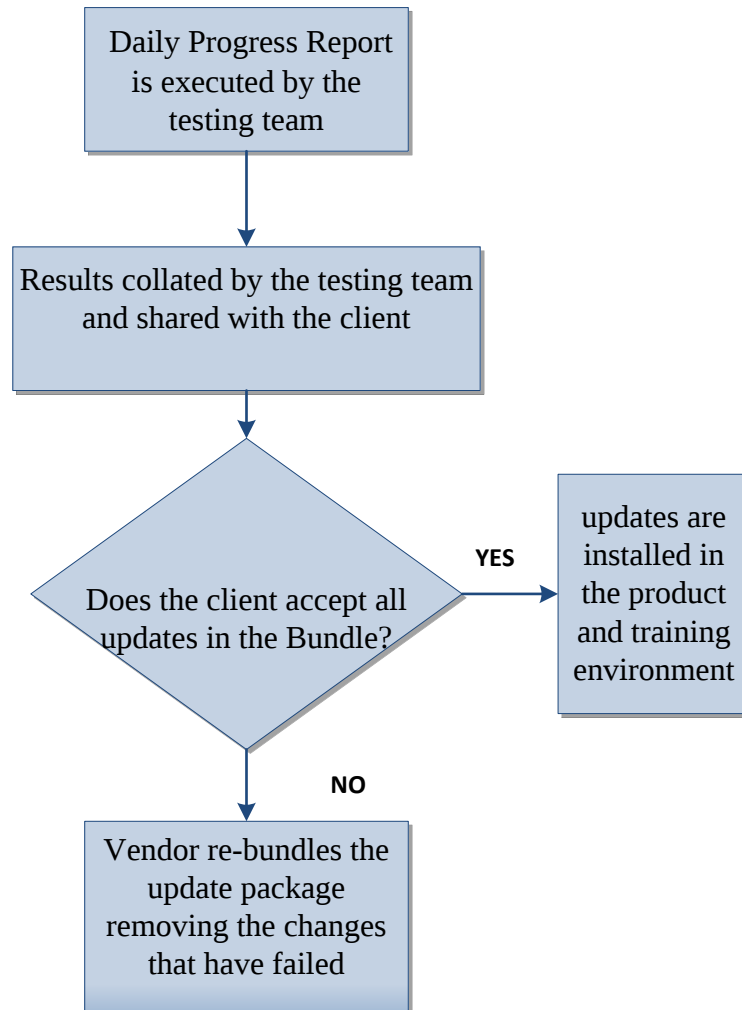


Fig 1.4: Update process: week 7

1.11 DESIGNING THE TRANSITION TO AGILE

Under the waterfall methodology, the team members divide the modules among themselves and begin with the application regression testing, following which integration testing is started.

Under the new methodology, the modules were first prioritised and divided into high, medium and low priority modules. Agile method was applied only to application regression testing.

- **Prioritization of the modules-** The modules were prioritised depending on two factors

1. Effect on patient's safety
2. Revenue to hospital

Module	Affects patient's safety	Revenue to the hospital
Emergency	Yes	Yes
Documentation		
OPD	Yes	Yes
Orders	Yes	Yes
ADT	Yes	Yes
Scheduling	Yes	
Hospital services billing		Yes
Information management		

Professional billing		Yes
Surgery & Anesthesia		Yes
Outpatient Pharmacy	Yes	Yes
Inpatient Pharmacy	Yes	Yes
Radiology		Yes
Oncology		Yes
Technical		

The modules that affected patient's safety as well as revenue were categorized as Level 1.

Those affected one of them were categorized as Level 2 and others as Level 3.

Level 1	Emergency OPD Orders ADT Inpatient pharmacy Outpatient pharmacy Scheduling
Level 2	Hospital services billing Professional billing Surgery and anesthesia Radiology Oncology
Level 3	Documentation Information Management Technical

- **Setting up of a timeline for regression testing of the modules-** timeline was set for the execution of the modules priority wise.

The test cases of Level 1 modules were tested in the first week, followed by test cases of level 2 in the second week and level 3 in the 3rd week.

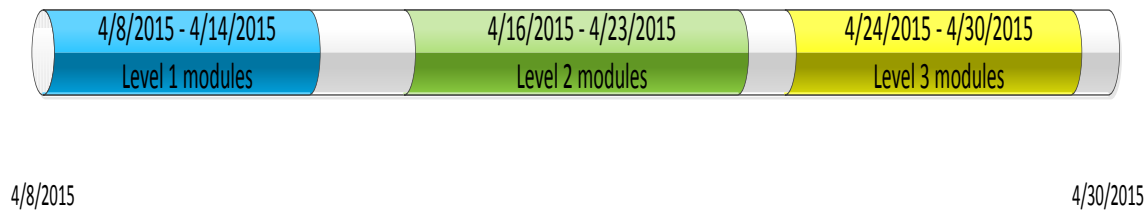


Figure 1.5: timeline for working on modules on basis of priority

- **Sprint planning meeting-** Meeting among all the project members was conducted in the beginning of the test cycle to prioritise the test cases within each module. Within each module the test cases were divided into three different priorities. The priority 1 test cases were executed in the first three days of the week followed by priority 2 and 3 cases. The entire workflow was thus divided into a week-long sprints. Sprints were formed for all three level of modules.
- The testing team members further decided the following
 1. Initial assignment of tasks among the members
 2. Time estimation for each task

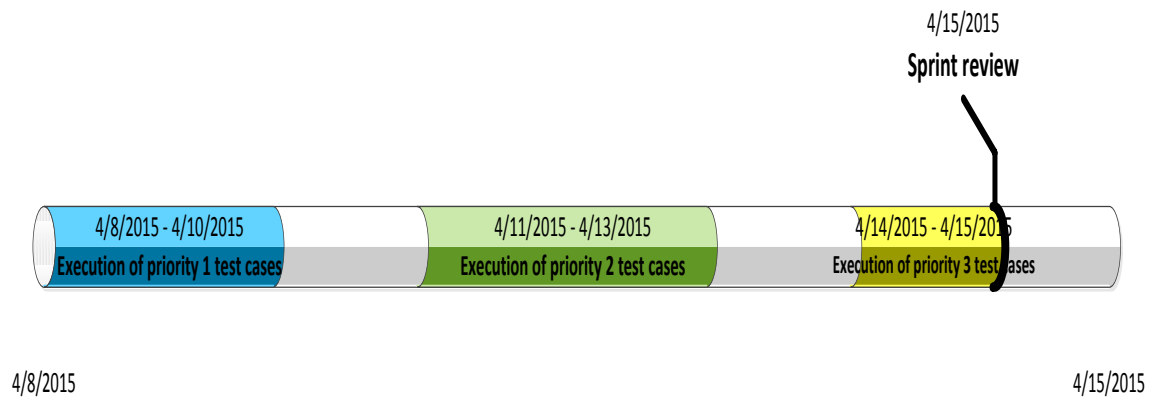


Figure 1.6: Sprint planning for test case execution within Level 1 modules

- **Sprint Review meeting-** At the end of each sprint, the team discussed the accomplishments of the sprint. Any tasks left incomplete were carried forward to the next sprint

- **Daily stand up meetings**
 - Morning Stand up
 - (1) 10 minutes meeting daily in the mornings to discuss the agenda of the day
 - (2) Discussion on what was done since last meeting and what will be done till the next meeting
 - (3) Notes were made of any issues that were brought up by the team members

 - Meeting at the end of the day
 - (1) The team had a discussion on the completion status
 - (2) A rough work plan was drawn for the next day

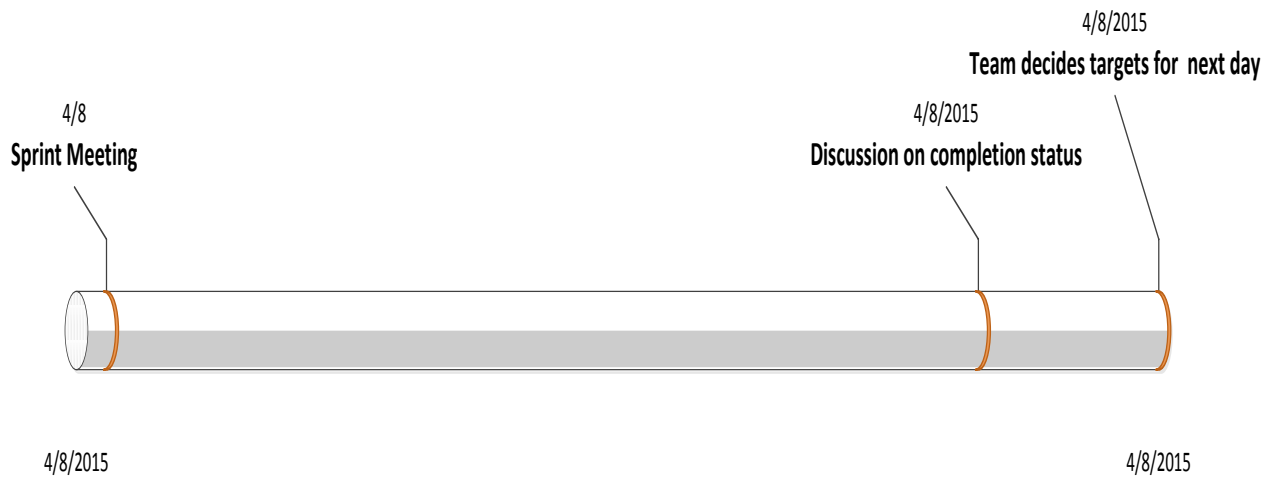


Figure 1.7: An example of daily sprint assessment plan

TESTING STATUS BOARD

At the end of each day, the status board was updated in accordance to the completion status discussed in the meeting. The format of the board was as follows:

Test cases received	No. of test cases executed	No. of test cases passed	No. of test cases failed	No. of test cases not started

1.12 RESULTS

With the introduction of module prioritization and sprints, there was a reduction in the total time taken in application regression testing.

The results were recorded for both the markets separately and compared to the time taken for the testing process in the previous test cycle.

- **MARKET 1**

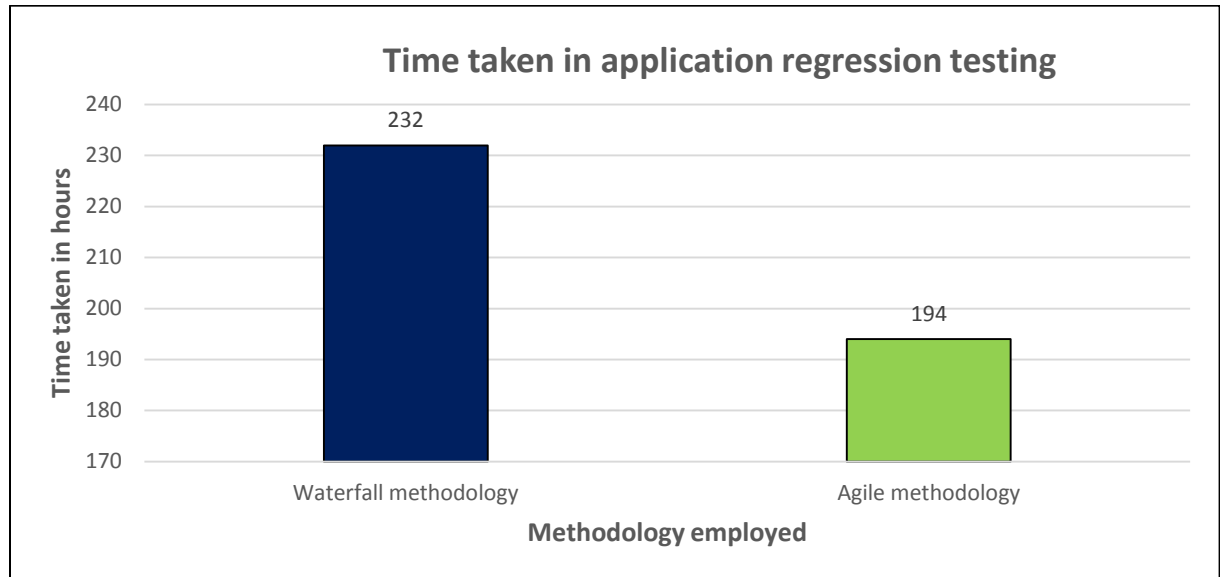


Fig 1.8: Comparison of time taken for regression testing under waterfall and agile methodology for market 1

The results showed that there was a reduction of 38 hours from the previous test cycle i.e. an improvement of **16.38 %**

The following gives the details of the time gained with respect to individual modules

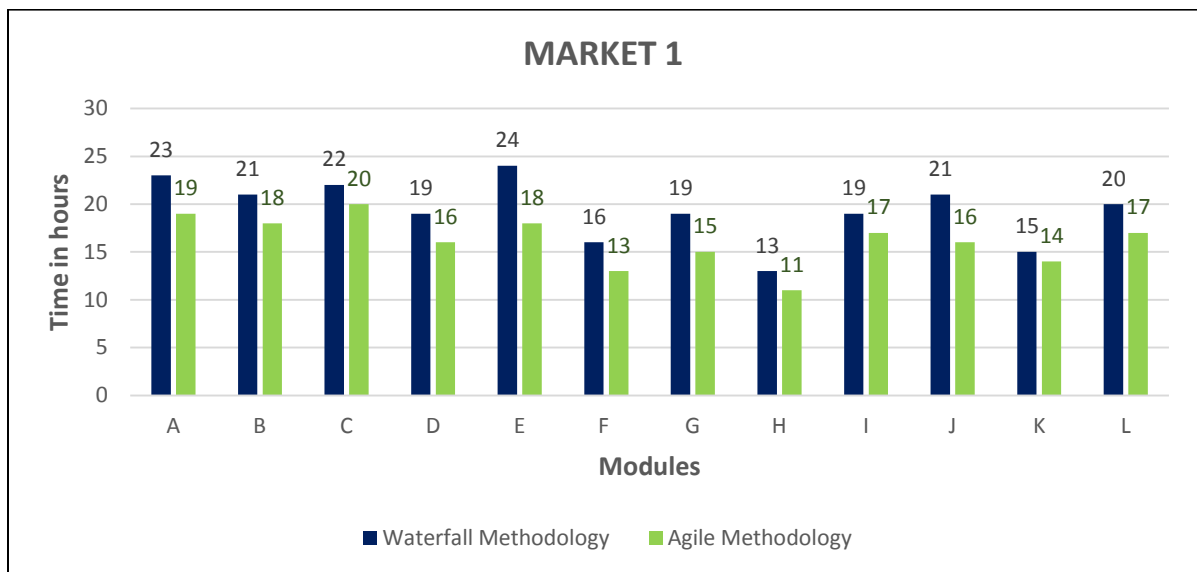


Fig 1.9: Module wise time taken for execution of test cases for market 1

A	Emergency
B	Documentation
C	Outpatient dept.
D	Orders
E	Inpatient dept.
F	Scheduling
G	Hospital services
H	Information management
I	Professional services
J	Surgery & Anaesthesia
K	Technical
L	Pharmacy

It was observed that there was an average difference of 2.32 hours in functional testing of the modules under both the methodologies.

- MARKET 2**



Fig 2.0: Comparison of time taken for regression testing under waterfall and agile methodology for market 2

The results showed a difference of 32.5 hours from the previous test cycle i.e. an improvement of **13.8 %**

The following gives the details of the time gained with respect to individual modules

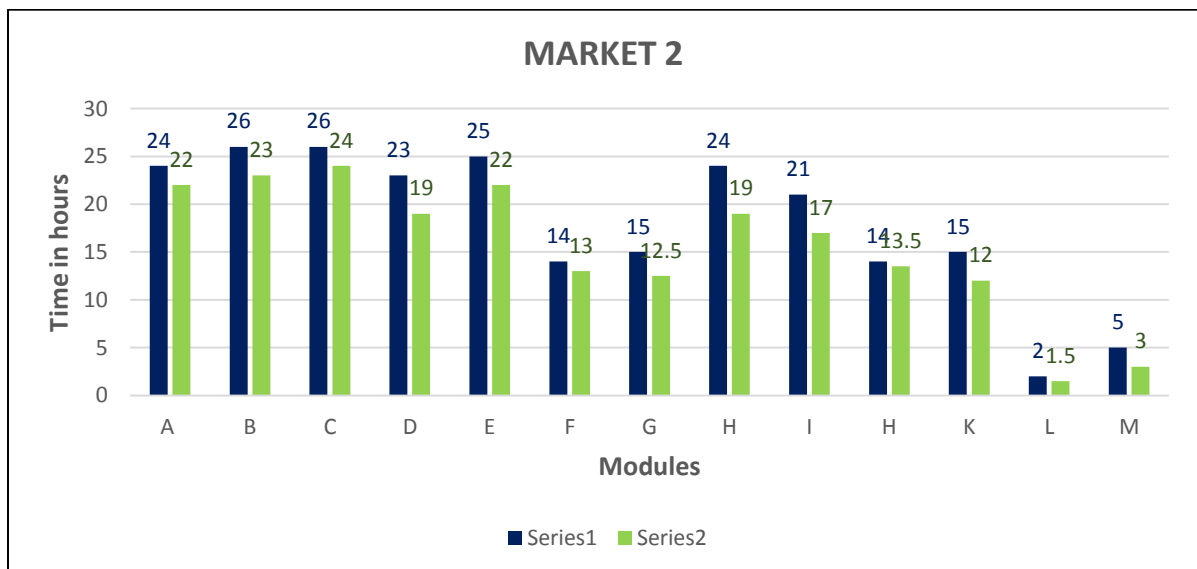


Fig 2.1: Module wise time taken for execution of test cases for market 2

A	Emergency
B	Documentation

C	Outpatient dept.
D	Orders
E	Inpatient dept.
F	Scheduling
G	Hospital services
H	Information management
I	Professional services
J	Surgery & Anaesthesia
K	Technical
L	Radiology
M	Oncology

It was observed that there was an average difference of 2.71 hours in functional testing of the modules under both the methodologies

1.13 DISCUSSION

The objective of the study was to analyze the feasibility of adapting Agile methodology in testing in the AMS engagement. It was found through the study that with collaboration and better communication among the team members, agile methodology could be successfully implemented in the testing process. Also, it led to overall reduction in the time taken for execution of application regression testing. This can be attributed to the following reasons:

- **Break down of the work into sprints-** The entire process was broken into weekly sprints. Setting up of sprints provided a deadline within which the activities had to be completed.
- **Stand up meetings-** The meetings helped in setting targets for a day and provided a platform to the project members to know their current status. Also, discussion on issues brought up helped in dealing with similar issues more effectively.
- **Prioritisation of modules and test cases within modules-** This helped in focusing on more important issues first. Also, it was found through the study that the high priority test cases take 45 -50 minutes on an average to be executed, mid priority ones take around 25-30 minutes and the low priority test cases take 10-15 minutes. Thus, through prioritisation of test cases, the most time consuming work was finished first.
- **Better utilisation of human resources-** pre-planned goals, periodic monitoring and better communication within members led to less time wastage and increased efficiency which led to decrease in time taken for test case execution

1.14 CONCLUSION

As evident from the results of the study, the testing team has been able to benefit by adopting Agile methodology that has resulted in the reduction in time taken in the testing process, ability to increase the test coverage and increased productivity of the team members. This was accomplished by collaborating with the functional teams in the areas of better planning, prioritization of work and more effective communication within the members of the project.

To achieve the goals of improved test coverage, better utilization of the practitioners and high quality client service delivery which in turn would translate as optimal patient care delivery for health care organizations, Agile Methodology would be the right fit to drive the testing the enhancements and updates sent by the vendor.

The adoption of agile methodology for testing has made several teams within the project to partner and work in unison to deliver the goal of improving the patient care delivery by complying with the client and vendor deadlines.

1.15 LIMITATIONS

- The data of only two out of three markets could be included owing to time constraint
- The information on time taken for execution of test cases was collected through informal interviews of the project members

1.16 REFERENCES

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