Waterfall Process Operations in the Fast-paced World: Project Management Exploratory Analysis

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Abstract

The software development processes must follow some specific system development life cycle. There are many SDLC methodologies proposed and are in working according to the developing software. The system development life cycle has been studied and investigated by many researchers and they have developed their own model which has own strengths and weaknesses. This analysis paper concentrated on the traditional methodology namely waterfall model as if it can be used in this new e-business era and for which type of business this model is suitable. It explains about the waterfall model and how this model works. The paper begins with explain about waterfall methodology. This paper also discusses the model's pros and cons. It also discusses about waterfall methodologies SWOT analysis. The paper concluded with summary.

Keywords: System development life cycle, waterfall, SWOT, requirements

JEL Classification: M11, M19, O22, O29

1. Introduction

Software and system development have a lot of challenges in this rapid change in markets (Bassil, 2012). A software development methodology means to the framework, which is use for planning, managing, and controlling of processes. The software development methodology is known as software development life cycle and it is used in many fields such as several engineering, industrial field, etc. this has been studied and investigated by many of the researchers and practitioners over the world and they have developed numerous models which have their own strengths and weaknesses. There are many such as the waterfall, agile, etc. They all share basic properties, and they have sequence of steps that should be followed to attain some results and deliver final products. The waterfall model comprises of five consecutive phases such as business analysis, design, implementation, testing and maintenance. This method was a success and many development firms and industrial manufactures have adopted this as their prime development framework. Moreover, besides this many people were hired to run different departments and the departments were its phases. It was very optimal to find out number of resources which should be assigned to complete the specific phases so, this created much fuss among project managers and the directors. This paper talks about waterfall method of software development.

Problem Statement

The problem statement is waterfall methodology still in use or the modern methodologies have replaced waterfall methodology. The system development life cycle methodologies are fall short in the new business world (Yourdon, 2000).

Aim

The aim of this analysis paper is to investigate whether waterfall methodology is still in operations in this new business world where customers are changing with fast pace.

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2. Literature Review

The Waterfall approach was introduced by Winston Royce in 1970, adopted by software project managers and further developed through lessons learned from software projects (Harrison, 2003, cited from Ruël et al. 2010). Modern project management methodologies, such as PRINCE2 and PMBOK, evolved from the Waterfall approach (Harrison, 2003) and are the most widely used project management methodologies in Europe and North America. The Waterfall approach treats a project as a linear process consisting of a series of basic sequential stages, each of which needs to be formally validated before moving to the next stage, thus reducing the complexity of an ES implementation process (Jurison, 1999; Khalifa, 2000; Huo et al., 2004)

The Waterfall systems development life cycle, or simply, the Waterfall model or Waterfall method, is one of the first development life cycles instituted and is still widely used today for systems development (Sasankar & Chavan, 2011). The Waterfall model was first recorded in 1956 by Herbert D. Benington where he proposed that software be enhanced in stages, but the model was revised by Winston Royce in 1970 by presenting a feedback loop so that each stage within the model could be re examined (Ruparelia 2010). Many researchers commend the Waterfall model because of it simplicity compared to other systems development life cycle models and share that it has even strengthened other system development life cycles. Waterfall steps have varied in name over the years, but still consists of five distinct areas: system conceptualization, systems analysis, system design, coding and testing (cited from McClinton, 2012).

3. Research Methodology

This part of the report discusses about the procedures of gathering information through secondary sources. Research methodology is the way research is carried out. It is to provide justification of the types of instruments and techniques taken into consideration for research (Haque et al. 2017; Imran et al. 2018a; Imran et al. 2018b; Imran et al. 2018c; Javed et al. 2018a; Javed et al. 2018b; Ślusarczyk, & Haque, 2019; Urbański et al. 2019; U-Hameed et al. 2019; Rahman et al. 2020; Ślusarczyk et al. 2020). Observation is a method to explain concepts into meaningful results (Gusakov et al. 2020; Hussain et al. 2019; Faizan & Haque, 2015; Faizan & Haque, 2016; Haque et al. 2015; Haque & Yamoah, 2014; Faizan et al. 2018, Faizan et al. 2019; Faizan & Haque, 2019; Haque & Yamoah, 2014; Haque & Aston, 2016; Haque et al., 2016; Haque et al. 2018; Haque & Oino, 2019; Haque et al. 2019; Haque, Kot & Imran, 2019; Haque et al. 2020; Haque et al, 2020; Kot et al. 2020; Kot et al. 2019; Kot et al. 2019).

Observations

This is a well-known method in the social science research (Gusakov et al. 2020; Hussain et al. 2019; Faizan & Haque, 2015; Faizan & Haque, 2016; Faizan et al. 2018). It has been observed that the waterfall methodology is the traditional methodology which requires a sequence of steps in which the progress flows downwards as a waterfall. It has several steps which should be completed before starting another phase. It is a sequence of logical flow of phases for the software development process. The basic steps of waterfall methodology include analysis phase where the software development process is analysed, followed by design phase when the design of the software is decided then implementation when the steps are being put into effect, testing phase when the software is tested and it ends with the maintenance phase when the output is refined (Bassil, 2012).

Library research

Many various papers have been read and observed in order to study the SDLC methodologies and read about waterfall methodology. This is common in the social science research papers (Haque et al. 2017; Imran et al. 2018; Imran et al. 2018; Imran et al. 2018; Javed et al. 2018; Javed et al. 2018; Ślusarczyk, & Haque, 2019; Urbański et al. 2019; U-Hameed et al. 2019; Rahman et al.

2020; Ślusarczyk et al. 2020).

Inclusion and exclusion criteria

Secondary resources are included which were peer reviewed and were 20 years back. Observations are the part of the report. Primary research methods have been excluded because of financial constraints. Besides this, advanced statistical tools are also excluded.

4. Findings and discussions

This part of the reports contains findings and discussions.

4.1. Waterfall model

The waterfall model is a software development life cycle model which was originally defined by Royce in 1970's (Sherrell, 2013). Before agile software developments projects were relying on waterfall approach to software development. The waterfall method was like a series of logical phases in which the progress use to flow from one phase to another. The basic assumption was like the requirements must be defined upfront for the software to be designed, build, and tested (Gray & Larson, 2017, pp.578). The waterfall model is sequential software development process which progress in downward direction like waterfall (Bassil, 2012). It defines several consecutive phases that should be completed one after another and it moves to the next phase only if the preceding phase is completely done.

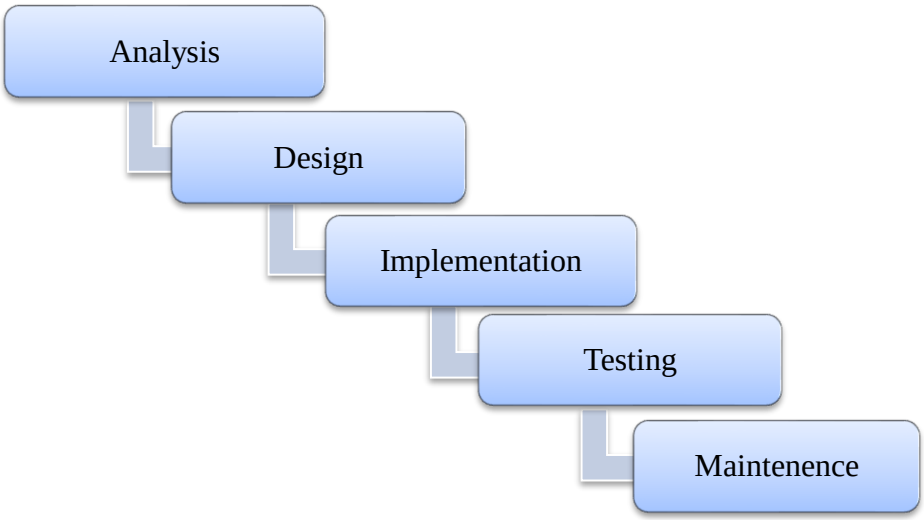

Figure 1: Waterfall approach

As we can notice the figure 1., which depicts a waterfall model. According to Dima & Maassen (2018), the classical waterfall approach models start with the analysis stage which includes the analysis for requirements. The model is considered offering well-defined set of criteria and the requirements indications before even starting the designing and implementation phase of the project, so it provides a basic plan of the project before starting in orderly sequence of the project. She also states that this type of method does not ensure quickly changes according to the stakeholders unless the project is finished or nearly finished. This type of method is suitable for those projects whose requirements are going to be stable for longer time or till the finish of the project. Waterfall methods comprises of following steps (Bassil, 2012):

Analysis phase: Analysis phase is also known as software requirement specifications (SRS) which is a complete description of the behaviour of the software which is going to be developed. This phase wants business analyst to define both functional and non-functional requirements. Functional requirements include requirements such as purpose, scope, perspective, functions,

software attributes, user characteristics and database requirements. On the other hand, non-functional requirements include constraints, limitations, requirements on design and operation of the software. It has properties like the reliability, scalability, testability, performance, and quality standards, etc.

Design phase: This phase includes the process of planning and problem solving for software solution. It means that the software developers and the designers are going to define the plan for a solution, and it includes algorithm design, software architecture design, logical diagram scheme, data structure definition, etc. The phase is about designing the software which includes furthermore efforts to design the software.

Implementation phase: It refers to the understanding of business requirements and designing requirements into a solid execution program, database, website through programming and deployment. This is where the real code is written and compiled into operational application, from where the database and text files were created. In a nutshell, it means conversion of the process phase into production phase.

Testing phase: This phase is also known as verification and validation which includes a process for checking that the software expectations meet the original performance and specifications and it completes its intended purpose. Verification refers to the process where the process of evaluation of software is done to determine whether the product at the given phase satisfies the conditions which were there in the start. Validation, on the other hand refers to the process of evaluating he software during and at the end of development process to find that the software satisfies the specified requirements. In this phase the bugs and system glitches are found, and they are corrected, redefined accordingly.

Maintenance phase: this phase includes the process of modifying a software solution after delivery and deployment to refine the output, correct the errors and improve performance and quality. This can also include adaption of software to its environment, accommodating new user requirements and increasing its reliability, etc.

Advantages of waterfall

According to Kannan, Jhanjhari es. el. (October 2014), the major advantage of waterfall model is that it provides a structure for organizing and controlling a software development project. The design details and errors are captured by the method before any software is written so, we can save time in developing process. In waterfall method, we have proper technical document which made is easy for customers to know what they should expect from the software. Moreover, the documentation also helps in process of maintenance. Whenever a new person enters the team it is easy for them to catch because of the documentation. If the procedures are followed correctly then we can accurately estimate cost and time.

Besides this, as this process includes a sequence or series of steps which helps in finding faults in one phase which can be detected before we move to another. This method is best for small projects and it requires less resources as compared to others. When we use this method, we can have departmentalization and managerial control which allows the product to be completed on time by setting a schedule for every phase. This method for those projects that are service oriented and nonphysical deliverables like the code, copywriting and designing projects.

Disadvantages of waterfall method

As every coin has two sides the waterfall method of project management comes with disadvantages. In waterfall methods all the requirements need to be specified at the start which is not possible for real life projects and customers always change their requirements frequently. The software is required to be highly flexible and adaptive because a consideration has been considered

that the requirements are subject to change. The model is not much flexible because everything is decided at phase 1 only. Real projects are rarely sequential and hence the waterfall model is not proper for large projects. It does not accommodate risks and uncertainties. It is difficult to measure progress at every stage of the model and the time, cost is not determined. Moreover, the integration is done at the end which does not even explain the identification of challenges and business bottlenecks in business life cycle. As the steps are interrelated and dependent on each other a lot of time is wasted. Coordination is very important which is not possible in simple method like waterfall (Kannan, jhanjhari es. el., October 2014).

When to use waterfall

Waterfall project is best when there is clear picture of the final product and the requirements are well defined which will not change frequently. When the time is not an issue and final product is main concern. It works well for those projects where design can be change or new can be added and still the development process goes on without requirement of customers or competitors. The waterfall method is hard because when some new content is added, or many uncertainties are there to resolve and if the testing fails then the developed product at the end may seem a waste (Kannan, jhanjhari es. el., October 2014).

Table 1: Summary of advantages, disadvantages and when to use

Model	Advantages	Disadvantages	When to use	Reference
Waterfall Method	The major advantage is it provides a structure for organizing and controlling the project. It has proper procedure which should be followed. It allows departmentalization and managerial control	It is difficult to have specifications for everything because the projects requirements are subject to change. It does not work well for larger projects.	When we have final picture of the final product, when the requirements are well defined, and they will not change. When time is not an issue.	Kannan, Jhajharia es. el. (2014)

5. SWOT Analysis of Waterfall Methodology

(Ashish B. Sasankar, Dr. Viny Chavan, 2011), these researchers found SWOT analysis for waterfall methodology and following is the SWOT analysis:

Strengths

This method can be even used by those people who are not from IT.

This is the easiest model that even nonexperience team members can work on it.

This is best option for small organization who have stable and clear requirements.

Weakness

The terms of requirement should be collected earlier and should be arranged.

It does not support problem solving techniques since there are no overlapping phases for verifications.

The chances for customer decrease to preview the system which is in progress.

Opportunities

Used technology can be understood.

There is stable definition of product.

Requirements are already in front.

Threats

The technological environment changes rapidly. The waterfall model is not practical to meet up the changes because the rapid changes in strategies that have increased the concentration on reuse and by implementing reusing of frameworks. For this reason, it is used as restricted model.

6.Waterfall Use in Today Business World

Traditional methods in today business world are no longer efficient. In traditional method we have lengthy timeline to complete the project. The traditional methodology also does not allow us to request timely changes which usually occurs at the end of project. This method is approach is complex which do not allow meeting customers targets. Modern methods had brought new vies to a project delivery. It approves that success that can be achieved quickly by delivery of actual product. Traditional method is different from modern method which makes difference in choosing a software development methodology (Kisielnicki, Misiak, 2017, pp. 273).

Traditional methods used to focus on project scope using them to determine cost and time schedule. The waterfall method is well suited for predictable environment whereas, modern method can be used in unpredictable environment. In today world scenario waterfall methodology is used very less because they are often teams which spend a long time on critical tasks which leads the project progress behind, and it ends up with a long list of unfinished tasks at the end of the project. In today's unpredictable world we do not have any predictable environment so traditional method is not much in use (Kisielnicki, Misiak, 2017, pp. 274).

A case study had been conducted to compare the modern and traditional methods in business intelligence implementation then in traditional managed projects, project organization included people from all departments which are involved in the implementation like different departments would be sales, marketing, finance, and administration. Time of the concept design had doubled as compared to the planned. The main reason was the extension of the schedule that had lack of clear direction and common goal of various departments. Moreover, the requirements were changing, and the projects could not familiarize the concept of document to move to further. Finally, when researchers observed everything then they concluded that with traditional methods the goals were not achieved. The main cause was the lengthy time of solution delivery and the less flexible product at the end of implementation (Kisielnicki, misiak, 2017, pp. 284). Traditional method today is not much popular because of the following reasons.

7.Conclusion

This analysis paper was about waterfall methodology. Software development follows a system development life cycle and many researchers have found different methodologies which included waterfall approach in it. The purpose of this paper was to find out about the waterfall methodology and search that whether today we still use this method. Waterfall methodology is like the series of logical phases in which the progress flows downwards in waterfall form. Waterfall methodology has five phases namely: analysis phases, design phase, implementation phase, testing phase and maintenance phase. This method has some advantages but as everything comes with its disadvantages then it also has some disadvantages. This analysis paper also explained when to use this methodology. It also followed by SWOT analysis. This ends with whether waterfall methodology is useful according to the today's business world.

Managerial Implications

Waterfall methodologies can be very useful for project managers. Waterfall methodology included

several steps from the analysis to maintenance. (Banica, Radulescu, et. Al., 2017). According to PMBOK (project management body of knowledge), there are five stages of project management: Initiation, Planning, execution, performance/monitoring, and project closure. When we consider the general requirements and establishment of the project which is based on the feasibility study then the project begins. Project planning is main concept and it involves planning of activities, resources, deadlines, etc. In this stage the project managers can divide the duties among the project team. The next two steps explain the deliverables achieved and controlled like the budget. When evaluating the key performance indicators ten project managers can observe the deviations from designed phase and they can check whether the changes are needed to adjust the schedule and resources or not. Project closure means that they can oversee the project and can evaluate its performance by identifying its failures. Waterfall methodology helps project managers in evaluating the overall project with step-by-step evaluations too.

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