Report on

"Study of Software models and Requirements Engineering"

Information Science & Engineering

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Abstract

This report is a compartive study and analysis of software process models that are sued in the development of large-scale electronics e-commerse systems similar to Best-buy (American based). The objective of this compartive study is a to analyse how suitable the system is by using a waterfall model, Incremental model and a Spiral model with respect to requirements engineering, cost, time and risk management. This report has analyzed how all the different processes model handles the functional and all the non-functional requirements and also showcases how it adapts to the changing needs of the customers as modern e-commerse platforms are dynamic in nature and that require frequent udates and maintenance.

A requirements specification document for a specific system has been developed which covers both the functional and the non-funtional aspects of the requirments of the selected systems and its importance is also discussed. The differneent versions of the systems have also been demonstrated using a GitHub repository that contains the initial versions of the system as well as a the final and revised version of the developed system This study concludes that the Incremental and Spiral models have been more suitable for such systems when compared to the waterfall model due to the Incremental and Spiral models haviing more flexibily and ability to manage risk effectively.

GitHub repostitory Link: https://github.com/SpoiltBananas/ISE-Porject-1-/tree/main

INTRODUCTION

Software engineering is a part of Computer Science that handles the designing, development, testing and maintenance of software applications. Computer Science engineers/ Software Engineers use these engineering principles of coding and using programming languages to build software solutions for complex real-world problems for the end users. [5]

Due to imporper requirement analysis, process selection and the inability to evolve and handle changes the software projects tend to often fail. Software process models hence help the developers and guide them to with a structured framework.

This report mainly centers on analysing and studying the different software process models and thier impact on the requirements engineering field using a rel-world case study. The case study is about an e-commerse platform similar to Best Buy. This report copares the Waterfall, Incremental and the Spiral models and identify its suitability for this sort of system. This

report is aligned with Unit I of the Software Engineering course, which covers the topics of software engineering and requirement engineering concepts.

Having a deep understanding of the different process model's strengths and weaknesses gives the most appropriate model for a given system and improves a projects success rate.

Problem Statement

The main objective of this report is to be able to analyze the different software process models required for the development of a large scale e-commerse system such as the e-commerse site of Best-Buy as given as an example. This system that has to be developed has to support online browsing, purchasing of electronics products, order and track the deleveries of the packages and ensure the secure payments of the products. This project mainly focuses on the ability to identify how different the development models are being able to manage the risks, costs,requirements and the ability to change during the software lifecycle. The predicted outcome is a clear analysis and comparison between the process models and a well defined reqirements specification.This project assumes a case of web-based system with a large user base as well as continuous changes and updates.

DESCRIPTION: E-COMMERSE SYSTEM

The chosen case study is an e-commerse platform to replicate the systems used in a electronics company similar to Best-Buy. This system would allow the user to browse different electronics appliances and products such as laptops, televisions, monitors, mobile phones and other accessories. The end user can complete each purchase with a secure and safe online payment method, be able to compare products on the website as well as add items to a shopping cart without any hindrance as it would have to be able to handel large volumes of users

The following system would also be able to provide order details such as live tracking and customer support services 24/7 all days of the week. The admininstators of the system can manage products listings, pricing, promotions and sales, available stock and shipping logistics.The system would need continours udates and strong requirements management as it would be having frequently changing product catalogs, pricing and user expectations.

This platform operates mainly on a B2C (business to consumer) operational model as the end users are the customers that are individual retail consumers who interact with the web interface to buy the products.[2]

Software Process Models

Selecting an apporpriate software process model is cruital for how the specification, development, validation and evolution are organized and run throughout the projects lifecycle, Hence the process model serves as a representation from specific perspectives. [1]

1.The Waterfall Model

This model follows a linear and sequential software development process where each individual phase must be completed before moving to the next. The Waterfall model utilizes the fundamental processes of specification, development, validation and the systems evolution and represents them as a separate and distinct process, such as requirements specification, software design, implementation and its testing. [1]

 In normal Waterfall development, before the implementation begins the requirements engineering is finalize fully. Any changes that must be done and implemented later has to be communicated with the customer through management process. [2]

The iterations of the system may be exceeding the costs and may as well involve significant reword due to the high cost related with the producing and approval of formal documents. Hence it is normal to prematurely freeze parts of the development, for an example is the specifications which may ultimately result in a system taht fails to perform what the user acctually needed. [1]
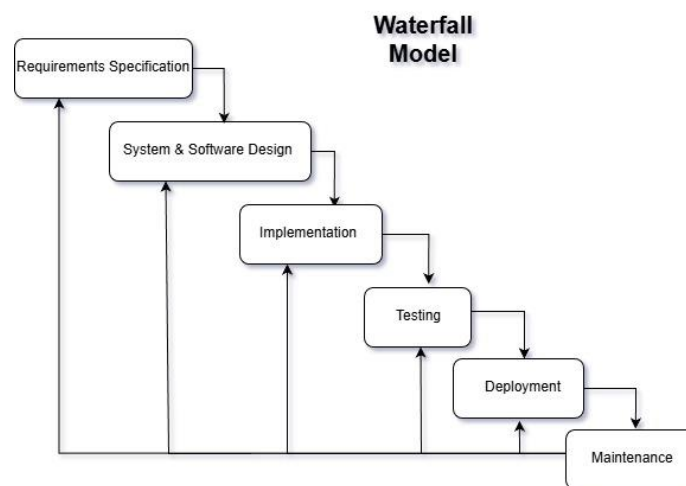

Figure 1: Waterfall Model [4]

2.The Incremental Development Model

This model utilizes the activities of specification, development and validation, I.E. the system that is being used is being developed with different series of versions and with each new version will be adding new and better functionality.
[1]

Hence by developing the software incrementally step by step it makes the process much cheaper and easier to make and develop changes in the software as it is in the development phase. [1]

This model accurately reflects the natural human problem solving process of moving towards a solution in a series of different steps and backtracking is possible when there is a mistake found [1]
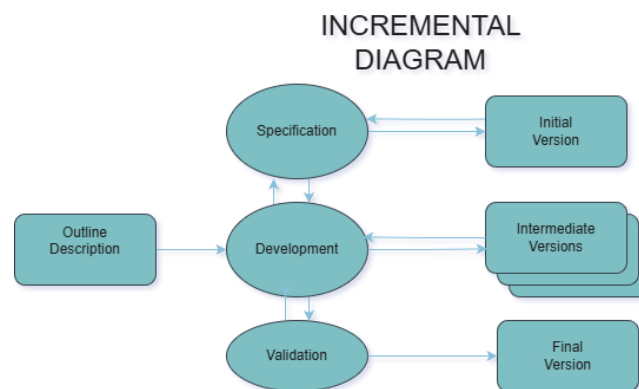

Fig: 2 Incremental Development [4]

3.Spiral Model

The Spiral Model is a risk-driven software process framework that was originally proposed by Boehm, where the software process is represented as an expanding spiral rather than a linear sequence of activities [1] The spiral model combines change avoidance with change tolerance [1] It explicitly assumes that changes are a direct result of project risks and includes explicit risk management activities to reduce these risks dynamically[1]
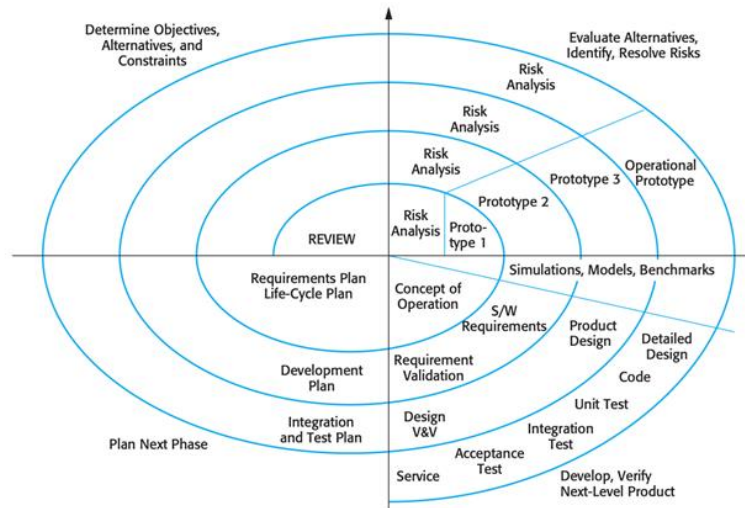
Fig 3: Spiral Model [4]

Comparative Analysis of Process Models

The following table outlines how each model impacts the e-commerce system across critical

Criteria	Waterfall Model	Incremental Model	Spiral Model
Requirements	Must be exhaustively finalized before implementation begins, which creates rigid baselines.	Evolve naturally as specification and development are interleaved iteratively.	Defined dynamically in loops based strictly on feasibility studies and mathematical risk analysis.
Risk & Change	Change is poorly tolerated. Iterations involve significant rework.	Highly tolerant of change. Only the current software increment has to be changed if rejected.	A strictly risk-driven framework that utilizes explicit risk management activities.
Time & Cost	Costs are heavily committed upfront. Late discoveries can lead to massive financial overruns.	Cheaper and easier to make changes during development, providing an early return on investment.	Can incur high upfront analysis costs due to extensive risk modeling but prevents catastrophic failures.

Fig 4: Table for Comparison of Models

Requirements Engineering

Requirements engineering represents the broad spectrum of tasks and techniques that provide the appropriate mechanism for understanding what the customer wants, analyzing needs, assessing feasibility, and specifying the solution unambiguously [4]. It encompasses seven distinct tasks: inception, elicitation, elaboration, negotiation, specification, validation, and management [4].

Functional Requirements

Functional requirements describe system functionalities or services [4]. In the context of e-commerce planning, they list the information system capabilities needed to achieve the business objectives [4]. For an electronics e-commerce platform, standard functional requirements include 'Find Component', 'Add Component to the Shopping Cart', 'Inspect Shopping Cart', and 'Checkout' [3]. Another vital functional requirement is 'Login', which requires that authentication is allowed to access the checkout process securely [3].

Non-Functional Requirements

Non-functional requirements define system properties and constraints [4] . Examples highly relevant to the Best Buy-style platform include reliability, response time, and storage requirements [4]. These are further categorized into Quality Attributes, External Interfaces, and system Constraints [4]. Additionally, these requirements are deeply intertwined with Business Rules, which dictate the corporate policies, government regulations, industry standards, accounting practices, and computational algorithms that affect the system [4].

Requirements Validation

Validation is a mandatory stage designed to ensure that brilliant and complicated technical solutions do not miss the actual needs of the market [3].

- Validation Strategy: A highly successful validation strategy in web application development is prototyping, which consists in the development of Web application prototypes from analysis models to validate requirements [3]. Additionally, agile practitioners managing B2C consumer software utilize A/B testing (split testing) to roll out specific functionality to a select set of users to gather data and behavioral feedback . [2]
- Challenges: In B2C consumer environments, defining the interaction of end-users with the software interface is exceptionally challenging because feedback from consumers is indirect and not immediate [2]. Development frequently begins before the user interface is completely defined, which introduces significant development overheads [2]. Furthermore, requirements documents frequently become outdated because they are not actively updated as new requirements emerge during the project lifecycle [2].

GitHub Version Control Usage

To systematically document the evolution of requirements from simple functionalities to comprehensive, highly secure standards, a GitHub repository is utilized. Configuration management is the process of managing changes to an evolving software product, involving configuration planning, version management, system building, and change management [1]. The repository contains versioned markdown documents (requirements_v1.md and

requirements_v2.md), demonstrating the continuous refinement of both functional use cases and non-functional constraints (like performance and availability).

Conclusion

The design and deployment of a large-scale electronics e-commerce platform require a structured, methodical approach to software engineering. This comparative study demonstrates that while the Waterfall model offers sequential clarity, the Incremental and Spiral process models provide superior risk management and evolutionary adaptability required for modern B2C platforms. By actively identifying core functional capabilities and enforcing rigorous non-functional constraints through structured Requirements Engineering and validation, developers can avoid scope creep, mitigate deployment risks, and guarantee a robust digital marketplace that meets evolving consumer demands.

References

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Declaration of Academic Integrity

I hereby declare that this research report is entirely my own original work and has been prepared specifically for this Software Engineering assignment. All concepts, definitions, and theories derived from external academic literature have been properly cited inline. I

acknowledge that plagiarism, fabrication of data, and unauthorized collusion are strict violations of academic integrity policies.

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