

Software Engineering Techniques in System Software Development Process

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Abstract: With the rapid development of information technology, system software development has become an indispensable part of modern enterprises and organizations. System software development not only involves complex business requirements and technical implementation, but also requires efficient and reliable development processes and tool support. As an important support for system software development, software engineering technology can improve the efficiency and quality of software development through scientific methods and tools. Therefore, this article elaborates on software engineering technology in the process of system software development, hoping to be helpful to readers.

Keywords: System Software; Development; Software Engineering Technology

1. Introduction

System software development, as a complex and systematic process, generally involves multiple stages such as requirement analysis, design, coding, testing, and maintenance. In this process, software engineering technology plays a crucial role because it mainly uses scientific methods and tools to help developers efficiently and accurately complete software development tasks, improve software quality and reliability. Therefore, in-depth research on software engineering technology in the system software development process is of great significance for improving the efficiency and quality of software development.

2. Characteristics of System Software Development

2.1 Highly Customized and Complex

Highly customized means that each system is designed and developed based on the specific

needs of users or organizations to meet their unique business processes and management requirements. This customization is not only reflected in system functionality, but also delves into multiple levels such as user interface, data model, workflow,^[1] etc. Moreover, due to the high degree of customization requirements, system software development often presents a high level of complexity, involving the integration of multiple modules and components, requiring consideration of various requirements and limitations such as performance, security, scalability, usability, etc. This complexity requires developers to have profound technical knowledge and rich development experience, to be able to handle large and complex data, and to provide powerful functionality to adapt to various operating environments and user needs.

2.2 High Technical Threshold and Long-Term Nature

The technical threshold for system software development is usually high, which includes not only a deep understanding of basic knowledge such as computer hardware, operating systems, and networks, but also a mastery of advanced knowledge such as data structures, algorithms, and design patterns; In addition, with the continuous development of technology, new programming languages, frameworks, and tools continue to emerge, and developers need to constantly learn and adapt to new technologies. Moreover, system development usually requires a long development cycle, from requirement analysis, design, coding, testing to deployment and maintenance, each of which requires a significant amount of time and effort. This long-term nature requires the development team to have strong project management capabilities, be able to plan project schedules reasonably, effectively coordinate the work of team members, ensure timely delivery of

projects, and meet user needs.

2.3 Scalability and Maintainability

Nowadays, with the development of business and technological progress, systems may need to add new features, optimize performance, or enhance security. Therefore, developers need to adopt a modular structure when designing and implementing systems, so that the system can be easily expanded and upgraded; At the same time, system software development also needs to pay attention to the quality and maintainability of the code. High quality code can reduce future maintenance costs and improve the system's lifecycle. To achieve this goal, developers need to write clear, concise, and code compliant code, and make full use of version control systems to manage code change history; In addition, complete documentation and sufficient testing are also key to improving system maintainability [2].

3. Application of Software Engineering Technology in System Software Development

3.1 Requirements Analysis and Design Modeling

In the software development process, requirement analysis is a crucial step because software engineering techniques, through a systematic methodology, can help development teams accurately understand and define user requirements, including functional requirements, performance requirements, security requirements, etc. Secondly, through in-depth communication with users, the development team can also clarify the goals of the software system and develop detailed software requirements specifications based on them, thereby laying a solid foundation for subsequent development.

As for the design phase, software engineering technology emphasizes modularity,

abstraction, hierarchy, and standardization. Through the use of various design patterns and tools such as MVC design pattern, UML (Unified Modeling Language), detailed system design is carried out to ensure that the structure and functionality of the software system meet the requirements, and to improve the maintainability and scalability of the software system.

Case Development of Tencent WeChat

Tencent WeChat is one of the most popular social applications in China and even globally. Since its official release on January 21, 2011, WeChat has had over 1 billion users. The success of WeChat cannot be achieved without the support of powerful software engineering technology.^[3]

When WeChat was launched, it did not simply imitate other instant messaging apps, but pursued a simple and unique design to attract users. The WeChat team has clarified the functional and non functional requirements of the software through in-depth market research and user feedback. These needs include but are not limited to: instant messaging, voice and video calls, social media, WeChat Pay, etc. In the requirements analysis phase, the team also considered multiple aspects of the system, such as scalability, security, and performance, laying a solid foundation for subsequent design and development.

In the design phase, the WeChat team adopted the MVC (Model-View-Controller) design pattern, dividing the system into three parts: model, view, and controller. This design pattern not only improves the maintainability and scalability of software systems, but also makes the development process clearer and more efficient. In addition, the team also focuses on user experience and interface design, continuously optimizing product functionality and interface design through multiple iterations and testing.

Table 1. Data on the Number of WeChat Users and Frequency of Use of Some Functions

Year	Number of users (in billions)	Voice call duration (100 million minutes)	Video call duration (100 million minutes)	Number of posts on social media (in billions)
2012	0.3	1.2	0.3	0.1
2014	3.0	20.0	5.0	2.0
2016	7.0	120.0	30.0	10.0
2018	10.0	300.0	80.0	20.0

It is not difficult to see from the data in Table 1 that the success of WeChat cannot be separated from the support of software

engineering technology. Through in-depth requirement analysis, reasonable design, high-quality coding, and strict testing, the

WeChat team has created a powerful, stable, and reliable social application. Nowadays, WeChat has become an indispensable part of people's lives. It not only provides convenient communication methods, but also integrates various functions such as payment, social networking, entertainment, etc., greatly enriching people's lives.

3.2 Encoding and Code Refactoring

The coding stage is a crucial step in transforming the design into an actual software system, so software engineering technology must follow good coding habits and standards during this stage, and use standard coding formats and annotation methods to improve the readability of the code; At the same time, utilizing testing methods and tools in software engineering, such as unit testing, integration testing, and system testing, to comprehensively test and debug the program, ensuring the correctness and robustness of the software program; In addition, code refactoring is also an indispensable part of software engineering technology. By modifying the internal structure of the software, the readability, maintainability, and scalability of the software can be improved without changing the external behavior of the software system. Code refactoring involves identifying redundant, inefficient, or difficult to understand parts of code, and then modifying them to make them clearer, more efficient, and easier to maintain [4].

Case Development of Amazon e-commerce platform

As one of the world's largest e-commerce companies, the success of Amazon's e-commerce platform cannot be achieved without the support of a strong software engineering team.

Amazon's software development work is mainly handled by its internal "Amazon Software Development Teams", which consist of thousands of experienced software engineers who use a range of advanced programming languages and development tools to ensure high quality and performance of software. In terms of programming languages, Amazon widely adopts mature and powerful languages such as Java, Python, and C++, which provide a solid code foundation

for the Amazon platform with their efficient, stable, and easy to maintain features. At the same time, in order to improve development efficiency and code quality, the Amazon team actively adopts advanced integrated development environments (IDEs) such as Eclipse and IntelliJ IDEA, as well as version control systems such as Git, to achieve collaborative editing, version management, and continuous integration of code.

Moreover, during the coding process, the Amazon software development team strictly adheres to coding standards and uses automated testing frameworks such as JUnit and PyTest for unit testing, ensuring that every line of code undergoes rigorous validation. In addition, they also adopted a Continuous Integration and Continuous Deployment (CI/CD) process, which achieved rapid code iteration and deployment through automated build, testing, and deployment tools such as Jenkins and AWS CodePipeline, significantly shortening the software development cycle. The application of these efficient development tools not only improves development efficiency, but also ensures the stability and reliability of software quality.

Finally, in terms of payment settlement, Amazon has adopted multi-level security mechanisms and data encryption technology to protect users' personal information and transaction security. The most critical security mechanisms include Multi Factor Authentication (MFA), Payment Card Industry Data Security Standard (PCI DSS) compliance, as well as real-time risk monitoring and fraud detection systems. In order to ensure the security of data transmission, Amazon uses SSL/TLS protocol for encrypted communication, ensuring that user data is not stolen or tampered with during the transmission process. At the same time, they also use strong encryption algorithms such as Advanced Encryption Standard (AES) to encrypt stored user information and transaction data, making it difficult to decrypt even if the data is illegally obtained. The application of these security mechanisms and data encryption technologies together form a strong defense line for Amazon's payment settlement system, providing users with a secure and convenient payment experience.

Table 2. Data Table on the Number of Amazon E-commerce Platform Users and Frequency of Some Function Usage

Year	Number of users (in billions)	Order quantity (in billions)	Number of product searches (in billions)	Number of times the shopping cart has been added (in billions)
2014	2.5	12.0	200.0	50.0
2016	3.0	20.0	300.0	80.0
2018	3.5	30.0	500.0	120.0
2020	4.0	40.0	700.0	180.0

It is not difficult to see from Table 2 above that the success of Amazon's e-commerce platform cannot be separated from the support of software engineering technology. Through in-depth requirement analysis, reasonable design, high-quality coding, and strict testing, the Amazon team has created a powerful, stable, and reliable e-commerce platform. Nowadays, Amazon has become one of the most popular e-commerce companies worldwide, with a wide variety of products, affordable prices, and thoughtful services on its platform, attracting a large number of users' attention and love.

3.3 Testing and Maintenance

Software engineering technology plays an important role in the testing process of software development, where testing methods include black box testing, white box testing, and gray box testing, which can effectively detect defects and errors in software systems^[5]. Through these testing methods, developers can discover and fix problems in the software system, ensuring the quality of the software system; In addition, software engineering technology also emphasizes continuous maintenance and updates after software development is completed, as it can quickly locate and repair problems in software through the use of software engineering methods and tools, ensuring the normal operation of software. The concepts and methods of software engineering can be used to guide the continuous development and improvement of system software.

4. Conclusion

In summary, through the analysis of successful cases such as Tencent WeChat and Amazon e-commerce platforms, we can deeply appreciate the important role of

software engineering technology in system software development. These cases not only demonstrate the widespread application of software engineering technology in various stages such as requirement analysis, design, coding, testing, and maintenance, but also reflect its effectiveness in improving software quality and efficiency. Therefore, it can be seen that in the future, we should further study and apply software engineering technology to cope with more complex and changing software development needs.

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