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# Utilization of Blockchain in Reputation Management for E-Commerce

Architecture Proposal

a Project/Thesis authored by

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**Abstract**

In the current e-commerce scenario, reputation management plays a crucial role in building trust among users engaged in online transactions. However, traditional reputation models face significant challenges, including centralized data and susceptibility to manipulations.

Conventional reputation models heavily rely on centralized platforms, encountering issues such as lack of transparency, review manipulation, and dependency on trusted third parties. These limitations compromise the effectiveness and security of online transactions.

In the pursuit of innovative solutions, previous research has explored blockchain technology as an alternative to enhance reputation management. Nevertheless, there is still room for advancing the development of practical and efficient solutions, especially by integrating blockchain technology into specific environments, such as e-commerce.

This work proposes a Design Science Research (DSR) approach to create a distributed architecture for reputation management in e-commerce, integrating the Hyperledger Fabric platform. The primary contribution is the development of a prototype that utilizes smart contracts to enhance transparency, immutability, and security in reputation management.

The prototype is a blockchain-based solution, utilizing smart contracts to decentralize reputation management. It incorporates a NodeJS API, a Wallet, and a functional WordPress plugin.

Additionally, as part of future work, improvements and expansions to the prototype could be explored, including the consideration of a potential mobile application for the Wallet. This takes into account that the initial version will be a web prototype, used solely for proof of concept.

We anticipate that the prototype will significantly contribute to enhancing reputation management in e-commerce environments, providing transparency, security, and reliability to online transactions. This work not only aims to enable a practical solution but also advances knowledge in the field of reputation management and blockchain.

**Keywords:** Hyperledger Fabric, Reputation Management, Blockchain, E-commerce, E-commerce Reputation Management.

**Resumo**

No cenário atual do comércio eletrônico, a gestão da reputação desempenha um papel crucial na construção da confiança entre os usuários envolvidos em transações online. Contudo, os modelos tradicionais de reputação enfrentam desafios significativos, incluindo centralização de dados e vulnerabilidades a manipulações.

Os modelos convencionais de reputação dependem fortemente de plataformas centralizadas, enfrentando desafios como falta de transparência, manipulação de avaliações e dependência de terceiros confiáveis. Essas limitações comprometem a eficácia e a segurança das transações online.

Na busca por soluções inovadoras, pesquisas anteriores exploraram a tecnologia blockchain como uma alternativa para melhorar a gestão de reputação. No entanto, ainda há espaço para avançar no desenvolvimento de soluções práticas e eficientes, especialmente integrando a tecnologia blockchain em ambientes específicos, como o comércio eletrônico.

Este trabalho propõe uma abordagem de Design Science Research (DSR) para criar uma arquitetura distribuída de gestão de reputação em e-commerce, integrando a plataforma Hyperledger Fabric. A contribuição principal é o desenvolvimento de um protótipo que utiliza contratos inteligentes para fortalecer a transparência, imutabilidade e segurança na gestão de reputação.

O protótipo é uma solução baseada em blockchain, utilizando contratos inteligentes para descentralizar a gestão de reputação. Ele incorpora uma API em NodeJS, uma Wallet e um plugin funcional para WordPress.

Além disso, como parte do trabalho futuro, poderiam ser exploradas melhorias e expansões no protótipo, incluindo a consideração de uma possível aplicação móvel para a Wallet. Isso leva em conta que a versão inicial será um protótipo web, utilizado apenas para a prova de conceito.

Antecipamos que o protótipo contribuirá significativamente para a melhoria da gestão de reputação em ambientes de e-commerce, proporcionando transparência, segurança e confiabilidade às transações online. Este trabalho não apenas pretende viabiliza uma solução prática, mas também avança o conhecimento no campo da gestão de reputação e blockchain.

**Palavras-chave:** Hyperledger Fabric, Gestão de Reputação, Blockchain, E-commerce, Gestão de Reputação em E-Commerce.

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# List of Abbreviations

**ISMAI** Universidade da Maia

**MTICM** Mestrado em Tecnologias de Informação Comunicação e Multimédia

# Chapter 1

# Introduction

## 1.1 E-commerce Reputation Management

In the contemporary landscape of e-commerce, which fiercely competes with traditional business models, trust emerges as a key factor to drive greater adoption of this digital model. The rapid shift to the digital realm, significantly intensified by the global pandemic, underscores the growing importance of trust in online transactions, particularly as we witness a substantial increase in internet-based commerce.

Within the context of commercial transactions, two correlated yet distinct concepts play crucial roles: trust and reputation. As previously mentioned in the article used as the foundation for this work, trust refers to one party's willingness to rely on something or someone, even in the face of potential negative consequences. On the other hand, reputation is the image that generally forms about the life, character, or position of a person or thing [9].

Additionally, it is important to note, as previously addressed, that the absence of trust manifests particularly relevantly in B2C and C2C online business models, where the prior relationship between participants is limited compared to the B2B model or traditional commerce. To overcome this barrier, strategies such as recommendations and reputation scores have been widely adopted, providing users, mostly buyers, with valuable insights into the risks associated with a transaction.

## 1.2 How is Reputation Managed in Current E-commerce?

In the current landscape of e-commerce, reputation management plays a fundamental role in fostering trust among users engaged in online transactions [9]. Two main approaches for assessing reputation in e-commerce are Reputation Recommendations and Scoring Models, and Dependence on Trusted Third Parties (TTP). It is important to note that in current systems, it is common to encounter a combination of these approaches. Modern systems often integrate both reputation recommendations and scoring models, as well as a reliance on Trusted Third Parties (TTPs), aiming to provide a comprehensive approach to bolster trust in online transactions.

**Reputation Recommendations and Scoring Model:**

Major e-commerce platforms such as Amazon, eBay, and AliExpress utilize recommendations and scores as primary indicators of reputation. These scores are typically assigned to sellers and products.

**Trusted Third-Party (TTP) Dependency:**

In B2C and C2C models, where there is no prior relationship between buyers and sellers, trust is often established through Trusted Third Parties (TTPs). These centralized intermediaries collect and store reputation data.

**Vulnerabilities in Traditional Systems**

The literature highlights various vulnerabilities inherent in traditional systems, including challenges such as "ballot stuffing" (vote inflation), traitorous attacks, and identity issues [13]. In contrast, blockchain technology, with its distributed (Peer-to-Peer) architecture and consensus mechanisms, demonstrates notable resistance against such attacks [9]. The concept of proof of individuality and the integration of decentralized structures significantly contribute to strengthening security and trust in reputation information.

The implementation of reputation systems based on blockchain offers an innovative approach to addressing vulnerabilities in traditional systems. By tackling crucial dimensions of formulating and calculating reputation models, as proposed by [7], blockchain's decentralization of data storage eliminates dependence on centralized sources, promoting transparency and immutability in records. Additionally, the use of smart contracts allows the formulation and calculation of reputation to occur in a decentralized and automated manner, contributing to the effectiveness and security of the system as a whole.

Even with the growing trend of e-commerce [1, 3], the inherent challenges of reputation management are becoming increasingly apparent. In this work, we will explore the blockchain technology approach as a way to overcome the obstacles faced by traditional reputation systems.

Conventional reputation models heavily rely on centralized platforms to collect, store, and distribute reputation data. However, this approach encounters significant challenges, including vulnerabilities to manipulation [13], lack of transparency, and dependence on Trusted Third Parties (TTPs). Blockchain technology emerges as an innovative alternative to address these concerns.

## 1.3 Problem Statement

**Inherent Issues with Conventional Models:**

Both models present significant challenges. The first model, while contributing to trust-building, encounters issues of data centralization in scoring and reputation, compromising transparency. The second model, relying on Trusted Third Parties, may result in a lack of transparency and create potential barriers to the impartiality and integrity of scores.

An illustrative example is the case of Rotten Tomatoes, recognized as an authority in film criticism. This platform, adopting a model similar to Trusted Third Party (TTP), became the target of a scandal revealing systematic manipulation of reviews. Producers paid critics to inflate the scores of their films, highlighting the vulnerability of these centralized systems to external manipulations and financial interests. [15]

These challenges underscore the need for a more innovative and secure approach to reputation management in e-commerce, leading us to explore blockchain technology.

Conventional reputation systems face significant challenges related to vulnerability, manipulation, and a lack of a comprehensive picture. The manipulation of reviews, whether by malicious users or unethical business practices, can distort the true perception of a seller's or product's reputation. Therefore, trust in reputation is proven to be crucial for a user's purchasing decision, and traditional methods often do not provide a fully secure and efficient environment for online transactions.

## 1.4 Research Question of the Present Work

Acording to Gonçalves et al.[9] Considering the premise supported by the article "User Reputation on E-Commerce: Blockchain-Based Approaches" [9], which found that blockchain represents a promising path for reputation management in e-commerce, the following question guides the present work:

*Is blockchain indeed a promising path for reputation management in e-commerce environments, as evidenced by the mentioned article? In this context, what would be the most efficient and effective architecture for implementing blockchain technology in reputation management, overcoming the limitations of conventional models?*

## 1.5 Objectives

In this context, blockchain technology emerges as an innovative solution to strengthen reputation management in e-commerce. This master's project proposes not only a theoretical analysis but also a practical contribution by creating a comprehensive framework. Our approach will encompass:

**Development of Architecture and Node API Creation for Integration with Hyperledger Fabric:**

The proposal aims to create an architecture for the distributed management of reputation in e-commerce, integrating Hyperledger Fabric. After defining the architecture, our focus will be on developing a NodeJS API to facilitate interaction with Hyperledger Fabric. This API will validate reputation data, including calculated scores and feedback records.

**WordPress Plugin:**

Development of a plugin for the WordPress platform that will integrate with various available e-commerce plugins. The goal is to test the effectiveness of the developed API and the chosen architecture model, addressing the majority of previously assessed possible cases. This plugin will be used as a case study to evaluate the feasibility of the model in a real e-commerce environment.

**Wallet Development:**

The developed wallet will allow the user to store their identity, credentials (Verifiable Credentials), and private keys. Typically installed on a user's personal device, for proof of concept purposes, this will be a Node-based application with a web interface.

## 1.6 Organization of the dissertation

Next, we present a theoretical foundation that introduces the non-specialist reader to Blockchain and Reputation Management, providing support for a complete understanding of the other sections. In Chapter 3, we will discuss the state of the art, emphasizing the central article used and other relevant contributions. Chapter 4 will address the employed methodology, and we conclude the article with Chapters 5 and 6, which will present details of the work plan and the Gantt chart, respectively.

# Chapter 2

# Theoretical Framework

In this section, we will initially explore Distributed Ledger Technologies (DLTs) and their applications. We will begin by defining the central concept of DLTs, highlighting their decentralized nature and the fundamental principles that make them disruptive.

In the second part, we will delve deeper into our understanding of blockchains, analyzing their variants, with emphasis on the crucial differences between public and private blockchains. This detailed examination will provide a clearer understanding of the distinctions involved in implementing these technologies and the importance of the choice relative to any project.

Finally, we will connect this knowledge to the study of reputation management and delve into the e-commerce environment.

## 2.1 DLT's

Distributed Ledger Technologies (DLTs), represent a fundamental innovation in the field of information technology. This revolution began with the introduction of Blockchain, a concept proposed by Satoshi Nakamoto in 2008. [12]

The fundamental principle of DLTs lies in decentralization and the distribution of records. As illustrated in Figure 2.1, unlike traditional systems where a centralized record is maintained, typically on centralized servers, DLTs distribute identical copies of the record to all participants in the network. This decentralization eliminates the need for a central authority and enhances security, as copies of the records enable verification and

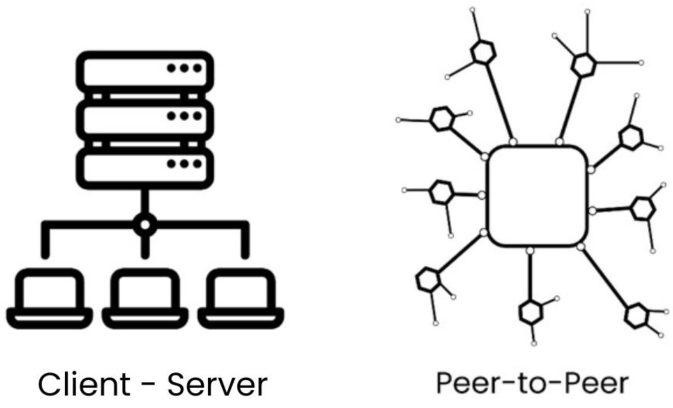


Figure 2.1: *Client-Server Model on the right and Peer-to-Peer on the left*

validation of information across the available peers in the DLT, providing greater security, transparency, and resilience to failures.

In addition to blockchain, there are other models of DLTs, each with distinct characteristics. Regardless of the model, DLTs share several features, including:

**1.** Decentralization: The elimination of a central authority promotes greater trust and security.

**2.** Immutability: Once recorded, transactions in DLTs are practically immutable, contributing to data integrity.

**3.** Transparency: Universal visibility of transactions promotes transparency, crucial for trust in distributed systems.

**4.** Fault Resistance: The redundancy of distributed records improves fault resistance, making DLTs more robust.

DLTs have significant implications in various industries. Besides cryptocurrencies, they are employed in smart contracts, supply chains, healthcare, electronic voting, among other applications. The ability to create reliable and decentralized records can transform the way we conceive transactions and trust in digital environments.

## 2.2 Blockchain

Blockchain, introduced by Satoshi Nakamoto in 2008, is a disruptive technology that has changed traditional approaches to data storage and management. At the core of this technology is the idea of decentralization and distributed consensus, offering a new approach to digital records and transactions. [12]

The 2008 financial crisis, stemming from the collapse of the real estate market in the United States, had global repercussions, shaking the foundations of the traditional financial system. In this scenario of distrust in centralized institutions, a revolutionary proposal emerged: Satoshi Nakamoto's whitepaper, which introduced the concept of Bitcoin and its underlying technology, Blockchain. The context of dissatisfaction with conventional banking practices and the search for decentralized alternatives propelled the rapid development and adoption of Blockchain as a solution to issues of trust and transparency. The technology, initially implemented as the backbone of Bitcoin, has become a global phenomenon, offering not only a cryptocurrency but also a new approach to distributed data structures, with the potential to reshape the economic and social paradigm.

Blockchain can be perceived as a decentralized and immutable digital ledger, organized into blocks that are chained chronologically. Each block contains a set of transactions and a hash code that connects it to the previous block, forming a continuous chain. This unique architecture gives Blockchain its distinctive feature of immutability, where altering any block requires modifying all subsequent blocks.

### 2.2.1 Mechanisms of consensus

Consensus is the mechanism the validity of transactions is achieved through algorithms; the most well-known models are Proof of Work (PoW) or Proof of Stake (PoS), ensuring that the majority of the network agrees on updates.

**Proof of Work (PoW):** This method requires participants, known as miners, to solve complex mathematical problems to validate and add new blocks to the chain. The complexity of these problems prevents a single actor from dominating the process, requiring significant computational effort. Bitcoin is a notable example that uses PoW.

**Proof of Stake (PoS):** In contrast to PoW, PoS determines the validity of a block based on the amount of cryptocurrency a participant owns and is willing to "stake" as collateral. According to Ethereum, the most famous blockchain using this system, "Proof of stake is a way to prove that validators put some value into the network that can be destroyed if they act dishonestly. In Ethereum's proof-of-stake, validators explicitly invest capital in the form of ETH in a smart contract on Ethereum. The validator is then responsible for checking whether the new blocks propagated by the network are valid and occasionally creating and propagating new blocks themselves. If they try to cheat the network, some or all of their staked ETH may be destroyed." [14]

### 2.2.2 Smart contracts

Smart contracts were designed to automate and facilitate contract execution, providing a decentralized and reliable approach. The concept of smart contracts was introduced by Nick Szabo in 1994 [16] with the aim of creating self-executing contracts based on computer code. They were designed to offer a more efficient and secure alternative to traditional contracts, eliminating the need for intermediaries and ensuring the precise execution of agreed-upon conditions. With the rise of blockchain technology, smart contracts have been implemented on platforms like Ethereum, becoming an integral part of many decentralized applications (DApps) and blockchain systems.

### 2.2.3 Oracles

Blockchain oracles are entities that connect blockchains to external systems, enabling smart contracts to execute based on real-world inputs and outputs. In other words, they act as intermediaries facilitating communication between smart contracts on a blockchain and external data or real-world events.

**Functions of Blockchain Oracles:**

**Connecting to the External World:** Oracles enable external information, such as price data, weather conditions, or specific events, to be incorporated into blockchain operations.

**Execution of Smart Contracts:** By allowing smart contracts to rely on real-world data, oracles expand the capabilities of these contracts beyond the scope of the blockchain, enabling the automation of agreements based on external events.

**Interoperability:** Oracles play a crucial role in connectivity between different blockchains and off-chain systems, promoting interoperability and facilitating the exchange of information across different platforms.

### 2.2.4 Public Blockchain

Public Blockchain refers to an open infrastructure where participation in the network is unrestricted, allowing anyone to join and participate in the consensus process. Examples of public blockchains include Bitcoin and Ethereum. In contrast to private blockchains, public blockchains are decentralized and typically do not require explicit permissions to validate transactions. This openness contributes to transparency and a broader user base, but can result in reduced control over governance and more robust and time-consuming consensus mechanisms.

### 2.2.5 Private Blockchain

Private Blockchain refers to an infrastructure where participation in the network is restricted to a specific group of entities, such as organizations or companies. Unlike public blockchains, where anyone can participate, private blockchains are more controlled and may require permissions to access and validate transactions. A notable example is Hyperledger Fabric, a private blockchain platform developed to meet specific business requirements, providing greater flexibility and control over network governance.

### 2.2.6 Differences Between Public and Private Blockchains

**Participation and Access:**

· Public Blockchains: Open to anyone.

· Private Blockchains: Access may be restricted to a predefined group of participants.

**Governance:**

· Public Blockchains: Decentralized governance often based on consensus involving the entire community.

· Private Blockchains: Governance can be more centralized, controlled by a specific set of people or entities.

**Speed and Efficiency:**

· Private Blockchains: With fewer participants and more controlled governance, they can often process transactions more quickly and at lower costs than public blockchains.

**Security and Privacy:**

· Public Blockchains: Designed for total transparency.

· Private Blockchains: Can restrict access to sensitive data, providing greater privacy.

**Consensus:**

· Public Blockchains: Often use more intensive consensus mechanisms like Proof of Work (PoW) or Proof of Stake (PoS).

· Private Blockchains: Can opt for more efficient consensus algorithms, validating transactions much faster due to centralized control.

Understanding these distinctions is crucial for deciding which blockchain model aligns better with the specific goals and requirements of a project or application. We will address our choices for this project and the reasons behind them in the future.

### 2.2.7 Security

Although blockchain technology offers various benefits, it is not immune to vulnerabilities that can compromise the security and integrity of transactions. Understanding and addressing these vulnerabilities is crucial to strengthen trust in operations conducted on blockchains. Some of the key known vulnerabilities include 51% attacks, insecure smart contracts, vulnerabilities in alternative consensuses, sybil attacks, insecure oracles, and implementation vulnerabilities.

## 2.3 Hyperledger Fabric

O Hyperledger Fabric, developed by the Linux Foundation, is a permissioned blockchain platform designed for enterprise applications. It provides a modular and flexible environment, allowing customization of consensus protocols and the implementation of smart contracts. With a focus on privacy and scalability, Hyperledger Fabric is widely adopted by organizations to build robust and adaptable blockchain solutions for corporate use.

In this section, we will delve into some aspects of Hyperledger Fabric. [8]

**Consensus Model:** Hyperledger Fabric supports a modular consensus model, allowing participants to choose the most appropriate consensus algorithm for their needs. This is crucial to accommodate different use cases, where some require high scalability and low latency, while others prioritize fault tolerance and decentralization.

**Modularity:** The modular architecture of Hyperledger Fabric allows developers to customize and choose specific components they want to use. This modular approach facilitates integration with existing systems and enables the implementation of sector-specific features. [9]

**Permissioned and Permissionless:** Hyperledger Fabric is a permissioned blockchain, meaning participation in the network is controlled and restricted to authorized entities. This offers greater privacy and control over who can validate transactions and participate in network governance.

In contrast to permissioned blockchains, permissionless or public blockchains allow open and unrestricted participation by any entity. In public blockchains like Bitcoin and Ethereum, anyone can join the network, validate transactions, and contribute to blockchain consensus. This decentralized approach provides greater transparency and resistance to censorship, as it does not require special permissions to participate.

For example, in Bitcoin, anyone can download the software, become a node on the network, and start mining or validating transactions. Participation is open and does not require approval from a central authority. While this model offers greater decentralization, it may also pose challenges in terms of scalability and efficiency, especially in business environments.

**Chaincodes (Smart Contracts):** Chaincodes in Hyperledger Fabric are smart contracts that define business logic and rules for transaction execution. These contracts can be written in languages like Go, Java, or JavaScript. The flexibility in choosing the programming language is a significant advantage, allowing developers to use familiar languages they are already accustomed to.

**Privacy and Confidentiality:** Hyperledger Fabric addresses privacy and confidentiality issues through channels. Channels are private subnetworks within the main blockchain, where transactions are visible only to authorized parties. This is essential for use cases where certain transactions need to be kept confidential among a select group of participants.

## 2.4 Reputation Management

Reputation systems assign scores to users based on collected information, providing positive ratings for trustworthy behaviors and negative ratings for dishonest behaviors. Many online commerce platforms have adopted reputation management systems that allow parties involved in transactions to provide specific ratings, making them available to all site visitors. Trust in the counterpart is often enhanced by positive ratings from business partners.

As proposed by [7], reputation models consist of three fundamental dimensions: formulation, calculation, and dissemination. The formulation dimension encompasses the mathematical foundation and types of inputs that fuel the model. Regarding formulation, the authors suggest types such as manual feedback, direct and indirect observations, and inferred data. These systems quantitatively build the reputation of sellers by collecting feedback from buyers with whom the sellers have interacted.

Moreover, [5] distinguish between explicit and implicit reputation systems. Explicit systems have models with explicitly defined formulation and calculation, while implicit systems, though not implemented in network services, conceptually possess a reputation model. Examples include social networks (explicit) and search engines (implicit), where trust/reputation is inferred through relationships or the number of links, respectively.

These dimensions and types of reputation models are crucial for understanding how systems are susceptible to fraud, as discussed in the next section. This analysis will be essential for proposing the reinforcement of reputation management in e-commerce through the implementation of a private blockchain.

**Functioning of Typical Reputation Models in E-Commerce and the Analysis of Trusted Third Parties**

In e-commerce environments, reputation models play a crucial role in building trust between buyers and sellers. Typically, these models involve collecting feedback from buyers about transactions, manifested through ratings and reviews. For instance, a satisfied buyer may assign a positive score to a seller, reflecting satisfactory performance in the transaction. However, a significant issue associated with this model is the centralization of information by the e-commerce platform itself, which may manipulate the information or even be vulnerable to reputation attacks.

Furthermore, many e-commerce platforms rely on trusted third parties to validate and authenticate user reviews. These third parties play an interesting role in ensuring the integrity of the reputation system, and many users trust the indicated scores. However, in the current model, they are still susceptible to fraud, as seen in the case of Rotten Tomatoes mentioned earlier.

# Chapter 3

# State of the Art

The field of blockchain-based reputation systems for e-commerce has been extensively explored to mitigate vulnerabilities found in traditional systems. In [9], the authors conducted a systematic literature review to systematize the existing knowledge about the application of blockchain technology to try to solve the problems of current reputation systems.

The search for empirical data covered the following academic databases, Web of Science (WoS), and SCOPUS, along with grey literature searches, including Google Scholar. The rigorous selection of 15 relevant articles provided a solid foundation for analysis.

Among the findings, there is a notable emphasis on blockchain-based reputation systems, highlighting transparency and resistance to fraud. The research, aligned with the PRISMA protocol, anchored the results in a literature review, presenting theoretical perspectives and innovations from leaders in the field.

In the subsequent discussion, architectures, consensus models, and other characteristics of reputation systems were explored, identifying trends and gaps in existing research. The work of the scholars laid a solid foundation to advance the understanding and implementation of reputation systems in e-commerce, with a focus on blockchain-based approaches.

Among the 15 analyzed articles, two stood out by employing Hyperledger Fabric, progressing with prototype development. The first, "Decentralized Reputation System on a Permissioned Blockchain for E-Commerce Reviews" [11], proposed a reputation system on a permissioned blockchain, aggregating product reviews from different retailers. The model involved consumers, retailers, and a membership service provider (MS). Tokens generated during checkout validated reviews, linking them to the product, retailer, and order information, with implementation on the Hyperledger Fabric Blockchain.

The second, "A Secure Personal Data Trading" [2], adapted a blockchain-based trust and reputation system to the data market. The transaction model and security measures against various attacks were highlighted.

In the literature, one can find relevant works sugesting the blockchain as a promising tecnology providing valuable insights for future work. The analysis of these works, especially those adopting Hyperledger Fabric, provides a solid foundation and valuable insights for the development of the proposed architecture in this project.

These approaches, such as token generation during checkout and validation by retailers, stand out as promising strategies to ensure transparency and security in online commercial interactions. Furthermore, the transaction model and countermeasures presented in the context of a reputation system for personal data demonstrate the diversity of challenges faced and solutions proposed in this complex scenario.

Given this landscape, the proposal of this work plays a crucial role in aiming to propose an architecture that not only incorporates innovative elements from Hyperledger Fabric but also seeks to optimize data management, apply reputation rules, and, above all, ensure transparency and prevent data manipulation in e-commerce environments.

In the next section, the methodology adopted in this work will be presented.

# Chapter 4

# Methodologies

## 4.1 Methodology: Design Science Research (DSR)

In the context of this master's project, the selection of the Design Science Research (DSR) research methodology is strategic and grounded in the need to develop practical and innovative solutions for complex challenges in reputation management in e-commerce.

Design Science Research (DSR) is an approach that aims to create, develop, and validate artifacts, such as systems, models, methods, or techniques, to solve real-world problems. In contrast to purely theoretical approaches, DSR stands out for its practical orientation, seeking not only to understand existing phenomena but also to actively contribute to the creation of new knowledge.

The use of the Design Science Research (DSR) methodology in this project is driven by the complexity of reputation management in e-commerce. This choice is supported by the fact that the initial research, based on the PRISMA model, provided a comprehensive theoretical analysis, establishing conceptual foundations. Now, as we move towards the practical creation of the proposed solution, inspired by the article "User Reputation on E-Commerce: Blockchain-Based Approaches," DSR emerges as the ideal approach.

## 4.2 Application in Architecture Development

A Design Science Research (DSR) methodology [16] will be applied following Hevner's guidelines [6]. The creation of the proposed architecture for distributed reputation management in e-commerce, integrating Hyperledger Fabric, will involve building a NodeJS API, developing a Wallet for secure storage of identity, credentials, and private keys, and implementing a WordPress plugin as a proof of concept.

DSR allows for an iterative approach, enabling adjustments based on results obtained during practical implementation. This flexibility is essential to enhance the proposed solution, adapting it to the specific complexities and challenges of the dynamic e-commerce environment.

Therefore, the choice of DSR as the methodology in this master's project not only enables the construction of a practical solution to strengthen reputation management in e-commerce but also contributes to advancing knowledge in the field, aligning with the goals of the master's research process.

# Chapter 5

# Work Plan

## 5.1 Overview and Methods to be Used

In implementing the proposed system, we will opt for the second approach mentioned in the literature, using permissioned consortium networks, specifically, the Hyperledger Fabric blockchain. The choice of this alternative is based on a series of advantages crucial to meeting the specific demands of the e-commerce context.

As proposed in the literature [9], there are two main approaches based on: public blockchain networks [19, 4, 17, 10, 18] and authorized consortium networks [2, 11]. We opted for the latter approach mentioned in the literature, using authorized consortium networks, specifically, the Hyperledger Fabric blockchain. The choice for this alternative is based on a series of advantages crucial for meeting the specific demands of the e-commerce context.

Firstly, Hyperledger Fabric allows the creation of a central entity, which efficiently aligns with the operational needs of reputation systems in e-commerce. This capability facilitates network administration, ensuring more effective governance.

The permissioned nature of Hyperledger Fabric also plays a fundamental role in our choice. Restricting and controlling participation in the network provides greater security and privacy, critical factors when dealing with transactions and sensitive information in online commerce platforms.

The modularity offered by Hyperledger Fabric represents another favorable aspect. This feature enables efficient customization of the reputation system, adapting it to the specific needs of the e-commerce environment where it will be implemented.

The rapid consensus offered by Hyperledger Fabric is a strategic advantage to meet the agility demands typical of e-commerce. The efficient consensus system contributes to the quick validation of transactions, ensuring a smooth experience for users.

Moreover, the choice of Hyperledger Fabric is supported by sustainable considerations. The energy efficiency and lower carbon footprint associated with its consensus model contribute to more sustainable practices, an increasingly relevant consideration in today's context.

Lastly, Hyperledger Fabric offers integration possibilities with identity managers, further strengthening the security and reliability of the proposed reputation system. This integration provides an additional layer of authentication and validation, essential to ensuring the legitimacy of transactions and reviews.

In summary, the choice of Hyperledger Fabric as the foundation for implementation reflects the pursuit of a robust, secure, agile, and sustainable solution, aligned with the specific requirements and challenges faced by reputation systems on e-commerce platforms.

## 5.2 Project Phases

### Case Studies and Theoretical Survey:

- Conduct a detailed review of existing literature on reputation management in e-commerce.
- Analyze practical cases and studies of blockchain implementations in similar environments.
- Identify common vulnerabilities in online reputation systems and how blockchain can mitigate them.

### Implementation Definitions:

- Define architecture, interfaces, and requirements for the project.

**Blockchain Development with Hyperledger Fabric:**

- Implement a private blockchain using Hyperledger Fabric.
- Tailor the blockchain to the specific needs of reputation management in e-commerce.
- Establish consensus rules for the validation and consolidation of transactions.

**API Development (NodeJS):**

- Develop a NodeJS API to mediate the interaction between the reputation system and the blockchain.
- Develop reputation data validation, including scores and feedback.
- Ensure transaction integrity (Security mechanisms to prevent data manipulation).

**WordPress Plugin Development:**

- Design interfaces and architecture for the plugin.
- Develop the WordPress plugin to seamlessly integrate with existing e-commerce plugins for WordPress.
- Connect the plugin to the previously developed API.

**Wallet Development:**

- Develop a wallet for users to securely store identity, credentials, and private keys (Web application, only for proof of concept).
- Integrate the wallet into the reputation process, ensuring the authenticity and security of transactions.

**Testing and Validation:**

- Perform tests in all project phases to ensure functionality, security, and efficiency.
- Collect user feedback and adjust the implementation as necessary.

**Documentation and Final Report:**

- Develop documentation covering all aspects of the implementation.
- Create a final report highlighting results, challenges faced, and practical contributions to reputation management in e-commerce.

## 5.3 Gantt Chart:

Figure 5.3 displays the Gantt chart illustrating the schedule and progress of key activities throughout the project. The horizontal bars represent different phases, from literature review to final testing and validation, providing a clear temporal overview of the project stages.

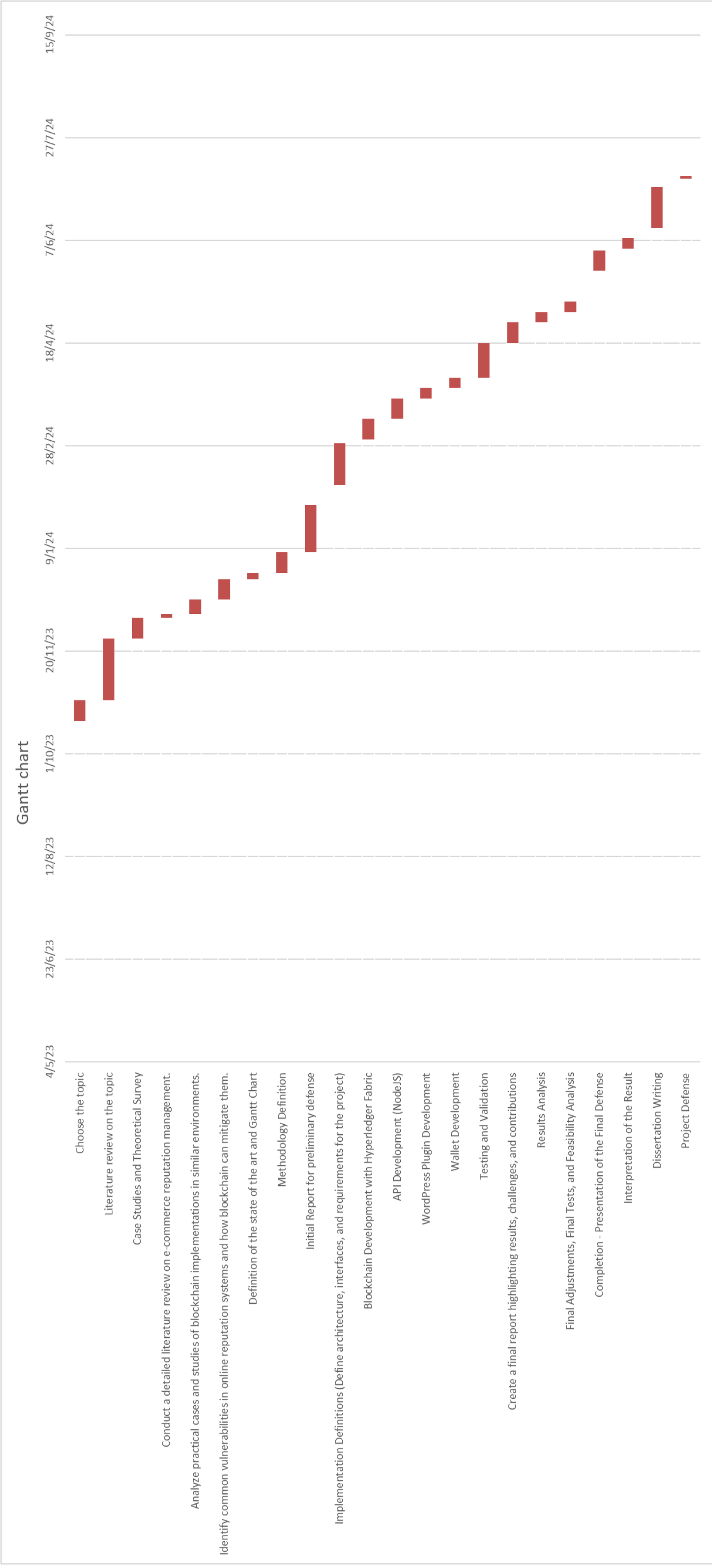


Figure 5.1: Gantt Chart

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