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Conceptual design for traceability and transparency in halal self-declared with blockchain

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ABSTRACT

Halal self-declared is a halal certification procedure for small micro enterprises (SMEs). However, sufficient technology support is required to ensure the halal process's transparency and traceability. By integrating blockchain-oriented software engineering (BOSE) technology with smart contracts and electronic product code information services (EPCIS), this study aims to deliver a conceptual design for traceability and transparency in halal self-declared. The effectiveness of the blockchain in storing data and disclosing private information to interested parties can be circumvented by utilizing both off-chain and on-chain technology. The effectiveness of blockchain data storage and the ability to disclose sensitive information to interested parties can be advantageous for both on-chain and off-chain applications.

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1. INTRODUCTION

By 2024, 10 million halal-certified goods are expected to be produced by the Indonesian Government's Ministry of Religion [1]. Increasing the number of helpers for the halal product process (P3H) is one way to optimize the attainment of this goal. However, micro small medium enterprises (MSMEs) constitute the most substantial economic pillar in Indonesia. The 64.2 million MSMEs generated a substantial 61 % of the GDP [2]. Reaching the 10 million certificate goal remains challenging despite the overwhelming presence of MSMEs. Hence, to streamline the verification process and enable halal self-declared document verification, P3H application support is fundamentally required.

To verify whether a standard has been met, the certification process entails auditing, calibration, evaluation, testing, inspection, and checking (ISO-IEC 17067). As required by article 4 a of the 2023 job creation law, micro small enterprises (MSEs) may complete the halal certification process using a halal self-declared. Still, a limited percentage of MSEs hold halal certifications [3], [4].

To guarantee that the raw ingredients, subsidiary materials, and equipment used to make, process, and distribute products comply with sharia, traceability is one of the most crucial requirements for halal certification. To increase public trust in a product's halal status, all these components must be transparent [5]. However, fraud and cross-contamination can compromise halal supply chains, jeopardizing a product's halal status [6], [7]. Transparency seeks to clarify the 'how' of tracking halal products, while traceability seeks to address the 'what', 'when', and 'where' questions of the inventory process in the supply chain [8]. An effective halal traceability system can recover supply chain transparency by enabling the tracking of possibly

non-halal materials, confirming and authenticating the product's halal status, and serving as a control for all parties involved [9].

Documentation of materials, ingredient composition, procedure, and halal product assurance system (SJPH) is another crucial prerequisite for halal certification based on Minister of Religion Regulation No. 20/2021. The largest flaw in MSEs is the documenting of all these things [10]. Additional challenges include inadequate technical support during the halal certification process [11], scarce resources for MSEs [12], and verification wait times at BPJPH that are still below recognized standards [4]. There is a perceived need for technology that can overcome resource constraints, help with halal paperwork preparation, shorten verification wait times, and operate on a bigger scale and in more places [13].

The presence of blockchain technology can solve a number of the previously listed issues, including tracking information and document transparency [10], tracing a product's traceability and halal transparency [14], [15], and integrating disparate applications [16]. The blockchain's smart contracts enable process automation, which lowers the need for technical support and resource constraints throughout the certification procedure [17]. Because there is less need for human intervention or centralized authority, the process can function effectively in this fashion [18]. Meanwhile, combining off-chain and on-chain can help mitigate the drawbacks of blockchain technology when used extensively [19], [20].

Blockchain technology is thought to be able to solve issues with product traceability and transparency regarding halalness [14], [15]. Through smart contracts [21], blockchain offers the traceability features needed in halal supply chains, enabling consumers to confirm a product's halalness back to its point of origin [7]. The integration of blockchain technology and smart contracts can enhance process traceability and transparency, ensuring the credibility, status, and uniqueness of the supply chain for halal items. In the field of blockchain-oriented software engineering (BOSE), this is feasible [22]. The idea behind BOSE is to approach blockchain-based software development in a more logical, regulated, and measurable manner by applying the concepts of software engineering.

This paper uses blockchain technology and smart contracts to give MSEs a conceptual design for halal traceability and transparency to support the halal product process (PPH) based on self-declared. Regarding Minister of Religion Regulation Number 20 of 2021 regarding halal certification for MSEs, it is hoped that blockchain technology, smart contracts, BOSE, and electronic product information service codes (EPCIS) will be able to provide traceability and transparency in the halal certification process for MSEs. Overcoming data explosion interference and preventing the publication of sensitive information are two further benefits that can be achieved with this strategy [23]. It is envisioned that this will boost Muslim consumers' confidence in MSE products' halal status and their acceptance of different halal certification organizations (LPH).

2. METHOD

This study employs a blockchain-based software development (BOSE) strategy while considering halal requirements from upstream to downstream to promote traceability and transparency of the halal process. This study starts by examining various regulations and issues about halal certification in Indonesian MSEs. Numerous issues about halal are still coming up nowadays [24]. The fundamental problem that frequently arises in MSE firms is the documentation system that can ensure all halal operations from the acquisition of ingredients to the ready-to-eat products [7]. A traceability and transparency system is crucial to guarantee that all procedures and materials meet the standards for halal certification [15]. Support from technology is therefore crucial to make it simple, quick, and easy. Blockchain can work with products and process codification tools like EPCIS to improve traceability and transparency [10], [23]. The use of smart contracts may accomplish all of this automatically [17]. BOSE will also incorporate all of these elements into a framework that is described in a conceptual design [22].

The specifics of the research phases are as follows:

- Review of the literature.
- The goal of the literature review is to gather information about the state of regulation and earlier studies on halal self-declared. It is anticipated that common practices and issues encountered during self-declared implementation would serve as a guide for self-declared implementation. Blockchain combined with product or process codification tools like EPCIS is the answer to the issue in MSEs.
- System analysis based on BOSE.
- Essentially, BOSE is the implementation of software engineering principles in blockchain technology to make it more quantifiable [22]. By integrating blockchain technology and software engineering, BOSE minimizes paperwork and unchangeable documents.
- Conceptualization of blockchain with smart contract for SMEs.

– The next stage is to create the conceptual designs for each tool that has been chosen so that the procedure can function automatically. Smart contracts can help with it.

Figure 1 briefly explains the research method applied in this study.

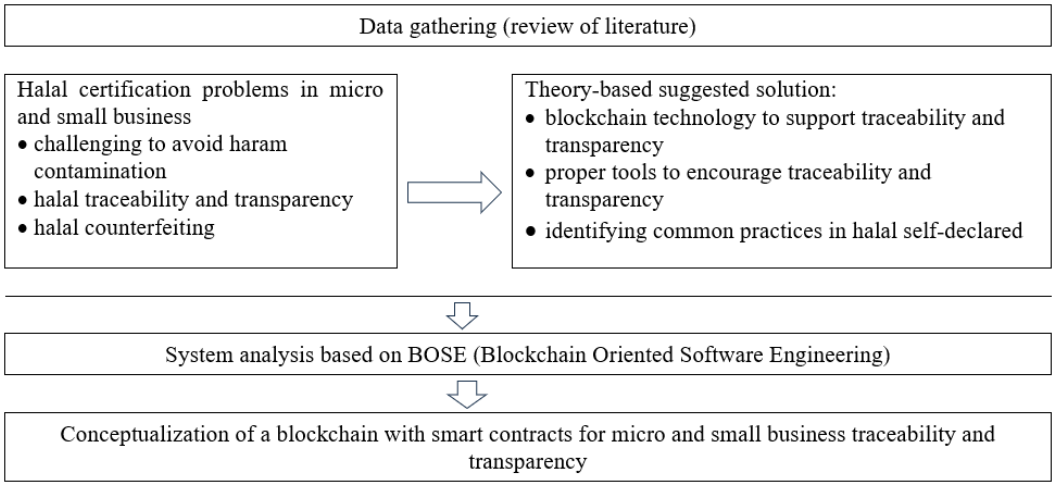

Figure 1. Research method

3. RESULTS AND DISCUSSION

3.1. Analysis of requirements for halal self-declared system support

According to Law No. 33 of 2014, every product that enters, circulates, or is traded in Indonesia needs to have a halal certification. In connection with this, halal certification MSE actors may be granted based on the business actor's halal self-declared (Regulation of the Minister of Religion No. 20 of 2021). The Head's Decree BPJPH Number 33 of 2022 is referred to in the technical implementation of the MSE actor's declaration. The competency of the assistance of PPH (P3H) is crucial in the halal self-declared process because it will be the P3H's responsibility to validate and confirm the product's halalness and help MSEs comprehend the halal product guarantee system (SJPH).

3.1.1. Micro small enterprises requirements for submitting a halal self-declared

SMEs may submit a halal self-declared if it satisfies the conditions outlined in the Decree of the Head of BPJPH (halal certification body) Number 33 of 2022, which include:

– Product categories: the following requirements must be met for a product to be eligible for halal self-declared: i) it must not be hazardous (using non-critical raw materials) or use materials that have been verified to be halal; ii) it must not contain any components of animal slaughter unless it is sourced from a halal-certified producer, slaughterhouse, or poultry slaughterhouse; and iii) according to the Indonesian business field standard classification (KBLI) stated on the business identification number (NIB), the products generated are in the form of goods rather than services, restaurant businesses, catering, canteens, stores, food stalls, or cafés.

Please refer to the attachment to BPJPH Head Decree No. 33 of 2022 for the list of products that can be registered by halal self-declared.

– Materials applied: the materials utilized are safe and halal, as demonstrated using a halal certificate or by being on the list of materials that are excluded from the requirement to get a halal certification (KMA Number 1360 of 2021).
– Procedure of production: it is a straightforward production procedure that is assured to be halal. Irradiation, genetic engineering, ozone, and a mix of many preservation techniques (hurdle technology) are not used in the product preservation process.
– The halal product process's location, setup, and equipment: halal product locations, places, and processing tools are distinct from non-halal product locations, places, and tools at MSEs. The machinery is low-tech production equipment that can be operated manually, semi-automatically, or both (this is a home-based business, not a factory). MSEs can only have 1 (one) production facility.

- Possess a NIB: when operating a business by their industry, MSEs are required to have a NIB, which is an identity number assigned to business actors. The one single submission (OSS) mechanism is used to create NIBs at no cost.
- MSEs' turnover or sales revenues: MSEs have business capital of up to IDR 2,000,000,000.00 (two billion rupiah) and yearly sales proceeds (turnover) of no more than IDR 500,000,000.00 (five hundred million rupiah), as certified by an independent statement.
- A letter of distribution authorization: regarding food and beverage items with a shelf life of fewer than 7 (seven) days, MSEs possess or lack a sanitation hygiene eligibility certificate (SLHS), distribution permission (PIRT/MD/UMOT/UKOT), and other industrial permits.
- Activity of production: MSEs applied for halal certification after a year of production.
- Completing the SiHalal application paperwork: the online application paperwork for self-declared must be completed by MSEs using SiHalal. Prepared submission materials include the following: a fully completed halal assurance system (HAS) manual template, photos of the production process, product photos, raw material data, and distribution permit documents (if applicable), as well as halal supervisor documents (copy of ID and letter of appointment).

3.1.2. Halal production process assistance mechanism

MSEs use the halal self-declared assistance system as a conduit for self-declarations. It is envisaged that this will help to expedite the goal of broadening the reach of halal certification for MSEs, in conjunction with partners from PPH and halal product process assistance agency (LP3H). Figure 2 illustrates the broad description of the independent halal declaration mechanism based on PMA No 20/2021.

The halal self-declared system involves several players, as shown in Figure 2, including business actors (UMK), PPH assistants (P3H), LP3H, BPJPH, Indonesian Ulema Council (MUI), and the system itself. This situation demonstrates the vital role P3Hs play in conducting field-based validation and verification. Likewise, P3Hs need to go with business actors/UMKs to adjust when results are made at LP3H, BPJPH, or MUI. The system issues a halal certificate to mark the completion of the process.

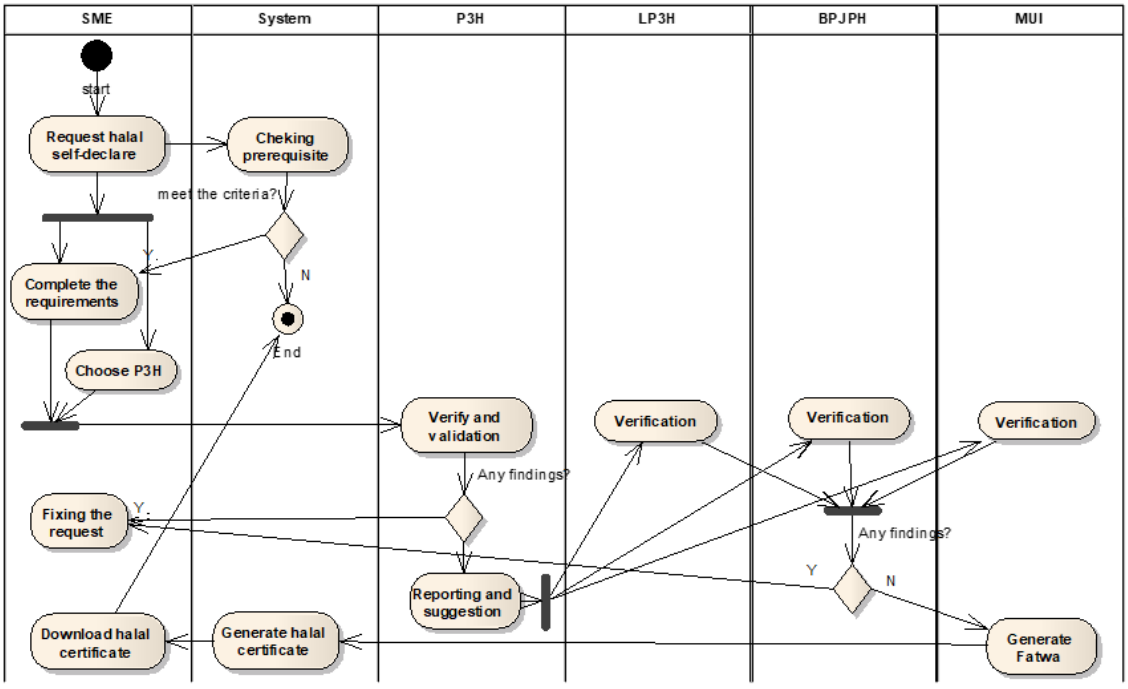

Figure 2. Halal self-declared systems

3.2. Conceptual design in halal self-declared with blockchain

A traceability client and certification server are part of the blockchain-based conceptual design for halal self-declaration. Based on the EPCIS architecture, the halal certification server is made to collect and handle product traceability keys. Halal traceability clients, on the other hand, deal with issues about locating

data on ingredients, procedures, and other things about a product's halal status. Figure 3 provides a quick explanation of the suggested architecture for system design.

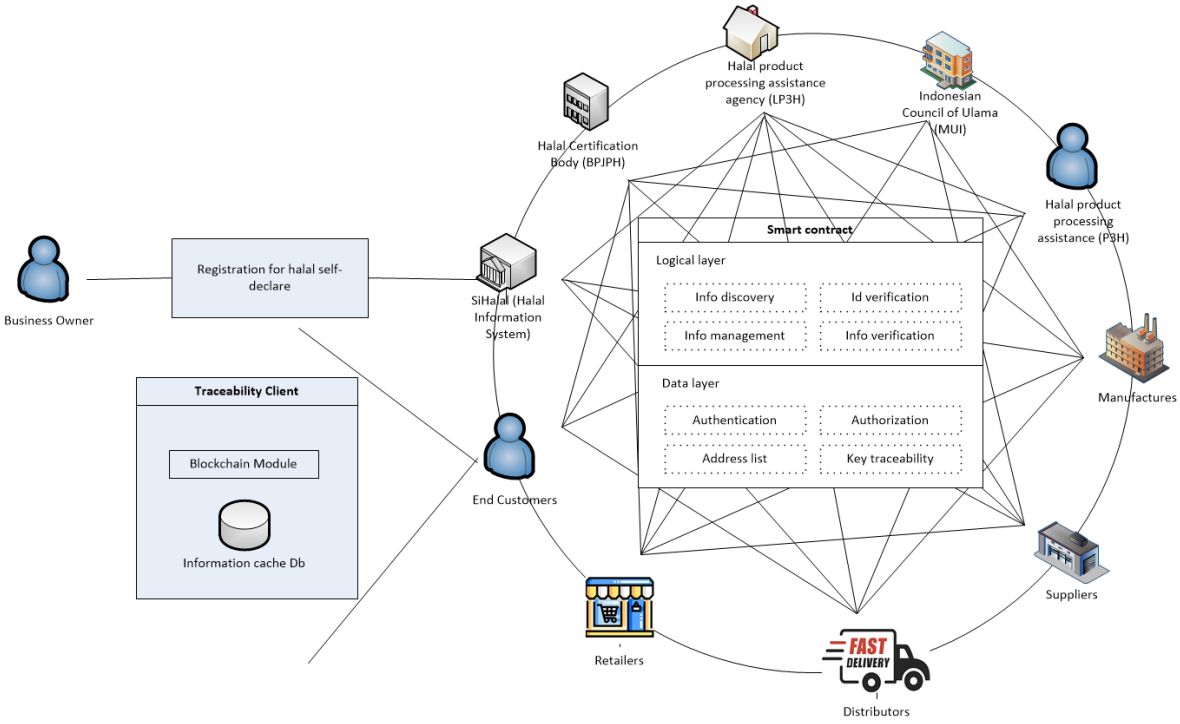

Figure 3. Proposed conceptual design for halal self-declared

Various modules make up the halal certification server, including these:

- Module for catching traceability data: this module gathers vital traceability data on the halal supply chain's production, storage, and distribution processes. The organization's halal supply chain can be updated manually or by inputting comprehensive event information derived from the product cycle.
- Database for event information: it is primary purpose is to maintain and update traceability-related data.
- The module for information abstraction is utilized to retrieve the required data from the database of traceability information. as well as get it ready for blockchain upload.
- Blockchain module: this module enables users to become either a full or lightweight blockchain through data interaction. Their involvement in blockchain maintenance is where they differ most from one another.
- The module for verifying authority is responsible for confirming if the person making the information request works in the halal supply chain by cross-referencing organizational identity.

The two parts of the halal traceability client are as:

- Blockchain module: this module retrieves and verifies data from the blockchain to manage links with customer systems. These nodes can employ lightweight blockchains to lower maintenance expenses.
- Information cache database: based on user requests, the cache database maintains and records information regarding a product's halal status.

3.3. Proposed system data flow

Data flows and system interactions can be explained using data flow systems. The proposal generally comprises 4 primary data streams as shown in Figure 4, which are as:

a. Distribute information on the blockchain. The whole procedure for loading data to the blockchain is described:

- Applicants for certification or P3H must supply distinct identifiers for every product (such as an RFID-aided EPC code) and any related events that will serve as a traceability key. After that, this traceability database is kept on a local or cloud server in a traceability information database.
- Employing the module for information extraction, the certification applicant or P3H obtains crucial traceability data, and the blockchain module automatically produces transactions to smart contract A. The

blockchain will receive transactions as soon as the peer-to-peer (P2P) network permits them to be posted. Details on product distribution to retailers and distributors is included in this extraction.

b. Interaction with off-chain data. An illustration of an off-chain data contact is as:

– Retailers and distributors can obtain product status information by sending the identity code and smart contract address. Whether it has access or not will be decided by the smart contract. The smart contract will handle the request and display the server address if verified.
– The smart contract will consider the source of the access request (distributor or store). Based on the rights that have been settled to it during validation, details will be available via the interaction authority management module.

c. Inquiries from customers. Customers can inquire about a product's halalness using the following basic methods:

– Customers scan the QR code or input the product ID code. An identification code must be provided in the query by BPJPH or LP3H.
– If no identity arrives, the smart contract will handle traceability on-chain and report the findings. In contrast, in the event that an identity is present, the smart contract will determine the product server's location and ascertain if the identity is authorized to access the server. All data will be shown off-chain if BPJPH does so. However, if LP3H implements it, the information provided is restricted to the power granted by BPJPH.

d. Verification of Halal food. The process that LP3H undertakes when asked to ascertain a product's halal status is as follows:

– Monitor daily HAS.
– Make sure that products labelled as haram and halal are circulated separately. If the same means of transportation is active, ensure that *istihalah* or tanned (*Samak*) is carried out before the shipment of haram goods.
– Make sure that products labelled as haram and halal are stored apart.

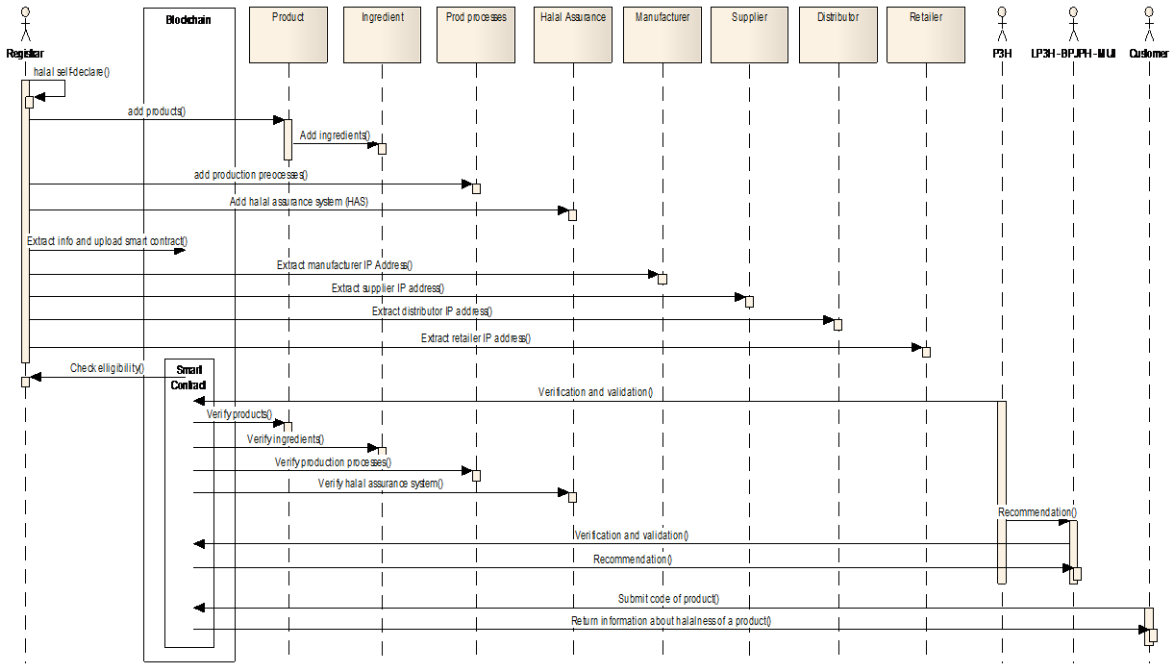

Figure 4. How to track a product's halal certification and the procedure of uploading data to the blockchain

3.4. Comparison between proposed design and previous research

It is necessary to evaluate the benefits and drawbacks of the suggested conceptual design compared to earlier studies. This makes it possible to identify the areas that require future improvement. Table 1 offers a fuller explanation of this comparison.

Table 1. Comparison between the proposed design and previous research

Parameter	Proposed design	Blockchain-based traceability system [25]	IS designed for blockchain-based MSEs [10]
Technology use	Blockchain, smart contract, off-chain, on-chain	Blockchain, smart contract, off-chain, on-chain	Blockchain
Adoption of the halal standard	PMA No 20/2021, The Head's Decree BPJPH No 33/2022	MUI's standard	HAS 23000
Adoption of development methods	BOSE	-	-
Additional instruments facilitated	EPCIS	Internet of things (IoT)	-
Coverage	MSEs, Consumers, suppliers, manufacturers, warehouses, distributors, retailers, halal certification bodies, MUI, LP3H, and P3H	Slaughterhouse, abattoir, halal body, distributor, retailer, consumer	MSMEs, consumers, suppliers, manufacturers, warehouses, distributors, retailers, halal certification bodies, MUI, LPH (halal supervisory agency)

4. CONCLUSION

Halal self-declared can be used to certify MSEs as halal. It is merely that sufficient technology assistance is required to be able to produce a halal certificate for halal self-declared practitioners. However, in the process of halal certification, traceability and transparency are two crucial factors. This is why blockchain technology combined with EPCIS and smart contracts can be quite beneficial, particularly regarding the traceability and transparency of the halal production process. Meanwhile, off-chain and on-chain applications can benefit from the efficacy of blockchain data storage and the disclosure of sensitive information only to interested parties. Further research is needed to translate the proposed conceptual design into an appropriate programming language.

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