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Research Article

A New Mass Customization Platform: Hyperledger Composer Use Case

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Abstract

Today, the use of mass customization applications has become inevitable with the increasing importance of customer demands and the proliferation of companies that respond to these demands. Although companies respond to customer demands and products are produced in line with these requests, there are not enough interactive platforms. Adequate connections with the actors and materials required in the process from the receipt of the product request to the production period cannot be provided. In models where customer-manufacturer integration cannot be achieved and demands are not met, the products cannot be sufficiently customized. In this proposed method, a platform is proposed that will bring together the actors in the production process and provide interaction. While establishing the platform, blockchain technology, which attracts attention with its reliable and traceable features, was used. Hyperledger Composer is a blockchain used for business networks and refers to the permissioned network type. With this technology, a collaborative, traceable and reliable platform where actors can transact together has been proposed. The furniture sector, which is one of the sectors where personal requests are increasing, is given as an example.

Keywords: Blockchain, Mass Customization, Consensus, Hyperledger Composer.

Yeni Bir Kitlesel Özelleştirme Platformu: Hyperledger Composer Kullanım Örneği

Öz

Günümüzde müşteri taleplerinin artan önemi ve bu taleplere cevap veren firmaların çoğalmasıyla birlikte kitlesel kişiselleştirme uygulamalarının kullanılması kaçınılmaz hale gelmiştir. Firmaların müşteri taleplerine cevap vermesine ve bu talepler doğrultusunda ürünler üretilmesine rağmen yeterince etkileşimli platform bulunmamaktadır. Ürün talebinin alınmasından üretim sürecine kadar olan süreçte gerekli olan aktörler ve malzemeler ile yeterli bağlantılar sağlanamamaktadır. Müşteri-üretici entegrasyonunun sağlanamadığı ve taleplerin karşılanmadığı modellerde ürünler yeterince özelleştirilemez. Önerilen bu yöntemde, üretim sürecindeki aktörleri bir araya getirecek ve etkileşimi sağlayacak bir platform önerilmektedir. Platform kurulurken güvenilir ve izlenebilir özellikleriyle dikkat çeken blockchain teknolojisi kullanılılmıştır. Hyperledger Composer, iş ağları için kullanılan bir blok zincir olup izin verilen ağ türünü ifade eder. Bu teknoloji ile aktörlerin birlikte işlem yapabileceği işbirlikçi, izlenebilir ve güvenilir bir platform önerilmiştir. Kişisel isteklerin arttığı sektörlerden biri olan mobilya sektörü örnek olarak verilmiştir.

Anahtar Kelimeler: Blok Zincir, Kitlesel Özelleştirme, Uzlaşma, Hyperledger Composer.

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1. Introduction

With the developing technology, manufacturers are faced with an intense competition. It is seen that service-oriented business models can gain more space in the market. Reaching customer requests has become a critical problem for manufacturers in today's world where customer requests are extremely important. To this end, more than a third of the major manufacturers work on customer service (Neely 2008). Companies are looking for ways to move away from traditional production models and offer personalized designs. With this trend, which covers all sectors from the fashion industry to digital platforms, the customer-oriented and collaborative production model is becoming widespread. In the studies carried out, they realized that manufacturers have serious benefits for their performance in line with the importance they give to customer feedback and service during the product production phase (Zhang, Guo, and Zhao 2017). For this purpose, the concept of mass customization, which adopts the principle of acting in line with customer requests, has begun to be implemented in production models. With mass customization based on customer requests, companies have been able to meet high volumes of different product options in large markets in a short time (Leng et al. 2020; Qi et al. 2020).

Collaboration, consistency and traceability are critical for commercial agreements between companies. In a study conducted in the literature, it was concluded that countries trade more with partners with similar commercial arrangements (Hildegunn Kyvik Nordås 2016). For this reason, it will be beneficial for companies to have commercial relations with similar regulations on common platforms. Researchers have found that customers are able to produce more innovative and needs-oriented products than professional developers. However, it should not be forgotten that professional developers have an important role in maintaining the balance in product design (Kristensson and Magnusson 2010).

Companies should be able to balance traceability and cost while offering special products to customers. Existing production models have limitations against customer product change requests. Therefore, data sharing throughout the supply chain is critical. Blockchain facilitates access to information by providing customer-manufacturer integration. Thus, when it comes to product changes, customer demands can be met with the traceable technology offered by blockchain technology. Another contribution of the blockchain is that it ensures that customer information is secured so that secure trade can be ensured. It is prevented from sharing personal information without the customer's request (ALTAY TOPCU and SUMERLİ SARIGÜL 2020; DİKİLİTAŞ, TOKA, and SAYAR 2021).

Studies show that the success of mass customization depends on manufacturers' flexibility, modular production model, quick response ability and easy integration with technological developments (Inayatullah and Narain 2017). With the developing technology, competition between companies is increasing day by day. Customer-manufacturer traffic has become very important today, as the demand for products developed in line with customer demands has increased. Studies have concluded that manufacturers need to develop both mass customization and product innovation capabilities while providing services. In addition, it is emphasized that investments should be made in lean and agile practices in service delivery (Qi et al. 2020). Consideration of customer feedback by product designers will contribute to product development.

In order to solve the problems in the market, there is a need for automatic systems that will strengthen the cooperation of the actors in the production sector. In addition, a common platform will be useful for product innovation and feedback. With this proposed study, we offer a secure, traceable, access-controlled and interoperable blockchain-based system. By monitoring and securing transactions between peers in a blockchain network, it has the ability to solve industry challenges. There is also an emphasis on collaboration with real-time data auditing verified by participants. Blockchain guarantees transparency, authenticity and auditability. Using these advantages of the blockchain, we propose a common platform that enables customer-manufacturer collaboration (Kumar and Chand 2021; Surjandari et al. 2021; Zhu et al. 2020)

The remainder of the article is organized as follows: Section 2 presents the theoretical background on the paper, section 3 details the proposed solution. In section 4, there is a discussion chapter of the article.The result of the article can be seen in section 5.

2. Theoretical Background

2.1. Mass Customization

Since the purpose of mass customization is to produce products in line with customer requests, the place of the customer in this production model is very important. In the study by Jessica and Sean, existing studies were synthesized and classified as mass customization from the consumer perspective. As shown in the Fig. 1, they divided the roles of customers into four main classes: assembler, inputter, designer and selector (Pallant, Sands, and Karpen 2020).

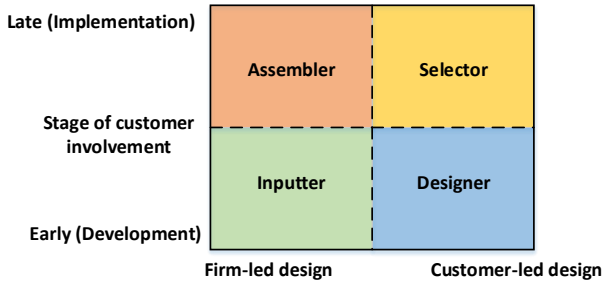

Figure 1. Mass customization strategies and customer customization (Pallant, Sands, and Karpen 2020)

In the production model where the customer contributes as the "assembler", the customer is only involved in the product application phase. For example, after IKEA customers purchase the products, they perform the assembly process at home. In the literature, the firm benefit of this model, why the customer is included, and the customer's psychological consequences have been examined (Huffman and Kahn 1998; Mills, Chase, and Margulies 1984). It is seen that the production models in which customers are included have a positive effect on customer psychology. Thus, contributions

are provided to companies as it increases the purchasing potential of customers (Homburg, Schwemmle, and Kuehnl 2015).

In the production model where the customers are "inputter", the customer is included in the product development process. For example, the interior architect can design the house with the data he receives from the customer in home decoration, and the design is realized in line with the customer's wishes. In this production model, the dialogue between the manufacturer and the customer continues actively until the end of the production process.

In the production model where the customer is the "designer", the customer is included in the product development process and the control of the product design is given. With the computer-aided Lego Digital Designer, various design products can be produced by including the imagination of the customer in the production process.

In the production model where the customer is in the "selector" role, the customer is given the right to configure. In this model, companies offer various options to the customer and produce products in line with customer choices (Pallant, Sands, and Karpen 2020). Studies have concluded that the products cannot be sufficiently customized in models where customer-manufacturer integration cannot be achieved and demands are not met (Ulrich, Anderson-Connell, and Wu 2003).

2.2. Hyperledger Composer

Hyperledger Composer is a toolkit supported by the Linux Foundation and used to develop blockchain applications. With this toolkit, it is ensured that transactions are executed according to the policy defined by the business network participants. It uses a simplified modeling language to implement business network and transaction logic. With Hyperledger Composer, assets and operations performed on these assets can be modeled. Applications can be simulated in the web browser. It also enables to create business network REST API and build a skeleton Angular application with Yeoman framework (Ho et al. 2021; Purohit et al. 2021; Typical Hyperledger Composer Solution Architecture n.d.). The Fig. 2 shows the architecture of Hyperledger Composer.

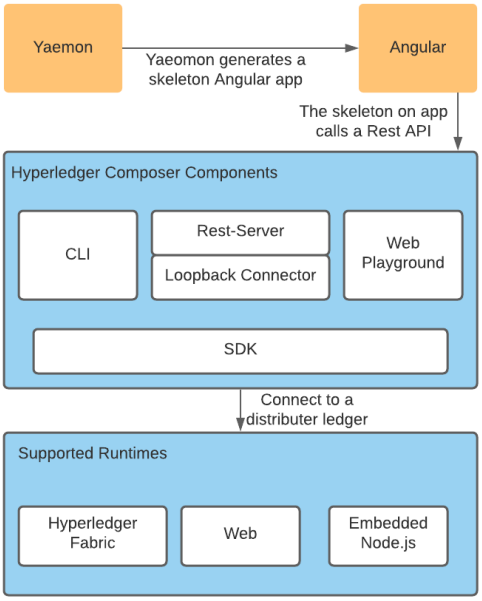

Figure 2. Hyperledger Composer solution architecture (Typical Hyperledger Composer Solution Architecture n.d.)

With its modular structure, Hyperledger Composer supports three different runtime implementations: Hyperledger Fabric, Playground and Node.js. The state is stored in the ledger in Hyperledger fabric, in the local browser with Playground, and in memory with Node.js (Typical Hyperledger Composer Solution Architecture n.d.).

3. Proposed Approach

3.1. Algorithm of Platform

As seen in the figüre 3, first, the customer's parameters are created. These parameters contain information such as the user's name and address. Then, the user requests the product to be produced in line with his request. In the proposed platform, it is assumed that the customer requests furniture. After the product request, it is sent for service evaluation. In service evaluation, there are manufacturers, designers and suppliers. Information is collected whether the manufacturer will provide machine support, whether the designer's product is functional, and whether the supplier can provide raw materials. In case of support and approval, the product production process is started. If any user does not approve, the product will not enter the production process. The customer will be informed that the product will not be produced.

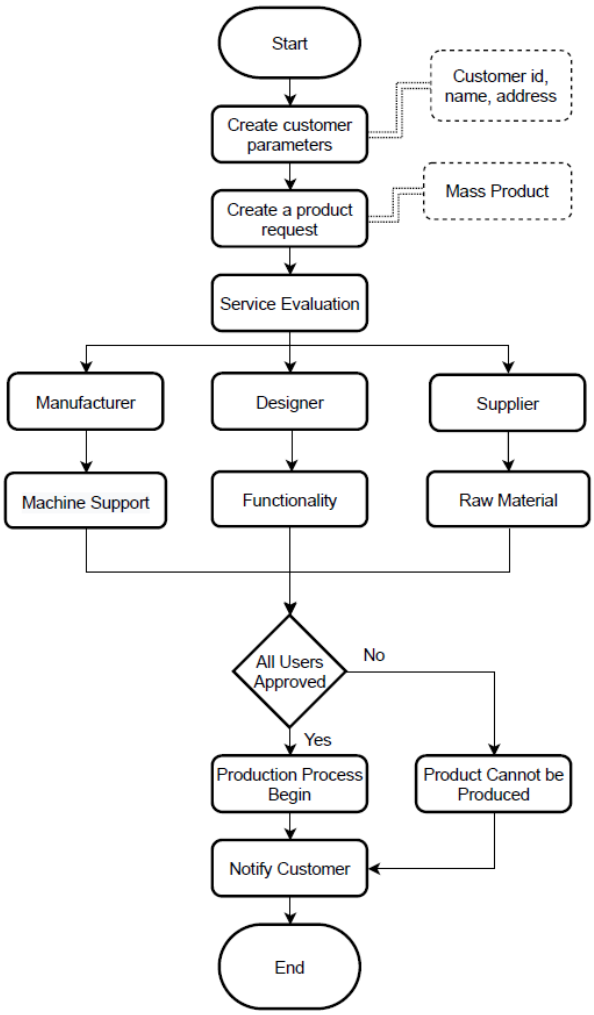

Figure 3. The algorithm of the proposed method

With this proposed method, customer-service provider communication is aimed. Customer requests received online are recorded. Thus, the product will be produced by communicating directly with the customer, not by taking the requests indirectly like the survey in the production sector. It is aimed that manufacturers make production in line with customer requests.

3.2. Components of Platform

In this part of the study, the Hyperledger Composer components that make up the platform are explained.

Participants: It refers to the actors who store and record transactions in a network. Participants can generally refer to other stakeholders as well as people in the business. In the proposed method, it refers to individuals and companies that enable mass customization to be carried out more effectively. These are customer, designer, supplier, and manufacturer. Table 1 defines the tasks of the participants, namely the collaborators. Each participant in the network commits to the task he receives.

Table 1. Participants in the proposed method

Participant	Description
Customer	This participant refers to the actor who will buy or design a product.
Designer	This participant gives confirmation whether the designed product will be produced or not.
Supplier	This participant refers to the actor who will supply raw materials for the product to be produced.
Manufacturer	This participant is the actor who will provide production of the product and machine support.

Assets: It refers to tangible or intangible goods and services in a network. For example, in a blockchain created by an airline company, airplanes can be defined as assets. In this method we recommend, products (furniture) and raw material assets are expressed. Every transaction performed on assets is recorded. Thus, the status of assets is kept up-to-date and participants are able to carry out their transactions securely on a trackable platform.

Transactions: It refers to the actions to be taken on the assets by the participants. In the proposed method, transactions such as design creation, design approval, machine request, design deletion, functional compatibility are defined. Transactions on assets are made and recorded by the participants. The times when transactions are changed with the "Time stamp" feature of the blockchain are tracked by each participant. In case of any irregularity or transaction, the system can be intervened.

Access Control Rules: A business network that can be controlled by blockchain can be created and traceability can be ensured. Using the access language with Hyperledger Composer, the privileges of the participants to create, read, update and delete items are defined.

3.3. Architecture of Platform

Smart contracts are important tools to ensure cooperation between users and determine the rules. In the proposed method, if a customer requests a product to be produced, all users are expected to approve the process. Otherwise, the product will be prevented from entering the production process. As can be seen in the Fig. 4, approval conditions are provided in case of consensus. It is very important to determine the rules in a smart contract. Because irreversible data transactions are added to the blockchain.

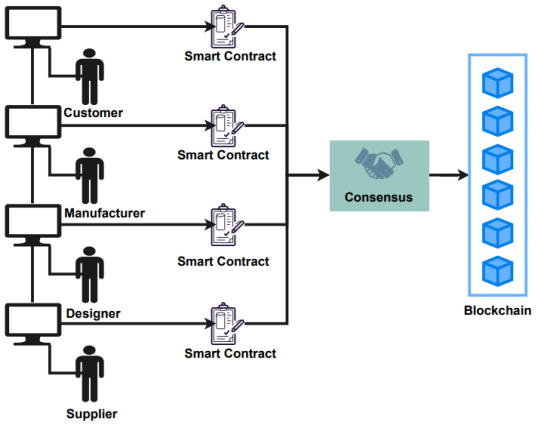

Figure 4. Approval process with smart contract

As seen in the Fig. 5, the proposed platform consists of five modules: users, frontend, core, manager and blockchain.

Participant Module: User section refers to the actors on the platform. Customer refers to the actor who will request the

product, Manufacturer refers to the actor who will provide the machine support to be used in the production of the product, designer refers to the actor who will decide on the functionality of the product to be produced, and Supplier refers to the actor who will supply the raw material required for the production of the product.

Front End Module: Operations such as user login, order creation, order rejection is offered to users with the front end. With the "Sign" operation, users are allowed to log in to the system. With the "Create Order", a product request is made in line with the customer's request. With the "Order Approval" process, Manufacturer, Designer and Supplier users approve the production of the product. With the "Order Reject" process, it is decided that the product will not enter the production process.

Core Module: In the core module, the functions that will be required in the product design process are defined. In this section, which is used by the admin, manufacturer, designer and supplier, operations are carried out in line with the product and user information. Product and user information are managed by the admin. Material request, machine request and design functionality are used by the manufacturer, designer and supplier.

Admin Module: It is provided to observe the user operations of the administrator section and to prevent unauthorized logins.

Blockchain Module: Blockchain part refers to the module where data is recorded, cooperation is ensured and transactions are stored irreversibly.

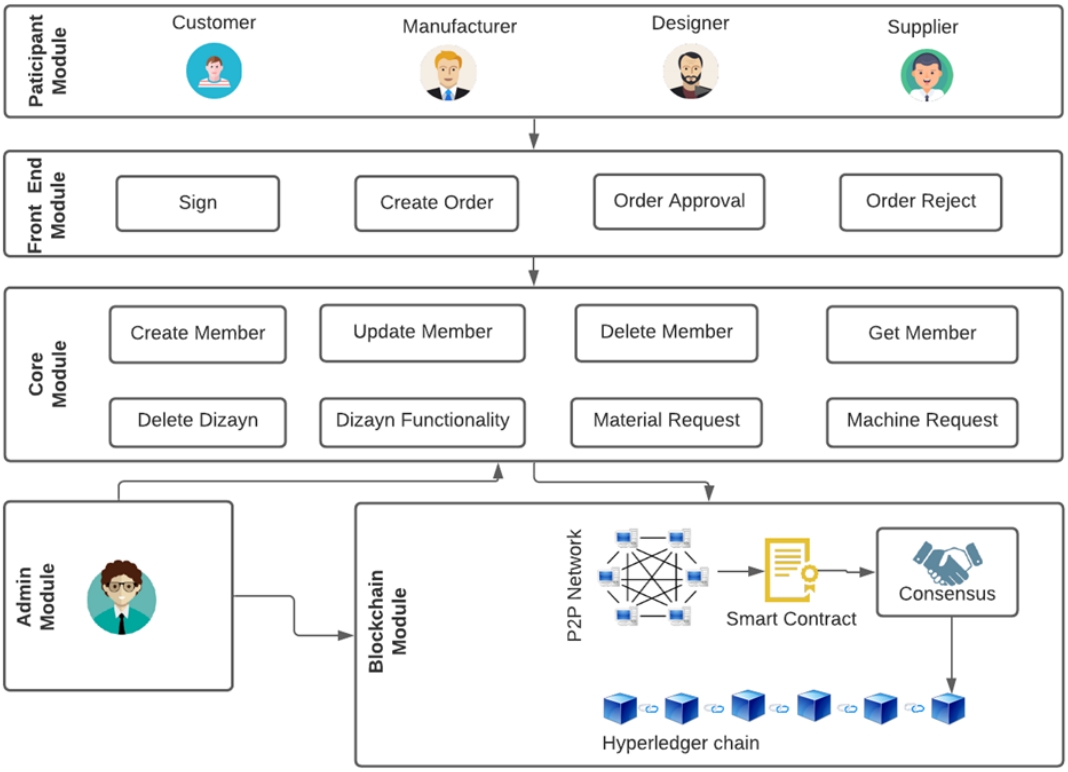

Figure5. Architecture of the proposed method

4. Discussion

Since the blockchain is a new technology, it faces various difficulties in the implementation phase. In the proposed application, the participants are required to support the technical infrastructure and pay a cost for it. As in many sectors, the production sector will also be shy about new technologies. It will have various concerns due to the fact that its applications are not widespread. Therefore, paying a cost for such a system would be risky for many investors.

A traceable and reliable system is offered as every user in the blockchain stores the data. But this will also bring with it the problem of storing increased data. This is one of the biggest concerns of systems designed with blockchain. As a solution to this, it is recommended to store big data outside of the blockchain. However, this will put additional costs and data security at risk. Another solution is to secure data stored outside the blockchain with cryptographic transactions.

5. Conclusion

This paper, a solution has been sought to overcome the communication problems of the actors in the sector today, where the demand for mass customization is increasing. Communication between actors (such as manufacturer, customer, supplier) is very important in mass customization. However, existing systems cannot provide the necessary infrastructure. Blockchain technology was used to solve this

problem. It adds security and traceability features to blockchain systems. With the proposed method, the communication and traceability of the actors on the sample scenario with each other were ensured. Transactions on the blockchain are transparent and immutable. For this reason, the transactions performed by the actors are recorded and secured. Identities are not important in public blockchain types. However, the identities of actors are important in business networks, as in the platform we propose. In trade, people care that the people they will do business with are reliable and their identities are certain. For this purpose, consortium Hyperledger Composer, one of the blockchain types, was used with Hyperledger Composer, the identities of the actors on the platform are known and the inclusion of unidentified people in the system is prevented.

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