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UML Artefacts for a Blockchain-enabled Platform for Fairtrade
(Full Paper)

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ABSTRACT

Fairtrade-certified products have successfully entered the mainstream distribution channels mostly in developed countries, and these products are now sold in famous supermarket chains. Nonetheless, the packaging and labeling of products as "Fairtrade" commands premium pricing in the marketplace. How much of this, however, is valid and justified? Despite the reputable certification mechanisms for quality assurance, mass media reports suggest that much of the "surplus value" goes to the accreditation agencies themselves instead of the producers. This article proposes an agenda to set this right with a blockchain platform that provides "trust-free" assurances of verifiable labeling. Using an Action Design Research methodology, we have specified a research prototype of a Blockchain-enabled Fair-Trade platform Unified Modelling Language artefacts. We believe this will set the direction for social inclusion as part of information systems scholars' aspiration to promote "tech for good".

Keywords: Fairtrade, blockchain, digital platforms

INTRODUCTION

Consider a socially aware consumer wishing to make informed choices about the products and services (s)he consumes, such as organic jasmine rice (see Figure 1). How does the consumer determine the trustworthiness of the product labels when paying a premium price? For example, the organic rice shown in Figure 1 costs about 50% more than its equivalent in a mainstream grocer. This is typical of the dilemmas that food consumers face at outlets such as grocery stores, cafés, restaurants, and e-tailers; myriads of certifications (e.g., "organic," "FT," "non-GMO," "rainforest alliance," "halal," or the one shown in Figure 1 below) confront the choice that they have to make. Implicit in that choice is consumers' "trust" in the brands and merchants. In many cases, there is a trusted third party (TPP) that authoritatively certifies a product by attaching the corresponding label (e.g., AsureQuality in New Zealand) on it, and that regulates the entire supply chain network, from production to commercialization (Ruggeri *et al.*, 2021). However, even with a trusted source, many consumers often wonder if they are paying an excessively high price for certification.

Figure 1. Buying with trust and confidence.

The aforementioned doubts are in fact warranted and provide an opportunity for a digital venture that unlocks value (Sharma *et al.*, 2010). According to a study about the production of flowers, coffee, and tea in Ethiopia and Uganda, which was commissioned by the U.K. government and has been widely reported (Vidal & Provost, 2014), the sale of FT-certified products failed to benefit the poor farmers in such countries. The wages of the farmers in the farms that grew FT flowers or who sold coffee and tea to FT-certified markets were lower than those of the farmers in the larger commercial farms that were

not FT certified (Vidal & Provost, 2014). In Marxist parlance, should the surplus value generated by "Fairtrade" go to the needy producer or to the exploitative distributor? What if the entire producer–distributor–consumer chain can be placed on a "trust-free" platform where open data are transparent, traceable, tamper-resistant, immutable, and compliant (the so-called 3TIC characteristics)? Such a "3TIC" mechanism (Sharma *et al.*, 2019; Jahanbin *et al.*, 2019, 2021) will also allow FT producers and distributers to create and capture the value that they bring to the marketplace (Croxson *et al.*, 2019).

This brief investigates the application of blockchain and augmented technologies such as Internet of Things (IoT), artificial intelligence (AI), and big-data analytics in creating a platform that does not require the overhead of a Trusted 3rd Party (TTP) for a digital FT platform. Blockchain (also called the distributed ledger) has grown in prominence in recent years (Berdik *et al.*, 2021). It is defined by Technopedia (n.d.) as a list of records linked together using cryptography, where the records (called blocks) contain the record data and a cryptographic hash to the previous block in the chain. According to the same source, the cryptographic hash is created using the record data, and changing any data will render the link to such data invalid. Technopedia (n.d.) claims that this data-linking mechanism ensures a secure record history as a record cannot be changed without also changing all the subsequent blocks attached to it (collectively called an immutable ledger). While value analysis has been performed for cryptocurrencies (cf. Wingreen *et al.*, 2020), this business issue has sparsely received scholarly attention. At a conceptual level, there is a certain elegance to a blockchain-based FT platform that (1) provides 3TIC assurances to savvy consumers that the premium prices they are paying are justified, and (2) allows producers mostly from non-Western countries to enter into simple contracts with distributors with low legal costs (Kshetri *et al.*, 2021). However, little empirical support is available for such a use case from field trials that will give confidence to digital entrepreneurs to launch such a venture.

FAIRTRADE PLATFORM DESIGN AND METHODOLOGY

Blockchain-enabled platforms have socio-technical characteristics; hence their affordances could be analyzed using appropriate methods from systems thinking. The configuration of a scalable, non-TTP platform using design science research (DSR) begins with understanding the socially desirable latent needs of consumers and then proceeds to developing a technically feasible proof-of-concept (PoC) design with the 3TIC principles that addresses the "what" question and the derivative design rules that address the "how" question. As an example, for the principle of tamper resistance, the use of IoT technologies such as unique QR (quick response) codes that "self-destruct" to be rendered non-reusable may be adopted as a design rule to achieve the aforementioned principle. The PoC design is then validated by determining if it is economically viable as an innovative solution to the business or industry problem. A number of blockchain development environments are commercially available, and for familiarity and experience, Ethereum (an open-source environment recently acquired by Microsoft) and IBM's HyperLedger Fabric were considered for adoption in this work to develop and validate a PoC design.

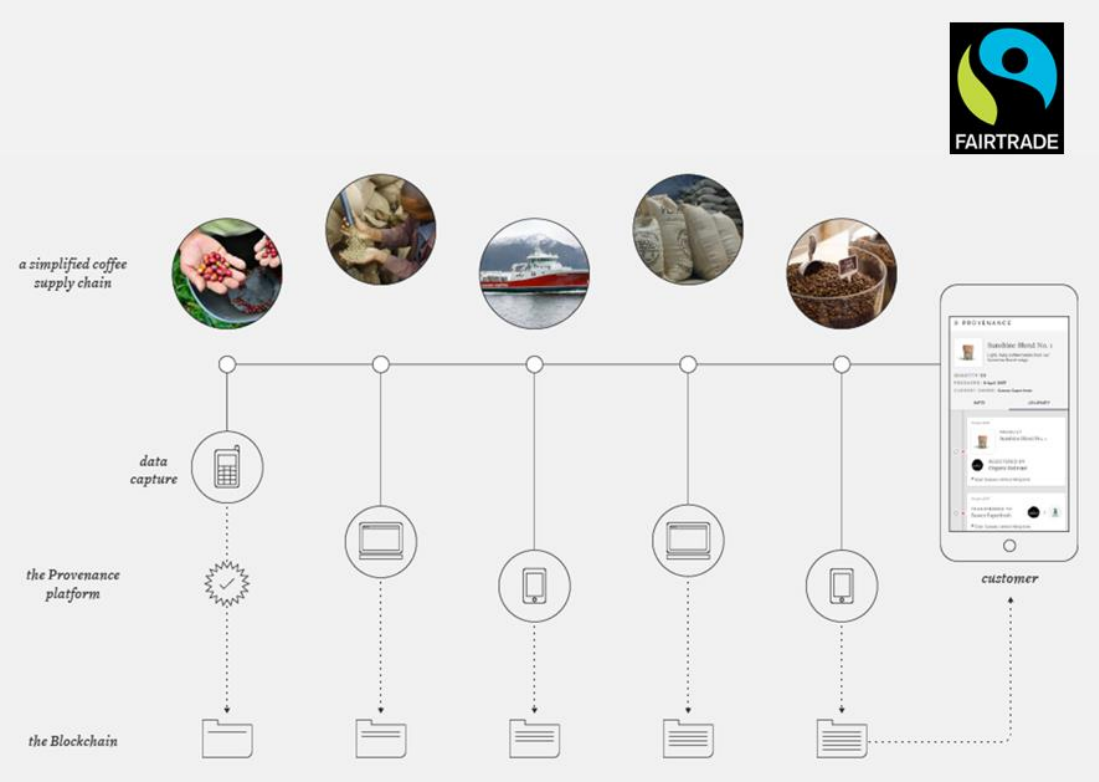

Figure 2. The blockchain FT Platform with five-steps.

For example, for FT coffee or cacao, there are typically five sets of data that a blockchain platform must be able to record or provide for it to be feasible (see Figure 2), as follows: (1) at the farm, the source, destination, grade, and purchase date of the

beans; (2) during the processing, the identity of the processing plant, the specific processes performed, and the quality checks made and their dates; (3) in the course of the shipment, the carrier, route, and arrival and receipt validation dates; (4) during the wholesale or retail packaging, the required label with regulatory and consumer information; and (5) at the time of purchase, the QR code that a consumer should be able to scan to confirm that the label is authentic, especially with regard to FT. It is therefore evident that a 3TIC blockchain platform for FT will work only if all its component data can be trusted and verified. The use of IoT devices and other tamper-resistant technologies (e.g., QR code stickers on the produce) augments the blockchain records (See Figure 3).

Three research issues need to be addressed to provide a minimum viable solution for the blockchain-enabled FT platform. The first is the issue of scalability. Blockchain solutions are regarded as computationally expensive and may not be feasible or viable in public (permission-less) marketplaces with thousands of producers and distributors and millions of consumers. A DSR approach will allow hybrid or private (permissioned) architectures with various transaction or block verification configurations (e.g., proof of work [POW], importance, or stake) to be field tested.

The second research issue is privacy. In conflict with data protection legislation (e.g., the EU General Data Protection Regulation), blockchain solutions can allow the identification of producers, their products, and prices, and such publicly available information may be mined to profile the consumers.

Figure 3. QR code sticker for tamper evident authentication.

Design rules for a hybrid architecture that partitions off-chain data (e.g., personally identifiable information and other sensitive data) and that allows the "right to be forgotten" should be explored.

The third research issue is trust. This "grand" research issue concerns the sound and rigorous validation of the PoC that will generate trust and confidence from the producers and consumers in the FT marketplace. The current practices of using AI-based or crowdsourced recommendation or suggestion systems have been revealed to be manipulated and flawed (Sharma *et al.*, 2021). Practices of using such systems thus remain a gap in the current marketplace, which may be addressed by a DSR approach.

When the above three issues are taken as design parameters for an FT platform, the validation of the PoC will have an entrepreneurial impact on how producers and consumers interact to create and capture value in the FT marketplace. This will be another use case of an inclusive digital enterprise that promotes demonstrable innovation with digital technologies.

Use Case of an FT Platform

The scenario depicted in the previous section is not a toy problem. The lack of a "trust-free," verifiable platform has in fact inhibited the perceived affordances of FT as an opportunity for socioeconomic inclusion. Trade Aid (www.tradeaid.org.nz), founded in 1973 by the Christchurch couple Vi and Richard Cottrell, is a Kiwi social enterprise that seeks to create fairness in trade by partnering with small food and craft producers around the world. Its vision is to support and educate Kiwi consumers to join in creating a world where trade is fair for all. This is philosophically identical to another well-known voice for fair and green: The Body Shop, founded by the late Anita Roddick in 1976 in the belief that business could be made a force for good. Social enterprises are businesses with a social purpose that are run along commercial lines so as to be sustainable for all the stakeholders. In other words, aside from being a sustainable and financial trading company, Trade Aid is managed in such a way that all the business decisions made will be good for the people it works with.

From the time the founders of Trade Aid gathered their friends and cleared out their garage in preparation for artisan handcraft shipments from around the world, Trade Aid started as a social enterprise in 1973, much before the notion of social entrepreneurship was popularized. To this day, no one owns Trade Aid, or maybe everyone owns Trade Aid, particularly the

New Zealanders working together to achieve equity for all. Since its inception, Trade Aid has been wholesaling select craft and organic food products to hundreds of other Kiwi businesses, which were welcomed into the FT family of businesses. It is a *whānau* that puts people over and above all else, Kiwi businesses that know that it matters who the producers are and that they are being treated ethically. In short, the FT platform supports an entrepreneurship ecosystem in which each contributor to a final product or service derives a fair return from the venture. Since the year 2020, however, the retail outlets for Trade Aid products have often been confronted with informed and skeptical consumers who require more than a label to be assured of FT and quality (See Figure 4). This is to be expected given the preponderance of such marketing messages and of social entrepreneurship. While a product like the one in the photo on the next page may have been a radical innovation in the 1970s, it is now part of the millennial mainstream. Millennial consumers consistently choose sustainability over price per se.

Trade Aid, Vittoria, and The Body Shop franchise are examples of social enterprises that live out the Maori adage "HE AHA TE MEA NUI O TE AO. HE TĀNGATA, HE TĀNGATA, HE TĀNGATA," which translates to "What is the most important thing in the world? It is people, it is people, it is people." In the present millennium of socially aware consumers, legislation has attempted to keep abreast of all the sentiments about ethical commerce. In the United States, iTSCI was established in response to the Dodd-Frank Wall Street Reform and Consumer Protection Act, which requires U.S. companies to vet their supply chains. Specifically, section 1502 of the Act requires resource-mining companies to disclose if they source conflict minerals such as tin, tungsten, tantalum, and gold from the Democratic Republic of Congo and/or nine other countries considered "hotspots." iTSCi's "bagging and tagging" system is an example of a traceability scheme in non-blockchain supply chains and involves a five-step due-diligence framework.

Figure 4. Product label traceability.

Internationally, there are suggested remedies. Given its troubled past, the Modern Slavery Act 2015 in the United Kingdom aims to fight modern-day socioeconomic slavery. This law requires organizations conducting business in the U.K. with worldwide revenues of at least £36 million to publish a transparency statement explaining the steps that they took in the previous financial year to ensure that their business and supply chains would be free from indentured labor and human trafficking. The British embassies in the Association of Southeast Asian Nations member countries funded the eMin tool to track contract workers in the maritime fishing industry and to compel them to comply with the aforementioned law. This blockchain-based mobile app (https://www.eminproject.com/) is used to store copies of employment contracts for workers in the maritime fishing industry and other aquacultural sectors. Employment contracts and related data are stored on the Ethereum platform, and both workers and employers can access their contracts, which will give them a basis for adjudicating the rights and benefits that were offered to them at the time of their recruitment. A blockchain platform augmented with smart contracts that enforce producer rights and fair pricing can enforce compliance with such legislation, which, after all, can only be as effective as its enforceability.

Ethereum Proof of Concept

At this exploratory stage of our DSR study, a PoC comprises Unified Modeling Language (UML v 2.0) design artifacts, which served to clarify the research understanding of the context, use cases, and sequences. Some of these artifacts are given in the Appendices.

A considered choice was made to use the Ethereum platform (rather than HyperLedger) for the development of the PoC. Ethereum is an open-source environment and has functionalities for smart contracts that run on top of it. Therefore, Ethereum is a public blockchain that offers a decentralized virtual machine providing smart contracts for private or permissioned blockchains. While Ethereum has one of the most extensive cryptocurrency offerings, with hundreds of private blockchains globally, it does not have an installed database larger than that of HyperLedger. To go around the scalability and interoperability issues of blockchain, IBM has partnered with Ethereum to build a blockchain platform that is more powerful than either Ethereum itself or HyperLedger. Moreover, while HyperLedger is a private blockchain that is currently in the beta stage, it offers features similar to those of the Ethereum blockchain, but in a more sophisticated and secure manner. As it is

used only for enterprise-level purposes and not by cryptocurrency miners or crypto-investors, it is considered a more serious platform. HyperLedger has such a reputation because it is very fast and scalable as it was built specifically for enterprise use whereas Ethereum was built as an open-source public blockchain. IBM also plans to integrate its own cross-chain system into the unified blockchain platform, allowing the exchange of different cryptocurrencies without using an exchange or third-party agent.

To obtain an initial understanding of the requirements of a blockchain-enabled FT platform, a context diagram was developed using UML. This is shown in Appendix A. Subsequently, a typical use case was discussed. Both the context and use case diagrams serve as design artifacts for clarifying the requirements of the specifications for the later development of the PoC. To represent the dynamic behavior of the FT platform, the use case diagram was made to include the significant actors and typical scenarios, and their relationships. All the major internal and external influences were incorporated so that the system interaction with other entities could be explicitly displayed. The functional requirements were translated to represent the major tasks and operations in a systematic manner, in accordance with the standard supply chain procedures. The standard UML naming convention was followed for easier the identification and understanding of events and their flow of logic. The diagram was repeatedly refined to achieve a well-structured system depiction.

Appendix D shows the UML sequence diagram of how the concept of the blockchain technology using the Ethereum platform may be used in the supply chain management for fair trading. All the main actors of the supply chain are duly represented: the producer (manufacturer), distributor (the one who packages the product), reseller (the one who sells the product to the consumers), consumer (buyer), validator (the one who validates the blocks), and approver (the one who provides the FT label). The cycle begins when a coffee-roasting enterprise known as ABC Company, for instance, signs the smart contract. The smart contract comprises the digital terms and conditions that should be accepted before performing any transaction inside the blockchain network. This process focuses on the transaction between the seller and the buyer. The steps below will further elaborate the sequence of steps necessary to establish the setup of this technology.

1. The smart contract has to be accepted by the producer, distributor, and resellers of the FT produce (i.e., coffee). For this, the digital contract is shared and agreement is received from all the parties.

2. Before buying the product, the consumer will scan a QR code, for instance, and the shared contract will be matched to the seller to initialize the transaction. In parallel, the transaction will also be performed by the seller.

3. At the same time, the transfer of assets (coffee beans) associated with the smart contract and the transaction will be certified by the approver. If the assets match the smart contract, the approver will store the transaction records in the shared ledger.

4. When the transaction is performed, the other parties in the distribution chain will also be notified, and storage will be done after the transaction is approved.

5. As the payment gateway is enabled for the transfer of the money from the buyer to the seller, the blocks are updated and retired.

Preliminary experience suggests that the approach suggested above is potentially feasible. As a next step, a pilot implementation will be validated in the field for FT merchants such as Trade Aid.

CONTRIBUTIONS TO DIGITAL ENTERPRISE RESEARCH

The validated findings will contribute to digital innovation and enterprise researchers' theoretical understanding of the affordances of blockchain and augmented technologies in addressing the challenge of generating trust in the marketplace. While research on trust is a long-standing market research tradition, never has the idea of a distributed autonomous organization been applied to co-opt confidence and participation in a digital platform. A practical outcome would be that the PoC will demonstrate the basis for scaling up the platform to include a larger community of producers, distributors, and consumers. While this may be applicable to a host of other labels for halal, sustainable, environment-friendly, or organic food, the key theoretical and practical contribution of the present research will be to make the digital marketplace for food more inclusive to producers who wish for FT.

As MIT's 2018 Platform Strategy Summit declared, "Everywhere there can be a platform, there will be a platform." The summit closed with three value propositions for the use of blockchain: *(1) improving efficiency, security, and transparency in traditional businesses; (2) reducing transaction friction across platforms; and (3) adding new revenue streams in the form of payments and efficient ways to transfer value. The above represent opportunities for a digital venture. Natarajan *et al.* (2019) have performed an extensive field study of middle-management involvement in the adoption of technology platforms for addressing distribution and compliance challenges. It is clear that a blockchain platform will also need to confront a host of stakeholder issues to become effective. Investigating managerial challenges and deriving suitable solutions is therefore another fruitful avenue for further research.

A platform strategy of future work can scale to include scenarios that inter-operate with other labels, such as halal, rainforest-friendly, sustainably produced, and 100% NZ Pure (BBC, 2019). Another fruitful avenue for entrepreneurship research is the market's acceptance of appropriate verification and consensus mechanisms such as POW (Technopedia, n.d.) on the blockchain platform. Then authentication of the labels of quality assurance, composition, or origin and consumer ratings and recommendations may be verified in a "trust-free" manner. While Choo *et al.* (2020) provided a recent and comprehensive set of managerial issues in blockchain research, workaround mechanisms that enforce the 3TIC attributes of blockchain platforms are gaps in the current research that need to be addressed. Such market analyses will highlight the multiple digital capabilities required to effectively conceive, design, implement, deploy, and evolve FT platforms in complex socio-technical environments. Demiray *et al.* (2021) suggested an entire stream of fruitful research in exploring new opportunities for entrepreneurs and businesses in collaborative or sharing platforms. The effects of institutional regulatory, cognitive, and normative dimensions on the perceptions of producers' and consumers' trust and engagement were investigated to understand their perspectives and what it took to maintain their continued participation in FT activities. In addition, trust enables engagement, which builds positive word of mouth (WOM) and satisfaction in the crowdfunding community. A blockchain-enabled FT ecosystem can be effectively designed to promote trust, positive WOM, and a good reputation among the producers, distributors, and consumers of products labeled "Fairtrade."

There is considerable agreement among scholars and policymakers that digital innovation and entrepreneurship are engines of growth and societal development and platforms for establishing new business enterprises and possibly generating socially inclusive growth (Shaikh *et al.,* 2020). Digital innovation and enterprise research must examine the opportunities offered by digital platforms and how millennial entrepreneurs may exploit these to bring socioeconomic value to the marketplace.

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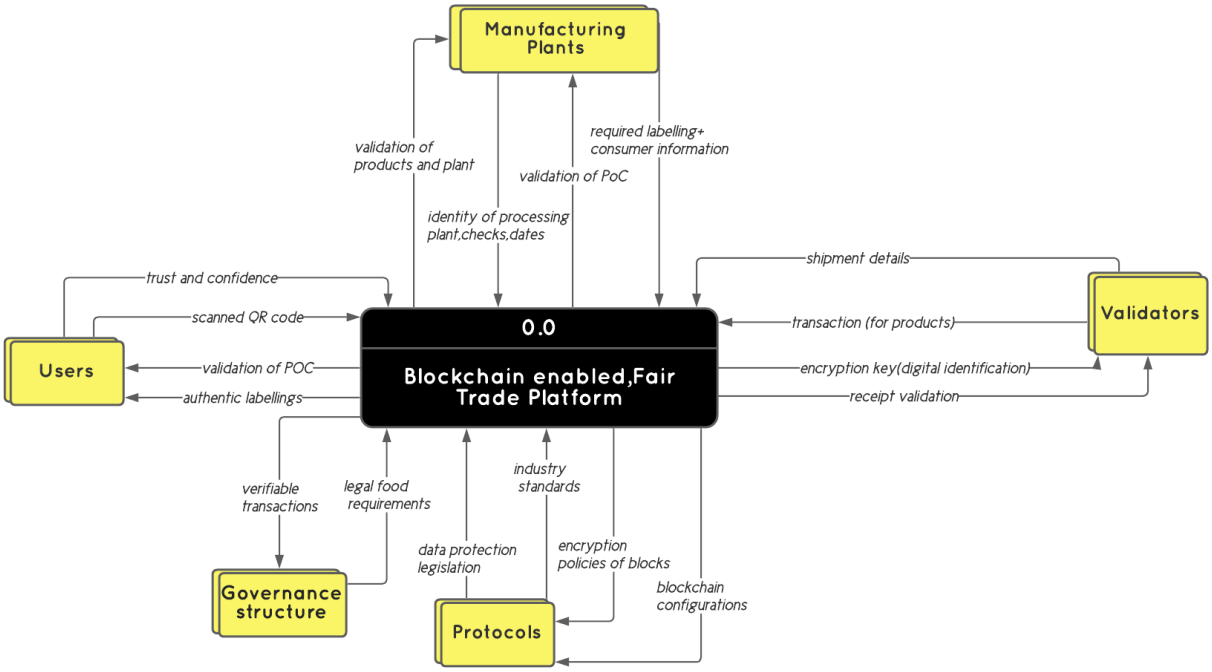
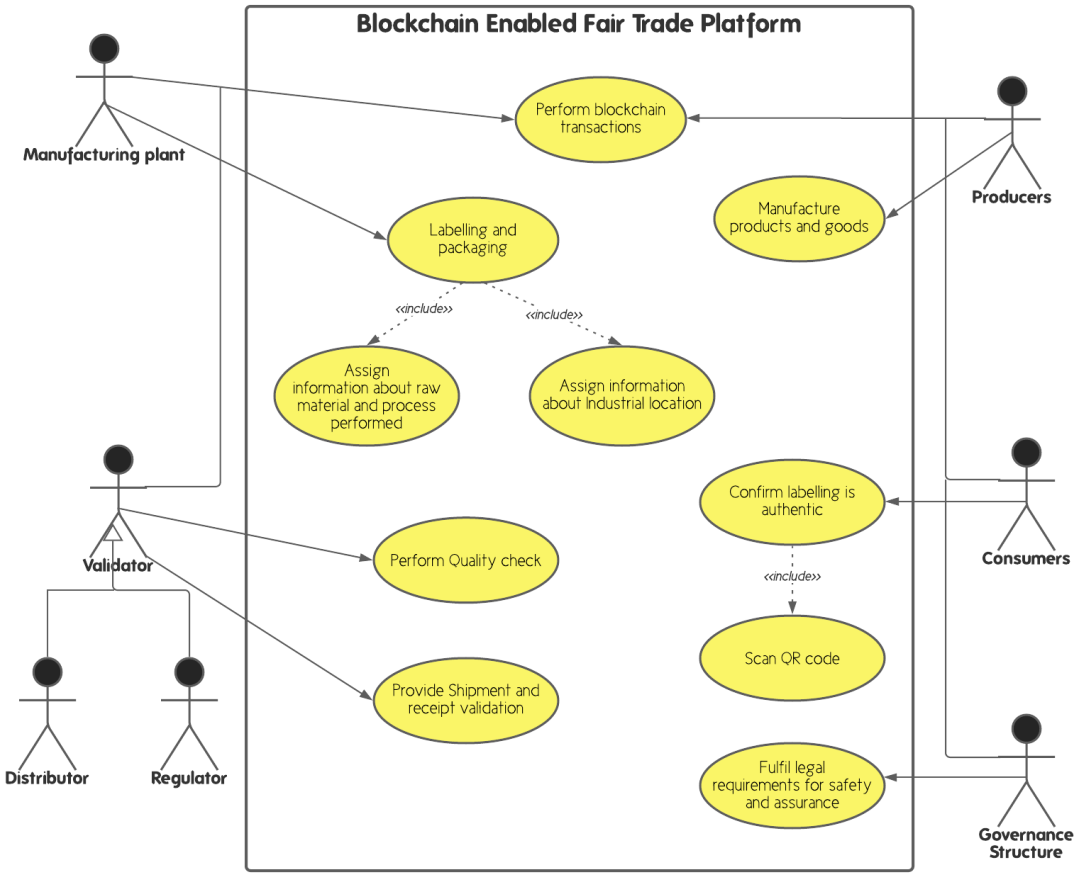
APPENDIX – Unified Modeling Language (UML 2.0) Design Artifacts of the Fairtrade Platform

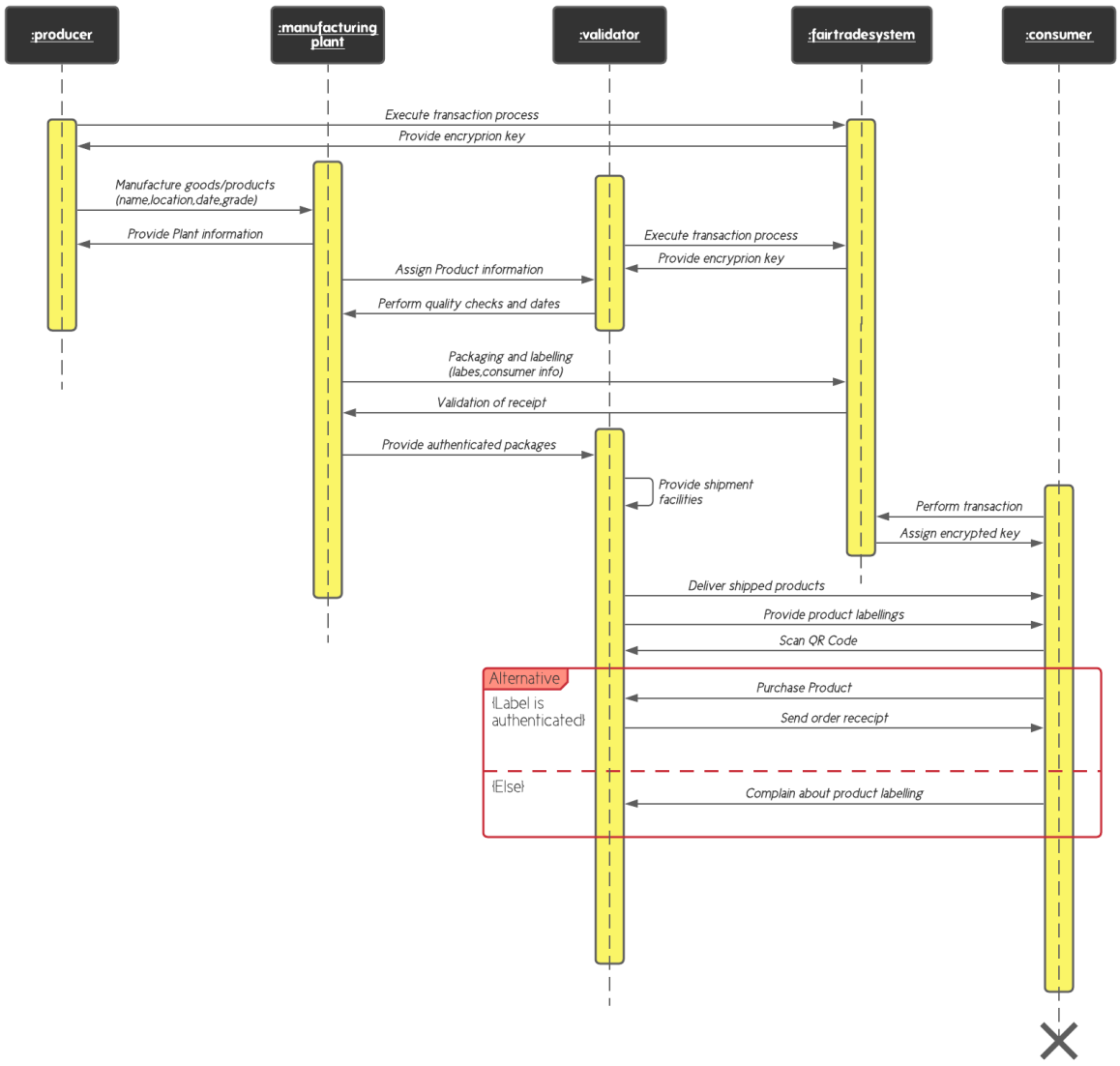
A. Context Diagram for Blockchain-enabled FT Platform.



B. Use Case Diagram for 3TIC Fair-Trade.



C. Sequence Diagram for Typical Fair-Trade Transaction (Generic Solution)



D. Sequence Diagram for Blockchain-Enabled Fair-Trade Solution