UNIKASSEL
VERSITÄT

Blockchain Technology in Sustainable Fashion Acquisition

— Bachelor Thesis Exposé —

University of Kassel

Department of Economics

DMCC - Dialog Marketing Competence Center

Submitted by:

Patrick Hassl – 33236016

Obere Königsstraße 22

34117 Kassel

patrick@hassl.de

To review for:

Prof. Dr. Ralf Wagner

Kassel, December 2019

Table of Contents

List of Tables

List of Figures

1. Introduction and Theoretical Background

The impetus for this bachelor thesis is based on three contemporary observations. The first one being the abundance of sustainability certification- and eco-labels in the retail fashion industry. The question arises whether or not these testaments of trustworthiness suffice to provide for the trust of consumers in the sustainability claims of various companies. Especially in the global textile production a variety of these labels can be found. The urge for sustainability, as it is coming from the visible problems of rising CO2 emissions as well as increasing water pollution due to chemicals and plastics, has become a fundamental issue for consumers and their decision-making process when shopping for new clothing and when taking position towards a company. Secondly, there is an ongoing global trend for vintage in apparel for the last ten years, backing the first observation by documenting a change in consumers' purchasing behavior, attitudes, and skepticism towards these items (Keim & Wagner, 2018). The rise of this vintage trend is triggered by, but also evidence for, the changes in both individual and social values and eco-sustainability as a lifestyle (cf. Cassidy & Bennett, 2012; in Keim & Wagner, 2018). The third observation is the current ongoing emergence of blockchain technology into mainstream, as the technology is being used by many companies for a variety of different purposes already, especially proving beneficial in supply chain management.

From a consumer-sided view, the variety of different labels adds confusion rather than orientation to decision processes (cf. Goryagin & Wagner, 2018). This not necessarily only considers a 'to buy' or 'not to buy' decision, but is essentially a question of trust, when it comes to the sustainability pledge of companies in the retail fashion business. In this thesis the adoption of an application, based on blockchain technology, to provide supply chain related information of a textile product to consumers to not only ease their decision-making process, but also to deliver tangible and trustworthy data, wants to be examined. Indeed, most retailers already pledge for transparency across their supply chain, promise fair pay and sustainable production and certify this with their own 'green' labels and campaigns, plus there are many third party labels verifying the sustainable production of an article or the sustainable sourcing of materials, as well as fair working conditions, such as 'OEKO-TEX', the 'Global Organic Textile Standard (GOTS)' or the 'Fair Trade' certification. However, consumers might find it difficult to build their trust solely upon these certifications, especially when it comes to companies that in the past have disappointed in that matter. This is due to the sheer lack of reliable sources and truth behind the amounts of data available to consumers that they need to process. Consumers want more reliable sources of data (cf. Goryagin & Wagner, 2018). This is

where blockchain technology can enfold its potential as a 'trustless trust' facility. Certainly, the distributed ledger technology itself cannot assure that the information inside is inherently correct, but it can assure that all entries are consistent, immutable and decentralized at best. It is a technology that is able to increase the level of security of information and can help build trust in a company's supply chain and product specifications in a way that given eco-badges and sustainability certifications arguably cannot. Nevertheless, it eventually comes down to the willingness of a company itself to act transparently and open about their supply chain and manufacturing processes. In theory, the consumer-sided adoption of a mobile application based on the blockchain technology implementation in smart supply chains as it is proposed in this paper, could help gearing the worldwide retail fashion industry towards a more sustainable and ethical production process, whilst being profitable for companies the same time, opening up new ways for eco-friendly marketing and transparent company vision and mission statements in an increasingly ecologically concerned and highly technologically affine society minimizing supply chain risk management synchronously. The possible consumer-end adoption of a tool like this, as well as the alleged trust that is put into blockchain technology, as opposed to the verification for a sustainable production via label, is to be examined throughout this research.

2. Current State of Research

There have been many research studies on blockchain related subjects over the past years with a considerable amount of them focusing on the connection to supply chain management. Adoption has been a subject apart from everything Bitcoin related and trust has been considered an important element throughout various researches regarding technology use, while being proposed as a central element provided by blockchain technology. The following table presents an overview of the most recent relevant research studies and articles regarding the subject of this thesis.

Subject	Title	Authors	Journal	Contents
UTAUT/Blockchain and SCM/Blockchain and Trust	The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency	Kristoffer Francisco; David Swanson	Logistics, Vol. 2, Issue 1, p 2, MDPI AG, 2018.	Costumer-end research on blockchain traceability applications employing UTAUT
UTAUT/Blockchain and Trust	An empirical study of behavioral intention to use blockchain technology	Lee, C.; Kriscenski, John; Lim, Hyoun	Journal of International Business Disciplines, Vol. 14, Issue 1, p 1-21, May 2019.	Research of acceptance of blockchain technology using UTAUT

UTAUT/Blockchain and SCM	Blockchain adoption challenges in supply chain: An empirical investigation of the main drivers in India and the USA	Queiroz, Maciel M.; Fosso Wamba, Samuel	International Journal of Information Management, p 70-82, June 2019	Research on the individual blockchain adoption behavior in the logistics and supply chain field in India and the USA.
Blockchain and SCM	Enhancing Trust of Supply Chain Using Blockchain Platform with Robust Data Model and Verification Mechanisms	Oh, Byungsoo; Jun, Tae Joon; Yoon, Wondeuk; Lee, Yunho; Kim, Sangtae; Kim, Daeyoung	IEEE International Conference on Systems, Man and Cybernetics: p 3504-3511, 2019	Technical Supply Chain Model utilizing Blockchain technology
Blockchain and SCM	Blockchain for and in Logistics: What to Adopt and Where to Start	Mario Dobrovnik; David M. Herold; Elmar Fürst; Sebastian Kummer	Logistics, Vol 2, Issue 3, p 18, MDPI AG, 2018.	Identifies blockchain opportunities in the logistics industry.
Blockchain and Sustainability/Blockchain and the Fashion Industry	Blockchain for a Traceable, Circular Textile Supply Chain: A Requirements Approach	Rusinek, M.; Hao, Z.; Radziwill, N.	Software Quality Professional, Volume 21, Issue 1, p 4-24, December 2018.	Examines the feasibility of using blockchain in textile supply chain management to increase traceability and sustainability.
Blockchain and SCM/Blockchain and Sustainability	Blockchain Practices, Potentials, and Perspectives in Greening Supply Chains	Kouhizadeh, Mahtab & Sarkis, Joseph.	Sustainability, Volume 10, Issue 10, Switzerland, Europe: Multidisciplinary Digital Publishing Institute, 2018.	Seeks to help advance the discussion and motivate additional practice and research related to green supply chains and blockchain technology.
Blockchain and SCM	Making sense of blockchain technology: How will it transform supply chains?	Yingli Wang; Meita Singgih; Jingyao Wang; Mihaela Rit	International Journal of Production Economics Volume 211, Pages 221-236, May 2019.	Sensemaking theory to gauge foresights via expert interviews.
Blockchain and SCM	Block-Supply Chain: A New Anti-Counterfeiting Supply Chain Using NFC and Blockchain	Naif Alzahrani; Nirupama Bulusu	Conference Paper	Proposed block-supply chain system that was able to track-and-trace products and detect modification, cloning, and tag reapplication attacks.
Blockchain and SCM	Blockchain in Logistics and Supply Chain: Trick or Treat?	Niels Hackius; Moritz Petersen	Conference: Hamburg International Conference of Logistics, Volume: Digitalization in Supply Chain Management and Logistics, October 2017	Online survey with logistics professionals for their opinion on use case exemplars, barriers, facilitators, and the general prospects of Blockchain in logistics and supply chain management.
Blockchain and SCM	Blockchains and the Supply Chain: Findings from a Broad Study of Practitioners	Saberi, S.; Kouhizadeh, M.; Sarkis, J.	IEEE Engineering Management Review, 47(3) p 95-103, January 2019	Explores how a variety of motivators and barriers are perceived by different companies from different industries.
Blockchain and Sustainability	Blockchain Applications and Sustainability Issues	Roberto Leonardo Rana; Pasquale Giungato; Angela Tarabella; Caterina Tricase	Amfiteatru Economic, Volume 21, Issue Special Issue 13, p 861-870, 2019	Describes the recent trends in the applications of the blockchain technology in the

				cryptocurrencies market and new projects considering environmental and social impacts.
Blockchain and SCM	Supply Chain using Smart Contract: A Blockchain enabled model with Traceability and Ownership Management	Koirala, Ravi Chandra; Dahal, Keshav; Matalonga, Santiago	9th International Conference on Cloud Computing, Data Science & Engineering, p 538-544, January 2019.	Presents a general model for a blockchain enabled supply chain using three smart contracts on an Ethereum platform.
Blockchain and SCM/Blockchain and Sustainability	Blockchain critical success factors for sustainable supply chain	Sachin Yadav; Surya Prakash Singh	Resources, Conservation and Recycling Volume 152, January 2020	This research represents the significant role of causes, which leads to the integration of BC with the SC resulting in achieving sustainability using Principal Component Analysis.
Blockchain and SCM/Blockchain and Sustainability/Blockchain and the Fashion Industry	The role of blockchain technology for transparency in the fashion supply chain	Jordan, Alicja; Rasmussen, Louise Bonde	Master thesis	Interviews with blockchain professionals and industry experts in supply chains and sustainable fashion. The study finds that blockchain has the potential to become the single source of truth for the fashion supply chain and provide transparency across the supply chain.
Blockchain and the Fashion Industry	How technology can help fashion retail's eco ambition	Sillitoe, Ben	Computer Weekly. Issue 1/29/19, p 19-22, 2019.	The article offers tips on the contribution of technology to fashion retail industry. Among these suggestions are the application of blockchain.
Blockchain and SCM/Blockchain and Sustainability	Blockchain technology and its relationships to sustainable supply chain management	Sara Saberi, Mahtab Kouhizadeh, Joseph Sarkis & Lejia Shen	International Journal of Production Research Volume 57, Issue 7, 2019.	How blockchain can address and aid supply chain sustainability.
Blockchain and Trust	Trusting in trustless trust: Blockchain information storage in product communication	Goryagin, K. & Wagner, R.	Strategica: International Academic Conference, Sixth Edition, Bucharest, October 2018.	Provides an assessment of consumers' trust regarding the concept of trustless trust as empirical results of a survey on consumer trust in trustless trust facilities provided by distributed ledger technologies are reported.

Blockchain and Trust	The Trust Economy	Philipp Kristian Diekhöner	Springer Berlin Heidelberg, 2018.	Shows contemporary problems and models methods for new innovations regarding the value chains of a digitalized economy in which trust plays a major role.
Blockchain and Trust	Vertrauen und Transparenz – Blockchain-Technologie als digitaler Vertrauenskatalysator	Silvia Palka; Volker Wittpahl	iit perspektive Nr. 39, Institut für Innovation und Technik (iit), Berlin, Juni 2018.	Looks at blockchain technology as catalyst for trust building.

Table 1: Current state of research

3. Thesis Objective, Research Gap, Questions & Limitations

The main objective of this study is to assess the consumer-end behavioral intention to use an application that is based on blockchain technology in their acquisition of sustainable produced clothing. The research question is formed as follows:

RQ: '*What are the key determinants that influence the behavioral intention to adopt the use of a tool based on blockchain technology for a sustainable consumption of retail fashion products?'.*

Also, the following sub-question is to be clarified:

SQ: '*Does a blockchain based application rather than a label provide trust in a retail fashion company's sustainability claim?'*

As it is visible in the stated questions, the focus of this research is clearly set on the retail fashion business, even though blockchain technology is applicable in other industries as well.

To be specific in the empirical research and elaboration of this paper, the blockchain technology will not be examined in all its technological scope, neither will all of its possible ramifications be. The essential context that applies here will be the theoretical benefit of a distributed ledger system in the globalized supply chains of the retail fashion industry.

Furthermore, the research is conducted with attention to consumer-use context only. The research gap is embedded in the fact that most applications that are utilizing blockchain technology, at least regarding supply chain related applications, focus on corporate usage, whereas the application in mind wants to provide information to the end-consumer. Besides, there are not many previous studies connecting blockchain technology to the fashion industry.

4. Proposed Conceptual Framework

The study wants to employ a fictitious mobile application that retrieves information about an article of clothing from a blockchain and provides this information to the customer by scanning a QR-Code attached to the article with a smartphone. The displayed information includes various general product information as well as supply chain related information, which can be customized through different predefined filters according to the information available in the database. An example would be the origin of a certain fabric that has been used in a certain piece of clothing or the place it has been shipped from to the place it reaches retail. In theory it is presupposed that all stations of the supply chain are reflected throughout the blockchain and can be retrieved with the application. It is purely fictious and has been made up for the purpose of this research.

Since the research attempts to explore the behavioral intention of customers to use such a tool in practice, participants of the study will be familiarized with the concept and the notion of blockchain technology as well as with the basic functionality of the application. This research also aims to complement to the study of Wagner and Goryagin from 2018 ‘Trusting in trustless trust: Blockchain information storage in product communication’, as ‘Trust’ is not only an essential concept in the field of consumer behavior, but also one fundamental feature of blockchain technology, hence the study’s sub-question in regards to their findings. To assess the proposed research questions an online questionnaire will be developed and conducted via Google Forms. The items will be based on the Unified Theory of Acceptance and Use of Technology 2 model (UTAUT2). The model synthesizes previous theories and models about technology acceptance and is tailored specifically to consumer use setting (Venkatesh, 2012). The authors suggested the extension of the model to better adapt to the appropriate settings, therefore the model will be modified as shown below.

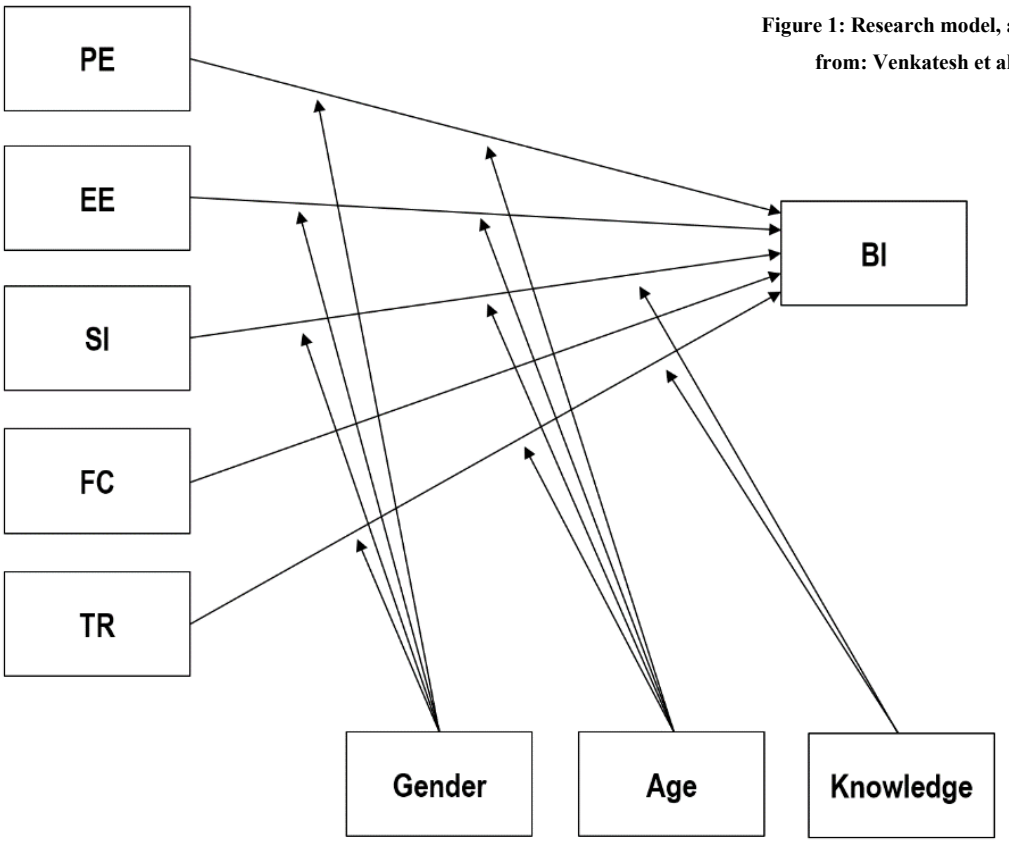

Figure 1: Research model, adapted from: Venkatesh et al. (2012)

5. Hypothesis Development

Performance Expectancy

Performance Expectancy (PE) has proven to be the most crucial determinant of behavioral intention (BI) of using a technology (Williams et al., 2015, in Francisco & Swanson, 2018; Venkatesh et al., 2003), therefore it is expected that the intention to use the application in mind will be higher if consumers think that blockchain technology will be beneficial for their acquisition of sustainably produced clothing.

H1: Performance Expectancy has a significant effect on Behavioral Intention.

Furthermore, the models moderating variables Gender and Age are expected to have effect on PE. As Venkatesh et al. (2003) stated, PE of men should be higher according to them being more task-oriented. 'Gender effects may be driven by psychological phenomena embodied within socially constructed gender roles (Lubinski et al. 1983, in Venkatesh et al., 2003). As it is observable with most new technological innovations, age is expected to play a role in its acceptance and in accordance to Levy (1988, in Venkatesh et al., 2003) studies of gender differences can be misleading without reference to age.

Knowledge about blockchain technology is not expected to have a moderating effect on PE, since for the application in this study (and for many other instances where blockchain technology is used), blockchain is the underlying technology and need not be fully understood to use. In other words, the application will perform the same, even without the user having more knowledge about the underlying technology.

H1a: The effect of Performance Expectancy on Behavioral Intention is moderated by Gender.
H1b: The effect of Performance Expectancy on Behavioral Intention is moderated by Age.

Effort Expectancy

Effort Expectancy (EE) refers to the ease of usage of the technology in question. It is equitable to suppose that the intention to use the application is higher, if there is not much effort involved in actually understanding and using the application.

H2: Effort Expectancy has a significant effect on Behavioral Intention.

Plude & Hoyer (1985, in Venkatesh et al., 2003) found, that increased age was associated with difficulty in processing complex stimuli and allocation attention to information complex stimuli and allocating attention to information, which is necessary when using the application. It is also suggested by Venkatesh and Morris (2000, in Venkatesh et al., 2003) that the effect of EE on behavioral intention is stronger for women. For the moderating role of having knowledge about blockchain technology, the same assumptions as for PE are hold.

H2a: The effect of Effort Expectancy on Behavioral Intention is moderated by Gender.
H2b: The effect of Effort Expectancy on Behavioral Intention is moderated by Age.

Social Influence

Social influence (SI) is defined as the degree to which an individual perceives the opinions of others as important. Since the recognition of worldwide ecological problems has become inevitable for almost everyone in society it is to assume that others opinions do matter in the act of consuming, and at least to a certain extend in the acquisition of new clothing as well and therefore in the behavioral intention to use the proposed application. However, ‘the role of

social influence in technology acceptance decisions is complex and subject to a wide range of contingent influences' (Venkatesh et al., 2003).

H3: Social Influence has a significant effect on Behavioral Intention.

It is suggested that men tend to be less sensitive to other people's opinions than women, with the effect declining with experience (i.e. knowledge) and increasing with age (Miller, 1976; Venkatesh & Morris, 2000, in Venkatesh et al., 2003).

H3a: The effect of Social Influence on Behavioral Intention is moderated by Gender
H3b: The effect of Social Influence on Behavioral Intention is moderated by Age.
H3c: The effect of Social Influence on Behavioral Intention is moderated by Knowledge.

Trust

Other than Francisco & Swanson (2018), who incorporated Trust (TR) as a moderating factor in their model, it is integrated here as a determining factor for the behavioral intention to use a technology, because of the assumption that in the process of acquiring sustainably produced clothing, trust in blockchain technology can be a central motivator for using the proposed application.

H4: Trust has a significant effect on Behavioral Intention.

For the moderators Awad & Ragowsky (2008, in Slade et al., 2013) found that the effect of trust on behavioral intention was important for both genders, however it was slightly more important for women. Francisco & Swanson (2018) claim that, 'the more users exercise and learn about technology, the more experience and knowledge they have, and the more trustworthy the technology seems to them', so it is therefore hypothesized that knowledge will have a moderating effect on trust as well. In accordance to the context of building trust in a company's sustainability pledge and to what Goryagin & Wagner (2018) concluded from their study, it can be assumed that increased knowledge about blockchain and trust work contrarily, since 'the majority of those who know what blockchain technology is understand that there is no such attribute as trustworthiness' in the data provided by a blockchain. Moreover, age is to

expected to have an effect on trust, since older users with less technological affinity are assumed to have less trust in technology generally.

H4a: The effect of Trust on Behavioral Intention is moderated by Gender.
H4b: The effect of Trust on Behavioral Intention is moderated by Age.
H4c: The effect of Trust on Behavioral Intention is moderated by Knowledge.

Facilitating Conditions

The Facilitating Condition (FC) the application in mind requires is a smart device. Not owning one would pose imminent hindrance for the behavioral intention to do so.

H5: Facilitating Conditions have a significant effect on Behavioral Intention.

To assess what has been hypothesized above, the questionnaire will be composed as shown in the table below.

Section A	***UTAUT core elements***
	PE
	EE
	SI
	TR
	BI
Section B	*Demographic Profile including:*
	Gender
	Age
	Knowledge
	FC

Table 2: Survey layout

6. Provisional Thesis Structure

The structure below is a work in progress and just serves as an overview. It will change to some extend in the final paper.

1. Chapter 1 - Introduction

1.1. Research Background

1.2. Thesis Objective, Research Question and Limitations

1.3. Proposed Conceptual Framework

2. Chapter 2 - Blockchain Technology

2.1. Overview

2.2. Basic Functionality

2.3. Types of Blockchains

2.4. Smart Contracts

2.5. Blockchain Technology in Supply Chain Management

3. Chapter 3 – Trust

3.1. The Concept of Trust

3.2. The Importance of Trust in a Digital World

3.3. Trust in Blockchain

4. Chapter 4 – The Fashion Industry

4.1. Environmental Issues

4.2. Sustainability in the Fashion Retail Chain

4.3. Sustainability Textile Certifications

4.4. Technology in Fashion Retail

5. Chapter 5 – Methodology

5.1. Introduction to the Unified Theory of Acceptance and Use of Technology

5.2. Research Design

5.3. Hypothesis Development

5.4. Data Collection

6. **Chapter 6 – Data Analysis**
    - 6.1. Descriptive Analysis
    - 6.2. Structural Equation Model
    - 6.3. Results
    - 6.4. Summary
7. **Chapter 7 – Discussion and Conclusion**
8. **Summary**

7. Schedule

Time	Phase	Plan
November – December '19	Research Phase	Literature Review & Preparation of the Exposé
January 2020	Theory Phase	Discussion of the Exposé and Questionnaire / Finishing the Theoretical Part of the Thesis
January 2020	Data Collection	Performing Survey
February 2020	Analysis & Finishing Phase	Analyzing Results & Finishing Thesis

References

Francisco, K., & Swanson, D. (2018). The Supply Chain Has No Clothes: Technology Adoption of Blockchain for Supply Chain Transparency. Logistics, 2(1), 2. doi:10.3390/logistics2010002

Goryagin, K., & Wagner, R. (2018). Trusting in trustless trust: Blockchain information storage in product communication. Strategica, International Academic Conference, 6. 718-729.

Keim, C., & Wagner, R. (2018). Back in time to move forward: An empirical study on luxury fashion vintage drivers. Journal of Global Fashion Marketing, 9:2, 87-102. doi:10.1080/20932685.2018.1432408

Slade, E., Williams, M., Dwivedi, Y. (2013). Extending UTAUT2 To Explore Consumer Adoption of Mobile Payments. UK Academy for Information Systems Conference Proceedings, 36.

Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425-478. doi:10.2307/30036540

Venkatesh, V., Thong, J., & Xu, X. (2012). Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology. MIS Quarterly, 36(1), 157-178.

Williams, M., Rana, N., Dwivedi, Y. (2015). The unified theory of acceptance and use of technology (UTAUT): A literature review. Journal of Enterprise Information Management, 28, 443-488.