Behavioural and organisational factors determination in **Blockchain analysis**

ABSTRACT

Aims: to describewhich behavioural and organisational factors determine the adoption of blockchain technology,next to technical aspects.

Research questions:(1) "Why would companies use it and insert information considered as strategic?"*(2)* "Why wouldcustomers use it and consumers trust it?"

Study design/methodology: a literature review combined with mind mapping describespotentially promising strong aspects andvulnerabilities. Limitations inpresent blockchain use are considered before moving towards a research method that observes, explains and predicts relevant human decision behaviour. A mixed methods approach of qualitative research applyingAtlas.tiuses participative observations next to narratives and interviews with selected interviewees. ThisStep Wise Two Stage MiniDelphi approach was used, resulting in the opinions of experts in Supply Chain Management, fashion, food and IT.

Theoretical framework: a Grounded Theory based methodology is used;various types of Institutional Isomorphismformthemain theoretical framework, next to the Resource Based View and Resource Dependence Theory.The behaviouraland organisational factors relevant in actual decision making are captured in a hypothetical LISREL model.

*Findings:*blockchain technology has the *potential* to facilitate secure information transfer, meeting demands of transparency, traceability, confidentiality, security, integrity and availability. However, it expires that adoption not so much is determined by technical aspects. The willingness to insert strategic information satisfying downstream actors, is balancing the trust downstream actors have in upstream actors. Factors that make upstream actors decide to adopt are *(1)* price and total costs versus perceived additional revenue, reputation and competitiveness; *(2)* coercion, mimetic behaviour, following the industry norms, regulation or other external drivers. Using block chain as marketing tool for only part of the total volume of goods occurs. Volatile and momentary supply networks are less suitable; so are situations where the supplier has no choice but to use the buyer's supply network, controlled by the buyer.

Key words: *Blockchain, Isomorphism, Supply Chain Management, Atlas.ti, Mini-Delphi*

1. INTRODUCTION AND BACKGROUND

1.1 Information sharing and variability

Supply chains (SC) are becoming more diverse and extensive as a result of a growing need for inter- and intra-organizational connectivity. This in turn is facilitated by developments in technology and tightly interconnected business processes [1]. Currently, inefficient transactions, fraud, pilferage, and poorly performing supply chains contribute to a *lack of trust* in the SC. It necessitates the need for enhanced information sharing and verifiability in many industries, including the agri-food sector [2] and high-value goods such as fashion [3].

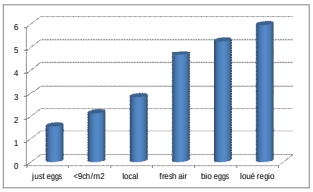
As a consequence, supply chains are experiencing an evolutionary transition as a result of continuous digitization. They are transforming into value-creating networks in which the value chain itself becomes a critical source of competitive advantage. This competitive advantage is obtained by making processes, goods and activities fulfil the specified requirements, including appropriate certifications [4]. Companies are implementing novel technologies such as the Internet of Things (IoT), cloud computing, business analytics, artificial intelligence, machine learning, and blockchain technology to cope with this dynamic environment and the increasing need to digitalize supply chains and boost competitiveness [5]. At the same time, increased demand for more sustainable and responsible products [6] builds up the pressure to conform to certain consumer expectations.

1.2 Scandals driven demand for trustfulness and completeness

Recent scandals in the global food and fashion SCs put the focus on trustfulness and completeness of information, especially dealing with: *1)* food safety;*(2)* the production of value via quality; *(3)* the battle against fraud and counterfeiting in fashion; *(4)* most important: the value of the knowledge and experience encoded in the product [7]. Consumers have become more aware of the role of the origin and quality of the products they buy, including the manufacturing and distribution. This increased the pressure imposed by for instance food safety regulations [8]. As a result, consumers and retail customers place additional pressure, by demanding more *transparency* and *traceability*. This implies improved access to information about the products they buy [8]. Security and associated certifications (such as 'Fairtrade', the EU 'AB' label or 'Organic') try to cover the complete life cycle of products. This way, they assist consumers in making more responsible consumption decisions. Presently, customers in the purchasing process are confronted with a plethora of information, mostly communicated through the brand, packaging, pricing, communication, and sales store [9].

1.3 Questions raised

Does the retailer really need a trustful information system to satisfy the end-customer's desire for information that up-stream participants in the SC might consider as 'strategic'? Or, to what extent does the end-customer actually (fully) trust the 'honesty' of its supplier, even without any certificates issued by autonomous institutions? Or, is that trust so badly damaged after the food- and fashion scandals mentioned above that additional certainties are demanded? How does anybody decide between 'no certificate', 'certified by autonomous authorities' and 'brand reputation *per se'*? How much is the consumer willing to pay for additional information it considers as critical? Figure 1 shows the apparent willingness to pay more for information about the life of chicken, when buying a simple product as *eggs*. The willingness to pay more for what one considers critical is quite significant and fits in with the US example of eggs [10].



Comment [lm1]: I recommend explaining a little more about the scandals that occurred in food and fashion so that readers have a better view of what is being said.

Source: prices (in Euro) noted by authors on 29 Nov 2021 in IntermarchéRoquebrune, France

Figure 1: Willingness to pay for information about chicken and their eggs (12 pcs).

Docustomers in the fashion chain show similar critical behaviour compared to those in food? Poisonous food may kill you while a garment polluting the river and where children are abused or workers died for, does not kill you nor makes you sick; and it is cheap. Actually, the same person may well show a different behavioural pattern: they care about food safety but with fashion care about the brand image rather than production safety. So: the pressures on the SC to reveal certain information may well differ between these two SCs.

1.4 Which factors make actors decide? Research questions

Effective information handling means satisfying the strategic information need of downstream actors in the SC. To what extend is the blockchain technology able to meet this in an effective way, and are the more upstream participants willing to meet downstream requirements? Which factors are persuasive for participants to insert the required strategic information? *Which factors make actors decide to use blockchain technology or not: price and costs, reputation, competitiveness, coercion, mimetic behaviour, following the norms, regulation or other external drivers?*

This contribution will first discuss and review the literature on blockchain use, with a focus on food and fashion as examples. Interviews – as part of a Mini-Delphi method - will add more information and will enable a hypothetical model as basis for future empirical work.

2. BLOCKCHAIN

2.1 Development of Blockchains

The development of blockchains has been dubbed one of the most significant discoveries in recent years [11]. However, according to some authors, blockchain–SCManagement (SCM) integration is still in its start-up phase [12]. Blockchain owes its recent prominence to Nakamoto [13], who used it to create the Bitcoin cryptocurrency [14]. Although its disruptive potential was originally identified in financial-oriented applications [15], enthusiasts investigated possibilities for nonfinancial uses such as e-government [16], fashion and food supply chains [17]. Blockchains, according to researchers, can provide special benefits to SCM. According to Wang *et al.*[18], blockchain increases SCM visibility and traceability since time-stamped blocks may be constructed for transactions that follow the product's digital footprint and each transaction is completely auditable. They further remark that, by design, every transaction on public blockchains is highly unstructured, ensuring user anonymity and, as a result, security. Hald and Kinra[19] examined the enabling characteristics of blockchain features on a set of data quality aspects:how *(1)* a decentralized ledger gives data availability; *(2)* cryptography guarantees immutability and tracking; *(3)* a consensus process permits data consistency. They argue that blockchain can improve supply chain visibility and transparency by maintaining irrefutable and reliable data about previous transactions. ‘Creating more openness and visibility’ as well as ‘enhancing procedures and decreasing costs’ are two significant drivers of blockchain adoption [20].

The characteristics that link blockchain to the supply chain area are often trust, technology, traceability, and transparency [21]. Recent publications also investigated if it

accomplishes the United Nations Sustainable Development Goals. Does it really improve product provenance, custody chain, and authenticity [22]. As Saberi*et al.*[23] explain, the contribution of blockchain to sustainable SCM is greater confidence in an information supply chain movement. Customers are concerned about the environment and the safety of those involved.Blomqvist and Ståhle[24] define trust as the interaction between expectations and the manifestation of those promises in the actual behaviour of the people involved.Therefore, a blockchain should enable the user to establish the quality of products and enable users to safeguard that particular supply chain [25] that effectively contributes to sustainable activities including a circular economy, less waste, and lower emissions [26[. It should connect producers to discriminating buyers, enhancing traceability, transparency [27] and trust [28]or, rather, a supply *system* or *network*containing multiple types of specialized SCs.

2.2Blockchain as *the*solution

Blockchain technology *might* be the solution; it has the ability to address various well-known supply chain difficulties [29]. Advancements and applications based on the blockchain technology idea make organizational, technological, and economic improvements possible [30]. Blockchain assumingly enables value chain exchange (or trading) partners to achieve new levels of effectiveness [31]. It is thought to maintain secure supply chain information networks as another key feature because the critical purpose of information security is to prevent user data from being modified or compromised. This begs the question of whether any SC can accomplish both efficacy and security at the same time [32].

Listing advantages, we find that blockchain use would potentially lower prices [33] and improve quality [34]; it would promote supply chain 'robustness'.Korpela*et al.*[35] argue that it may increase organisation effectiveness and cost-effective manufacturing by securing data and transactions.

2.3Beyond technology:behavioural aspects

The technology's current condition was reviewed above to shed light on the potentials *and* problems. This study will move beyond the debate over which strategy improves the effectiveness of blockchain *technology*, but will focus on organizational and behaviouristic aspects for example 'Experience', 'Living environment', 'Bias' and 'Judgments'. Therefore, these aspects are studied within the theoretical framework set by institutional isomorphism with reference resource dependence theory and the resource based view as driving forces for adaptation. The fashion and food sectors in particular will be used as focal sub-sectors because of their more outspoken demands in terms of strategic information. It should assist in delivering answers to the question"*Which factors influence the attractiveness of blockchain usage in securing key information required in for instance food and fashion supply chains?"*

2.4Key aspects

The following two key aspects were distilled from literature what blockchain use should deliver: *(1) Security,* relating to confidentiality, integrity, and availability; *(2) Transparency,* related to trust.

2.4.1 Security: confidentiality, integrity, and availability

Globalization, innovation, and the rising complexity of supply networks have enhanced our awareness of the need for security in supply chain management [36]. Data is protected by information security, preventing unauthorized access, use, disclosure, interruption, alteration, inspection, recording, or destruction of information [37]. When designing information security rules inside an organization, the aim is to preserve the three most critical components of security, known as the CIA triad: confidentiality, integrity, and availability [38]. For decades, the CIA triad has served as a fundamental conceptual foundation for information security [37]. Confidentiality implies that only authorized users have access to data or information systems. Integrity guarantees that information is reliable and correct. The availability of information ensures that authorized users have consistent access to it. As a result, this framework safeguards data quality and promotes information accessibility throughout the system.

2.4.2Transparency versus security: a trade-off?

Improving transparency and enhancing the security of supply chain networks are both crucial elements for effective SCM. However, since transparency necessitates the sharing of information among supply chain players, increased openness results in less security. Hence, there is a trade-off between transparency and secrecy. The capacity to maintain secrecy and a refusal to divulge sensitive commercial data indicate a lack of trust. Trust is built when supply chain members continuously carry out their anticipated tasks and disclose correct information [39]. This suggests that confidence may not be established if a supply chain member fails to protect critical information supplied by other members. When this occurs, there is less effective information exchange, therefore, less transparency in a supply chain.

Another implication is that volatile supply networks, with relatively short buyer-supplier relations, do not have time to build up enough trust to comply with this aspect.

Hence, the presence of trust in a supply chain should lead to more information exchange [40]. Because transparency necessitates information sharing among supply chain members [41], a lack of trust may considerably impede supply chain transparency. Trust – or rather the related 'lack of opportunism'- might be related to the 'temporal embeddedness' of a relationship, where the shadow of the *past* refers to the accumulated organizational memory about behaviour of partners and the shadow of the *future* stands for the length of the future of the relationship, controlling opportunism through an ability for 'tit-for-tat'[42]. Hence, the lack of temporal embeddedness would prevent certain configurations to be suitable for blockchain usage.

3. THEORETICAL FRAMEWORK

3.1 Institutional isomorphism

According to institutional isomorphism, firms have a variety of techniques to reduce uncertainty when faced with uncertainty.

3.1.1. Mimetic isomorphism

Mimetic isomorphism is the process of attaining conformity by *imitation;* it is a simple and effective response to uncertainty [43]. Already Cyert and March [44] suggested that when faced with uncertainty, businesses may reduce their decision-making costs by duplicating previous judgments taken by other businesses. This strategy enables a company to

supplement its specific competencies with the aggregate wisdom of other companies. Nevertheless, can mimetic isomorphism lead to better performance *per se*? Abrahamson and Rosenkopf[45] indicate that it is a sensible and lucrative concept from an economic standpoint. Imitation merely would demonstrate that businesses respond to signs (such as market indicators, peer institutions, or external capital markets) that particular behaviour or tactics may lead to superior outcomes. This would contribute to the formation of "rational bandwagons" of imitative judgments, methods, and behaviour.

3.1.2 Coercive isomorphism

Government regulations, laws, rules and external factors beyond control are likely to result in similar responses and behaviour by actors. Demands made by tax offices, customs control, animal safety regulation or consumer protection laws may and will differ between countries. The response by those who have to deal with this all can be described as *coercive* isomorphism. Actors do not copy-cat or*like* the particular option but simply are forced to apply it.

3.1.3 Normative isomorphism

Business or professional norms may next to ethical norms and values drive a person to make certain choices or at least affect them[46]. Hence, personality and leadership style are likely to have an impact on behaviour, especially when it is about deciding on normative sensitive aspects. Here, both emotional intelligence and adaptability intelligence are relevant in explaining and predicting behaviour in buyer-supplier relations [47].

3.2 Resource Dependence Theory and Resource Based View

A company may simply decide to join a particular group of companies in a blockchain since that would provide the company with *resources* it lacks *and needs*. This might be in terms of reputation, access to buyers or suppliers or simply in order to satisfy the bank, tax office or parent company. As such, this view of the Resource Dependence Theory fits well with each of the three types of institutional isomorphism just described.

From the perspective of a network of firms using blockchain technology, they may use this as a valuable Resource to persuade customers to accept their products. As such, this would fit with the Resource Based View.

4. METHODOLOGY

4.1 Mixed methods

A step-wise qualitative-quantitative exploratory research method (Mixed-Method) using a Grounded Theory approach is used. Figure 2 represents the research flow for this study.

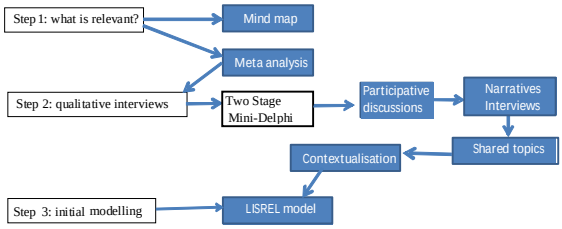


Figure 2: Research flow through 3 steps

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4.2 Meta-analysis and mind mapping

Information bases like Google Scholar, Ebsco, Scopus and WOS [48] were used for a Meta-analysis, with appropriate keywords: blockchain effectiveness, (slow) food SC, (slow) fashion SC, blockchain technology, transparency and secrecy. This resulted in a systematic review of *relevant factors and key words.* To facilitate interpretation, *mind mapping*was used to show an overview of relevant aspects, issues and topics (figure 3). From all 153 articles reviewed, six - covering a wide range of key words - were selected for table 1.

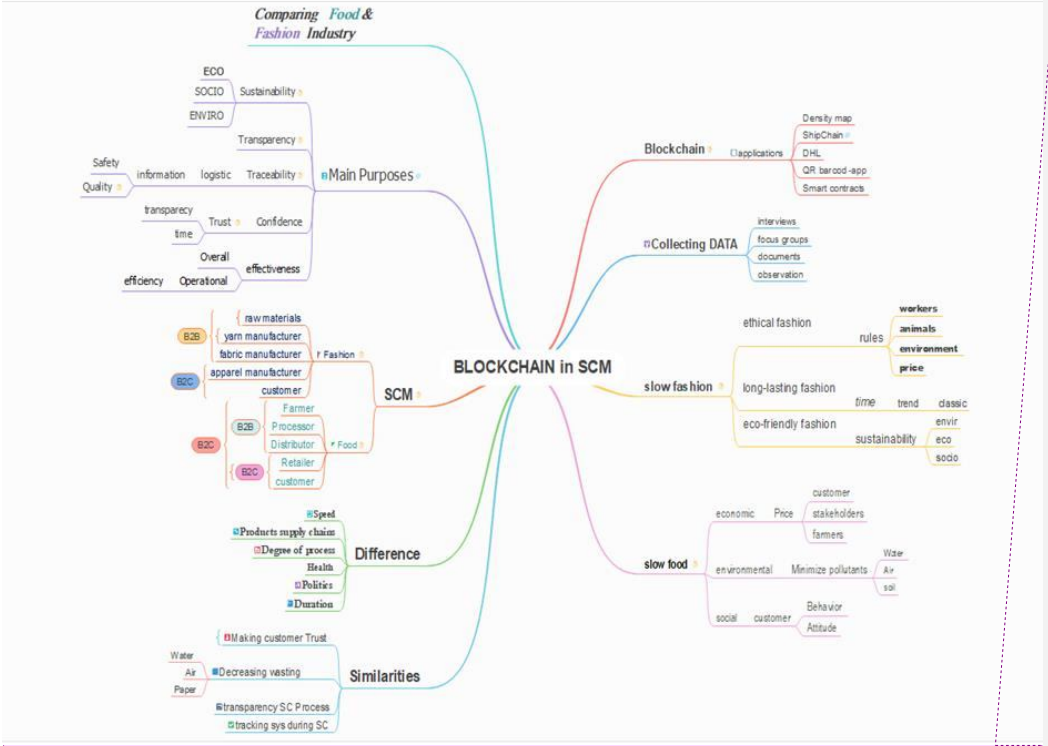

Figure 3: Mindmap of relevant aspects, issues and topics for Blockchain in SCM

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Table 1: Selected items resulting from the meta-analysis

Authors	Year	Method	Key words
Xiaoning Qian and Eleni Papadonikolaki [51]	2020	Mixture of grounded theory research and narrative research	Trust, Blockchain, Experience, Supply Chain
Alessandro Scuderi and GiuseppoTimpanaro [8]	2019	A review of the systematic literature; case studies	Blockchain, Traceability, Consumers, Security
Alexander Kharlamov and Glenn Parry [31]	2018	The reviewed literature studied	Blockchain, SC, Habits, Biases
Viswanath Venkatesh and James Thong [50]	2016	The reviewed literature studied	Theory Evaluation, Technology Acceptance and Use, Unified Theory of Acceptance and Use of Technology, Research Context, Literature Review, Multi-Level Framework
Sara Saberi, MahtabKouhizadeh, Jospeh Sarkis and Lejia Shen [23]	2018	The reviewed literature studied	Blockchain, SCM, Sustainability, barriers
Kristoffer Francisco and David Swanson [52]	2018	Introduction of Unified Theory of Acceptance (UTA)	Blockchain, Innovation, Traceability, Provenance, SCM, Transparency, Trust, UTA

4.3 Interviews: Two Stage approach

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In the second step of the study, a Two Stage Mini-Delphi strategy[49] was used, using the extracted relevant factors so far. The *first* stage aimed at collecting viewpoints by participative observations, taking part in informal discussions. Table 2 shows the 24 participants and their background.The *second* stage contained 11 interviews with selected experts. Interviews started with inducing a story-telling reply, resulting in a narrative to be analysed using software like Atlas.ti. Both Open Coding – based on the interpretation of the coder - and In Vivo Coding – as direct quote - were used. The second part of the interview was more structured and shed some further light on the factors respondents were using to secure strategic information and why they participated in blockchain use, or not.

Table 2: 24 Participants in discussions in the First Stage: gathering and checking viewpoints

Theme		Sources of data (interview or public lecture)
Blockchain	Interviewee 1A	Research fellow in blockchain solutions
	Interviewee 1B	Professor on computer security
	Public lecture 1C	6 Blockchain experts in technology
	Public lecture 1D	8 Blockchain experts in applications
Applications of Blockchain in SC	Interviewee 2A	Professional in operating electronic payment
	Interviewee 2B	Business developer of Internet of Things (IoT)
	Interviewee 2C	Economics expert researching & developing smart contracts
Construction SCM	Interviewee 3A	Construction procurement manager
	Interviewee 3B	Director of a logistics firm on construction materials
	Interviewee 3C	Operation officer of logistics firm for construction materials
	Interviewee 3D	Professional in port warehouse (logistics recorder)
	Interviewee 3E	Project manager of a construction firm

Respondents were selected to cover a broad spectre and included experts in the field of the blockchain, the supply chain, information technology, fashion, food, HRM and

consumerdemands. This way, factors extracted in the first step could be corrected and verified using their feedback.Atlas.tiwas used to check if selected topics in the first step were shared by the interviewees as important and how to contextualize them.

5 RESULTS

5.1 First Stage: Participative observations

5.1.1 Volatility

Outcome of discussions in the first stage –the participative observations part – was that not all supply networks are suitable for blockchain use. Examples are *(1)* short term supply networks in cases of project based industries and consortia, *(2)* spot buying trading companies and*(3)* capacity suppliers who get all inputs for their contracted production organised and controlled by the outsourcing customers. Apparently one needs time and longer term relationships to build up a stable network with enough trust to think about transferring potential strategic information. That implies that all volatile supply networks are less suitable for using blockchain. This may exclude quite a large number of supplier networks, actually.

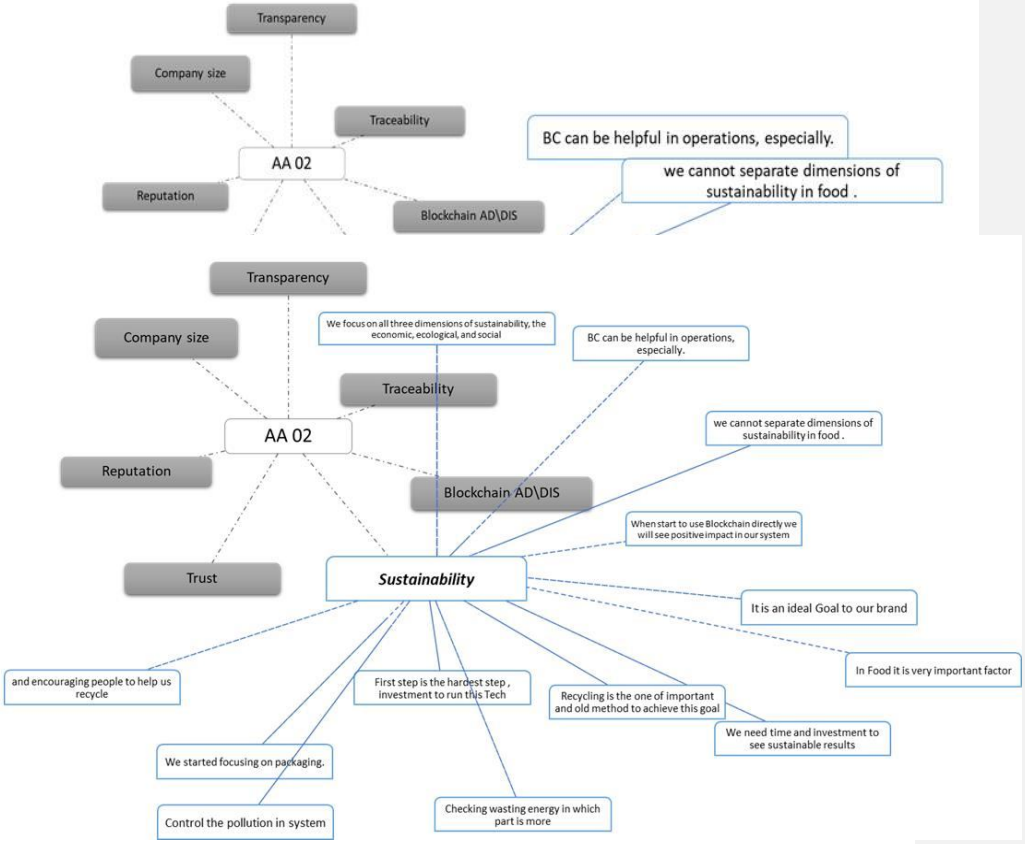
5.1.2 Who is in?

An average company has at least 50 product related suppliers in its first tier; actually up to thousands of total suppliers for a large company. Each first tier supplier in turn also has at least 50 suppliers in the second tier and these have in the third tier of suppliers also at least 50 each. This implies that the upstream supply network contains at least 125.000 suppliers three tiers deep. Who should be included in the blockchain? It is impossible to include all, so, the question rises “who is in?” Risk analysis? Auditing? Experience? AI and Big Data? The question remained unanswered.

5.2 The Second Wave interviews

5.2.1 The narratives

Eleven interviews resulted in narratives, analysed using Atlas.ti. Figures 4 and 5give examples of the coding results for the most mentioned topic of two interviewees. Tables 3 and 4 summarize the frequency distribution of topics raised and selected statements of the interviewees.Table 5 shows the ranking of importance of topics, as expressed by the frequency a particular topic was raised..


Transparency
Company size
Traceability
AA 02
Reputation
Blockchain AD\DIS
BC can be helpful in operations, especially.
we cannot separate dimensions of sustainability in food .
Transparency
Company size
We focus on all three dimensions of sustainability, the economic, ecological, and social
BC can be helpful in operations, especially.
Traceability
AA 02
we cannot separate dimensions of sustainability in food .
Reputation
Blockchain AD\DIS
When start to use Blockchain directly we will see positive impact in our system
Trust
Sustainability
It is an ideal Goal to our brand
In Food it is very important factor
and encouraging people to help us recycle
First step is the hardest step , investment to run this Tech
Recycling is the one of important and old method to achieve this goal
We need time and investment to see sustainable results
We started focusing on packaging.
Control the pollution in system
Checking wasting energy in which part is more

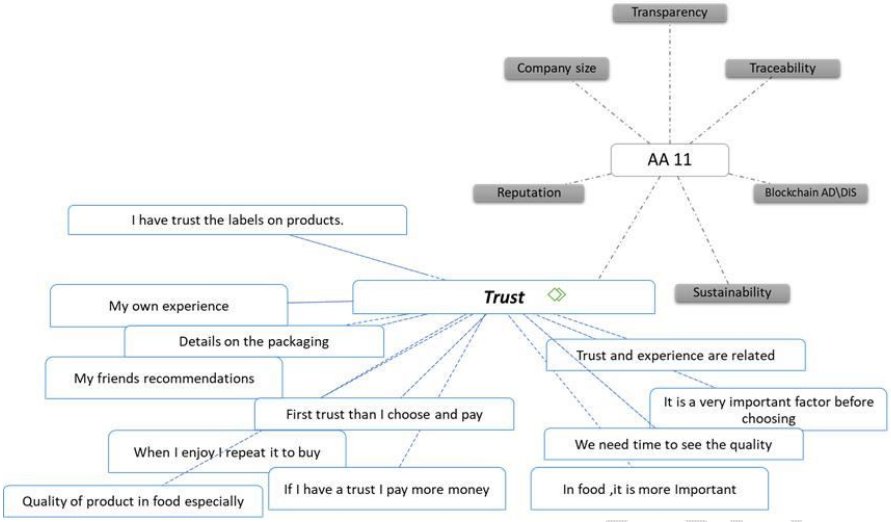


Figure 5: In Vivo codes and Open Codes of interviewee AA11 for topic Trust

Table 3: Selected interviewees Second Stage: the experts talk about BC – first 5 interviewees

Interview	Transparency	Traceability	Costs <> benefits	Sustainability	Trust	Other Tech	Reputation	Size
1 F	8	5	6	7	2	5	2	B
Fashion	Sharing information only partially.	Traceability and tracking; fulfills customer demands	Advantages larger; Certifications can be helpful	Sharing information has impact on sustainability	Need time in the fashion market.	IOT QR barcode scanning	Marketing view: BC has competitive advantage.	
2 M	3	1	7	9	6	1	1	B
Food	Transparency, info on nutrition + sustainability required	Transparency and traceability are two sides of one coin.	Disadvantages: government regulations + costs.	In all three dimensions of sustainability, BC can be helpful.	BC can help with a portion of this problem.	Barcode scanning	No need for improving reputation; prove honesty.	
3 M	4	2	10	6	3	9	5	B
Tech	Focus on origin + authenticity; total transparency is far deeper.	Obtaining traceability in a different way possible	Disadvantages outweigh advantages; needs highest level of quality	All aspects of sustainability; BC can be more effective in social aspect	Trust, completely back to the brand image and quality.	NFT, IOT, QR barcode scanning Robots	Sharing full info improves reputation; incomplete info harms it	
4 F	6	3	8	14	8	3	8	B
Fashion	Important for consumers to know; BC has a very effective role in this	Ability to trace the history of the product is very important factor.	Depends on company size, reputation, and marketing power.	Sustainability is derived from customer and stakeholder requirements.	It needs time and quality.	barcode scanning Robots	A goldmine of modern marketing.	
5 M	3	2	12	3	1	6	3	S
Tech	We cannot say BC is a key to opening the transparency	Roots in the use of technologies, such as barcode scanning.	Disadvantages : allocate enough budget and time; need experts	Technology achieves sustainability, not the first goal	Depends on industry and reputation.	IOT QR coding Barcode scanning	Totally, it is a sword that can kill or save their brand.	

M = Male interviewee F= Female ++ <> --- = advantages versus disadvantages; ; blue background: most mentioned topic

Table 4: Selected interviewees Second Stage: remaining 6 interviewees

Interview	Transparency	Traceability	Costs <> benefits	Sustainability	Trust	Other Tech	Reputation	Size
6 M	8	10	1	3	7	0	3	S
HRM	Proves with people that the brand is honest.	BC makes and shares motivation in whole system.	Elon Mask makes cryptocurrency trendy; other brands follow.	Possible reduces negative environmental impact.	Internet users are increasing; shopping online is safer.		People follow and use famous brands; gives confidence.	
7 F	8	2	1	8	12	2	12	-
Consumer	Honest system when they use BC to obtain transparency.	I don't care to follow up on products. Time problem.	Honestly, I just know about cryptocurrency.	Bio product, Use a paper bag instead of a plastic one.	Based on brand name + experience, I can trust them.	Food delivery applications and Online shopping.	Very important in fashion; pay money for famous Brand.	
8 F	6	3	3	4	16	4	10	-
Consumer	They make a link between the internal and external parts.	I cannot follow and check the product during process.	I heard about this platform's positive capabilities	I have used my own bag to help.	I have trusted the labels on products plus experience.	Online shopping.	Highest priority, It shows and proves the quality.	
9 M	10	7	4	7	5	1	2	B
Fashion	It is a first reason we started to use BC tech.	We can provide nice and effective relationships between actors.	We can manage financial points, BC is helpful.	We can achieve it on the inside of our company by using BC.	We will achieve it directly after achieving transparency.	QR scanning during the retailing process.	We have it already. We just try to keep it.	
10 M	11	4	5	11	8	3	4	B
Food	The most valuable factor for our brand.	We look at the BC as a solution to achieve it.	focus on Advantages; we have long term goals.	We started focusing on packaging and recycling.	Most important factor from marketing side.	Barcode Scanning , More about raw material.	Our marketing sector is working very hard to improve it.	
11 M	2	2	1	9	14	4	8	-

M = Male interviewee F= Female ++ <> --- = advantages versus disadvantages; blue background: most mentioned topic

Table 5: Frequencies of topics mentioned by clustered interviewee results

Topics:	Fashion				Food			Tech			HRM		Consumer			
Interviewee #	1	4	9	%	2	10	%	3	5	%	6	%	7	8	11	%
Transparency	8	6	10	20%	3	11	19%	4	3	10%	8	25%	8	6	2	12%
Traceability	5	3	7	12%	1	4	7%	2	2	6%	10	**31%**	2	3	2	5%
Advantages/Disadvantages	6	8	4	15%	7	5	16%	10	12	**32%**	1	3%	1	3	1	3%
Sustainability	7	14	7	**23%**	9	11	**27%**	6	3	13%	3	9%	8	4	9	16%
Trust	2	8	5	12%	6	8	19%	3	1	6%	7	22%	12	16	14	**32%**
Other technologies	5	3	1	7%	1	3	5%	9	6	22%	0	0%	2	4	4	8%
Reputation	2	8	2	10%	1	4	7%	5	3	12%	3	9%	12	10	8	23%

Yellow = most mentioned topic; blue = least mentioned topic

While the clustered narratives of the 'tech-', 'consumer-' and 'food'-interviewees show resemblance in the (un)importance of certain topics, 'fashion' shows a difference: sustainability or transparency? This may well be explained by market segment and strategy of the companies involved.

5.3 The structural equations model (LISREL)

Based on the results so far, a hypothetical model was constructed, to be further tested with LISREL in future research, using survey data. Only the *latent* exogenous constructs are shown.

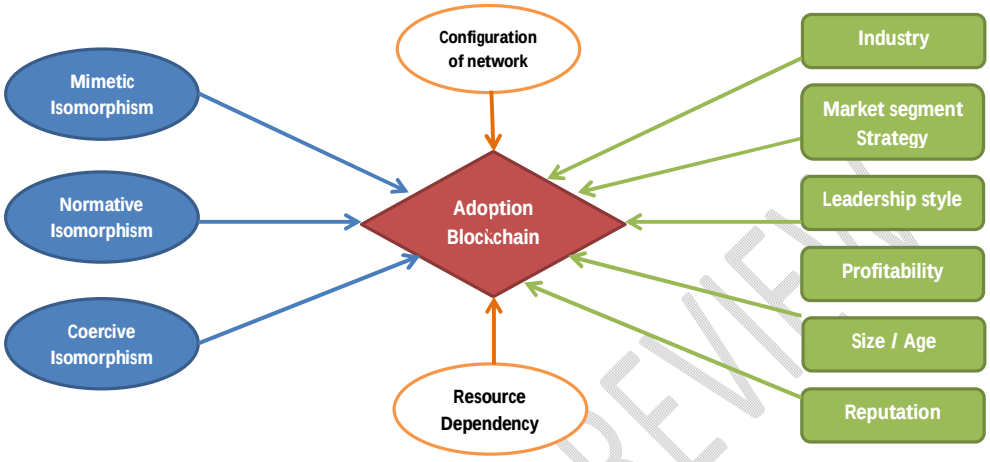


Figure 6: Hypothetical LISREL model about adoption of blockchain usage

6. LIMITATIONS AND DISCUSSION

This contribution identifies and categorizes blockchain adoption factorsbased on human behaviour. Three types of Institutional Isomorphism, Resource Dependence Theory and the Resource Based View are used as theoretical framework. Together, these theories explain, make us understand and even predict human decision behaviour determining the adoptionof blockchain technology, with its impact on customer trust, security and transparency.

6.1 Technological issues

While literature shows that blockchain technology makes it a potentially useful solution for the use of strategic information, its technological complexity generates certain issues about implementation, security, and sustainability. Firms may encounter integration challenges:*(1)Time:* it may take a long time to duplicate and enhance existing supply chains as blockchains; *(2)Expensive* operating costs: running blockchain technology needs a significant amount of computational power, which may result in high marginal costs as compared to traditional systems; *(3)Storage constraints*in terms of Mb of data and speed of transactions[53].

6.2 The human factor

Independent from technological issues, there is the human factor: why would upstream participants reveal information they might well consider strategic, and why would downstream participants 'believe' the information they receive from the upstream participants and found it sufficient? How do downstream participants persuade upstream

participants to reveal information the downstream participants consider vital, important, relevant or just 'nice to know'.By just accepting to pay higher prices or getting regulation forcing companies to do it? How relevant is the security aspect?

So, there are two aspects: the upstream actors/participants/suppliers and the downstream actors and participants, customers and/or consumers; their relative position determining their attitude:

(1) Willingness to insert strategic information by upstream actors that could well affect their competitive position.

From the discussions and interviews expires that this willingness is determined by the *ex-ante* perceived additional profit, increased market share and improved reputation. But also the coercive forces that force the actor to behave according to certain rules and *regulations*, the *norms* that the actor wants to follow and what its stakeholders tell it to do since "everybody does it".Not to forget the fear that if the actor *fails* to release certain information, it will harm its reputation and possible revenues. This might result in a lower profit and loss in market share.

(2) Willingness to 'believe' the upstream actors and be satisfied with the info provided, by the downstream actors

This seems to be determined and expressed by the willingness to pay more for getting the desired information by the downstream actors. Furthermore, it relates to the ability to enforce availability of desired information by means of countervailing power, lobby and politics. And trust, because at the end, it focuses on trust and security, as Schneier[54]writes. Four ingredients work together to promote trust: *(1)* morality; *(2)* reputation; *(3)* institutions that enforce norms and laws; *(4)* security systems, given the temporal embeddedness mentioned.

6.3 Dual supply systems in a dual economy

This altogether could mean that a dual economy could evolve, where one part is using blockchain technology in its better form of sharing all strategic information demanded by downstream participants and consumer organisations indeed. The other part of the dual economy would consist of actors that do *not* use blockchain and rely on price, availability and/or brand image. They can be cheaper, saving on the cost of using blockchain and meeting all kind of demands by certificate issuing institutions. Also, actors favouring spot buying each time from different suppliers - hence with zero temporal embeddedness - will find it practically impossible to turn their volatile supply chain or supply system into something that could use blockchain technology.

In this context, it would be interesting to observe the segmentation results such as info and price difference between comparable products: those that fulfil the expectations of for instance 'slow food' consumers and those that have no additional product information than just the minimum: type of animal, weight, final expiration date and at what temperature to store.Figure 1 already gave an example, albeit from the same retailer but with different upstream suppliers involved. Expansion of this example might be worthwhile to use in gamification experiments on the willingness to pay for info (consumers) and the willingness to give info (suppliers).

6.4 Technology alone is not good enough

The most important question is whether blockchain is genuinely useful for establishing *trust* in supply chains. There will always be a large vacuum that cannot be filled only by technology since blockchain does not eliminate the need to trust human institutions. For, human beings must still be in control, and there is always a need for governance outside the system. Blockchain security as a deterrent to centralization and a promise of trust might be deceptive. What blockchain accomplishes is to transfer some of the trust away from human beings towards technology. It seems however inevitable that any blockchain system must live with other, more traditional systems.

7. CONCLUSION

Comment [lm4]: Several questions were asked to be answered by the article.I suggest that the questions be listed and answered in a way that facilitates the readers' understanding, making the connection between the questions and the results obtained.

Literature shows that blockchain technology certainly has the *potential* to facilitate secure information transfer, meeting demands of transparency, traceability, confidentiality, security, integrity and availability. However, it also shows that the willingness to adopt not so much seems to be determined by technical aspects, but rather by human behaviour, apart from network configuration aspects.

The willingness to insert strategic information satisfying downstream actors, is balancing the trust downstream actors have in upstream actors. Perceived positive effects on reputation and competitiveness and hoped for revenue increases have to outbalance possible negative price effects and perceived total cost impacts. This, while dealing with regulations, meeting industry norms, accommodating demanding powerful customers or other external drivers for change.

Literature has shown [55] that the final outcome of any decision to a large extent is determined by the network embeddedness and the personal leadership style of the decision maker. These are human factors, next to factors as supply network configuration, volatility of buyer-supplier relations and results from coercive effects like health and hygiene regulations, environmental regulations or demands in the context of social governance. This also implies that we cannot expect uniform decisions and behaviour, even by seemingly similar companies in the same industry.

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