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A roadmap for the effective implementation of blockchain technology

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Purpose: *This analysis aims to propose a reference model that could support companies in the implementation of a Blockchain-based initiative in their supply chain. This research identifies the sequential phases for the introduction of a Blockchain solution in an effective way. Furthermore, critical factors to consider in each stage are defined.*

Methodology: *A multiple case study approach was carried out. 22 interviews were conducted with different informants. Among them, companies that have implemented a Blockchain project for their supply chain, software providers, consultancy organisations that provided the Blockchain infrastructure or the support during the project, and a Blockchain expert.*

Findings: *The roadmap is a framework that encompasses stages, critical factors, and guidelines for implementing a Blockchain initiative in the supply chain. The roadmap is made up of four phases: (i) Approach Blockchain technology, (ii) Define Blockchain value for the business, (iii) Develop a proof of concept and pilot, (iv) Scale-up the solution. Regarding external dimensions to consider during the implementation, they include the technological development of Blockchain and the political and legal evolution.*

Originality: *The roadmap has been developed to foster the diffusion of Blockchain supporting the supply chain processes by showing the steps of adoption for its implementation.*

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1 Introduction

The economic, legal, and political systems in the society are based on contracts, transactions, and records of them, that are essential elements in interaction between organisations but also individuals (Atzori, 2015). The Blockchain technology has an immense potential to change how parties interact (Mettler, 2016). Disintermediation could be imagined, as this technology records transactions in a secure, transparent, and decentralised manner (Mudliar et al., 2018). Thanks to its potential impact on the business environment, there is a lot of enthusiasm around this technology (Mougayar, 2016). Still, a lot of barriers need to fall and, as stated by Iansiti et al. (2017), "true Blockchain-led transformation of business and government, we believe, is still many years away. Blockchain is not a "disruptive" technology, which can attack a traditional business model with a lower-cost solution and overtake incumbent firms quickly (Dobrovnik et al., 2018). The Blockchain can potentially redefine the shape of society, but the process of adoption and integration is likely to be gradual (Wang et al., 2019).

Since this technology offers a decentralised approach to data management and sharing, supply chain management seems to be a promising field in which Blockchain could be applied (Queiroz and Wamba, 2019). The new way of recording transactions is likely to impact on current supply chain models (Schmidt and Wagner, 2019). The first implication regards the disintermediation effect that implies the removal of centralised positions (Schmitz, 2020). With the Blockchain, various players operating across the supply chain can exchange value without appealing to an intermediary to guarantee the transactions integrity (Cole at al., 2019). Furthermore, the Blockchain allows parties participating to the network to have a unique and shared view about the actual supply chain situation, improving supply chain visibility (Perboli et al., 2018). These concepts are becoming more and more crucial in a competitive environment that is always more complex and interconnected, if compared to the past (Perboli et al., 2018). Given these considerations, this work aims at exploring the connection between the Blockchain and the supply chain management.

Some gaps are still present in the literature on Blockchain application in the supply chain:

- existing contributions do not explain when the implementation of a Blockchain-based solution is valuable in the supply chain field. In this regard, a clear and unique definition of possible use cases is not present and the relationship between the Blockchain and existing technologies employed for the supply chain management is not defined;
- as the topic is quite new, critical factors for the implementation of a Blockchain project for the supply chain are not addressed by the existing literature;
- overall, no existing theory explains how to realise a Blockchain initiative in the supply chain context.

For these reasons, this study is developed on the following research questions:

- *Research question 1*: What are the stages of implementation for Blockchain projects in the supply chain and which are the guidelines that could be provided to companies willing to implement them?
- *Research question 2*: What are the critical factors for the implementation of a Blockchain project for the supply chain?
- *Research question 3*: What are the conditions in which the Blockchain application in the supply chain is valuable and what does this technology offer more than the existing technologies used in this context?

The paper is organised as follows: the literature review presents evidence from the extant knowledge, the methodology describes the adopted methodology, the findings section introduces the results, and conclusions and further development summarise the contribution and limitations of the model which can be addressed through future works.

2 Literature review

Even if Blockchain was born for the finance sector, projects outside the financial world have been mainly experimental, especially in the supply chain (Kshetri, 2018). There are a lot of reasons why this innovative technology may strongly fit supply chains (especially for the most complex ones that span over a multitude of production stages across many different geographical locations) (Kshetri, 2018). The principal ones are linked with the concept of transparency, accountability, and social responsibility, which according to Lee and Pilkington (2017), “are in high demand from consumers, thereby exacerbating both reputational risks and creating new opportunities for supply chain management”.

Moreover, companies are always more focused on developing collaborative initiatives in their global supply chains (Lee and Pilkington, 2017). Many enterprises are outsourcing whole noncore stages of their production, keeping core their competences in research, design, and development. This trend explains why real time data exchange and integration of financial, logistic and information flows between supply chain partners are urgencies that call for new solutions (Kshetri, 2018). Blockchain could be an enabler of a new decentralized information system that is no more trust based.

Moving from the lack of transparency and accountability in complex supply chain, Kshetri (2018) sustains that Blockchain may lead a higher supply chain visibility offering big gains to operations. Another important contribution to the Blockchain impacts on the supply chain is given by Lee and Pilkington (2017). The researchers introduce six principal use cases for Blockchain to improve the supply chain management. Even if Blockchain technology has a huge potential, according to Fiaidhi et al. (2018) it is crucial to keep in mind that it will have a bigger impact on their business and on their existing technologies, such as EDI. Indeed, since EDI alone cannot support the complex supply-chain processes of today, integrating a Distributed Ledger Technology (DLT) with the current system may be a feasible solution to benefit the whole ecosystem. Moreover, continuing to describe the relation between Blockchain and the more traditional technologies, O'Leary (2017) relates some proposed uses of Blockchain for transaction processing to other technologies, such as data warehouses and databases.

Wu et al. (2017) proposes a framework consisting of a set of dynamic and private sub-ledgers and a central public ledger. The sub-ledgers are order-based in the sense that they are created when an order is issued between certain trading partners and terminate when the order is satisfied. The sub-ledgers are private since only the partners involved in the execution of the order can participate to it. A similar Blockchain architecture based on a double chain is introduced by Leng et al. (2018), always to solve, at least in some extent, the trade-off between privacy and transparency mentioned before. A curious framework for traceability is presented in Toyoda et al. (2017). In this research is described a novel Product Ownership Management System for anti-counterfeiting purposes that tries to solve some limitations linked with the usage of RFID technology in the post supply chain.

Figorilli et al. (2018) suggest a tracing system within the wood supply chain that, based on RFID open-source technology and Azure Blockchain with a cloud deployment, integrates information related to the quality of the product with those linked with the traceability (logistics information). A different approach to study the Blockchain applied to supply chain is proposed in Gausdal et al. (2018). They aim to identify the main drivers and barriers of Blockchain adoption within the maritime industry. Specifically, the case studies examined are all related to the Norwegian offshore industry, and, for this reason, a limitation of this study could be a lack of generalization capability. Finally, a completely different use case of Blockchain application in supply chain management is presented in Mao et al. (2018). This innovative work assumes that information asymmetry is one of the most crucial issues that affect the food supply chain. Because of this, and due to the increasing supply chain complexity, as stated by the researchers "the credit risks of traders have increased rapidly". To overcome this dramatic issue, a Blockchain-based credit evaluation system is developed.

The main contributions that propose specific supply chain solutions to implement the Blockchain technology in different industries are presented in the Table 1.

Table 1*:* The usage of Blockchain in Supply Chain

Author	Application	Brief description
Wu et al. (2017)	Traceability	It is an online shipment tracking framework that complements current enterprise-based SC management solutions. The proposed framework consists of a set of private distributed ledgers and a single Blockchain public ledger.
Toyoda et al. (2017)	Product Ownership Management System (POMS)	It is a novel POMS of RFID-attached products for anti-counterfeit that can be used in the post supply chain.

Author	Application	Brief description
Lu and Xu (2017)	Traceability	OriginChain provides transparent tamper-proof traceability data, enhances the data availability and automates regulatory-compliance checking.
Kennedy et al. (2017)	Traceability	An anti-counterfeiting method: linking unique chemical signature data to Blockchain databases is used to limit the threat of counterfeiting of additive manufacturing parts across the supply chain.
Kim and Laskowski (2018)	Traceability	A traceability ontology and translation of its representations to smart contracts that execute a provenance trace and enforce traceability constraints on an Ethereum Blockchain platform.
Gausdal et al. (2018)	Data and document management	After identifying the main drivers and barriers for Blockchain adoption in the maritime industry, a Blockchain process framework is developed.
Leng et al. (2018)	Matching supply and demand	A double chain structure Blockchain application in agricultural supply chain to match demand and supply of resources.
Mao et al. (2018)	Credit Evaluation	A Blockchain-based credit evaluation system to strengthen the effectiveness of supervision and management in the food supply chain.
Figorilli et al. (2018)	Traceability	A distributed ledger that keeps records of digital transactions in such a way that makes them accessible and visible to multiple participants in a network while keeping them secure without the need of a centralized certification organism.

3 Methodology

The literature review on Blockchain confirmed that the Blockchain is a new technology, for which there is limited academic theory (especially for its application in the supply chain context). For these reasons, it was clear from the beginning that there were insufficient data to perform quantitative analyses. The conclusion reached was that the approach to investigate the Blockchain applied in the supply chain context should have fit for an exploration in a quite unknown field. A case study approach was chosen as the most appropriate methodology to carry out the whole research. A case study, according to Yin (1984) is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used". This kind of research method typically addresses questions that investigate how and why a phenomenon occurs, in unexplored areas such as the one analysed in this study. The deliberate purpose has been to develop new theory, not to test it. The fundamental principle of this approach was to exploit case studies, as the basis from which to inductively build theory.

Multiple academic researchers have focused their efforts in developing the case study methodology as a qualitative research method Yin (1984). One of the first work in this direction was the one by Glaser and Strauss (1967). These scholars developed their method to build grounded theory based on an incremental approach that relies on a continuous comparison between data and theory.

Case studies are used to create theoretical constructs, propositions that are based on the empirical evidence (Glaser and Strauss, 1967). The case study is particularly relevant as it represents a vivid empirical picture of certain instances of a phenomenon Yin (1984). This research methodology can involve a single case study or multiple case studies (Eisenhardt and Graebner, 2007). For this work, a multiple case studies approach was chosen. The theoretical reasons behind the selection of multiple cases were driven by the need for replication (even contrary replication), enlargement of theory and removal of alternative explanations. Since the purpose of this study is to develop theory and not to test it, a theoretical sampling was considered appropriate. This kind of sampling implied

that cases were selected because they were particularly suitable for supporting the development of a theoretical framework, revealing, or adding relationships among constructs.

The unit of analysis identified is the "Blockchain project in the supply chain". The cases were then selected using the following three main theoretical reasons.

- Replication: convergent evidence from various cases was sought to investigate analogies between them. Similar Blockchain projects were examined.
- Contrary replication: cases representative of different pattern of behaviours were chosen. Various cases regarding different industries and different project size were selected specifically to highlight the differences among them.
- Extreme cases: some cases of clearly successful implementation and other characterized by an unsuccessful deployment were picked.

Multiple data collection methods were used with the purpose of triangulate different data sources regarding the same case to provide stronger and better-grounded constructs. The data sources used were interviews, a workshop discussion, internal and public companies' documents, and websites. Interviews were the principal source of information for developing the model since these represented a rich and effective way of gather data about a specific Blockchain project. However, there is a crucial issue regarding this data collection method: the personal biases generated from the informant. Despite he tries to be as much impartial as possible, it has its own view of the project. Therefore, to mitigate this risk, highly knowledgeable informants belonging to different companies (typically an interviewee was performed with the technological provider and the other with the company implementing the project) were interviewed, with the purpose of collecting different perspectives about the same project.

The target organizations and informants identified as relevant for conducting an interview, were split in the following categories.

- "Demand" companies: companies that have implemented a Blockchain project for their supply chain.
- "Supply" companies: software providers and consultancy organizations that have provided the specific Blockchain infrastructure and support for the development of the project.
- Blockchain experts: specialists and researchers that are studying Blockchain technology and its applications in the supply chain field.

A total of 22 interviews were conducted. One interview was performed with a Blockchain expert, and it was used to investigate the overall phenomenon of Blockchain for the supply chain. In the following table, it is shown how the remaining 21 interviews were used for creating case studies. It must be mentioned that some interviews were exploited twice, thus creating more than one case study with a single interview. In some situations, it was possible but also necessary to deepen some aspects for the specific case. Therefore, more than one interview was dedicated to certain case studies. Given these considerations, the 21 interviews contributed to the creation of the model, through 15 cases studies. A table showing the list of informants interviewed per case study is provided (see Table 2).

Table 2: List of informants interviewed per case study

ID	Case study	Number of interviews	Role of informants (# of interviews)	Length
1	Shipping company and provider	2	Blockchain Solution Leader at logistics company (1) Senior Consultant, Blockchain Local Practice Leader at provider (1)	60'

ID	Case study	Number of interviews	Role of informants (# of interviews)	Length
2	Provider	1	VP, Head of Governance, Risk and Compliance, Asia Pacific & Japan, and Greater China at provider (1)	45’
3	Provider	1	Chief Operation Officer at provider (1)	35’
4	Provider	1	Chief Financial Officer at provider (1)	30’
5	Provider	1	Logistics & Technology Lead at provider (1)	30’
6	Agri-food company and provider	2	Blockchain Solution Leader at agri-food company (1) Senior Consultant, Blockchain Local Practice Leader at provider (1)	65’
7	Agri-food company and provider	3	Consultant at agri-food company (1) Founder & Director and Co-founder at agri-food company (1) Co-founder at provider (1)	70’
8	Agri-food company and provider	2	Senior Manager, Blockchain HUB MED Leader at agri-food company (1)	40’

ID	Case study	Number of interviews	Role of informants (# of interviews)	Length
			Senior Consultant Digital and Innovation and Director at provider (1)	
9	Agri-food company and provider	2	Senior Manager, Blockchain HUB MED Leader at agri-food company (1) Export Director at provider (1)	45’
10	Provider	1	Partner, Head of FSI Tech & Fintech, EMEA co-leader at provider (1)	30
11	Utility company	1	Director at textile company	35’
12	Provider	1	Senior VP, Head of Advisory services at provider (1)	35’
13	Shipping company	1	Senior VP, Global Director M&A and Digital Transformation at insurance company (1)	30’
14	Shipping company	1	ICT Business Development Executive Manager at insurance company (1)	30’
15	Utility company	1	Power Trader & Blockchain Manager at energy company (1)	40’

Contextually with the interviews, all the data collected also from other sources were examined and a lot of observations and first impressions were taken about what was emerging from the research, in the form of notes. The continuous overlap between data collection and data examination "allows researchers to take advantage of flexible data collection" as stated by Eisenhardt (1989). Thanks to this flexibility, this process of theory building from case studies also gave the opportunity to change the line of thought when new significant themes emerged from some cases, with the purpose of improving the resultant theory.

To analyse the interviews, the first step was the transcription of them in a textual format. After this necessary passage, the software *Nvivo* was used to investigate and classify the content, through the coding process. Coding is a process that consists in examining data line by line, looking for concepts, events, feelings and so on. Thanks to *Nvivo*, the interviews transcriptions were analysed with the purpose of labelling emerging themes. The starting point was choosing the nodes. A node can be thought as a logical container that groups together conceptually similar events, actions, and interactions. Thanks to this process, the data collected from the interviews and from other sources were organized in a precise structure. This process facilitated the identification of patterns, relations, and theory by means of within-case and cross-case analysis. The list of nodes chosen, in line with research questions, can be seen below:

- Stages of implementation.
- Critical factors.
- External dimensions to consider during the implementation.

After this part, an important stage is the iteratively comparison, in a systematic way, of the emergent model with the evidence from each case, to assess how well or poorly it fits with case data. (Eisenhardt, 1989) The main purpose of this continuous checking process is creating an empirically valid theory. During this step, the main constructs such as stages of implementation and critical factors characterising the model, were subjected to a continuous sharping process: the accumulation of evidence from diverse sources to confirm or change the elements of the model, was fundamental to converge, at the end, on a single and well-defined structure. The relationships between constructs were examined by looking for evidence through the different cases. Using replication logic,

cases have been used to confirm emergent relationships, such as the chronological order of different guidelines or the relationship between a certain critical factor and the correspondent stage of implementation.

In a multiple case studies approach, a number between 4 and 10 cases is usually considered to work well (Eisenhardt, 1989). The maximum of ten cases is usually set to avoid the risk of getting lost in a huge amount of data coming from different sources. As regards the conclusion of the iterative process, this process ends when the theoretical saturation is reached. The theoretical saturation is defined by Glaser et al. (1967) as "simply the point at which incremental learning is minimal because the researchers are observing phenomena seen before". It can be asserted that the degree of saturation reached was satisfactory.

4 Findings

The final framework is now illustrated. This phase mainly consisted in formalisation of concepts emerged during the methodology process. The proposed model is structured as a broad and not prescriptive roadmap that guides during the implementation of Blockchain projects in the context of a supply chain. The ambitious goal of this framework consists in highlighting all elements and criticalities to consider in the implementation of such projects. The roadmap focuses on the earlier stages of projects realisation. The decision to deepen these phases is guided by the empirical evidence: many Blockchain projects for supply chain have been announced or they are starting to be realised, few are operatives.

The roadmap is divided into four phases, as shown in the next figure. Each phase includes:

- a phase outline, containing a brief description of the identified phase and explaining why this phase should be taken into account;
- critical factors that represent those essential elements for a successful implementation of the Blockchain in the supply chain context;
- guidelines as a useful step-by-step tool for guiding in the realisation of such projects.

Transversely to these phases, the model encompasses two external dimensions to consider during the implementation of these projects. Critical factors and guidelines will not be presented in the executive summary for sake of conciseness since they require an in-depth explanation. The roadmap is represented in the following figure (see Figure 3 below).

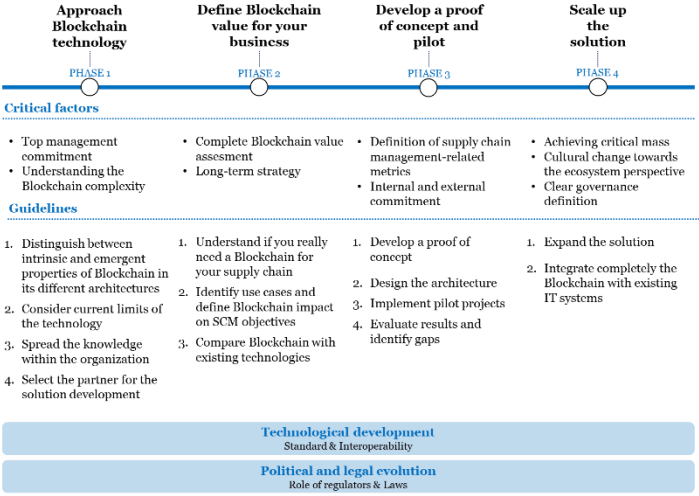

Figure 1: Final research framework

The roadmap encompasses the following phases:

1. Approach Blockchain technology. The first phase in the implementation of a Blockchain project is represented by initial steps a company should take to understand what this innovative technology is. This phase begins with the analysis of the main Blockchain properties, key concepts, and limitations.
2. Define Blockchain value for your business. This second phase is particularly important for companies willing to implement a Blockchain solutions in the supply chain. During this phase, the company defines whether the Blockchain is valuable for its business. Having described this phase, a visual framework is presented to properly answer the third research question. It represents both a theoretical and practical tool that resumes this phase of Blockchain value definition (illustrated in chapter 4). It encompasses a checklist that can be

used to identify whether the Blockchain can be the right solution. Having confirmed this, the relationship between the Blockchain and existing technologies employed in the supply chain is analysed. This step is essential since the Blockchain is not a stand-alone entity. In the light of these considerations, it can be understood how the Blockchain can be leveraged and the value deriving from its introduction in the supply chain.

3. Develop a proof of concept and pilot. This phase is related to the moment in which the company starts to develop an experimentation to concretely verify the validity of the thought solution. This stage can encompass the development of a proof of concept and, in a successive phase, pilot projects.
4. Scale up the solution. In the fourth phase, involved companies try to expand the solution in terms of new actors and/or functionalities. During this phase, a governance model is necessary to be clearly defined.

As regards external dimensions to consider during the implementation, they include:

- the technological development of Blockchain. It should be considered due to the low maturity level and diffusion of Blockchain. In particular, the lack of a standard and the need for interoperability between different Blockchains are two elements that should be constantly evaluated by companies;
- the political and legal evolution. It encompasses the role played by governments (and other authorities) in the diffusion of the technology and the introduction of laws related to the Blockchain.

The roadmap is a framework that encompasses stages, critical factors, and guidelines for the implementation of a Blockchain initiative in the supply chain. Each case study differs from others for certain aspects. For example, the sector, the type of use case, the role of the company, but also the direction taken for the development of the solution can distinguish one case from the other. By mapping case studies through phases identified in the roadmap, it was possible to create behavioural clusters that explain different development paths. In each phase, differences but also similarities emerged. Clusters were created starting from the sector the Blockchain initiative belongs to. The sector turned out to be relevant for differentiating case studies. The result is the identification of six paths, belonging to three different sectors: international shipping, agri-food and utility ones. Here below, a brief explanation of different paths is provided.

4.1 International shipping sector

In this sect, path A called “An international shipping ecosystem” and path B, “A Blockchain-based solution for the international trade” were identified. In both paths, it is a major player in the international shipping sector that approaches the technology. In path A, the Blockchain provider is represented by a big tech company while, in path B, the technological provider is a smaller company. These paths share the same use case (i.e., data and document management) and the same supply chain management objectives are impacted (i.e., cost, time, and risk reduction). The biggest difference regards the ambition and the consequent direction taken whether in path A the aspiration is to create a market solution for the global shipping industry, in path B projects are set on a smaller scale. In both cases, the scale up is complex since there is the need to involve many different players in this sector.

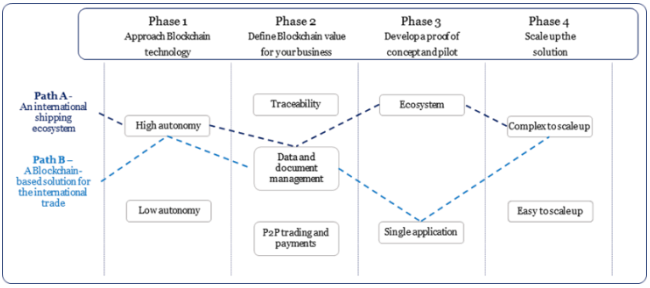

Figure 2: Blockchain development paths in the international shipping sector

4.2 Agri-food sector

Three different development paths were observed: path C called “An ecosystem for food trust”, path D called “Traceability for the single supply chain” and path E, “Blockchain for certification companies”. The main differences between path C and path D consist in the different ambition and the role of the company promoting the project: in path C a leading company in its market aspires to create an ecosystem, including different parties from various agri-food supply chains; in path D, instead, promoting companies (usually smaller firms that are less autonomous in approaching the technology) want to offer

higher quality products to customers by strengthening their traceability process. Thus, the focus is solely on their supply chain. The identified use case, in both paths, is traceability. The path E regards a different type of company, a certification body, that develops a Blockchain solution with the objective of strengthening its role in the supply chain.

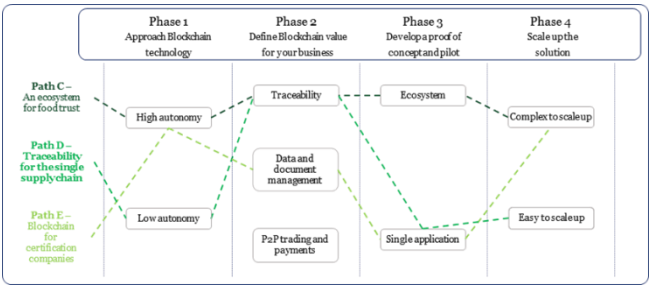

Figure 3. Blockchain development paths in the agri-food sector

4.3 Utility sector

The last path belongs to the utility sector, specifically the energy one. The path F is called "A peer-to-peer marketplace for energy trading" and it mainly differs from others for the implemented use case (i.e., peer-to-peer trading). The identified path consists in the creation of a peer-to-peer marketplace based on Blockchain. This marketplace includes many companies of this sector, and it allows to eliminate the need for intermediaries in trading. The governance is in the hands of a consortium formed by participant companies, with the objective of including interests of all parties.

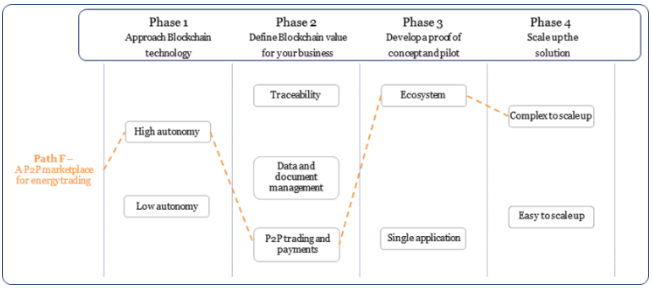

Figure 4: Blockchain development path in the utility sector

5 Conclusions and further development

This paper has the main aim to provide an effective practical tool for managers to understand the possible usage of Blockchain in the supply chain. The visual framework that explains when a Blockchain implementation is valuable in the supply chain is the first theoretical contribution provided by this work. The result of this analysis consists in the identification of how the Blockchain can be leveraged for defined use cases, explaining the Blockchain relationship with existing technologies and highlighting what this technology offers more than existing ones.

A significant contribution regards the identification of critical factors for a Blockchain implementation in the supply chain field. No existing literature identifies the most critical factors to consider for a successful implementation of the Blockchain technology. Moreover, the recognition of four sequential phases characterising the implementation of a Blockchain solution for the supply chain can be valuable from a theoretical viewpoint. Both critical factors and phases indicated in the final model have been validated through a multiple case study approach, thanks to the various interviews performed.

Finally, the results obtained from the case studies can give a theoretical contribution for the research. Indeed, they can be used as valuable sources to study more in detail the diffusion of Blockchain in many industries, with a specific focus on supply chains. The

case studies can also support researchers interested in investigating the evolution of the phenomenon in the next years.

From a managerial point of view, the roadmap proposed can support companies' managers to face in an efficient way a Blockchain implementation for a supply chain use case. Indeed, the research team behind this work firmly believe that achieved results can be useful, under various perspective, in the decision-making process of companies willing to adopt a Blockchain solution for their supply chain. The guidelines identified in each different phase of implementation aim at helping companies' managers in the whole implementation process, supporting them in considering all relevant elements that, if ignored, could potentially transform the initiative into a not desired outcome. This roadmap is thought to be useful in the specific situation in which companies nowadays operate. Considering the current level of technology maturity and deployment in the supply chain context, it becomes so valuable to understand the necessary steps for the implementation of the technology. This kind of framework could help in achieving a higher diffusion and experimentation of Blockchain for different use cases in the supply chain. At the same time, the model has been defined to offer a "safe approach": Blockchain is not the panacea for all supply chain pain points and, considering the existing complexity in defining realistic returns on investments, its deployment must be cautiously evaluated. A relevant part of this framework is dedicated to the understanding of how the Blockchain could create value in the context of a supply chain. In this sense, the framework is valuable as it presents conditions in which it makes sense to apply the Blockchain, the potential use cases and the relationship between the Blockchain and existing technologies for such use cases. In this regard, it is also shown how the Blockchain could be leveraged for supply chain and what makes it unique, if compared to existing technologies. Another part of the model with significant managerial implications regards the last phase of implementation. Since few Blockchain projects have already passed through this phase, the current knowledge about it is generally low. For this reason, it is particularly valuable for a company to be aware since the beginning of the project that, for instance, the Blockchain solution can scale up only by shifting the traditional mentality towards a new ecosystem perspective. This concept is crucial in every Blockchain implementation, especially in the supply chain field. If a company does

not change its mentality, it will be impossible to define a clear and shared governance within the ecosystem. Consequently, it will be unfeasible to obtain the expected value-added from the solution, by considering the various interests of parties involved.

Additionally, the paths of development have the specific purpose of offering a concrete tool to companies willing to implement a Blockchain solution. By assessing similar paths, a company could use this instrument as reference for moving the next steps toward an effective Blockchain implementation.

Besides the results achieved, the research presents some limitations. The qualitative methodology chosen implies some limitations in terms of generalisability. The risk of resulting in narrow and idiosyncratic theory is present. The selection of cases in specific sectors and the selection of interviewed informants can decrease the generalisation capability of the model. Future studies should be carried out to include in the research other case studies from different sectors, possibly involving a broader set of informants. This future research could verify the generalisability of the proposed framework, eventually enhancing results of this investigation. As soon as the Blockchain diffusion in the supply chain context will be sufficiently wider, the interpretative methodology could be combined and enriched with quantitative research methods. Another research limitation regards guidelines and critical factors included in the model. The intent of the roadmap is to be broad and not prescriptive. In this sense, some guidelines and critical factors deserve to be further deepened by future research.

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