Blockchain-driven supply chain finance: Towards a conceptual framework from a buyer perspective

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Abstract
The main objective of this article is to develop a conceptual framework for blockchain-driven supply chain finance (SCF) solutions. The frame of reference intends to foster the coordination in buyer-supplier relations and eliminates existing inefficiencies in the execution of discrete SCF-instruments, such as reverse factoring and dynamic discounting. Moreover, we introduce value drivers for blockchain technology (BCT) to elaborate unique characteristics for its application in the field of SCF. While BCT is considered as one of the most disruptive enablers in financial technology (FinTech), it received only little attention within the emerging field of SCF. Therefore, the results contribute to future developments of appropriate SCF-solutions based on the newest technology innovations.

Keywords: Blockchain technology, supply chain finance, reverse factoring, dynamic discounting, conceptual framework

Submission Category: Working Paper (WP 29)

1. Introduction

The relevance of working capital optimization and cost of capital reduction is highlighted by an increasing adoption of supply chain finance (SCF) instruments within industries. From a single firm perspective, it is important to optimize the financial flow by applying low-cost financing solutions (Klapper, 2006). From a broader supply chain perspective, SCF has further the ability to create a win-win situation for both, buyers and suppliers by improving liquidity and capital allocation across the value chain (Popa, 2013). Instruments as reverse factoring or dynamic discounting enable companies to optimize working capital and to smoothen financial risk. Although potential advantages of SCF solutions are already known in theory, the execution of these instruments still show inefficiencies in practice. Whereas SCF offers a wide range of techniques, blockchain technology (BCT) inheres a disruptive potential for the development, deployment, and usage of convenient business applications as well in the area of SCF.

The digitization of physical supply chains received a lot of attention in recent years, but the flow of goods, information and finance are often considered as isolated streams across different functions and parties. Thus, the initiation of business processes is dependent on sequential input and manual confirmation (Zhang and Dhaliwal, 2009). Additionally, transactions involve a vast number of agents and intermediaries. High costs and complexity for large IT-systems, security flaws as well as time consuming processing are just some of the disadvantages of the operations today (Fellenz et al., 2009).

According to that, weak contract institution, tax, legal systems, and regulations exacerbate effective interaction and standard procedures between supply chain partners (Klapper, 2006). Moreover, inconsistent governance structures complicate the collection of

receivables for the focal firm and the access to historical data for credit risk evaluation. Pfohl and Gomm (2009) mentions that the buyer will not be able to monitor the purchased receivables. Subsequently, the seller performs the receivable monitoring process, which remains unobservable to the buyer side. As a result, intransparency and fraud represent a major concern in conventional reverse factoring practices (Beck et al., 2003; Klapper, 2006).

By aligning all relevant data streams on a digital scale establishing trust and transparency, it is not only possible to make trading processes significantly more functional, but also to improve regulatory control through elimination of redundant practices (Templar et al., 2016). A digital, autonomous, decentralized, and distributed network of real value would be applicable to a countless number of services and processes (Raval, 2016). So far, there is no approach, which shows the potential in SCF by systematically exploring the challenges and opportunities. The initial concept provides here a foundation to close the gap between vague assumptions and practical contributions. If a grounded conceptual framework is developed, appropriate strategies and directions can be taken. The areas for future research can be determined and the scope for industry applications as well as business solutions can be addressed. BCT has the ability to provide such technical infrastructure, as one of the most promising and disruptive technologies in recent years. Regarding the assumption that operational barriers prevent focal companies from a widespread adoption of SCF-instruments, the paper explores the potential of BCT in general and discusses its practical value for SCF in particular. The research questions are outlined as followed:

RQ1. What are inefficiencies of existing SCF-instruments from a technical perspective?
RQ2. What are the general potentials and benefits of BCT?
RQ3. How does BCT improve SCF-solutions by eliminating technological inefficiencies?

In order to address the research questions on how BCT improves SCF solutions from a buyer perspective, conceptual research by Meredith (1993) is applied. According to the research design, a study about the current state of SCF and two specific practices in particular, reverse factoring and dynamic discounting, takes place. A further objective lies in identification of BCT-value drivers. Based on a literature review and a desk research, it is possible to highlight main abilities of BCT for characterizing its unique features from a technological viewpoint. Moreover, a problem awareness is created by elaborating the need for improvement of existing SCF instruments. Through an iterative approach, design propositions and requirements are developed. Based on this input, a conceptual framework for the two practical cases is designed. At last, the overall benefit from a theoretical and practical perspective is evaluated and discussed. The reminder of this paper is as follows: The next section 2 provides the theoretical background by outlining the most important aspects of BCT and relevant challenges of SCF. Section 3 deals with the analysis and main findings by adding a technological dimension in the first place to discuss the reverse factoring and dynamic discounting use cases. Before the paper closes, a conclusion and outlook in section 4 takes place.

2. Conceptual background

2.1 Blockchain technology

The blockchain has become one of the most disruptive innovations in recent years and attracted the interest of practitioners and executives in various industry sectors (Kelly and Williams, 2016). In general, the blockchain refers to a new form of decentralized data management and is further a synonym for a public accessible distributed ledger that ensures the integrity of all kinds of transactions. Mostly known as the main technical component running the cryptocurrency Bitcoin, it raised growing interest since its invention in 2008. The increasing

attention for BCT, as an enabling technology, is the result of its ability to establish trust between participants in a decentralized network without the need of a third party (Swan, 2011). Conventional transactions, on the contrary, are often centralized and monitored through an additional instance. Accordingly, the entity in charge verifies that the transaction is viable and took place. Whereas assets, for instance real money, inheres sophisticated security marks and cannot be physically in two places at once, digital data can be easily copied or intercepted. For that reason, an intermediary in form of a bank is required to execute a digital payment. This process also applies to the digitization of products, such as software licenses or music files. Even in our day-to-day life, a verification at notaries or a registration through public authorities is necessary and often inevitable. Consequently, the indirect interaction between two principal entities is often costly, time-consuming and represents in terms of centralized systems a single point of failure (Bertino and Sandhu, 2005). Instead of one authorized ledger that holds proof that a transaction actually happened, a so-called shared ledger could replicate its content on thousands of nodes. Trust would shift towards multiple copies as long as a majority of ledgers is able to outnumber corrupted and manipulated information. As a result, a central authentication of ledgers would not be required anymore. Although the decentralization of data constitutes a viable option, one overriding entity is still necessary to manage which information should be rightfully stored. From a technical perspective, it must be defined which systemic truth is chosen to update the whole network (Mainelli and Milne, 2016). Whereas replication is the key to decentralization, a so-called distributed ledger represents the concept to provide the functional infrastructure among equipotent participants. It was not before the Bitcoin Whitepaper in 2008, until a practical concept appeared that was technically able to establish trust between unknown participants.

The blockchain is therefore the first functional solution to implement a fully public permissionless distributed ledger. The ability of the system to establish trust between unknown parties refers basically to the immutability of data and relates further to the way information is structured, generated and distributed. As a result, the technology unified decades of research and was built on four main pillars (Antonopoulus, 2015):

- Peer-to-peer network: The architecture provides the database structure for a public distributed ledger.
- Transaction logic: Cryptography and a digital signature is used to secure the transactions process between anonymous accounts.
- Immutability of data: The ledger consists of consecutive data blocks individually secured and cryptographically sealed, interlinked to previous data within a chain
- Consensus mechanism: An algorithm enables a global election allowing users to agree about one true systemic-state of the network for synchronizing the shared ledger.

Although the terms blockchain and distributed ledger are often used interchangeably in discussion, a shared ledger approach is technically not always dependent on employing blockchains. Today, the developments in BCT enable a multitude of distributed database solutions that store a growing list of transaction records. Any exchange of an asset, physical object or fund can be digitally maintained. Everyone confirms that the transfer has actually taken place, as the data records are consistently validated by the system. For that reason, no third party nor intermediary is required. While the blockchain includes all information about every transaction ever completed, it provides full data integrity (Swan, 2011).

Given the fact that there are countless possibilities for applications in various areas, we want to derive three key characteristics based on the technical capabilities. Starting with efficiency, it is possible to improve processing throughout various aspects in administration, verification, approval, transactions and settlements. For example, in terms of administrative

procedures, BCT can be applied to automate and distribute the execution of standard operations or accounting. The technology reduces time and errors, lowers costs, eliminates waste and improves resource allocation and friction. The second key feature refers to greater transparency through availability of full records and the immutability of a distributed public ledger. As a result of deficient information, rules, collaboration, governance and distrust of authorities, many businesses operate still in opacity. BCT improves the visibility of errors, misappropriation, and misdirection. The availability of information about procedures and processes, increases accountability and provides more accurate monitoring and evaluation. The last key aspect to be mentioned, relates to autonomy by decentralization of control and delegation of power. These greater self-governance structures allow effective consensus and foster trust among all participants leading to more amenable, equitable, and representative execution. Despite some technical challenges and limitations, the interdisciplinary exploration of blockchain-based applications represents an interesting and growing area for future research (Swan, 2011; Burgess, 2015).

2.2 Supply chain finance and its challenges within supply chain

Due to globalization, increased competition and higher levels of risks in the supply chain, many companies are facing complexity and uncertainty in their businesses (De Boer et al., 2015). A major consequence of this complexity is the need for transparency in the supply chain in order to manage the basic supply chain processes, risks, and financial flows properly. In order to cope with these challenges, independent companies are required to coordinate and collaborate with each other to cut unnecessary costs and to improve inefficiencies (Omran et al., 2016). In fact, many firms have recognized to optimize not only the flow of materials and information, but also the financial streams. Furthermore, companies realize that optimization of financial flows and the allocation of working capital in the supply chain has led to improvements of the overall supply chain performance and to a reduction of financial risk. Addressing these challenges, SCF has emerged and evolved to provide innovative financial services for partners in the supply chain. Accordingly, SCF has been defined in many different ways in literature. Pfohl and Gomm (2009) describe SCF as an intercompany optimization of financing through integration of financing processes with supply chain partners. Wuttke et al. (2013) have considered financial supply chain management as optimized planning, managing and controlling of cash flows among the value chain to facilitate the optimal control of material flows. In addition, Hofmann (2005) defines SCF as an integrated approach for two or more organizations in a supply chain, including external service providers, to jointly create value through means of planning, steering, and controlling of financial resources on an inter-organizational level.

SCF is an interesting approach used by many focal firms to optimize the flows and allocation of financial resources in the supply chain. As a result, it leads to higher profits and cost reduction in company financing. SCF includes a wide range of financial instruments and techniques to improve financial flows. In a broader sense, these solutions aim to facilitate transactions between supply chain partners. By providing financing and payment options, they optimize the liquidity and the financial standing for all partners within the network. Reverse factoring and dynamic discounting are two instruments of SCF within post shipment (after invoice is released), which aim to relieve buyer and supplier payment tension.

Reverse factoring is a buyer centric approach, where big buyers work closely with financial institutions to provide cheap and short term financing for their suppliers. Both buyer and supplier benefit by implementing reverse factoring. The buyer negotiates with the supplier to extend the payment terms and the supplier takes advantage from an early payment. With the help of reverse factoring, suppliers sell their account receivables to a financial institution to to increase liquidity. The suppliers receive a discounted payment from the finacier and the interest

rate charged is deducted from the invoice value. The buyers pay the payment on due date to the bank eventually (Seifert and Seifert, 2011). Figure 1 shows the process of reverse factoring.

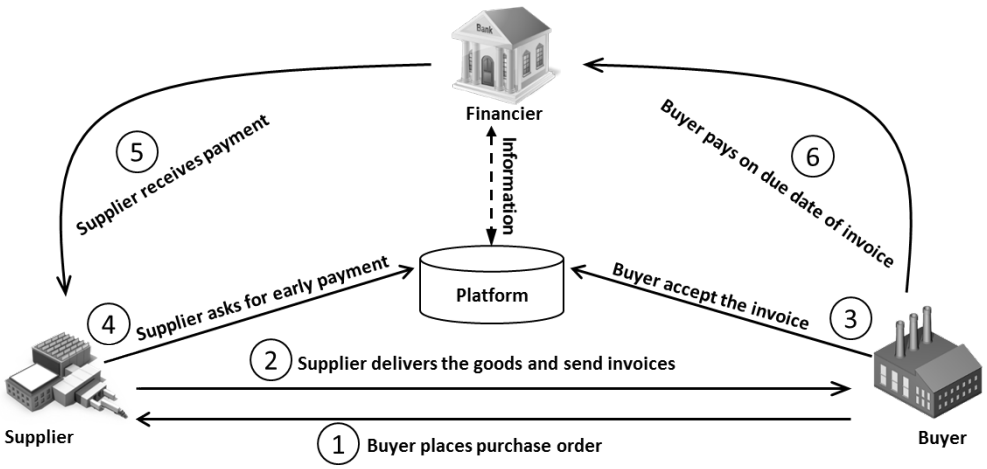

Figure 1 Example of reverse factoring

In reverse factoring, the buyer is an initiator and needs to onboard its suppliers one by one, which is a time consuming and even costly process. Moreover, financial institutions demand know-your-customer checks on suppliers as new trading partners. Dynamic discounting, similar to reverse factoring, is a buyer-driven approach helping the companies to optimize the cash flow by dynamic settlement of invoices in buyer-supplier relations. (Nienhuis et al, 2013). Dynamic discounting allows the buyer to receive a discount from the supplier in terms of a dynamic payment behavior. Moreover, in dynamic discounting, suppliers and buyers are both connected to the same platform. On this basis, the involved parties optimize the timing of invoice payments by exchanging an early payment proposal. The earlier the supplier receives its payment, the higher is the discount the buyer gets from the supplier. Apart from this, cash rich buyers initiate an early payment in exchange for an agreed discount rate. There are also non financiers involved as both the buyer and supplier interact directly (Nienhuis et al., 2013). Figure 2 shows the process of dynamic discounting. Within the context of dynamic discounting, the suppliers are funded directly by the buyer, not relying on a financier. Additionally, there is no need for KYC check in dynamic discounting once the supplier is funded.

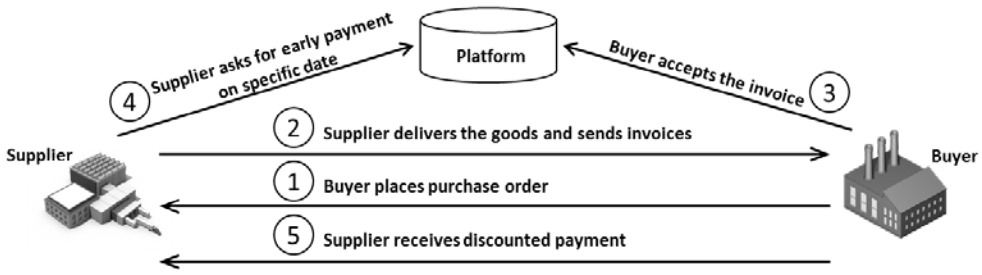

Figure 2 Example of dynamic discounting

Reverse factoring and dynamic discounting offer possibilities for participants to utilize SCF and to cooperate with each other for an effective capital allocation and management (Popa, 2013). In reverse factoring, financial institutions purchase account receivables from high quality buyers and collect credit information to calculate the credit risk for selected buyers (Klapper, 2006). In contrast, dynamic discounting helps to optimize the cash flow by dynamic invoices in buyer-supplier relations (Nienhuis et al., 2013). However, the general lack of appropriate technology-based platforms for financial and material flows has caused major costs in many areas, such as disputed invoices (Fellenz et al., 2009). Since reverse factoring and

dynamic discounting are buyer centric programs, buyers initiate these arrangements to extend the payment and to hold cash for working capital optimization in the first place. Additionally, account receivables of more than one buyer are sold by suppliers to financial institutions or factors. Therefore, financial institutions need to evaluate the buyers credit portfolio before approval that results in a time consuming process. Despite positive efforts to stimulate the adoption of SCF, a large group of SMEs are excluded and have limited financing options. Financing SMEs has always been considered a risky business by banks and other types of lenders due to the lack of an automated infrastructure that provides real-time visibility about the SMEs financial situation. This prevents full adoption and collaboration, such as regular banking, mobile technology, and internet services (Nienhuis et al., 2013). Furthermore, paper-based transactions and a lack of automation increase the total transaction costs for supply chain partners. In the current SCF context, supplier onboarding is a complex activity when a big buyer is required to integrate a large number of suppliers. The execution involves a wide range of tasks and requires multiple parties to work together in effective and easy manner. There are still inefficiencies in the process of supplier onboarding such as manual operations, inaccurate information or missing real-time data. Apart from this, onboarding processes should also be transparent for all stakeholders to avoid a communication gap. Given the intangible benefits, operational inefficiencies and high investments often prevent the focal companies from the adoption of specific SCF solutions (Wuttke et al., 2016). It has been clearly observed that data and information sharing, trust, transparency and collaboration among supply chain partners are important elements of a successful adoption of supply chain finance solutions in the whole network. Missing and timely information such as purchase order data, order quantities, and ID numbers cause moreover a delay in cash flow calculations and payments (Gavirneni et al., 1999). Emerging technologies, such as web-based cloud applications in the past, play therefore an important role for successful implementation. New hardware enables further the access to real-time data across the boundaries of physical supply chains. Accordingly, transparency and automation will constitute a key basis for buyer-supplier relationships and collaboration (Hofmann and Belin, 2011).

The digitalization of official documents and sensitive information often inheres a lack of authenticity. Contracts, licenses, certifications all come with security features to carry official status. Digital property can be copied, so trust must commonly be established through a centralized data management or authorized intermediaries. This involves on one-hand large IT-systems located within single institutions and on the other authorities, such as banks, traders, exchangers, clearing houses, which legitimate information and proceed transactions. Especially ledgers are an integral part of commerce and therefore centrally stored or managed by trustworthy partners. Now, for the first time, algorithms enable the collaborative creation of fully digitized registers. BCT has the power to transform ledgers as tools to record, enable and secure an enormous range of transactions. Like the Internet, it has no central authority. Instead it is a shared record of information distributed over a vast network of users (Raval, 2016). Physical documents are no longer the only means to create trust between unknown disparate parties. According to this, the basic blockchain approach can be further modified to incorporate rules, smart contracts, digital signatures and an array of other applications.

3. Analysis and main findings

3.1 General framework

Innovative technologies and growing information availability in the supply chain enable new developments of SCF solutions. This trend has been accelerated by the negative economic circumstances, which has increased the importance of working capital and liquidity. In such a complex environment with difficulty to access financial resources, it is important to strive for

a full adoption among large and small firms. Where every actor individually controls how to organize SCF, the dependency towards financial institution decreases, such as onboarding and KYC processes. This inspiration comes from a digital trust infrastructure, such as BCT, as a new form of a permissionless and collaborative platform. On this basis any actor is able to build an ecosystem by offering innovative services. At first, we will take a look at post shipment financing, where supplier will be financed after the invoice is approved by the buyer. However, there are additional risks for financial institutions, because the goods have not been transported and supplied to the buyer yet. Besides this, further technological developments based on a full integration of all parties in the financial supply chain will improve transparency among the value chain. Creating such open platforms allow multiple financial institutions and companies to organize SCF within their own control. As a result, there is no dependency on a new onboarding activity. These developments will provide the active collaboration between companies, knowledge institutes and the government in the near future.

BCT is a disruptive solution that has the ability to make trading processes among supply chain partners more efficient, to improve the buyer-supplier relation in terms of payment process and to eliminate the inefficiencies in financial flows. Similar to the rise of the internet, blockchain has the potential make processes truly more secure, transparent, and efficient. There is still huge potential growth in SCF with digitization of processes. However, in order to create news solution within the boundaries of technology, a new perspective is needed. In particular, the digitization of the whole value chain brings all participants together on a digital and collaborative scale. Such integrated approaches, unites not only the material flow, but it also considers information and financial streams. Based on an extensive literature review, an integrated BCT-driven supply chain finance framework (Figure 3) has been developed.

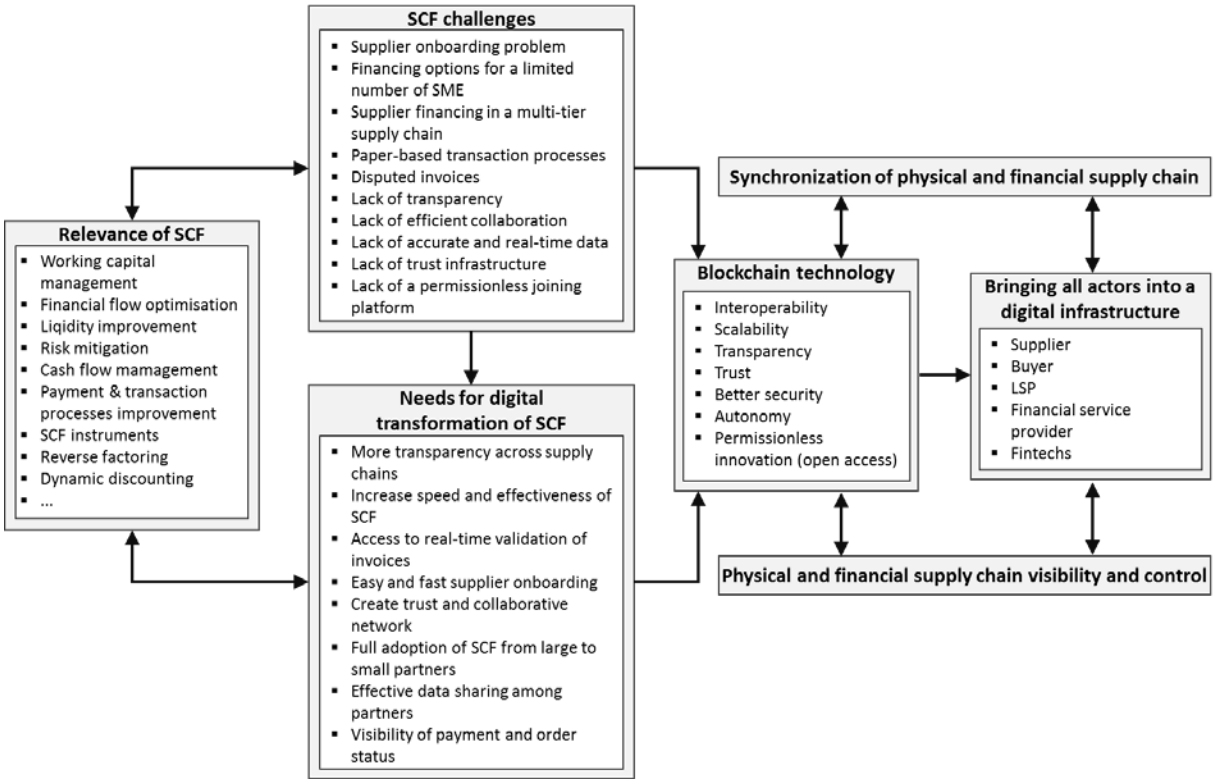

Figure 3 Integrated SCF with digitalization

SCF today is an isolated series of steps taken to optimize financial flows and working capital through supply chains. Complexity and operational inefficiencies of existing financial services has caused a major risk for companies to effectively manage their working capital. Moreover,

the lack of transparency and visibility results in distrust and a certain sense of insecurity among supply chain partners. Technology is a key enabler of SCF to make processes and information sharing more efficient. With digital technology, the supply chain partners will be integrated into one ecosystem that is fully efficient and transparent to all. From suppliers, buyers, financial service providers to LSPs and to technology providers. The logistics service providers (LSPs) play an important role, especially when they manage large parts of the customers supply chain. The financial supply chains are still mainly the domain of banks. With further developments of SCF practices, for instance an increased managing of invoices, LSPs can provide cross-functional offers. LSPs have much data about logistics processes as they continuously monitor the status of goods. Risks are more visible and it allows LSPs to collaborate with partners, for instance financial institutions, to develop innovative services in the field of SCF. Quick approval of invoices by buyers is essential for reverse factoring. Due to inefficiencies within the invoicing process by LSPs, the payment processing time can increase. Therefore, an automated transaction, invoice and payment status, as well as the access to real time information for all involved partners are only achieved through digitization and technology. All partners will benefit from this inclusive supply chain finance approach through transparency and the reduction of costs associated with disputes and transaction processes.

The digitalization of supply chain finance relies not only on the technology side, but also on the need for a proactive collaboration. The goal is to bring all partners together on basis of an integrated supply chain finance ecosystem. In fact, a new generation of collaborative networks will help companies to streamline invoice processing and to facilitate supplier onboarding or working capital allocation. However, these benefits will not be achieved in an isolated and disconnected business network. BCT is a disruptive innovation that has the potential to radically change business operations. By fully integrating this technology into existing networks, it can significantly improve SCF and transparency along the supply chain.

3.2 The reverse factoring use case

In today´s business environment, there is still a huge potential for supply chain finance and its practical instruments. Reverse factoring has become a short term approach to finance the tier-1 suppliers. This instrument has shown a great practice to unlock cash along the supply chain and to finance the suppliers with an early payment. However, there is still considerable potential for this instrument according to the benefit of suppliers. Additionally, supply chain finance has not been fully integrated into upstream and downstream supply chains, as it is only applicable for cooperation of strong credit rating buyers with its direct suppliers. The network of partners involves the complete end-to-end supply chain from point of origin to the point of destination. Therefore, SCF barely effects indirect suppliers that are traditionally allocated beyond first tier suppliers. On an operational level it is assumed that reverse factoring, for instance, experiences untimely information about receivables and credit limits. On a strategic level, authorized institutions are necessary to establish trust. It takes days to verify if firms have actually received goods in order to arrange the movement of funds and to lock ownership data. It is concluded that a match between inefficiencies of SCF-practices and BCT-value drivers takes place.

In order to evaluate and explain the impact on reverse factoring, we take integrated supply chain finance with digitalization into consideration, as shown in figure 3. Therefore, we systematically explain the major BCT value drivers to further extend the reverse factoring tools with the benefits and unique features of this technology. However, to create new solutions, a perspective is needed that involves all partners within a digital collaborative network. An integrated BCT-based SCF solution for reverse factoring is therefore presented in figure 4.

Such an integrated approach needs to be adopted through the entire supply chain ecosystem of partners. The results will enable the participants to have access to real-time information related to material, information and financial flows with more visibility into supply

chain and reducing the risk of supply chain disruption. BCT has the potential to trigger a new innovation perspective in the area of SCF especially in reverse factoring. In comparison to other IT-infrastructures, BCT has the potential to enable a database that is directly shared among the boundaries of trust. Every participant in a blockchain independently verifies and processes transactions. This is possible because every actor within the system has visibility into the current database accessing status and real-time validation of transactions through a digital signature and a private key.

By using BCT as an underlying infrastructure for an entire supply chain ecosystem, every buyer can electronically connect with every supplier along the whole upstream supply chain. In addition, there is no dependency on a new onboarding activity for the suppliers at financial institutions. Invoice status information are transferred securely, and financiers can offer high-frequency financing services for any transaction value at lower risk. The suppliers will be also able to connect with any customer within this digital system. Credit ratings and supplier evaluations will be saved and cryptographically secured in the blockchain. A dynamic adaption and automated evaluation takes place, if buyers pay too late or supplier do not deliver goods in time. The information will be further visible to every actor that participates in reverse factoring to set an incentive for all partners and to increase reliability. As a result, all actors will benefit from real-time access to data, which relates to transactions, invoices, or payments.

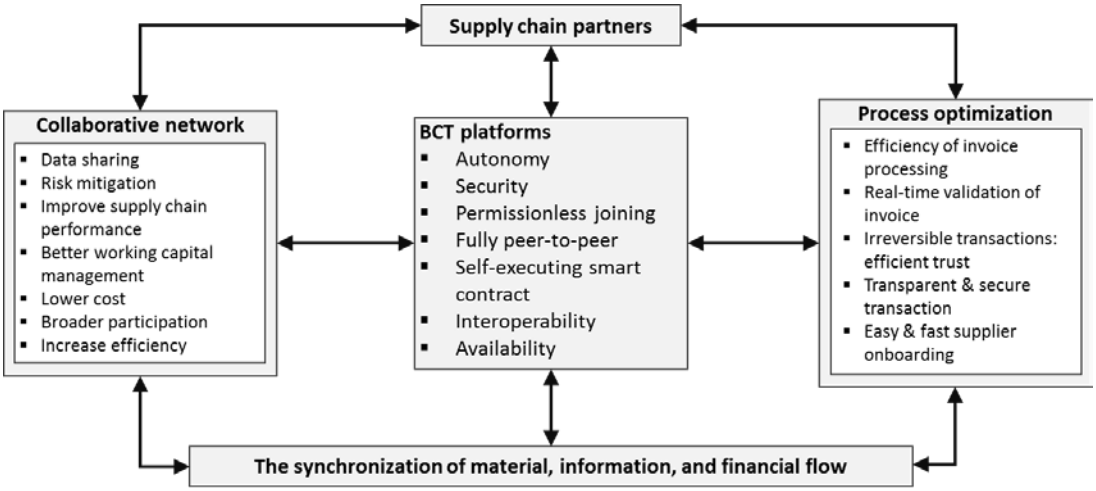

Figure 4 Conceptual framework for a BCT-based reverse factoring solution

BCT can also increase transparency within supply chains and allows trading partners to collaborate more effectively to achieve new levels of efficiency and responsiveness. Blockchain is also a valuable technology for tracking inventory, monitoring product components, and tracing of the global footprint. It reveals the provenance of a product to everyone involved, from origin to end user. There is no longer a need to manually keep track of items. Blockchains can create a formal registry to identify individual goods and track possession of materials through different points in a supply chain.

Robustness is another advantage of BCT in comparison to other IT-infrastructures. It ensures high availability of data and shows an increased fault tolerance to centralized systems. BCT allows participants to write smart contracts, which can automatically execute the terms of a contract. If a set of preconditions are met among participants in a smart contract, the contractual agreement can automatically initiate payments in a transparent and efficient manner. Additionally, blockchain can create a distributed database that stores any type of records, which are potentially open access to all participants in the system. If appropriate within reverse factoring, data can be accessed, shared, and added, but cannot be changed or deleted by an individual at all. Everyone has access to a shared ledger and a single source of truth,

increased transparency and trust through a tamperproof and fraud less system. These aspects play the key role for BCT as a preferred IT-architecture within a SCF-context.

4.2 The dynamic discounting use case

Where an effective collaboration between supply chain partners is mainly based on a valuable exchange of information, an appropriate integration of information and communications technology (ICT) is required to automate business processes and transactions (Pramatari, 2007). As a result, new financing instruments in SCF mostly rely on such supply chain links, using electronic data interchange and integrated business solutions to optimize the working capital and to create financial value for the organizations involved (Gelsomino, 2016). For a detailed investigation of the dynamic discounting use case, it is therefore appreciated to follow the broader concept of supply chain collaboration. This approach helps to compare BCT with conventional IT-solutions in general and alternative SCF applications in particular.

According to its potentials, we define supply chain collaboration as a business process where supply chain partner work together to execute supply chain operations (Mentzer et al., 2001). Bowersox et al. (2003) further extends this definition by introducing information, resource, and risk sharing. Through a combination of both concepts, we add a first conceptual element into the framework. It consists of six interconnecting components for collaborative advantage by reducing costs, response time, leveraging resources, and improving innovation (Cao and Zhang, 2010). In order to describe and assess the different principles and mechanics of BCT, we apply further concepts of the general systems theory. Following Boulding (1956), a second dimension is introduced based on the function, structure and dynamics of technical systems. Figure 5, presents here the conceptual framework for integrated blockchain-based solutions in SCF. Dynamic discounting utilizes trade process visibility to initiate the dynamic settlement of invoices in a buyer-supplier relationship and relies therefore on an enabling technology (Polak et al., 2012). The conceptual framework serves here as a starting point to discuss the premises for an integration of BCT into dynamic discounting practices.

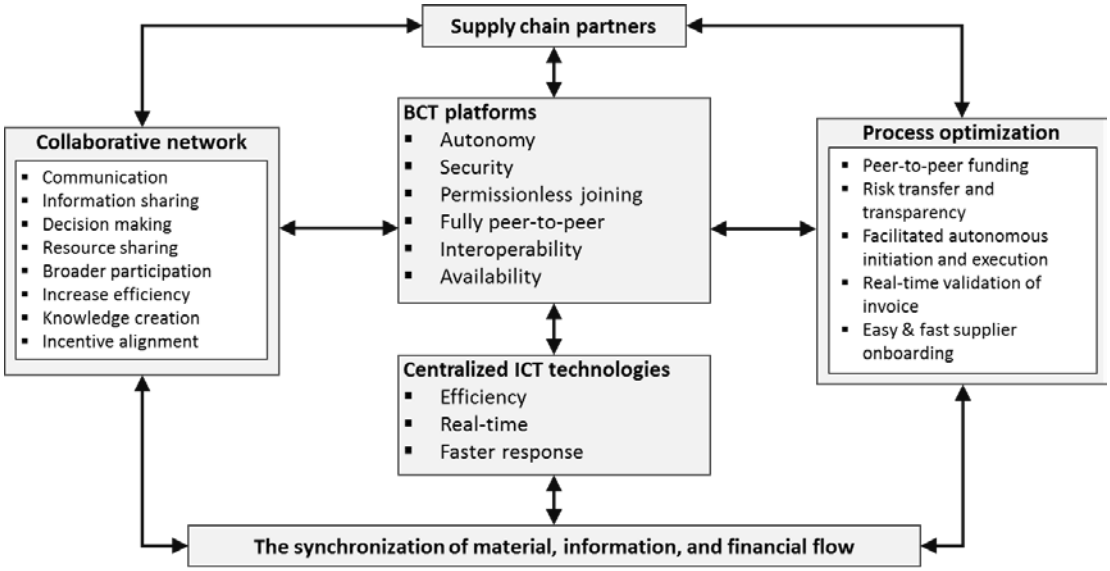

Figure 5 Conceptual framework for a BCT-based dynamic discounting solution

Following Gelsomino et al. 2016, the basic process of dynamic discounting is structured into four phases. In order to identify and assess relevant value drivers, each phase is applied to the elements of the conceptual framework. For the purpose of this study, we further consider a buyer centric approach with self-funding of payments and assume that goods invoiced are pre-

shipped. The activities presented are conventionally conducted through individual applications, cloud solutions, or third party add-ons based on the existing ERP system.

In general, the buyer organization starts the program by offering early payments to suppliers in case of a discount. Upon agreement, an invoice processing follows where the supplier creates, uploads and exchanges relevant documents electronically through electronic data interchange (EDI). This phase is finished when the buyer receives the electronic invoice. Within a second step, the buying organization initiates the receipt, reconciliation, and final registration of the needed payments to start an iterative approach defining an early payment proposal (EPP). Accordingly, the purpose of this third stage is to agree upon the day in which the payment is going to be settled and the discount proposed for such early payments. Therefore, after the buyer submits the proposed EPP, the supplier can accept or decline it. In case of rejection, the buyer has the possibility to further adapt the terms and conditions. If an agreement has been reached, this stage is completed through archiving. Regarding this final step, both supplier and buyer store the invoices in an electronic or physical manner.

In comparison to common ICT platforms, BCT shows valuable advantages in its structure. Especially in multi-echelon supply chains or supply networks, the distributed database and interoperability improves information, and resource sharing. In combination with its functions, in particular smart contracts, BCT facilitates and even anticipates the initiation of a dynamic discounting program. Analogous to multi-criteria approaches during the supplier onboarding process, the improved availability and auditability of trustworthy information automate decision-making. With the interconnection of different blockchains, it is possible to implement an autonomous approach through so-called pegged side chains. If the financial flows of the whole value-chain are structured on the same interconnected ledger, the risks for early payments and reduced liquidity is automatically transferred. The parameters of an early payment proposal would be consistently calculated regarding also the more solvent partners within the downstream supply chain. Concerning the dynamics of BCT, a scenario would be applicable where not only vertical but also horizontal structures would be taken into consideration. Decisive is not the current financial state of the buyer anymore, but more likely the expected demand in terms of customer orders within pull oriented supply chains. This multi-criteria approach can be further extended by transforming physical objects into smart property and monitoring of the material flow on the blockchain.

In general, BCT always represents an easier accessible, more secure and cheaper solution. Especially, within a scenario where the ICT-service provider offers external financial resources to the buyer. In this case, BCT is capable to provide an open and direct funding between parties on basis of a full peer-to-peer network not relying on intermediaries. Whereas the levels of transparency do not differ between the technologies, the lack of effectivity of BCT will be still a major obstacle in the future. Within dyadic configurations, a centralized ICT-solution is still faster enabling real-time data without any delay. BCT is still limited to its consensus mechanism. As a result, it takes several minutes to create one block, as the security of the whole chain only increases with time. Beside these technical aspects, the use case outlines also qualitative aspects of the supplier buyer relationship according to the key characteristics of self-governance and autonomy. As complexity is rising, a solution is appreciated where decision-making is executed within a predefined set of rules based on decentralized resources and group consensus. All participants can benefit if the whole supply chain relies on the same visible information and agreements. According to conventional buyer-initiated dynamic discounting, the operations show strong centralization among independent actors. In order to take full advantage of a BCT-based solution, a paradigm shift is necessary to achieve a global instead two single local optimums between the buyer and the supplier. Therefore, it is assumed that the main value driver for adoption lies rather in qualitative key aspects, such as transparency and autonomy, than in efficiency. In the end, the adoption of a BCT solution will

be strongly dependent on the supply chain configuration and market environment itself. Once the technical limitations are removed and new consensus mechanisms are established, BCT has eventually the chance for major adoption within highly integrated supply chains.

5. Conclusion

Financial flows can be increasingly streamlined using digital technology like blockchain, where all involved partners will be able to share and monitor financing related information such as latest invoice status, check credit limit and payment in a transparent manner. The new digital infrastructure environment allows all participants to have easy access to real-time SCF information. Participants are able to continuously monitor the detailed goods and transactions digitally. Such an inclusive infrastructure relies on a shared ledger that provides any supply chain related information and ensures global authenticity and security for data and information at the same time. This significantly reduces the costs and complexity of today´s systems.

By addressing the first research question and identifying the inefficiencies of existing SCF instruments, it can be stated that the existing challenges create a need for SCF in digitalization. New technologies can close the gap for an effective management. By synchronizing the material, information and financial flows, which have been considered as isolated streams, all partners can dramatically benefit from a digital infrastructure. Beside supply chain collaboration and conventional centralized technologies, BCT is here a paramount technology to streamline the flow of information, goods and money on one digital platform.

By identifying the general potentials of this new innovation, we relate to the second research question. We conducted a conceptual approach to identify the value drivers. The study revealed such unique value proposition of BCT, to facilitate the implementation of SCF practices. According to this, the supply chain partners strongly benefit from three key characteristics in form of efficiency, transparency and autonomy. In order to answer how these BCT value drivers improve SCF-solutions, we discussed two practices in SCF referring to reverse factoring and dynamic discounting.

As a result, a conceptual framework was developed on basis of supply chain collaboration to define the technological requirements for SCF-practices. Thereby, the paper shows how companies can benefit from BCT for managing their financial flows through supply chains and it identifies the value drivers how reverse factoring and dynamic discounting services can be improved. BCT based reverse factoring and dynamic discounting helps the supply chain partners to make decision independently and helps to smooth financial flows along the supply chain. Furthermore, it improves the security and service quality of reverse factoring in a way that the whole process is monitored in a visible and trustworthy manner. We have shown that, interoperability, trust, and robustness play the key drivers for BCT over conventional IT-infrastructure. Furthermore, the results indicate that BCT creates an open and permissionless platform where all supply chain partners can organize SCF individually. By taking a closer look on dynamic discounting, we compared BCT with conventional ICT technologies using the capability levels of structure, functions and dynamics. Whereas conventional and centralized technologies show higher efficiency in terms of quantitative factors, such a responsiveness and speed, BCT enables more qualitative aspects in dynamic discounting. Because of a blockchain-based solution, the interoperability, availability and trustworthiness of information enables autonomy within full peer-to-peer information’s systems. The results reveal that the choice for BCT or conventional solutions is strongly dependent on the individual supply chain configuration and the initial tradeoff between quantitative and qualitative factors. It is very likely that BCT is much more applicable in responsive and multi-echelon supply chains, where trustworthiness and availability of information as well as autonomy of decision-making processes result in higher cost savings. In

stable supply chains with higher levels of vertical integration and focus on efficiency, centralized ICT solutions are maybe the preferred choice.

Our results show that unlike other IT-architectures, Blockchain technology is a promising technology platform for creating transparency, automation, and trust for SCF-instruments. Following this, it is suggested to conduct a practical case-based research to investigate and provide usable applications. Although two solutions have been presented, they still lack concrete evaluation on their effectiveness. Beside a theoretical discussion, a more practical research approach is necessary. A scenario analysis or even a simulation would be appreciated to measure both qualitative and quantitative aspects. This would be beneficiary for further developments of BCT applications and a widespread adoption.

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