Chapter 5
Concept—Where Are the Opportunities of Blockchain-Driven Supply Chain Finance?

Blockchain is an elegant solution to clean up a tangled mess of documents, databases, regulatory compliance, international boundaries, auditing and management. N. Bauerle, Blockchain strategist and author of the Coindesk.com Report, 2016

As seen in the first chapters, technology plays a central role in supply chain finance (SCF): the improvement of software and platforms allows businesses to come together and speed up process flows throughout the supply chain, enabling various forms of financing solutions—from dynamic discounting via reverse factoring to the more complex reverse securitisation. Nevertheless, some barriers and pain points, which increase the set-up and transaction costs, still exist and have a negative impact on spreads and the value created for the supply chain community and its investors.

Chapter 4 showed how Blockchain technology (BCT) could enable the creation of new services and application programming interfaces (APIs) that promise to lean up structures, speed up processes and make services more efficient and less costly. In order to outline the opportunities, this chapter deals first with the use cases that could help overcome barriers that arise when discussing and presenting the different SCF models, and it then successively analyses the impact of the adoption of this technology by the supply chain communities.

5.1 Dealing with Supply Chain Finance Barriers and Supply Chain Processes

A number of issues have already been described, from questions relating to the accounting treatment of SCF transactions, compliance obligations and the high transaction costs in reverse factoring instruments. The following sections describe the different use cases with related scenarios and identify the opportunities for approved payables financing solutions.

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5.1.1 Compliance Requirements (KYC)

BCT as an identity register is a discussed use case for KYC and anti-money laundering (AML) purposes, and such uses fall under the asset registry use cases underlined in Sect. 4.3. The key feature of a decentralized database in which information is immutably recorded and available in near real time would allow other financial entities to access secure and trusted sources of information about new customers, such as IDs, bank related data and any required background documentation. As the onboarding of suppliers onto SCF platforms is manual and complex, usually only the 'top slice' (i.e. the largest suppliers) is invited, and the potential value in the 'long tail' supplier base is lost. A cost-effective KYC check could simplify the suppliers' onboarding process and could allow banks to also include the long-tail supplier-base, supplying funding to a sector (usually smaller SME suppliers) where credit capacity remains limited (Nassr and Wehninger 2015).

Deloitte (2016) sees the technology as particularly useful for this purpose. Their publication underlines how it could be possible to avoid duplication of KYC checks by sharing proper checks and registering them on a Blockchain so that other banks would no longer have to perform the same checks, since adequate evidence will exist on it. Historical records will provide proof that the bank that performed the KYC has done it properly. Other advantages highlighted in this study are that the encrypted details could be updated in near real time so that all banks engaged with a particular customer are updated on the actual status. Once registered on the Blockchain, no single entity could tamper with the historical data, providing a trusted public registry for which access to information could be restricted only to interested parties.

Martinelli and Smith (2015) also underline the significant benefits that a distributed ledger system could bring in handling and organising identity for KYC requirements. They see BCT working as an identity and financial information registrar with banks acting as validators in order to obtain a secure online data source for any other financial provider who needs to comply with KYC requirements for a given client.

Biella and Zinetti (2016) instead propose both a conservative and a disruptive scenario for Blockchain-driven identity management solutions. In the conservative scenario, every bank group will maintain its registry for which they perform the checks, and the information will then be available only for the bank's group entities. According to this solution, each customer will have only a single cryptographic identity so as to avoid any duplicative efforts for customers involved in multiple legal entities and jurisdictions. In the disruptive scenario, any institution could instead issue clients fingerprints (hashes) on the Blockchain, and customer identity will be cryptographically and digitally registered so that the banks that will receive a digital document version from their customers will use the Blockchain registry to prove its authenticity and validity without the need for further due diligence (p. 14). This will drastically speed up the KYC process and thus reduce the compliance costs.

Despite advantages associated with the possibility of reducing (or avoiding) the duplication effort, Goldman Sachs (2016) assume only modest cost savings related to customer onboarding (pp. 74–77). They point out that 'Blockchain would not remove banks' KYC liability, and thus we think banks will remain cautious when onboarding new accounts given AML penalties, despite improvements in customer data transparency and security' (p. 75). They estimate that Blockchain use would decrease customer onboarding headcount by only 10%. This is because banks would still need to run customer diligence checks when the prospective account is a private company or an individual setting up a bank relation for the first time (p. 75). The authors point out that pre-existing customer data on a Blockchain could in fact be questionable if validated by only a single source.

In order to work properly and efficiently, this kind of database will therefore have to achieve a critical mass of participants and validators. Another issue is caused by limitations related to privacy due to confidentiality requirements varying across different legal frameworks (Biella and Zinetti 2016, p. 14).

A cost-effective onboarding process could thus simplify the set-up of SCF programmes, particularly for buyers with a dispersed geographical (from various jurisdictions) supplier-base. Multi-bank SCF solutions could be particularly beneficial, because they can avoid the duplicative effort of the checks, since each bank has to perform them independently. A shared and trusted KYC registry could encourage banks to participate in SCF programmes, increasing competition and thus providing better financing rates.

For reverse securitisation programmes, the advantage will be of a lower magnitude, because KYC requirements for Luxembourg special purpose vehicle companies (SPVs) are already less extensive than for banks (see Chap. 3), but they will also benefit from a simplified compliance process.[1]

5.1.2 Accounting Rules and Treatments

As underlined in Chap. 2, reconciliation from trade payables with bank debts stems from various agreements between the financing provider and the buyer leading the programme. The point is to determine how a Blockchain could avoid reclassification while being in an agreement. The options are to either change the accounting rules or change the way auditors treat the issue. As already discussed, BCT can change the way transactions are processed and the way data is stored and shared, but it cannot change the accounting rules. For this reason, we now discuss whether the technology could have an impact on the way auditors respond to accounting issues.

[1]In practice, however, some bank typical KYC requirements need also be applied to SPVs because some bank's compliance rules might demand the same diligence for the SPV's KYC process as if performed by the bank itself.

A list of criteria that is important in keeping approved payables financing as trade debt is presented by Gustin (2014):

- Buyer should not indicate a higher commitment to pay to the financial institution by confirming to the latter that he will pay the invoice at maturity regardless of trade disputes or other rights there may be against the supplier.
- Buyer should always pay on the maturity date stated on the invoice (i.e. no early payments with discounts shared with the bank and no prolonged payment terms with interest payments to the bank).
- There should be no agreement made between the buyer and the bank ('kick-backs') in order to share revenues from the spreads in the form of different kinds of fees for services provided.

As it was originally intended to serve a distributed accounting system for digital cash, Blockchain and distributed ledger technology (DLT) are discussed as uses for corporate accounting. The capacity of Blockchain technology to avoid siloed-systems and reconciliation in corporate accounting could enable a new way of managing ledger entries in a network of companies. A strong focus is set on the potential of changing the auditing processes, based on both a disruptive scenario and more conservative one.

In a disruptive scenario, key features of immutability and transparent real-time data could potentially replace auditors if all business transactions take place on a Blockchain (Lazanis 2015). Since what is registered and validated on it can be trusted, performing an audit would no longer make sense, which would automate and potentially eliminate related audit costs.

A more conservative scenario is presented by Deloitte (2016) that sees the technology features as allowing auditors to automatically verify large portions of the most important data behind the financial statements. The cost and time necessary to conduct an audit will therefore be considerably reduced, and auditors could 'spend freed up time on areas they can add more value, e.g. on very complex transactions or on internal control mechanisms' (p. 3).

As a matter of debate even between auditors in the same office (Gustin 2014), the bank debt versus payable issue could therefore attract more attention due to the freed-up time provided to auditors. The application of BCT in corporate accounting could therefore represent a threat more so than an opportunity. Later in the chapter, this use case will instead be discussed from a different angle for which a number of possible opportunities may arise.

5.1.3 Issuing and Post-trade Clearing and Settlement Processing

Because the financing is provided through securities issuance in the primary market, only reverse securitisation financing would benefit from this specific use. As underlined in Chap. 3, clearing and settlement are fundamental processes that

require various intermediaries, the principal tasks of which rely on matching the buyer and seller records, confirming that the counterparts agree to the terms and fulfilling the delivery requirements by exchanging securities against cash (i.e. the role of a trusted third party). The process requires data reconciliation and manual intervention because of the multiple ledgers that must be updated, consequently making post-trade processing slow and costly (actual standards see securities settlement in two to three business days after trade).

Blockchain solutions allow digital securities to be issued directly to the distributed ledger (ESMA 2016, p. 11; Wyman and Euroclear 2016, p. 10).[2]

The asset ledger will store ownership details and transaction history—assuming the role of custodians (Wyman and Euroclear 2016, p. 11) and smart contracts—which would sit on top of the ledgers and reduce the uncertainty and counterparty risk related to contract terms and enhance the automation of the processing (ESMA 2016, p. 10). Distributed ledger technologies could also facilitate the implementation of a unique reference system across securities markets—a unique security identifier that would be embedded in the system (p. 10). A Blockchain solution avoids the need of central securities depositories (CSDs) and custodian banks to manage the process of issuance, clearing and settlement or redemption, which, according to the market, costs up to 500 EUR for each issuance. Furthermore, with DLTs, a digital asset (i.e. a single token that represents a security) is settled in near real-time (T + 0), since the trade is complete when the next update to the Blockchain is validated by the network (for example, this takes an average of 10 min for the Bitcoin Blockchain and mere milli seconds in the SETL Blockchain). Since money is tied up until settlement with the actual standards, near real-time settlement would unlock capital for suppliers and market investors. Since the funds are released to the suppliers once the note is successfully settled to the investors, the supplier community will have access to the funds earlier (3 days represent 10% of a 30 day maturity invoice), leading to lower financing costs. In addition, the interest period becomes extended by 2 days with the effect that more payables become eligible for the program, and short-term securities become more attractive to the investor because they carry a higher interest.

Regulation and legal admission of fiat currency in a Blockchain represents a key point in order to maintain the promises of faster and cheaper clearing and settlement. According to Mainelli and Milne (2016), the fastest settlement (T + 0) provided by distributed ledger technologies would require pre-disposition of cash ownership prior to trade and would represent a barrier to adoption due to the change required at the business process level (p. 14). However, this would probably not be true if assets, cash and securities were all available on the Blockchain so that pre-disposition would not be required due to real-time delivery versus payment (DvP) settlements. Furthermore, switching the ultimate record of ownership from CSDs and custodians onto a DLT will have to deal with a set of problems

[2]Various private or consortium projects such as the Corda R3, Nasdaq Linq, Digital Asset Holding or SETL.io are addressing this specific financial application.

concerning trust and legality. Today, the vast majority of resources employed in clearing and settlement are in fact required for three other tasks beside the sole transfer of ownership against payment (Mainelli and Milne 2016): (a) establishing trust before final settlement and ensuring that the trade is agreed accurately on both sides and that counterparties are ready and willing to settle; (b) ensuring the legal validity of the exchange; (c) dealing with the exceptions that arise when trust and legal validity are not established automatically through the automated clearing processes carried out before final settlement (p. 24).

But as seen in Chap. 4, counterparties do not need to have established any trust relationship when a transaction is executed on a Blockchain. So with a Blockchain-enabled real-time delivery versus payment (DvP), all these tasks could be handled by the technology itself. Furthermore, cancellation would become easier if real-time settlement is possible, because a quick (real-time) cancellation reduces the risk of losses due to price changes, for example.

McKinsey (2015) and GBST (2016) analysed the possible evolution and scenarios for DLT applications in the capital markets. Both see the adoption of this technology in four different scenarios, which depend on the level of adoption by the capital market participants and the ultimate potential in delivering a peer-to-peer marketplace between issuers and investors. GBST (2016) focuses particularly on the change in the role of custodians and CSDs and the effects on back-office infrastructure for financial providers.

The following are four possible scenarios and their consequent impact on approved payables financing.

Scenario 1—Single adoption
Technology will be adopted directly by CSDs and custodians for specific instrument types (e.g. fixed income) with no significant change in infrastructure (traditional third parties will remain). The technology will enhance the efficiency of the processes, but T + 0 settlement is unlikely to become standard, and the scope of the solution would be limited to secondary low volume market. For issuers, service providers and investors, this scenario provides only minimal cost reductions, and as the notes are issued in the primary market, the reverse securitisation model illustrated in Chap. 3 would not be affected.

Scenario 2—Smart contract enables small subset adoption
Smart contract-driven transactions allow automation between banks in addition to depository and transfer functions. The return processes for short-term securities could be performed automatically, and participants could introduce new functionalities on the system on their own terms. Clearing institutions will still exist, but multiple providers could compete to clear transactions or receive a small fee for the temporary supply of liquidity to the settlement process. Enhanced automation and competition would probably lower transaction fees, potentially drive settlement to trade day plus 1 day (T + 1) and provide automatic redemption at maturity date (M). Figure 5.1 illustrates a simplified notes issuing and post-trade processing.

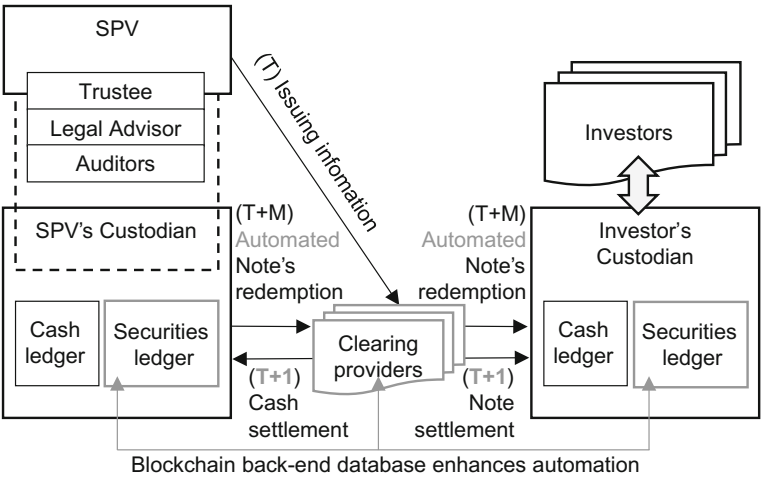


Fig. 5.1 Simplified post-trade clearing and settlement services in the reverse securitisation model (Scenario 2)

Scenario 3—New global infrastructure

Global distributed ledger consortiums would only solve clearing and settlement problems that are currently poorly served by the existing infrastructure, and fixed income post-trade processing would not be the primary focus. Furthermore, it would probably impact international trade, for which CSDs could outsource their function to a globally distributed ledger, while locally the processes would remain unaltered principally due to local market regulations. The reverse securitisation model illustrated in Chap. 3 would not be affected, as fixed income post-trade processing is not seen as the primary focus in this scenario.

Scenario 4—Global peer-to-peer network

Trading and settlement would happen between investors and issuers directly, replacing the traditional capital market system and removing any financial intermediary layer between issuer, buyer or seller. Substantially reduced fees due to back-office infrastructure would be replaced by a software that can be installed in the cloud and will provide access to the most commonly required functions. Even if not stated in the report, near real-time settlement should be expected to be the standard in such a disruptive model (Fig. 5.2).

The greatest benefits for capital market investors and corporations exist in Scenario 4, for which third parties' services are not requested or limited. GBST (2016) states that 'several technology platforms capable of providing this service already exist in some form, or are in the process of development' (p. 9).

A general reduction of costs is the main suggested benefit of a DLT application in securities clearing and settlement—particularly by reducing the need for multiple intermediaries—and the capital market community could particularly benefit from

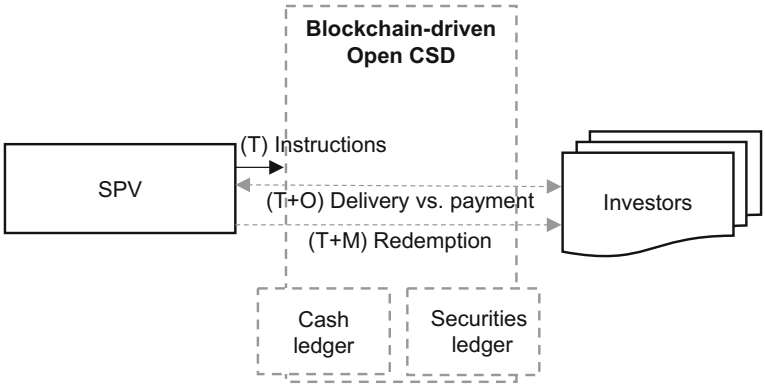


Fig. 5.2 Simplified post-trade clearing and settlement services in the reverse securitisation model (Scenario 4). Adapted from SETL.io (https://www.setl.io/opencsd/#)

reduced transaction costs. A peer-to-peer securities exchange scenario could drastically cut post-trade costs, avoiding the use of existing CSDs and custodians and enabling securities to be settled in near-real time and thus providing funds sooner to suppliers. The London-based financial Blockchain specialist SETL.io has presented the Blockchain-based 'OpenCSD', a platform that combines the trading venues, clearing house and ledgers for issuers and asset owners. Consequently, all functions and services, such as cash management, collateral management, securities lending, corporate actions and reporting, are managed by the 'OpenCSD', making existing CSDs, clearing houses and central counterparty clearing (CCPs) with general clearing members (GCMs) and non-clearing members (NCMs) for cash products obsolete. This would have a far bigger impact than just lower transaction costs, because due to the eliminated settlement risk, GCMs and NCMs would not need to provide collateral to the CCP or clearing fund.

A cost-effective securities settlement process means fewer transaction costs for investors. Especially fixed income securities with short maturities (e.g. SCF reverse securitisations) benefit most from these cost savings as here the costs have the highest proportion compared to the investor's income. The resulting enhanced competition could lower the spreads and potentially allow the onboarding of larger suppliers that have lower marginal fees because of better access to credit conditions. Furthermore, lower transaction costs enable smaller buyer programmes to participate in reverse securitisation programmes, thereby increasing the total market volumes significantly.

From an interview with Nestlé the world's largest food and beverage company it became clear that the issues highlighted in this first part of the chapter capture the attention of world leading companies that benefit from SCF programmes and are concerned with the possible benefits offered by BCT-use cases in this specific area.

Interview with Frédéric Lelieur, Operations controller in charge of Supplier Financing deployment, Nestlé

7th March 2017

Authors Today, Nestlé is running several SCF programmes globally. What was the motivation to offer SCF to your suppliers?

Lelieur *We want to give our suppliers the opportunity to benefit from the capital strength of Nestlé. Simply—and this motivation has not changed since we started SCF—we offer SCF to strengthen the relationship to our suppliers in a context that is mutually beneficial.*

Authors How important is the technology when it comes to supporting the SCF process?

Lelieur *Technology, and in particular the standardization of technology, is one important element when it comes to selecting the right partners. We already experienced banks in the relatively young SCF markets that decided to discontinue their SCF offering virtually overnight. This is an issue for our suppliers. In this case, we need to be quick to replace this partner. By choosing a standardized technology that is easy to adapt and compatible with our processes and technical infrastructure, we mitigate the risk of damaging our supplier relationships or—even more crucial—their financial solvency.*

Authors Where do you see the roadblocks of SCF, and how could Blockchain technology help to overcome these barriers?

Lelieur *Fraud is a risk when deploying SCF, and therefore we carefully monitor the sources of information and the technology that is transporting this information. Here, we believe that the Blockchain technology can play an important role to prevent fraud and provide additional security to the chain of payments. Moreover, Blockchain can cut intermediaries and reduce process steps. Blockchain technology provides the potential that the full transaction flow will be processed in a single technical environment that is secure due to the approval of many entities that share the same distributed ledger. By reducing the number of involved parties and by simplifying the transaction, we also expect that the cost per transaction can be reduced significantly for our suppliers and therefore make the SCF programs more attractive to them. This is important to Nestlé.*

Authors One of the main SCF-related Blockchain use cases is KYC. What is your view as a corporation on the impact of BCT on KYC?

Lilieur *From the corporation's point of view, we are not directly affected, as our suppliers are existing relationships and thus there is no need for us to KYC them again when they are offered to join an SCF program. Nevertheless, I see the relevance of KYC for SCF programs. It is one of the critical hurdles in the supplier onboarding process for our SCF partners, and it can result in significant costs for the highly regulated banking industry. Therefore, KYC today is one reason why SCF programs may not be available to those smaller and weaker suppliers that could actually benefit the most from the positive effects of SCF, such as early collection and access to lower financing rates. It is Nestlé's ambition to include all types of suppliers, including from countries where KYC is today difficult and costly, because our main motivation for SCF is to strengthen the close collaboration with our suppliers.*

Authors A wide definition that is often used by experts is 'Blockchain lets you put all of the information across all of the participants so that everyone can do useful things with it while maintaining a single source of truth'. Translated to supply chain finance, it would mean that all invoices appear in a distributed ledger, enriched by SCF relevant information, such as current ownership of a certain receivable (i.e. is it still owned by the supplier or assigned to a factor, is the invoice offered to a supply chain finance program, has it a 'promise-to-pay' from the debtor, etc.). Only those market participants provided with a special key would be able to read only those pieces of information that are relevant to them. Thereby, legal validity and a lot more information that gives transparency and security to the involved parties could be assured by Blockchain technology. What is your take on this scenario—'Common practice in 5–10 years', or rather 'Brave new world'?

Lelieur *From where we stand, this seems currently hard to believe. In its pure form, it would mean that there is a global distributed ledger that holds all invoices of all market participants, and therefore all past and present invoice information is stored in all Blockchain nodes. I am sceptical whether today this is technical feasible or commercially viable.*

Authors Compared to putting all relevant invoice information in the Blockchain, money transfers via the Blockchain seem to be a doable use. But does it have a relevance for SCF from the corporation's point of view?

Lelieur *Yes, but not a very big one. High costs for cross-border payments always have a negative impact on the funding offered to our suppliers, and the reduction in costs for payments would ultimately be beneficial to all parties.*

Authors	Some SCF platforms securitize bundled invoices to finance the SCF programme. Due to current settlement standards, it takes about 3 days to receive the money after the supplier has elected to sell an invoice and collect early. Moreover, the buyer typically must transfer the due invoice amount 2 days before the securities redemption date. With Blockchain-driven settlements and payments, these time lags could be reduced to zero.
Lelieur	*Yes, it has a positive effect, but for most suppliers, 3 days are no issue. However, for suppliers that use "blind factoring" arrangements, 3 days might be the decisive reason to participate in an SCF programme or not. But a far more crucial area where discounting days may be reduced is the buyer's invoice approval time. Here, may lose potentially weeks not just days until they can approve an invoice. That is a field where the high level of standardization and transparency brought through the Blockchain technology may prove to be a strong enabler for SCF programmes.*

5.1.4 Relevant Supply Chain Activities

Because dealing only with the capacity to overcome certain barriers could mean neglecting other important opportunities offered by this new technology, this section also takes a different approach. In fact, SCF services could be strongly influenced by the adoption of new technologies or solutions on the corporate side. The automation of B2B processes provided by the development of ERP systems, as well as the rise of e-invoicing, is an important enabler of faster and more efficient SCF solutions. As our focus is on approved payables financing, the procurement and fulfilment processes (Magal and Word 2011)—following the key steps, namely (a) order processing, (b) shipping, (c) billing and invoicing and (d) payment—are of special interest.

(a) *Order processing*

A buyer sends a purchase order (PO)—a commitment to purchase some goods under specific terms and conditions—to his supplier via EDI or web services. This triggers the sales processing steps in the supplier's ERP system with the creation of a sales order. A sales order contains data related to shipping, billing, partner functions and data from the buyer. After this step, a transfer of requirements for the material planning process is generated. Before filling the sales order, an availability check is performed in order to determine whether the material can be shipped as requested.

(b) *Shipping and material flow*

The shipping step takes place once the orders become due for delivery. At this point, a delivery document and a transfer order for warehouse management are created. When the shipment has left the facility, a *post good issued* is generated in the supplier's ERP system, and the sales order is updated with the shipment details. Once the goods are transferred to the buyer, it matches the delivery document with the related PO and creates a good receipt document with the related PO number. A signed bill of lading issued by the carrier accompanies the delivered goods as proof of shipment for Incoterms obligations.

(c) *Billing and invoicing*

After successful shipment,[3] a billing due list is updated, and the billing step can be executed. Billing utilizes the data from the delivery document and the sales order (material number and quantity) and creates an invoice. After receiving the invoice, the buyer verifies it before making the payment. A common method of verification is the three-way-match between PO, goods receipt (or any delivery document) and the invoice. Once approved, the account is debited.

(d) *Payment*

The buyer selects the payment method and bank. Payments could be made automatically with a specific software, which retrieves all authorised invoices within a specified timeframe and automatically generates payments. The cash transfer is not instantaneous, but funds may take several hours or even days to move from the buyer's account to the seller's account, and certain fees are collected. For international wires transfers, the delays and fees are expected to be higher.

5.2 Layers of Blockchain-Driven Supply Chains

From the previous section, it is possible to derive the four layers of interaction between a buyer and a supplier (i.e. a payment, billing, shipping and an order-processing layer) (Fig. 5.3). While ERP systems allow the partial integration of different layers into one wide application system, silos (i.e. isolated operating units and layers) can still exist within the same organization. This leads to reconciliation efforts and manual updates from one system to another with weak integration between the different layers and the risk of human errors.

[3]In the case of a new customer or poor payment history, suppliers usually request payment before shipping (Magal and Word 2011, pp. 5–39).

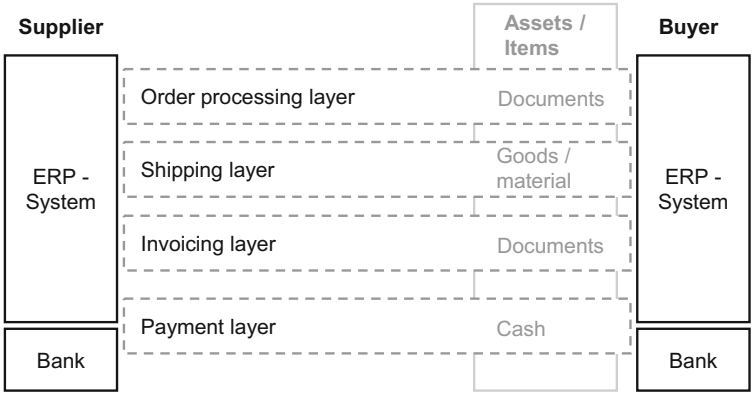


Fig. 5.3 The four supply chain-layers between buyer and supplier

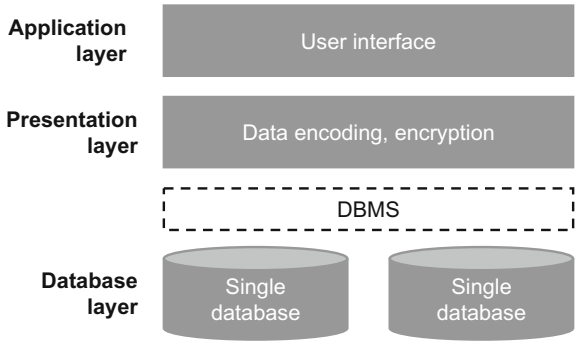


Fig. 5.4 IT systems' basic components. Adapted from Gronau (2004)

An IT system such as an ERP basically consists of three basic components: a database layer, a presentation layer and an application layer (Kent 1987) (Fig. 5.4). The produced data is stored in a single database, which is made available through database management systems (DBMS) (Gronau 2004, p. 9) in which typical data producers are ERP users from the 'front-end' departments, such as sales and purchasing (Röthlin 2010, p. 116). As each organization's ERP is built upon a single database in order to run the ERP's application layer, the assets and items exchanged are transferred from one organization's individual database to another. With the use of Blockchains as underlying technology, all the information is recorded and broadcast across all of the participants so that everyone can use it as a basic component for their applications while maintaining a single source of truth.

5.2.1 The Order Processing Layer

The order-processing workflow starts with a PO from the buyer. Within the Blockchain, once created, the PO is time-stamped and can become a valid document whose clauses can be executed only if valid, due to the programming features of smart contracts (Camerinelli 2016, p. 9). Purchase orders can become 'live' contracts that are always subject to possible adaptations, and changes can be tracked by the embedded time-stamp when key metadata is registered on the Blockchain. Assuming delivery documents can also be registered on it, the metadata of the invoice, PO and bill of lading could be matched automatically due to the smart contracts feature, which ensures consistency between price and quantity in all three documents (i.e. three-way-match), permitting an automated and fast invoice approval. The entire history of the transactions offers perfect audibility, and trust between parties is provided by the immutability of the data entered in a Blockchain.

5.2.2 The Shipping Layer

Keeping track of the material flow at each step, along with the corresponding paper flow, is a major undertaking that requires manual processes that are subject to human error, loss, damage or even theft and fraud (Harris 2016). For example, Provenance—a London-based startup—offers a Blockchain-based application that provides chain of custody along the supply chain for a given product or item. Information is open to end customers to prove the authenticity and provide assurance against counterfeits, and the product can be tracked along the supply chain. Another potential application is provided by smart contracts and cryptographic multi-signatures for all the various documentation and processing stages involved in a trade transaction (EBA 2015, p. 14). For example, a documentary trade could be ruled on a Blockchain, and execution of the payment to a vendor could be automated when certain criteria is met [e.g. goods have been received or shipped or a particular date has been reached, (EBA 2015, p. 14)]. The transfer of title would be secure due to being triggered by a smart contract representing pre-set contractual agreements (Camerinelli 2016, p. 10).

Furthermore, Wave Inc.—an Israeli-based startup—is creating a product that aims to take the place of traditional bills of lading using the Bitcoin Blockchain. It aims to replicate the industry standard workflows but replace printed documents with versions that are stored electronically in Blockchain transaction metadata, managing the ownership of each document or good in transport (Bauerle 2016, p. 13).

Other solutions, such as the IBM's autonomous decentralized peer-to-peer telemetry (ADEPT), propose an even higher integration level by combining internet of things (IoT) with BCTs. Right from the time that a product completes final

assembly, it can be registered into a Blockchain representing its beginning of life so that the product remains a unique entity within that Blockchain throughout its life when it passes from owner to owner (IBM 2015, p. 6). In such a Blockchain-based IoT, there is the possibility of maintaining product information, its history, product revisions, warranty details and end of life, transforming the Blockchain into a trusted database. IBM (2015) also postulates the possibility of devices and products that engage in autonomous transactions and form records.

The potential of having all the information written in a Blockchain allows the creation of an authoritative record that can be used to automatically establish smart contracts. Without such an authoritative record, smart contracts written on a Blockchain could hardly be executed, because parties need to agree on data and information that, like smart contracts themselves, are agreed to by a whole network through a consensus mechanism.

The one-layer Blockchain solution sees as such a fully integrated and automated trade network where documents and goods are transparently identified and tracked along the supply chain. Because the information is registered on a distributed database, it makes it tamper-resistant and fosters greater trust in the trade network.

5.2.3 The Invoicing Layer

As explained in Harris (2016) and Lawlor (2016), the principal purpose of 'tokenizing' invoices on a Blockchain is to avoid fraud and double-financing issues in invoice discounting and factoring. Blockchain-based services can register the invoice-related information on a Blockchain in order to avoid duplicates and fraud across the network (Harris 2016). As explained by Lawlor (2016), each invoice would be distributed across the network and, similar to Bitcoin transactions, hashed and time-stamped in order to create a unique identifier. If a supplier tried to sell same invoice again through the network, that invoice would indicate a previous instance of financing to all parties, and the double financing would be avoided. Oliver Wyman and Euroclear (2016) point out the possibility of placing invoices on the Blockchain in order to create a more reliable source of value to be used as collateral or as a demonstration of worthiness (p. 7).

For example, the London-based startup Tallysticks is creating a network where their Blockchain-driven application permits companies to automatically reconcile invoices, increasing accountability and efficiency. Because the invoices are tokenized in a Blockchain, they can be factored more easily since they are approved by the buyer and uniquely identified. Investors who finance the invoices could be sure that they are not previously sold or fake, reducing risk and therefore the cost of financing. It is therefore important to point out that a tokenised invoice results from the active participation of the commercial partners (i.e. suppliers and buyers) that

have to cryptographically sign the invoice document on a Blockchain. For this reason, the solution strongly depends on the broad participation in the network. Invoices created by this mechanism can then be factored.

The integration with the payment system is given by the ability of smart contracts to take control over an asset registered on a Blockchain (e.g. crypto-cash) and automatically trigger the payment. This solution is proposed by Fluent Inc., a US-based startup, that aims to create a real-time payment platform for supply chain networks where all transactions are tokenised and pegged to fiat currency at a 1:1 ratio (Bauerle 2016, p. 27). Such a Blockchain-driven platform would integrate the payment and invoice layers, achieving faster and safer systems.

5.2.4 The Payment Layer

Developed to create 'a purely peer-to-peer version of electronic cash to allow online payments' (Nakamoto 2009), payments are the first application of BCT. With the use of Bitcoin or similar cryptocurrencies in a B2B scenario, buyer and supplier could transact without any intermediaries (e.g. banks) and with very small transaction fees. Although companies such as CVS, Amazon or WordPress already accept payment in Bitcoin,[4] Bitcoin and other cryptocurrencies are far from mainstream economy payment volumes. From the findings in Chap. 4, it can be assumed that throughput capacity and high volatility represent serious barriers to mass adoption and to serving B2B transaction volumes. As underlined by Yelowitz and Wilson (2015), users are still primarily computer programming enthusiasts and people driven by 'illegal' activities, and limited support exists for political or investment motives (pp. 3–6).

Blockchain technologies have instead found strong potential applications in the banking industry for improving the existing payment services (Accenture 2015, p. 13), particularly for international transactions and real-time payments (EBA 2015, pp. 11–13). This offers advantages for cross-border payments, for which transaction costs are relatively high. The use of smart contracts combined with a distributed ledger architecture could enable the real-time transfer of funds with minimal fees and guaranteed delivery without the need for correspondent banks or custodians (WEF 2016, p. 51).

Blockchain solutions could create more efficient payment processes between banks, eliminating the need for each institution to maintain and reconcile their own ledger. Fiat-pegged-cryptocurrencies are still in an early discussion stage, but they could radically improve the actual payment system. Andolfatto (2015) proposes a

[4]A full list can be found on http://www.bitcoinvalues.net/who-accepts-bitcoins-payment-companies-stores-take-bitcoins.html.

government-sponsored cryptocurrency where the exchange rate is pegged to the legal tender currency and where fiat-tokens will be guaranteed and issued by central banks.

5.3 Opportunities of Blockchain-Driven Supply Chains

Figures 5.5 and 5.6 sum up and illustrate a supply chain process driven by different technological solutions (i.e. with and without BCT). Trade document flow could be processed using the Blockchain as the underlying database layer, which will guarantee the authenticity and allow the straight through processing in the invoice approval. The traded goods are also uniquely identified and submitted to the custody of a smart contract that guarantees that a payment will be processed if certain events are satisfied (e.g. a successful shipping and invoice due date). Higher levels of trust in commercial relations, fast straight through processing and cheaper transaction costs could be the results of using the Blockchain.

We now try to define how the different use cases, which could be implemented in the different supply chain layers, can create opportunities for approved payables financing solutions. A set of opportunities have been identified and are discussed in the following subsections.

5.3.1 Increased 'Window of Opportunities'

Since SCF solutions rely on efficient and fast processing of supply chain data, the automation of processes is a key driver for the development of the SCF market (Camerinelli and Bryant 2014). A certain extent of dematerialisation and acceleration of processes is already offered by e-invoicing, which replaces the paper-based distribution and provides faster receipt of the document by the buyer. Certain forms of automation already exist with the self-billing procurement model, which can be deployed in the large ERP systems and simplifies the approval of payments due to electronic three-way matching. A back-end Blockchain system could further enhance the automation of such processes, since fully digital and signed delivery documents, such as 'bills of lading', would exist on it. The earlier the invoice is approved, the longer the time interval in which financing is possible (see Fig. 5.7). Blockchain-driven documentary trade processing could, in this sense, become the catalyst to establish a fully straight-through process (STP) and, thus, faster invoice approval.

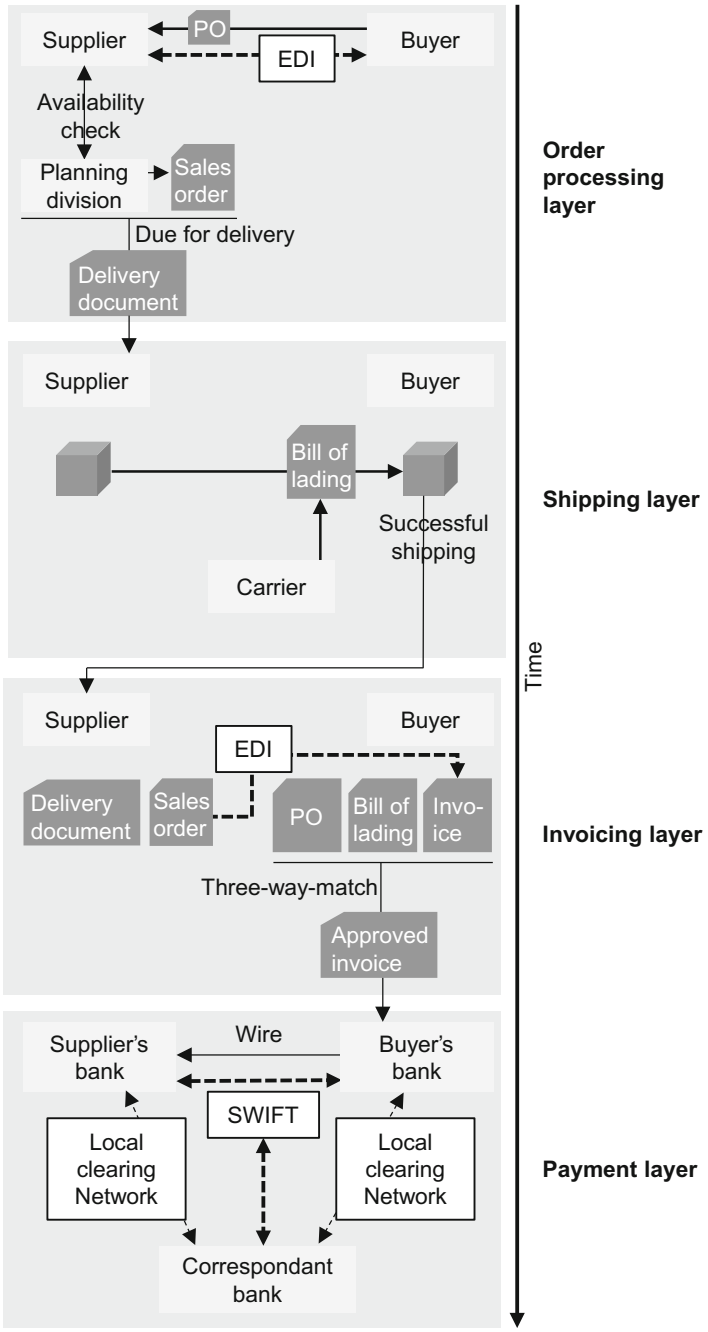


Fig. 5.5 Procurement and fulfilment process without BCT

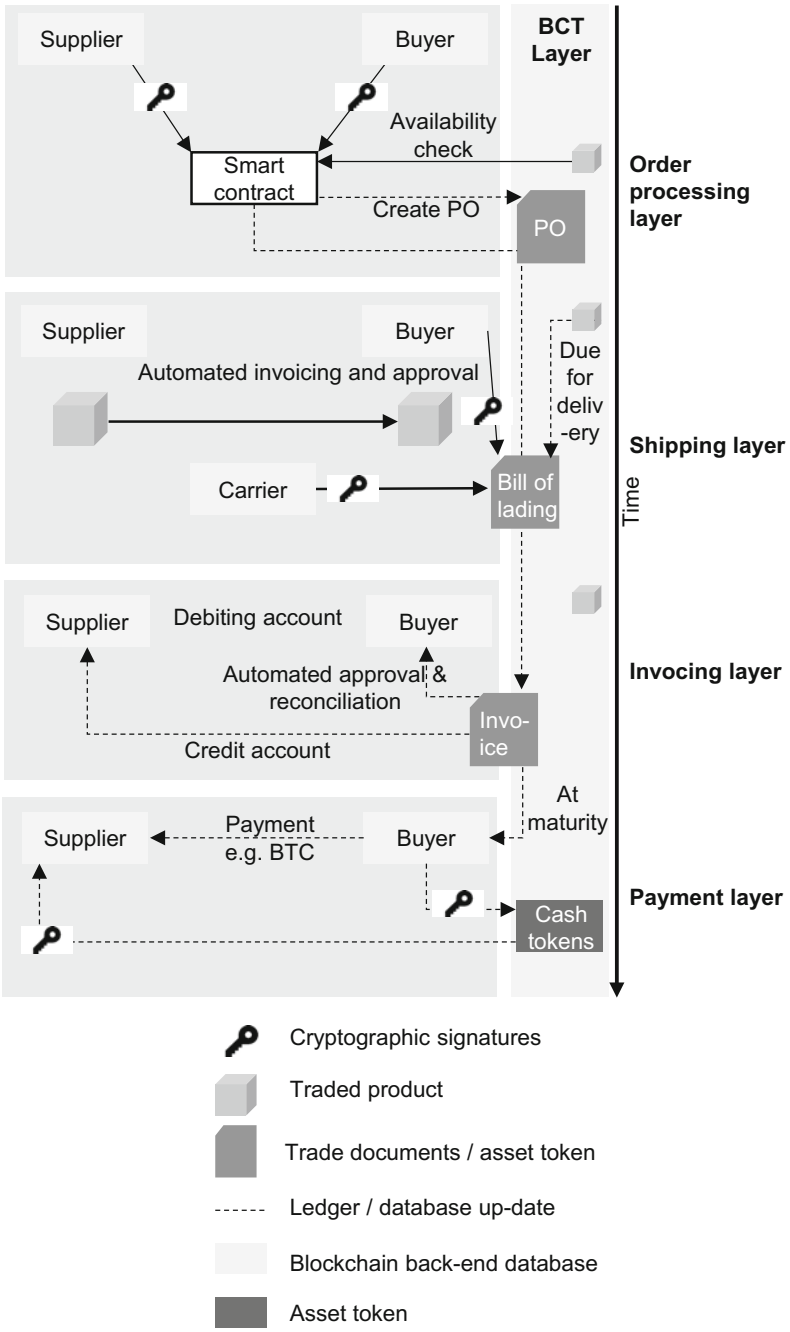


Fig. 5.6 Procurement and fulfilment process with BCT

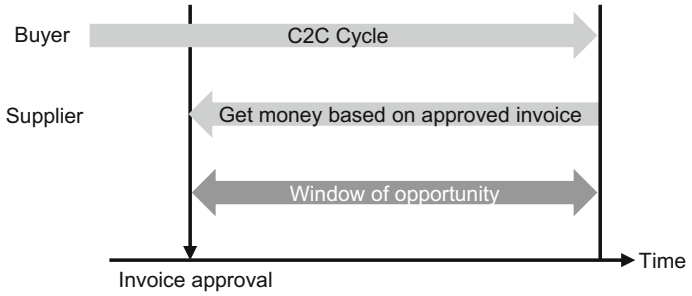


Fig. 5.7 The 'window of opportunity' (adapted from Camerinelli and Bryant 2014, p. 94)

5.3.2 *Efficient Cash Settlement*

An interesting feature is the opportunity offered by smart contracts to create a one-layer invoice payment system. 'Smart invoices' could be paid automatically at maturity to reduce manual intervention and ease the processes. Such possibilities, however, already exist with modern ERP systems: payments can be made automatically via a payment program that retrieves all authorised invoices within a specified timeframe and automatically generates payments (Magal and Word 2011, pp. 4–35).

Also, if pure peer-to-peer payments (such as Bitcoin) are highly unlikely to be deployed at B2B transaction levels, improvements offered by DLTs for the bank-driven payment systems would allow faster cash settlement and lower transaction fees with benefits for the entire SCF community. Multi-currency and global supplier-base programmes would particularly benefit from lower transaction costs in such a scenario.

5.3.3 *Simplified Invoice Validity Check*

Legal validity of invoices is a major issue for SCF programs. First of all, the buyer has the risk of double payment in cases in which invoices were already sold to a third party. Second, as the existence of undisclosed assignments in the purchased receivables portfolio cannot be determined by the financing party, the risk needs to be mitigated by a strong 'promise to pay' from the buyer. By assuring legal validity through BCT, the 'promise to pay' can be phrased less strongly (what helps the issue of accounting treatment), and the overall risk of the structure is reduced, which helps all parties of the SCF program.

The legal validity issue also presents itself in supplier-led financing solutions (e.g. factoring or receivables finance), because the buyer (debtor) is usually not

known by the financing parties. Because there are players in the market (e.g. banks) that are obliged by internal rules to perform checks on the legal validity of invoices, appropriately tokenised invoices would bring advantages for approved payables finance as well as supplier-led financing solutions. To be valid, an electronic invoice must be digitally signed, an element that is an integral part of every Blockchain solution.

5.3.4 Integration of Product and Money Flows

Being largely event-driven, SCF could strongly benefit from a technology that can create trigger points to key events in the physical supply chain. The combination of Blockchain and IoT solutions could offer the possibility to track the physical supply chain so as to adjust the risk at each step of the shipping process to fulfil the PO.

Tracking the product along the shipping process is already possible thanks to special devices that provide, for example, GPS, temperature or other relevant data to the interested parties in a trade transaction. The key features of immutable, tamper-proof and real-time data offered by a Blockchain solution could provide greater trust and availability to data consumers (e.g. banks involved in pre-shipment finance) and generate authoritative records for the execution of smart contracts and automation in the creation of trade documents.

The problem today is that perceived risk does not reflect the real risk profile because of the inability to track each step of the PO fulfilment process with sufficient granularity, resulting in fragmentation (see Fig. 5.8). The real risk profile could be illustrated as the composition of credit risk and performance risk, where the latter is related to the performance risk of the supplier in fulfilling the PO, and the credit risk is the credit quality (e.g. rating) of the buyer (Camerinelli and Bryant 2014, p. 82). The possibility to obtain information on goods to be despatched, conduct a pre-shipment inspection or obtain evidence of shipment can create data that could be matched with the PO and enable an automated adjustment of the performance risk. Performance risk also includes the willingness to pay from the buyer that depends on disputes caused by unmatched delivery versus PO.

As seen in the previous chapters, the trigger event in reverse factoring is the invoice approval, which allows the release of the funding against the approved payables. At this stage, the related risks depend only on the credit risk of the buyer, because the willingness to pay is confirmed (i.e. delivery is matched and payable approved), and any tracking information of the physical supply chain would become obsolete for this type of instrument. For this reason, integrating product and money flows is interesting only for SCF instruments that are triggered in the pre-shipment phase, such as inventory financing or PO financing.

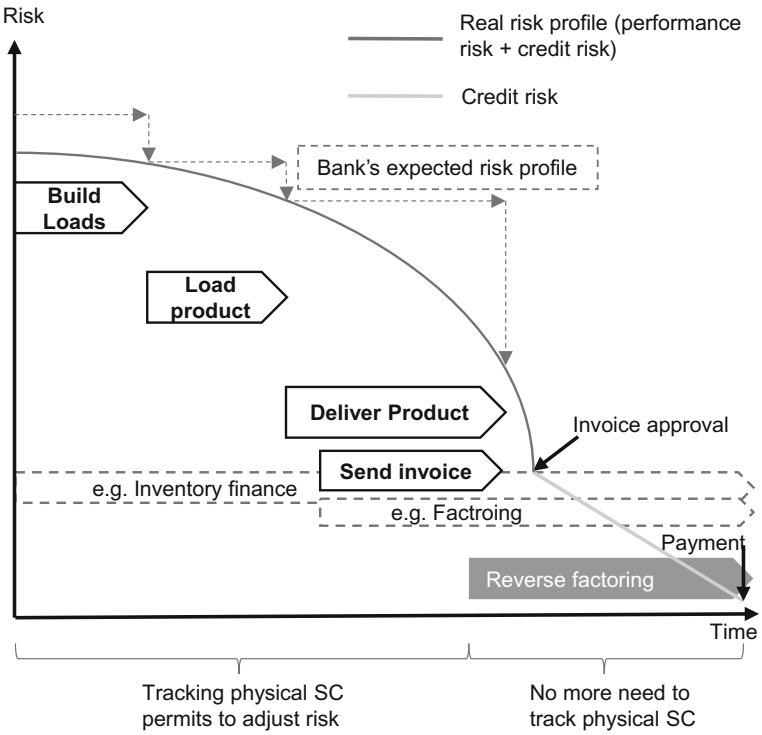
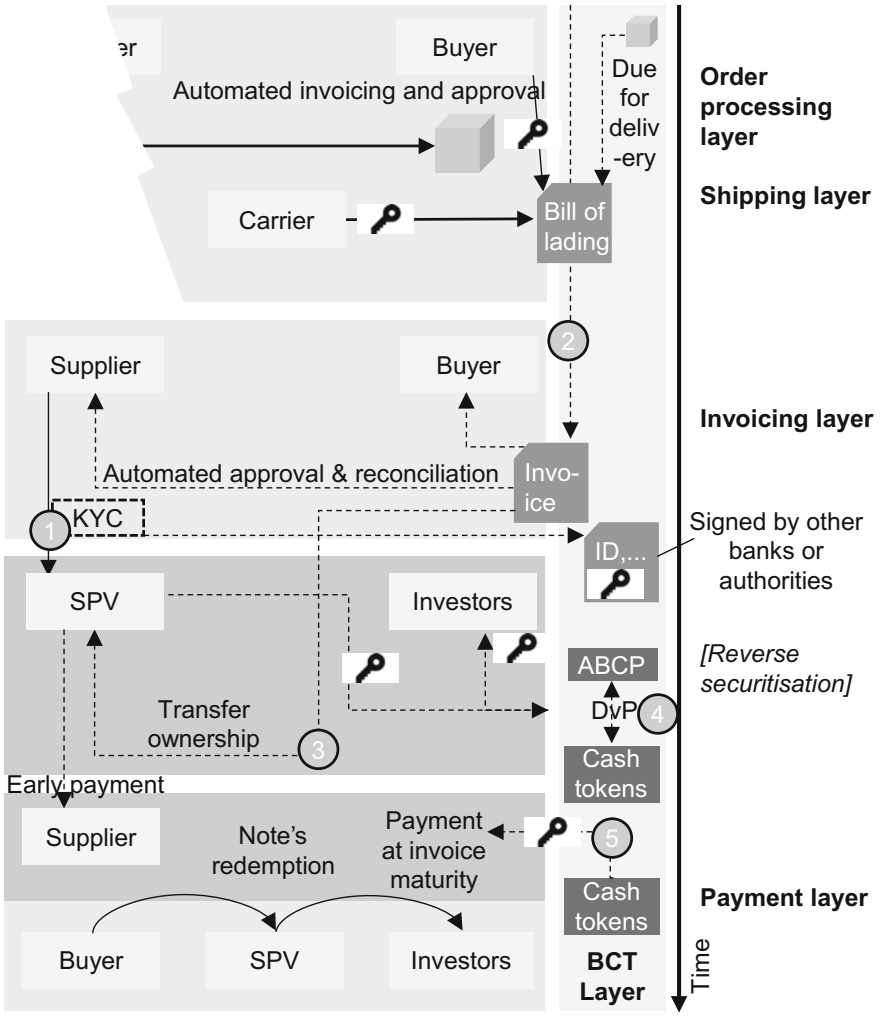


Fig. 5.8 Simplified risk perception in supply chain processes (adapted from Camerinelli and Bryant 2014, pp. 79–83)

5.4 Blockchain-Driven Reverse Securitisation

Figure 5.9 illustrates the principal opportunities that arise from the adoption of BCT in delivering a multi-investor reverse securitisation financing. As shown in the previous chapters, the use of a shared and trusted database layers can support the financing process, beginning with the programme setup until the key day-to-day operations, which include the invoice approval, note's issuance and related post-trade processes, payments and compliance activities (Fig. 5.9).



1 Cost-effective supplier on boarding

2 Straight-through trade document processing - faster invoice approval

3 Clear title of ownership and invoice validity

4 Efficient note issuance and clearing & settlement

5 Faster and cheaper payment systems

Fig. 5.9 Blockchain-driven multi-investor reverse securitisation

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