EMSFEI-III

SG7

Discussion paper on

The Impact of Emerging Technologies on Electronic Invoicing

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1 Management Summary

After the Directive 2014/55/EU on electronic invoicing came in force many companies and governmental institutions are now thinking how to use e-invoice data. The purpose of this discussion paper is to show how new technological solutions could change the e-invoice data usage and e-business processes in the future. The document points out how the use of new technology mainly in the area of distributed architecture (e.g. Distributed ledger technologies, Blockchain) present new ways and solutions for companies to improve their processes and to solve some of the interoperability issues. This new way of making e-invoice and other document data available is described as a paradigm change compared to the traditional send-and-receive mode. It allows the collaboration, document and data sharing and so development towards more automated processes. This is possible because simultaneously the technological development has made it possible to those solutions by using robotics or DLT.

This paper describes also the zero-corner model and some existing initiatives and experiences.

However, this paper does not go deep to technical details but tries to point out issues that companies should consider before start to use new solutions.

The discussion paper made by subgroup 7 tries to bring forth possible way to use technical solutions forward especial now when European member states started to utilize e-invoice widely, so it is good time to look beyond e-invoice process.

2 Mandate

The Sub-Group 7 ('SG7') was formed at the 15th meeting on October 24th, 2018. The SG7 was tasked by the European Multistakeholder Forum on electronic Invoicing (EMSFEI) to produce a report on the subject '*New technologies and impact on eInvoicing*', describing how new technologies may impact e-invoicing (and subsequently e-business).

The SG7 worked until May 2020 with meetings by conference call twice a month, reviewing input, and by having one Face-to-face meeting in January 2020. During the spring of 2020 the Coronavirus pandemic has affected SG7's work and caused the next EMSFEI meeting to be organized as a virtual meeting. The Commission has therefore suggested that instead of submitting a report with Recommendations, this subgroup should product a discussion paper on how technological developments can help private and public sectors to improve e-invoicing adoption and more generally paperless and touchless global supply chain processing.

3 Introduction

The Directive 2014/55/EU[1] on electronic invoicing in public procurement pushes member states to implement interoperable e-invoicing solutions to ensure that public contracting authorities and contracting entities can receive and process electronic invoices. Also, the European Interoperability Framework[2] action plan requires that public administrations should deliver services digitally, including machine readable information, as the preferred option ('*Digital by default*'). When businesses can provide information to authorities in structured form, both businesses and authorities can automate e.g. reporting. An example is the Nordic Smart government program, where Nordic countries try to create value for businesses, public authorities and society by sharing data across the region in an automatic, smart and secure manner. The Real time Economy[3] program has similar goals. It aims to create an environment where all information regarding

[1] https://eur-lex.europa.eu/eli/dir/2014/55/oj
[2] https://ec.europa.eu/isa2/eif_en
[3] http://rte.fi/

transactions between business parties is in a digital format, increasingly automatically generated, and completed in real-time both from business and IT-processing perspectives. This means, for example, that not only orders, order response, dispatch advice documents, invoices, but also payments or data from those documents flow from system to system without delays. This makes it possible to move towards electronic archiving, electronic bookkeeping, and automated accounting.

However, it has to be stated that businesses are far from 100% full automation on the global supply chain despite a lot of effort and supporting regulations. Low adoption can be explained by many reasons, complexity of the full process, which asks for an alignment of practices and information solutions among communities, compliance constraints, European VAT control diversity, interoperability, trust, security and so on.

Distributed Ledger Technologies (DLT), Identity Management, Robotization Process Automation, Machine learning are new technologies which can bring added values and solutions to speed up adoption. In particular, DLT could represent a disruptive approach by switching from a situation where business partners exchange business information through a lot of business documents bilaterally to a situation where all actors of a supply chain transaction share the business transaction's data, which represents the common truth on which they realize their process.

This discussion paper presents how and why these kinds of new technologies represent a paradigm change, potentially with new challenges to face, and may bring added value and flexibility, accelerate adoption and improve process automation.

4 Documents supporting Business Processes in Trade

4.1 The (electronic) invoice

An invoice is a multi-function business document:

- It is a sales document, which is part of the commercial transaction between the seller and the buyer and materializes a request to pay from the seller to the buyer.
- It is an accounting document which builds and supports the seller's and the buyer's accounts (Profit and Loss (P&L) and balance sheet), respectively booking the income and expenses in the P&L, and the VAT collected or deductible and the accounts payable or accounts receivable in the balance sheets.
- It is a tax document, proof of the deductibility of VAT, which constitutes a claim on the Tax Administration for the deductible VAT amount on the buyer side.

As a result, invoices are subject to numerous regulatory provisions relating to commercial, accounting and fiscal rights in particular, which specify the information they must contain (the "mandatory fields") and the conditions which makes an invoice compliant as a supporting document for Tax Administration, including copies of it for the seller, but also for Trade and accounting regulations.

In order to provide invoice process automation, electronic invoices in structured format have been developed since the 1980's in addition to other supply chain electronic documents such as Orders, Delivery and Receipt notices or advice notices in different syntax, such as EDIFACT, X12, TRADACOM, EANCOM syntax and several XML formats, in parallel to non-structured formats, mainly PDF.

Since Directive 2006/112/EC, amended by Directive 2010/45/EU, the fiscal provisions are applicable to paper invoices and electronic invoices based on a principle of equal treatment between paper and electronic forms.

As stated in article 217 of this Directive, *'electronic invoice' means an invoice that contains the information required in the Directive, and which has been* ***issued and received*** *in any electronic format*.

The authenticity of the origin, the integrity of the content and the legibility of an invoice, whether on paper or in electronic form, shall be ensured from the point in time of issue until the end of the period for storage of the invoice (article 233 of this Directive).

An electronic invoice can be a full structured file, machine readable for invoice process automation, including an ability to provide a human-readable view, or a non-structured file (native human readable view but with a few values for process automation), or an hybrid format composed of a non-structured file embedding a set of invoice data in structured form, or the reverse (a structured file of invoice data embedding a human readable view).

Since 2014, thanks to Directive 2014/55/EU on electronic invoicing in Public Procurement, a European Semantic Norm for a full structured electronic invoice has been published (EN 16931)[4], implemented in different syntaxes, with an obligation for all public entities in EU Member states to accept and process any full structured electronic invoice in 2 XML formats :

- UBL invoice and credit note messages as defined in ISO/IEC 19845:2015
- UN/CEFACT Cross Industry Invoice XML message as specified in XML Schemas 16B (SCRDM - CII)

The date from which contracting authorities and entities had to comply with Directive 2014/55/EU and receive and process electronic invoices according to the EN was 18 April 2019. This deadline could be extended to 18 April 2020 for the sub-central contracting authorities of those Member States & additional European Economic Area (EEA) having requested an official extension.

For the purpose of this Directive, an electronic invoice is defined as an invoice that has been issued, transmitted and received in a structured electronic format which allows for its automatic and electronic processing.

However, especially for B2B transactions, fiscal and other regulations compliance, an electronic invoice remains an electronic document issued and received in any format, as stated in Directive 2006/112/EC modified by Directive 2010/45/EU.

In addition to the Directive 2014/55/EU, several EU Member states have added an obligation to send electronic invoices (full structured or not, depending on the country) to public entities, and some countries have also implemented or started to implement an obligation to exchange electronic invoices in B2B and sometimes even in B2C scenarios, with an obligation to send VAT information (VAT reporting or the invoice itself) to the Tax Administration, in real time (Continuous Transactional Control) or even before sending it to the buyer (Clearance model).

Most of the time these additional requirements are organized around a national platform, which plays different roles, with different additional domestic e-invoice formats accepted, and different procedures, which increase the complexity of implementation for companies and therefore would need harmonization at EU level, as concluded in the EMSFEI WG3 report[5].

Directive 2014/55/EU states in article 9 that it has no prejudice to the provisions of Directive 2006/112/EC (modified by Directive 2010/45/EU, a.k.a. the VAT Directive). Therefore, derogations from the VAT Directive application authorized according to the procedure set out by its article 395 (such as split payment) can introduce specific requirements on the content of the invoice, leading to deviations to the application of the EN16931 standard. The progressive shift from to fully structured invoices brings to light the limits of a VAT

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[4] https://standards.cen.eu/dyn/www/f?p=204:110:0::::FSP_PROJECT,FSP_ORG_ID:60602,1883209&cs=104E4C4FA3744A8DEA8E98A7B500306FD

[5] See Discussion paper on the growth of additional requirements and the fragmentation of provisions relating to e-Invoicing at Member State https://ec.europa.eu/cefdigital/wiki/pages/viewpage.action?pageId=62890256&preview=/62890256/62890251/EMSFEI_Additional requirements and opportunities_FINAL.pdf

Directive that was fundamentally conceived for unstructured invoices and suggests a shift from the equal treatment principle to the digital by default principle at policy level, to make the digital transition ever smoother.

4.2 Other documents

4.2.1 Introduction

There are a number of documents in addition to the invoice that support the procurement business process.

In order to develop electronic procurement in the public sector the ESPD[6] (European Single Procurement Document) has been developed as a self-declaration form used in public procurement procedures.

Different initiatives have been set up for electronic public procurement in several EU Member States, following the methods and principles already developed for B2B e-procurement for decades, but with no global approach yet at EU level (regulation, standard to be defined and used, …) as it was done for e-invoicing for the public sector.

The invoice is a business document, which follows other supply chain documents, to which it must be matched in the invoice validation process, in order to secure and support the business controls that build a reliable audit trail. Such other documents are purchase orders, order changes and order responses, dispatch advice, shipping advanced notice, delivery notes, transport documents, receipt advices, … They are documents or messages, used since the 1980's and known as "traditional EDI"[7], in various formats, mainly EDIFACT, X12, TRADACOM, EANCOM and more recently in XML messages like UBL, C-XML but also a lot of proprietary formats proposed by large buyers to their suppliers.

Some of these documents also exist in non-structured formats in addition for instance for SMEs or consumers, especially in PDF format, used in many e-commerce marketplaces, or through P2P (Purchase to Pay) or O2C / C2C (Order to cash / Contract to cash) solutions.

In order to support e-procurement, electronic catalogues have also been developed, including the punch-out catalogues mechanism allowing the supplier to implement dedicated electronic catalogues and prices to buyers based on a global supplier catalogue. Then, like what is developed for marketplaces, the buyer's users can create baskets of goods and services online, which will become purchase orders.

The development of e-Business, including the zero-stock principle, brought its challenges for logistics, in order to reach the same day delivery mechanism, including the use of external warehouse and real time instructions to organize the timely delivery or pick up of goods. (Note that Electronic Business, the process of doing business electronically (or e-Business for short), is more than "Electronic Commerce". While e-Commerce describes the world of Business-to-Consumer commercial transactions, the term "eBusiness" usually refers to a broader scope of electronically-enabled activities, including Business-to-Business, Business-to-Consumer and Business-to-Public Sector). Consequence is a more complex process with new players (here an external warehouse) and a need for fast and errorless delivery instructions. Another illustration is a dropship vendor process, where the final customer buys a good from a retailer on a website, which in turn immediately buys it from its supplier and ask him to deliver directly the final customer. All this has to be done on a real time basis with view on supplier's stocks, and orders, delivery instructions, invoices processed automatically as a consequence of the final customer purchase.

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[6] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0024&qid=1428299560152&from=EN, Article 59

[7] Note that https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31994H0820:EN:HTML defines EDI as: Electronic data interchange is the electronic transfer, from computer to computer, of commercial and administrative data using an agreed standard to structure an EDI message.

Finally, as one of the major objectives of e-invoicing is to accelerate payment and cash flows, financial supply chain solutions have been developed. Based on additional business documents or functionalities such as the Invoice Response Message in order to share invoice process statuses (especially for invoice approval), these solutions provide payment acceleration through factoring, reverse factoring or dynamic discounting functionalities. When it comes to payment, instant payment, contactless payment and the Request to Pay messages also contribute to full automation. Furthermore Enrollment and Activation messages are developed in order to set up Request to Pay messages embedding e-invoices and to secure the so called "Know your Supplier" / "Know your Customer" procedures, as well as allowing new services on payment (such as pay now, pay later, payment guarantee for the payee etc), all based on ISO 20022 syntax, and developed under ERPB (Euro Retail Payment Board) working groups[8].

Supply chain and supply chain finance business documents or messages are primarily used or under development for B2B transactions. The public sector has mainly developed e-invoicing upon reception thanks to Directive 2014/55/EU, and pre-award electronic solutions (starting with ESPD and pre-award platforms).

4.2.2 Playing field

In line with the above, the following document exchanges / interfaces can be identified.

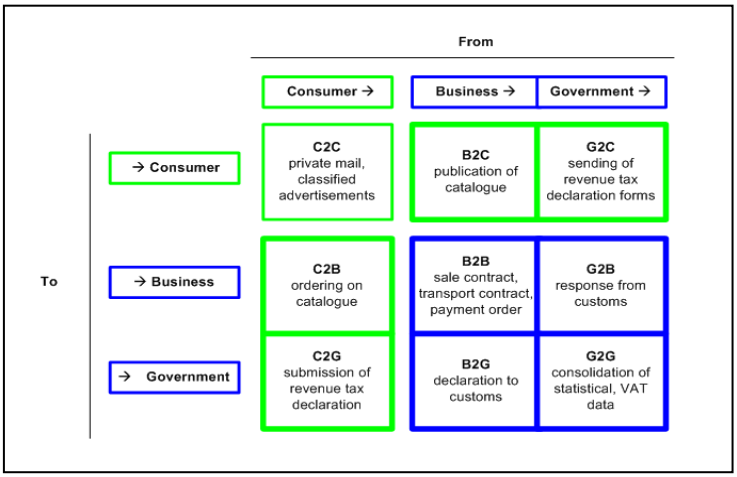

Figure 1

This discussion paper focuses only on the blue boxes (and not consumer invoicing) as business and governments have a greater need and wish to reuse the e-document data further. Consumers often just want a pdf-document to verify the transaction.

4.2.3 Actors

In the basic invoice process, there are two business parties, the Customer and the Supplier. Each party may fulfil two or three different roles in the process. The Customer party has the role of the Buyer (the commercial role that contracts with a Seller and orders the goods and services) and the Receiver (the operational role that receives the goods and services). The Supplier party has the role of the Seller (the commercial role that is contracted by a Buyer) and the Payee (the role that receives the payment). Both parties are normally Taxable persons (the role that declares and pays or reclaims VAT). The Supplier may delegate the operational aspects of that role to a Tax representative, who declares and pays VAT on his or her behalf[9].

[8] https://www.ecb.europa.eu/paym/groups/erpb/shared/pdf/12th-ERPB-meeting/Report_from_the_RTP_MSG.pdf?efe8385c4196f8094d5b6625f7ffdc79

9 EN 16931 Electronic invoicing. Part 1: Semantic data model of the core elements of an electronic invoice

Actor Type	Possible Roles
Customer	Buyer, Consignee, Payer, Importer, Invoicee
Supplier	Consignor, Payee, Seller, Manufacturer, Exporter, Invoicer, Seller's Tax representative
Authority	Chamber of Commerce, Customs, Licensing, Receiving Authority, Standards Institute, TAX authority
Intermediary	Bank / Financial Institution, Broker, Carrier, Credit Checking Company, Export Agent, Freight forwarder, Import Agent, Insurer, Receiving authority, e-invoice service provider

Figure 2 Actors in International Trade and Their Roles

Where the trade in goods and services is done between a buyer (who purchases the goods and/or services from a supplier) and a supplier (who delivers the goods and/or services purchased to the buyer) it must be considered that these are not the only actors involved in the trade. Many more actors can have a role; think of transporter, customs, financial service provider for payments or trade finance, etc. The above table briefly lists the common actors. If all the actors are put in a matrix, then the document / information interchanges between actors could be shown. That goes beyond the scope of this document. For further detailed information, the reader is referred to the 'Supply Chain Operations Reference Model'[10] or its ´Quick Reference Guide´.[11] This document has its focus around the ´invoice´ / the document that informs the buyer how much to pay for the goods and-or services delivered in the transaction that the invoice refers to.

5 The critical evaluation of the traditional "send-receive" model

The main objectives for businesses to engage in e-invoicing are payment acceleration (or payment delay reduction) and process automation. Processing an invoice means getting business information and match it with previous steps (contract, purchase order, delivery, consumption report etc.) in order to facilitate its booking and to approve it for payment. Fundamentally, it means that the buyer and the supplier must have the same understanding of a business transaction regarding the goods or services, their prices, the quantities delivered, the VAT regime(s), and the compliance with the business documents supporting the transaction (especially, but not only, the invoice).

In order to have this "synchronization" of a business transaction in the respective information systems, current solutions are based on an exchange of business documents, as it has been done for decades with paper documents, although more and more in an electronic form and more structured business data. **It is been called the "send-receive" model.**

Each company, public entity or trading partner operates its own view of a business transaction, starting with a contract, mostly followed by a purchase order, then a delivery of goods or services which can involve third parties for transportation, next an invoice which must be related to a delivery of goods or service on the seller side and on the buyer side (with a matching process), and finally a payment which has to be reconciled with the invoice especially on the seller side. In addition, the Tax Administration for VAT deductibility or VAT collection and Factoring Companies for invoice refinancing also need certain information in order to support the reality of the transaction (mainly at the invoice level).

10 https://docs.huihoo.com/scm/supply-chain-operations-reference-model-r11.0.pdf
11 https://www.apics.org/docs/default-source/scc-non-research/apicsscc_scor_quick_reference_guide.pdf

Finally, both the seller and the buyer, and third parties as Carrier, Financial institution, Tax Administration, need to synchronize their view of the transaction and its reality; this is done through business documents "sent and received" bilaterally, such as Orders, Delivery Note or Advanced Shipping Notice, Invoices, Payment receipt or means. In addition, in order to make sure each document is successfully processed for business transaction synchronization, response messages are also required from the Receiver to the Sender such as Order Response, Receiving Advice, Invoice Response, as well as phone calls or emails to solve discrepancies or litigations.

Historically, all this was done through paper exchange using technologies and services to extract business data from business documents in order to feed information systems on both transaction sides (like ERPs). With the development of Electronic Data Interchange, this synchronization has been automated through structured business messages supported by Standard messages and file exchange networks, under the constraint that both the seller and the buyer information systems can interoperate. It means that they share the exact same understanding of data exchanged for their business transactions (including credit notes management).

Indeed, the fundamental needs to automate process synchronization or to "interoperate" business transactions information are:

- **To have a common understanding of all business DATA** needed to follow and manage business transactions in order to share a common view, taking into account that each Party has its own information system and procedures, different from each other. This is done through structured messages agreed between parties. The more **Standard** these messages are, which also means the more commonly used in the exact same way they are in the largest community of parties, the more efficient and faster is the management of business transactions.
- **To connect automatically each Party's information system** in order to share the same business transaction through a common representation brought by the common Standard messages. It means an ability to connect information systems technically and **DELIVER** electronic messages, but also to address the right counterpart for each business transaction (**DISCOVERY**). It includes the authentication of parties (so called "Know Your Customer" / "Know Your Supplier" processes), confidentiality and secure exchanges, and integrity of information shared / exchanged (which is key to guarantee a real business transaction synchronization).
- **To comply with regulation and business requirements (DIRECTIVES),** especially regarding business documents compliance and business rules in relation to the business cases or scenarios regarding specific data presence, calculation rules, documents exchange choreography.

Starting in the 1980s, this electronic business transaction synchronization was done first on a peer-to-peer mode (2 corner model), using EDI messages (mostly EDIFACT), with the use of X.400 messaging protocol or VAN (Value Added Network) for transportation, progressively replaced with AS2 connections. An intermediate development for the exchange of information was Electronic Invoice / Bill Presentment and Payment (EIPP / EBPP)[12]

Then, some Service Providers proposed some internet platforms for e-invoicing or e-procurement, which merged in P2P[13] and O2C solutions, implementing standard business scenarios and documents (sets of business data) exchanged or shared through these platforms and portals (especially in XML format like UBL or other) for their community of Clients / Users / Trading Partners (3 Corner Model).

Since about a decade, Service Providers have started to interconnect bilaterally in order to extend their own network of users. More recently, an effort was made on interoperability on DATA with at least the European Semantic Norm for e-invoices (EN 16931), and on E-DELIVERY and DISCOVERY (addressing) with the

12 See https://www.crfonline.org/orc/pdf/ref17a.pdf

13 http://euro.ecom.cmu.edu/resources/elibrary/epay/b2b-presentment-models.pdf and http://euro.ecom.cmu.edu/resources/elibrary/epay/B2BPaymentOptions.pdf

development in Europe of the CEF eDelivery building block (with SML / SMP as a global register), implemented for instance by the PEPPOL network in Europe and worldwide.

Many reports have been made on interoperability and recommendations such as the *"Report on interoperability and transmission of e-invoices with a special focus on the needs of SMEs"*[14], published by the EMSFEI in October 2018.

OpenPEPPOL, ConnectONCE, BPC (Business Payments Coalition) and EESPA (the European E-invoicing Service Providers Association) have also launched a working group on Global Interoperability Framework as a worldwide guidance for interoperability, based on 4 D-layers: Data, Discovery, Delivery and Directives.

Work is ongoing in OpenPEPPOL to extend EN 16931 to enable its use at international level, allowing support for other tax regimes. If taken up by ISO member, it can be the basis for international standardization in ISO.

Even if underlying technologies have been developed to automate business document exchange, data extraction and integration, it is still a process which replicates the paper-based model that is used to synchronize business transactions between two parties (or more) by exchanging bilaterally a set of business information on a document (electronic or paper).

However, as described in paragraph 4.2.1, business transactions more and more frequently involve several parties in addition to the seller and the buyer (see figure 2), such as external warehouses (Consignor or Consignee) and carriers, ultimate customers or suppliers (in case of e-Business for instance), Shared Service Centers, Service Providers, Financial institution, Custom services, Tax Administrations, ect. They all need to have access to some of the business transaction information or to enrich it (for instance on delivery of goods or services), depending on their rights and roles and with a need for all to be confident as to the integrity through time and authenticity of the information they access or provide.

In addition to the necessary interoperability in order to synchronize business transaction between 2 parties, the "send-receive" model will rapidly reveal some limits when it comes to the synchronization of the business transaction between many players from order to payment, including Custom and Tax services who request more and more real time information (with the development of Continuous Transaction Control or Clearance around the world).

Lastly, the business transaction is a process with different steps supported by different business documents where a lot of information is repeated, coming from each information system. For instance, a purchase order defines the parties, the delivery of goods or service requested instructions, the detail of goods and services with unit prices and quantities. It can also give some VAT information for invoice booking preparation. An Advanced Shipping Notice or Delivery Note or Good Receipt Notice or Dispatch Advice then repeats most of the business transaction information, although the actual new information at this step is the confirmation of delivery instruction and quantities of each goods or services from the purchase order that have been delivered and received. Finally, the invoice is a request for payment of the goods or services delivered (so mainly described in the Order and the Delivery messages) with VAT and payment information.

As an illustration, it can be easily noticed that around 80% of the business information present in an invoice is repeating what is already present in the corresponding order, and the same level of information replication can also be found in delivery messages or even previously in a quote message.

As a first conclusion, the "send-receive" model already represents an interoperability challenge on large scale, and is only used for synchronization of two parties in a business transaction, at each step of the supply chain process (from order to payment), with integrity and compliance concerns for each document exchanged.

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[14] See https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/2018/11/20/EMSFEI+published+a+key+document+on+eInvoicing+transmission+and+interoperability?preview=/80184632/84411741/FINAL%20EMSFEI%20report%20on%20Interoperability%20and%20transmission.pdf

Purchase to Pay (P2P) or Order to Cash (O2C) solutions propose to share a common business transaction on their platform, which is a way to naturally ensure the synchronization of a business transaction by building a single business transaction reference on a platform on which all parties can synchronize. The more advanced solutions organize access to a business transaction for third parties or an ability to publish part of the business information for third party sharing (including Tax Administration). Integrity of information and authenticity of parties are guaranteed by the Service Provider who plays a role of a Third Trust Party. However, this applies only to the companies connected on the same platform (back in a three-corner model).

New technologies like Distributed Ledgers (of which Blockchain is one implementation example), associated with Global Identifier for companies and Identity Management for users and rights could enable natural interoperability, in a N-Corner or 0-Corner model, where business transaction information can be built, published and registered on the "cloud" by different means, with rights for involved parties to read or enrich each parcels of business data, and from which their information systems can synchronize and produce different views to get the traditional business documents when necessary.

The richness and reliability of business transaction data could in the next step open many opportunities for Robotization and Artificial Intelligence technologies to be applied on supply chain and supply chain finance processes.

6 Business requirements

6.1 Introduction

To be able to apply Robotization and Artificial Intelligence technologies (as proposed above in business processes) companies need to be able to process a lot of business data. This chapter is considering the business requirements that are imminent, but it also aims to open the thinking and considerations to requirements that are today not possible or realistic to meet (or require too much efforts and/or costs/complexity) in the traditional send-receive model.

6.2 (Digital) Business systems are expected to be transactional

When it is stated that business systems are expected to be transactional, it must first be defined what is meant by transactional. According to Merriam Webster it is "a communicative action or activity involving two parties or things that reciprocally affect or influence each other".

It feels justified to extend this definition to "multiple parties" in this context.

It is widely accepted that the speed of operation is essential for business. Losing control over a company's action by not being informed (even temporary) of the result of input is not satisfactory.

Business processes widely use the term of "adjustment" to correct discrepancies, mistakes or updating modified demands. In the "traditional" send-receive model, essentially replicating the paper-based processes, the data transmission is electronic, but the process is paper based (see Joao Rodrigues Frade article where Figure A and Figure B shows that CEF Delivery only replaces paper document exchange by a secure electronic document exchange[15]). One of the most important characteristics of such processes is that the sender loses control over the data and the process the moment he or she clicks on the Send button.

15 https://www.linkedin.com/pulse/three-reasons-why-ict-industry-should-discover-cef-rodrigues-frade/?trk=pulse_spock-articles

On the other hand, in a transactional environment the result of these adjustments must be immediate in contrary to the traditional way of conducting the business, e.g. calling the partner on the phone, which is being the least efficient way of communication in such cases or sending emails equally of low efficiency.

Then, on a transactional environment, each time a player adds or corrects business information, all other players involved are automatically updated, which save a lot of human time and provide a better data quality for all.

Another aspect of the issue is the relatively painless move towards automation by learning what can be automated and how.

6.3 Interfacing with "any" process and "any" document by "any" partner based on access control

6.3.1 End-to-end monitoring capabilities, freedom to access (permitted) data of external systems

In business processes and supply chain processes numerous actors participate, such as ordering party, supplying party, transport agency, insurance company, payment service provider, trade financing organisation, etc. It is well known that most of these organisations are using their own IT systems and it is impossible and are ultimately not expected to unify these IT systems. On the other hand, to monitor the process in full needs access to data that originated in these "alien" systems. Traditional (tight) integration of such systems is complex and would be tremendously costly, and impossible to maintain. These reasons make interoperability so important.

Sharing the data of these "alien systems" and subsets of data pertaining to certain operations can through a single source of transactional data, reduce the burden of interoperability issues on one hand. On the other, this opens the door to genuine end-to-end monitoring to find discrepancies and the ways of adjusting data elements.

6.3.2 Transparency and symmetry for all partners

The traditional need for synchronising data in different IT systems of the players is complex, expensive and prone to errors and mistakes. The consequence of this is that it is difficult to guarantee an identical view of the transaction's data by all parties at the same time.

The best solution to achieve consistent data throughout the business can be to follow the one single data instance principle, to be used by all players. One should understand that most shared systems (DLT based or others) take care of using different methodologies and tools to have multiple physical copies synchronised.

6.3.3 Freedom to create own processes

It is not only IT systems that are unique to each actor in business. Processes are even more diverse. To "synchronise" internal processes with external ones is possible but inconvenient, difficult or cumbersome let alone the costs incurred.

Accessing data elements or subsets of them arbitrarily creates an environment of total flexibility to create the most efficient processes and creates a "friendly" relation with partners. Co-operation based on this flexible process can further improve efficiency.

6.3.4 Freedom to introduce new functionalities

The business environment continuously demands new functionalities.

New functions like various trade finance offerings, e.g. dynamic discounting, reverse factoring, public financing require data and access by third parties to part of the transaction data. Business, among them prominently SMEs, can best utilise these new functions if they are competing providing the best alternative of the end user instead of relying on services (functions) provided by dominant players.

6.3.5 Privacy (GDPR)

It is utmost important to comply with the mandatory General Data Protection Regulation (GDPR) requirements. However, the current status of the IT systems needs special subsystems to be built as there are no generic offerings available.

The word “any” in 6.3 paragraph title can be interpreted as exclusion as well. It is needed to set up rules to limit the scope of data elements to be disclosed to certain groups of users.

6.4 Data quality improvement

Entering data in the ERP systems (registration) from incoming documents is a major source of later problems and costs more if they are identified later.

Data quality can be improved by involving the originator in the data extraction process in a self-care/service manner.

6.5 Improve user experience

Current systems suffer from the limitations of the technology used. Attempts like the omni channel approach make use of some new technology elements, like mobile phones, with limited scope. This is valid for screens and videos, etc. Users prefer to see the immediate results of their action.

Rule-based presentation of data to groups of users is a tool for increasing efficiency and reduces the tension of the operator. Although most of designers make attempt to comply with this requirement, there is a lot of room for development.

6.6 Establishing the grounds for “maximum” automation

Process automation is one of the most frequently heard terms in business circles. Although most people agree that this is the goal, as those who have already embarked on this venture can prove, that it is chiefly for big players, takes a long time to introduce and costs a lot even if the ROI figures can be impressive.

Being realistic at the beginning and designing processes – with an eye on automation in the not too distant future – can mean “halfway to automation”, with the aim of helping the operators to be efficient, errorless and quick.

6.7 Confidentiality. Security

Trust is one of the most important requirements in business to be extended with the appropriate controls.

It is up the specifications of the planned system to set the level of credentials, confidence and security. To implement these requirements, you need a thorough analysis based on considerations like complexity, cost, availability of experts, etc..

6.8 Interoperability

This issue is of utmost importance whether a traditional technology environment is used or an emerging technology.

It is to be noted that the less complex data is, the easier it is to provide an interoperable offering. For example, consider a single number for quantity. Then, interoperate directly with single truth data element should be much easier than interoperate on documents containing a lot of data, which are not all available for any user or useful for any process.

6.9 Coexistence with legacy systems

Big bang solutions are to be avoided.

Any system based on emerging technologies must cater for co-operation with existing ones. It is not only a philosophical question but practical as well. A legacy system has something that emerging systems do not: users.

7 The Zero Corner Model (ZCM)

7.1 Introduction of the Zero Corner Model

The currently widespread traditional "send-receive" model has certain limitations, as listed in Chapter 5. Therefore new technologies are emerging that try to meet the business requirements described in Chapter 6 in various ways. The Zero Corner or N-corner model is a concept where a business transaction is built by all actors that have to play a role in it and share a single truth source of data (for example using distributed ledger technology in which it is highly replicated on the network by design) in order to guarantee its integrity and authenticity. This is why it can be called a Zero Corner model, as there is no Corner 2 or 3 or 5 to synchronize or interoperate but only a single source of business data that all players need or provide and that the network is designed to keep synchronized. Distributed ledger technologies guarantee by the replication process and specific consensus based mechanisms that the single truth source of data is shared by several players, which guarantee its integrity and authenticity. This is why it should also be called an N-Corner model. This concept can be expected to be a "game changer" as it is a possible road to introduce new ways and solutions for companies to improve their processes and to solve by construction some of the interoperability issues. The model follows the principle of collaboration, document and data sharing and "maximum automation" principle.

7.2 Document essentials e.g. Getting rid of the “corners”

It is important to note that this ZCM (Zero Corner Model) principle is valid for the whole supply chain transaction, dealing with other traditional business documents, in relation with procurement and business communication in general.

As stated in the EMSFEI report *“report on interoperability & Transmission, with a focus on SMEs”* in chapter 3.7[16]:

“The development of ‘cloud’ technology may facilitate new paradigms for transmission based on ‘data sharing’ rather than a model based on ‘sending’ and ‘receiving’, with the sharing of information resting on:

[16] https://ec.europa.eu/cefdigital/wiki/display/EINVCOMMUNITY/Sharing+of+EMSFEI+Sub-group+4+deliverable

1. digital access rights

2. distributed systems in many business and technical forms.

The latter includes distributed ledger technology. The concept facilitates a move away from 'e-delivery' towards the principle of data sharing in all document management processes including e-invoicing[17] The key to making this work for e-invoicing and supply chain automation is to create several instances where both centrally provided and distributed service platforms are connected and with many end-users to allow data access, event management and ongoing services and processing.

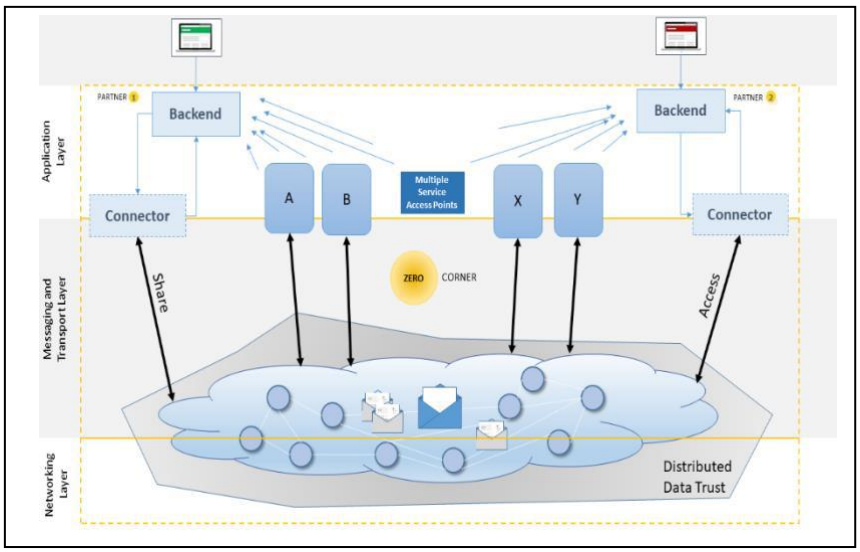

Figure 3 The layers of the Zero Corner Model

It is referred to here as a Zero-corner model because instead of operating a 3 or 4 corner transmission model the emphasis moves to a data-centric concept with a separation of the data itself from the services, which are demanded and delivered by the many players. Services are facilitated at the data level rather than by interconnecting heterogeneous systems directly. The model can be viewed as a network of independent 3-corner model platforms working on shared, distributed data instead of the data residing on a single storage device of a service provider or other actor.

The Zero Corner model would likely use the 'Smart Document' principle with the recognition that most operations do not need all data elements of a document, but a restricted "view" only. Smart documents, also known as intelligent documents, are files programmed with functions that helps carry out work tasks. In order to have smart documents the data capture is essential to create structures where all individual data elements can be individually addressed and managed. The quality of the data is improved by providing self-service data capture. All the same issues that apply in other models such as the adoption of standards and creating workable interoperability arrangements apply in this model.

Distributed ledger technologies and Blockchain as specific DLT implementation are seen as promising technologies that along with other technologies support this mode. In view of current perceptions on cost and complexity DLT and blockchain are seen as having a role in managing access rights and supporting the integrity of data held in the model.

Diagnosis: Advocates of the zero-corner model emphasize the benefits of a transparent transactional approach based on full interactivity, capability for bi-directional and symmetric operations, a freedom to access (permitted) data not originated in a player's own systems, a freedom to create own processes, services and functions, an ability to interface with 'any' process and 'any' documents by 'any' partner based on access

[17] http://europa.eu/rapid/press-release_IP-18-521_en

control, access to information at the data element level, confidentiality and privacy (GDPR), interoperability, security, and an ability to coexist with legacy systems. Further investigation of these concepts as applied to e-invoice transmission could be made paying due regard to feasibility, cost and compliance."

Recognising the limitations outlined in Chapter 5 and the business requirements in Chapter 6, it is proposed that the business data element of the "traditional" supply chain documents are shared with the partners with a stringent permission control without "corners" (owners and service providers) to facilitate the transmission and the symmetric access for all players.

It is also important to stress that the ZCM is a principle of data centric solutions with many possible ways of implementing it. The currently hyped Blockchain, often used as a synonym of Distributed Ledger Technology, is one of them with a lower level of abstraction than ZCM. Implementations attempt to be universal or specific to a certain type(s) of needs. Such example is the UN/CEFACT Single Submission Portal project – an early attempt to ensure using the same data for everyone by what is called today the 3 Corner model operating on a centralised database - aiming at serving the logistics, transport and ultimately the customs and excise requirements (see Chapter 7.5.2).

With a proper extension to the ZCM (see below the Smart Documents) systems can be designed to be open ended aiming at universal requirements. The Figure 4 depicts the unlimited way in which more and more operations can be attached or connected to the shared data. The free allocation of rights by the owner for individual operators to access data elements one by one in a view are far more flexible than the "promise" of the owner of, for example, a 3-corner model service that the operation can be extended.

The sharing of business data elements removes the tight connection between the data and the transmission, and thus the directly working operation environment. By separating the operations from the data and transmission and by having been made available symmetrically for all players (based on permission control) the following diagram shows the advantages of the "symmetric" nature of such a system.

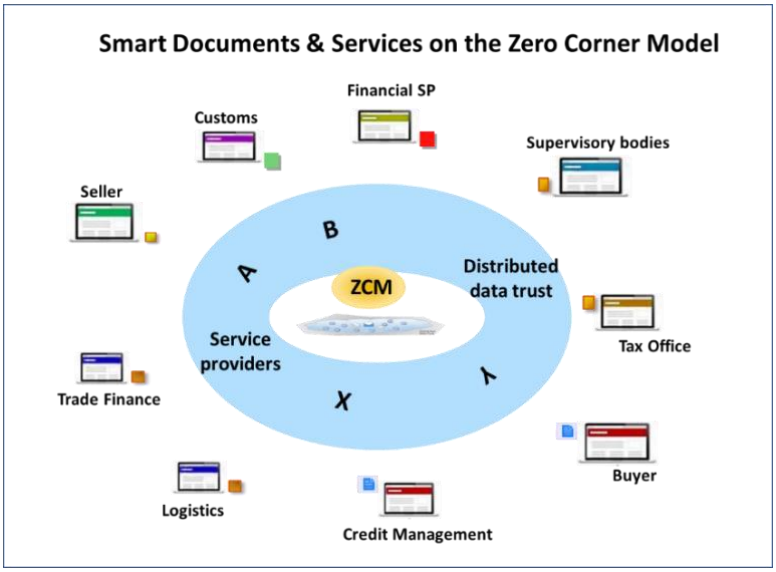

Figure 4: Smart Documents & Services in the Zero Corner Model

7.3 An important extension to the Zero Corner Model: The Smart Documents

This principle has been introduced based on the recognition that specific business operations do not need all data elements of a document but subsets of the data only. This obviously does not mean that there are no players who need to have the full document; such could be tax offices or other controlling or auditing bodies, including courts).

The easiest operation with which to explain the above is the payment. For example, while there can be dozens of different types of data (fields) with hundreds of lines on an invoice, to execute a payment instruction the service provider needs only 6-8 elements, such as an account number, amount, due time, currency, cost bearer, etc. To disclose the rest of the data is redundant, it contains sensitive portions and is simply not needed. Such a "stripped down" document can be called a "payable" document. Similarly, it can be created disputable views, factorable views, negotiable views and the like.

In addition to the set of shared business data element, traditional supply chain document can be added for legal compliance or compatibility with legacy / traditional send-receive business documents.

7.4 Access to data element on a ZCM

Typically, today data are available from the owner (creator) of the data, a private repository of the owner in a direct manner, a centralized or decentralized repository of a service provider, a government or internationally owned repository in a 3 or 4 corner model based on the send-receive characteristics.

In a ZCM based solution, data (subsets, views, limited collections) are available from a shared usually distributed repository based on rigorous access control, implemented by various methods like cryptography, distributed ledger technology. Original documents are archived the same way as in traditional systems according to the specification of the systems.

Having a permission to access and work with a subset of data (view) of a document, which contains all elements pertaining to that specific operation, the operator and user have full control over creating their own processes. Views can be created literally by anybody having the access right: by the service provider, including the various players in the chain (ordering and supplying party, transport agency, payment processor, authorities, etc.).

In case of large specialized service providers like Shared Service Centers (SSCs), there is a way to improve data quality by letting the data supplier create their forms on a self-care basis.

In a broad term, GDPR requirements can be respected by using a filtering process hiding sensitive information from those who are not permitted to access such data. A view filtering out these portions can be freely distributed, and any derivative views will have no way to see these hidden elements automatically.

8 Existing initiatives, experience of implementing a single source of data concept

The Commission has launched the EU Blockchain Observatory and Forum[18]. The Blockchain Observatory and Forum is highlighting key developments of the blockchain technology. The EU Blockchain Observatory and Forum is playing an active role in helping Europe to seize new opportunities offered by blockchain, build expertise and show leadership in the field.

8.1 Introduction

Removing paper documents from business processes has been a business driver for companies for many years. In today's global economy, every business faces constant pressures to improve the quality of its products or services, while at the same time tightly controlling or reducing costs. While computer information technology has automated or streamlined many internal processes, in many businesses the external processes of exchanging information with other actors still lag far behind the internal procedures. The need for speed and accuracy of the information flows in external processes is becoming ever more critical.

[18] http://europa.eu/rapid/press-release_IP-18-521_en

To determine the definition of the information flow is important because:

- Supply chains have become much more complex in the globalized economy. Information of the trade transaction is vital to reduce delays and costs. In recent times, there is also increased need for governments to receive advance trade information for automated risk analysis;
- The harmonization of processes and the simplification of cross-border procedures require clarity in the data required and provided. As documents are the core means to transfer data in international trade, the precise definition of the information in the trade document is important to simplify and harmonize processes.

Although most organizations have traditionally focused on improving efficiencies of the physical supply chain, *effective management of all information flows* (the green area in figure 5) is beneficial to all parties.

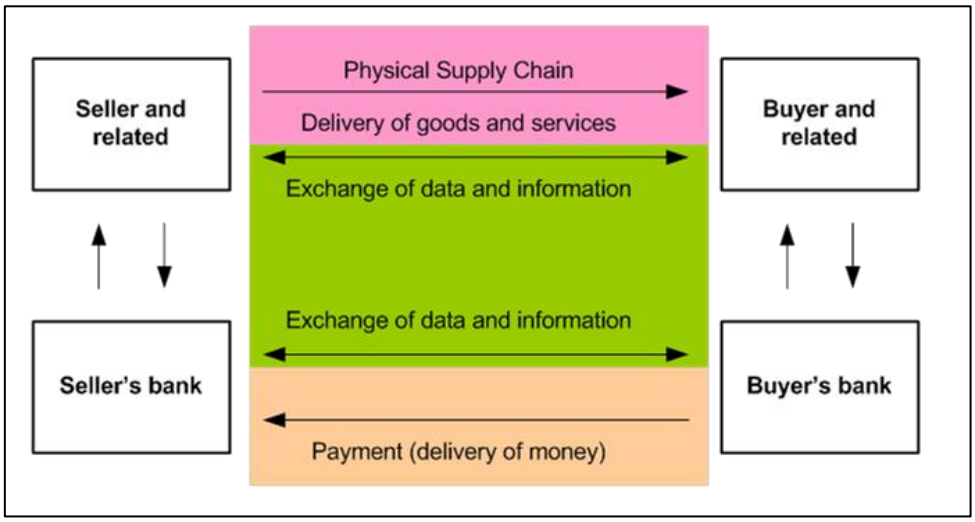

Figure 5

Figure 5 highlights the meaning of the following concepts:

1. The physical supply chain (top pink), which consists of the flow of goods or services that move between the supplier and the Buyer;
2. The financial supply chain (bottom, orange): This is the flow of financial transactions (e.g. payments, invoice financing) that are implied by the move of the goods or services physically down the physical supply chain;
3. Underlying information flows (middle, green): These are the supportive flows of both the financial and physical supply chains and include things like purchase orders, confirmations and invoices.

With the many actors involved in trade, there are many times more information exchanges between these actors often concerning the same transaction. It can be very beneficial to contribute to minimization of these information exchanges.

With automated and electronic solutions, information could be processed faster and more accurately so that lead-times could be reduced. A procurement process would also be quicker if purchase orders were managed electronically.

Furthermore, if a company is able to forecast its purchases and sales with a high degree of accuracy, it will gain a competitive advantage by successful management of the supply chain.

The introduction of data interchange using electronic means (instead of paper) is a major contribution to *this effective management of information flows*. It should be noted, that for maximum efficiencies to be reached, not only business processes need to be automated – regarding the exchange of information – but also re-engineered. It should be recognized that trade patterns are not static; also, new transport logistics concepts are developed which pose new information requirements.

The introduction of electronic data interchange should therefore not be a mere 1:1 substitution of paper documents by electronic messages, as that would practically freeze the current situation and make future developments and innovation difficult, if not impossible. Replacing paper documents with electronic ones will therefore change the way that business is done.

Note that COM(2013) 453 final 'End-to-end e-procurement to modernise public administration'[19] states: '*End-to-end e-procurement is not about implementing an IT project which would just replicate paper-based processes; it is an opportunity to fundamentally re-think the way public administration is organised. End-to-end e-procurement is therefore a key enabler of the above priorities, and can contribute to the sustainable growth objectives of the EU 2020 Strategy'* for which the above is clearly a prerequisite.

Today, concepts have been developed, agreed and implemented that try to contribute to the approaches described in the introduction. Below two examples are mentioned, as a further introduction to the concept of Single Source of Data.

8.2 UN/CEFACT Single Window

The United Nations Centre for Trade Facilitation and Electronic Business (UN/CEFACT)[20] is a subsidiary, intergovernmental body of the United Nations Economic Commission for Europe (UNECE), which serves as a focal point within the United Nations Economic and Social Council for *trade facilitation recommendations* and *electronic business standards*. It has global membership and its members are experts from intergovernmental organizations, individual countries' authorities and from the business community.

Trade facilitation[21] looks at how procedures and controls governing the movement of goods across national borders can be improved to reduce associated cost burdens and maximize efficiency while safeguarding legitimate regulatory objectives. Business costs may be a direct function of collecting information and submitting declarations or an indirect consequence of border checks in the form of delays and associated time penalties, forgone business opportunities and reduced competitiveness.

UN/CEFACT defines trade facilitation as "the simplification, standardization and harmonization of procedures and associated information flows required to move goods from seller to buyer and to make payment".

The single-window system[22] is a trade facilitation idea. In simple words, it allows a user to get sufficient information from one source. As such, the implementation of a single window system enables international (cross-border) traders to submit regulatory documents at a single location and/or single entity. Such documents are typically customs declarations, applications for import/export permits, and other supporting documents such as certificates of origin and trading invoices.

[19] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM%3A2013%3A0453%3AFIN%3AEN%3APDF
[20] https://www.unece.org/cefact/
[21] https://en.wikipedia.org/wiki/Trade_facilitation
[22] https://en.wikipedia.org/wiki/Single-window_system

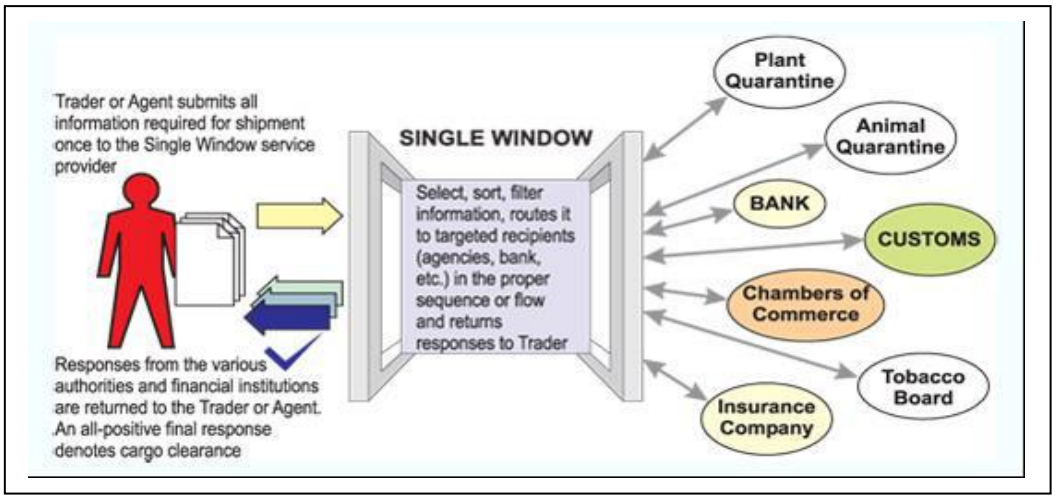

Figure 6

The most commonly applied definition of the term Single Window[23] is the following[24]:

A single window is defined as a facility that allows parties involved in trade and transport to lodge standardized information and documents with a single-entry point to fulfill all import, export, and transit related-related regulatory requirements.[25]

The single window is clearly a trade facilitative measure. It permits the trader or transporter to submit all the data needed for determining admissibility of the goods in a standardized format *only once* to the authorities involved in border controls and at a single portal.

The main value proposition for having a *single window for a country or economy* is to increase the efficiency through time and cost savings for traders in their dealings with government authorities for obtaining the relevant clearance and permit(s) for moving cargoes across national or economic borders[26].

In a traditional pre-single-window environment, traders may have had to contend with visits and dealings with multiple government agencies in multiple locations to obtain the necessary papers, permits, and clearances to complete their import or export processes. See Figure 7.

[23] http://tfig.unece.org/contents/single-window-for-trade.htm
[24] http://www.wcoomd.org/~/media/wco/public/global/pdf/topics/facilitation/activities-and-programmes/tf-negociations/wco-docs/info-sheets-on-tf-measures/single-window-concept.pdf
[25] https://www.unece.org/fileadmin/DAM/cefact/recommendations/rec33/rec33_trd352e.pdf
[26] https://en.wikipedia.org/wiki/Single-window_system

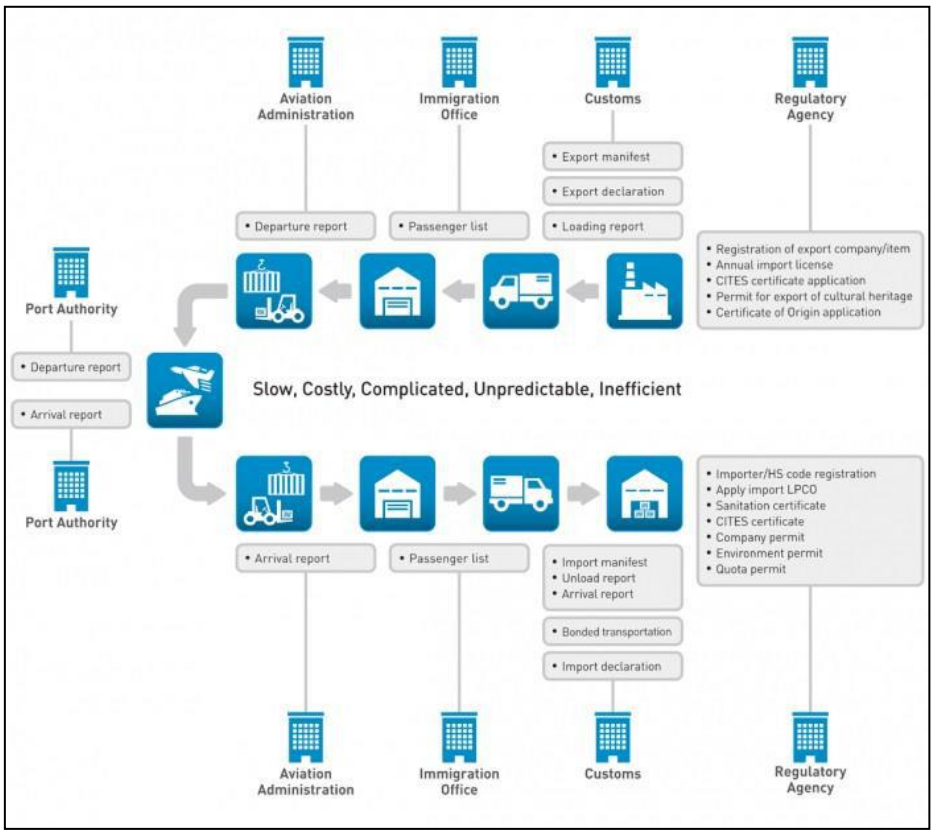

Figure 7

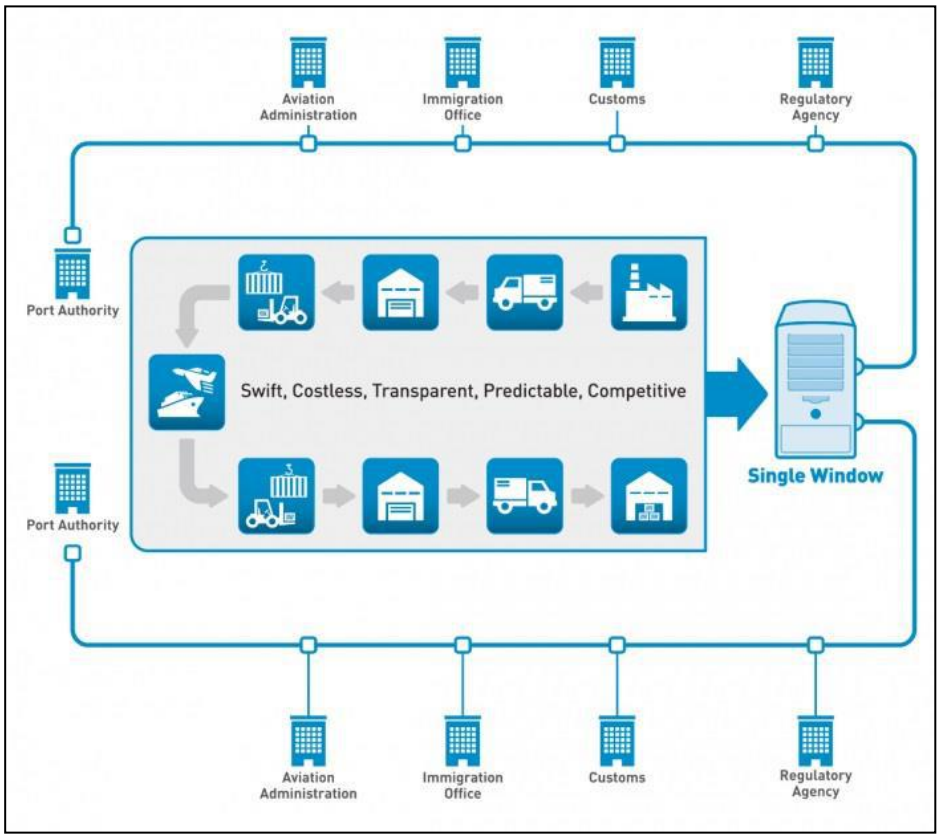

Figure 8

Figure 8[27] depicts the simplification and facilitation that can be achieved by using a Single Window.

Experiences[28] [29]: USD 1.5 billion – that's the annual saving in logistics costs in Thailand following an investment of USD 7.5 million in setting up a national Single Window, based on UN/CEFACT Recommendations.

Speeding up border crossing for trade with tools like a Single Window – which make it easier to input all regulatory and commercial information at a single-entry point - has been a key preoccupation of countries for many years.

The UN/CEFACT Single Window Concept is used in the world and there are many implementations. Countries wishing to implement Single Windows as described in the UNECE Recommendation and Guidelines on Establishing a Single Window often face challenges, which have been faced by other countries. UN/CEFACT has developed a template of questions in order to gather country experiences in this area, outlining the challenges and best practices they have experienced. It is hoped that this repository[30] can help potential implementers to find solutions in their roll out of Single Window.

This repository was started in 2007 and contained over twenty use cases. These experiences prior to 2015 can be accessed on this page[31]. Much of the experience gathered is documented and freely available.[32]

See also 'UNDERSTANDING SINGLE WINDOW ENVIRONMENT' [33] and 'the WCO Single Window compendium.[34]

The latter compendium[35] consists of two volumes. Volume 1, the Executive Guide, deals with aspects of Single Window that are of concern to senior management. Volume 2, the Professional Practice Guide, is a collection of tools and techniques to support technical experts working on projects to establish a Single Window.

Chapters 1-8 of Volume 1 cover:

1. Understanding Single Window Environment
2. Border Management Functions and the Single Window Concept
3. Single Window as Part of Customs Modernization
4. Agenda Setting & Policy Planning
5. Establishing the Formal Structure
6. Designing Single Window Services
7. Dealing with Legal Issues
8. Human Resources & Change Management

Chapters 1-7 of Volume 2 cover:

1. Global Trends in Single Window Implementation
2. Functional Assessment for the Single Window Environment

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[27] https://en.wikipedia.org/wiki/Single-window_system

[28] https://www.unece.org/info/media/news/trade/2019/uncefact-to-showcase-country-experiences-of-using-single-windows-to-streamline-cross-border-trade/doc.html

[29] https://unctad.org/meetings/en/Presentation/ditc_tab_NTM_Week_2019_09_UNECE_en.pdf

[30] https://www.unece.org/cefact/single_window/welcome.html

[31] https://www.unece.org/tradewelcome/un-centre-for-trade-facilitation-and-e-business-uncefact/outputs/cefactrecommendationsrec-index/cefactsingle-windowwelcome/doc.html

[32] E.g. https://www.wto.org/english/tratop_e/tradfa_e/case_studies_e/escwa_e.pdf , http://icdt-oic.org/RS_67/Doc/WTO.pdf , https://worldcustomsjournal.org/Archives/Volume%2013%2C%20Number%201%20(Mar%202019)%20copy%201/1877%2001%20WCJ%20v13n1%20Widdowson%20et%20al.pdf?_t=1563333690

[33] http://www.wcoomd.org/-/media/wco/public/global/pdf/topics/facilitation/instruments-and-tools/tools/single-window/compendium/swcompendiumvol1parti.pdf

[34] http://tfig.unece.org/contents/wco-single-window-compendium.htm

[35] http://www.wcoomd.org/en/topics/facilitation/instrument-and-tools/tools/single-window-guidelines.aspx

3. Single Window Business Processes
4. Single Window Data Harmonization
5. Single Window Data Harmonization in a Single Window Environment
6. Architecture for the Single Window Environment
7. Writing a Business Case for Single Window

The Single Window concept provides a Trade Facilitation environment in which the benefits of electronic invoicing can be well reaped.

The invoice could be perceived as one of the first documents that could be exchanged using this concept, where, as developments progress, other documents exchanged (beyond just the buyer and the supplier) could be added.

8.3 UN/CEFACT Single Submission Portal

UN/CEFACT has continually worked on the topic of Single Window since the early 2000s. Though it is believed that National Single Windows can render long-term savings and facilitations, in the short term, the private sector sees the benefits that such mechanisms can provide and are not necessarily waiting for these to be fully implemented. They are launching facilitation platforms now, and traders - especially Micro, Small and Medium sized Enterprises (MSMEs) - can reap the benefits immediately. These private sector driven initiatives correspond to what UN/CEFACT has termed "Single Submission Portals" (SSP)[36].

The purpose of establishing a National Single Window (NSW) is to streamline procedures at the border and connect traders to all relevant agencies through a single portal. The purpose of establishing a Single Submission Portal is to concentrate on a national environment of data exchange only.

Figure 9 illustrates the differences between a National Single Window (NSW, left) and a Single Submission Portal (SSP, right).

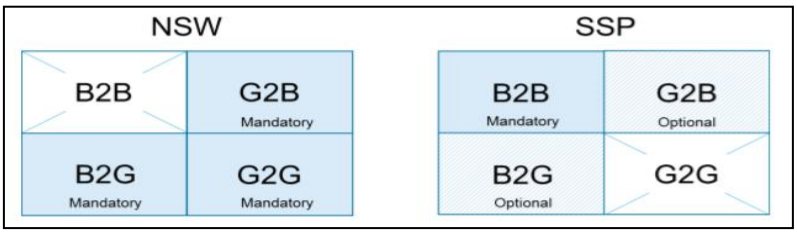


Figure 9

UN/CEFACT has released Recommendation 37[37], with provides guidance on the functions, services and benefits of Single Submission Portals as well as potential types. It is accompanied with an Annex I on abbreviations, an Annex II on terms used and an Annex III with a questionnaire in view of establishing a repository of case studies.

Following the release of the Recommendation 37 on Single Submission Portals (SSPs), it was beneficial to gather a number of use cases to showcase how this recommendation can be implemented as well as provide guidance to countries and potential suppliers on best practices.

The Repository[38] offers case studies from organizations with functional SSP solutions.

[36] http://www.protect-group.org/assets/Uploads/SSP-project-RFD-08122017.pdf
[37] https://www.unece.org/fileadmin/DAM/cefact/cf_plenary/2019_plenary/ECE_TRADE_C_CEFACT_2019_06E.pdf
[38] https://www.unece.org/cefact/single_submission_portal_repository/welcome.html

8.4 The SELIS project

Of course, there are developments similar in intentions and concept to the Single Window or Single Submission Portal. An example is the SELIS project[39] (Shared European Logistics Intelligent Information Space) [40].

It was set up[41] with the aim at delivering a 'platform for pan-European logistics applications' by:

- Establishing an exceptionally strong consortium of logistics stakeholders and ICT providers, that can leverage EU IP from over 40 projects to create proof of concept Common Communication and navigation platforms for pan-European logistics applications in month 18 deployed in eight living labs (LLs) representing the principal logistics communities.
- Establishing a research and innovation environment using the LLs to provide data than can be used for discovery of new insights that will enable continuous value creation supporting the large-scale adoption of SELIS.

The proposed Shared European Logistics Intelligent Information Space, SELIS, is a network of logistic communities' specific shared intelligent information spaces termed SELIS Community Nodes (SCN). SCNs are constructed by individual logistics communities to facilitate the next generation of collaborative, responsive and agile green transportation chains. SCNs link with their participants' existing systems through a secure infrastructure and provide shared information and tools for data acquisition and use, according to a 'cooperation agreement'. Connected nodes, provide a distributed common communication and navigation platform for Pan European logistics applications. Each Node decides what information it wishes to publish and what information it wants to subscribe to, such in contrast to Single Window and Single Submission Portal where in fact the same information is available to all (if authorized).

Further information on SELIS is publicly available[42]. See also SELIS 'D8.2: Policy, Standardization and Research Recommendations'[43]

9 Distributed Ledger Technology (DLT) - Overview

9.1 DLT can support implementations of the ZCM

The following definitions are adaptations from ISO/FDIS 22739:2020.

Distributed Ledger Technology (DLT) here relates to a technology that enables the operation and use of distributed ledgers.

A distributed ledger is an information store that keeps records of transactions that are intended to be final, definitive and immutable, that is shared across a set of DLT nodes and synchronized between the DLT nodes using a consensus mechanism.

A record is any information created, received and maintained as evidence and as an asset by an organization or person, in pursuit of legal obligations or in the transaction of business. Electronic documents such as invoices, orders, etc. are example of what a record can be in the context of this document.

A DLT node is a device or process that participates in a network and stores a complete or partial replica of the ledger records; immutability is a property wherein ledger records cannot be modified or removed once

[39] https://www.selisproject.eu/
[40] https://www.selisproject.eu/uploadfiles/Whitepaper_10_Oct_secure.pdf
[41] https://ec.europa.eu/inea/en/horizon-2020/projects/h2020-transport/logistics/selis
[42] https://www.selisproject.eu/Results
[43] https://www.selisproject.eu/uploadfiles/SELIS-D8.2_1.8_FINAL.pdf

added to a distributed ledger and the consensus mechanism is the set of rules and procedures by which consensus is reached. Finally, consensus is agreement among DLT nodes that (i) a transaction is validated and (ii) that the distributed ledger contains a consistent set and ordering of validated transactions.

While the general concept of ZCM assumes that the same information is available at the same time to each actor that has the right to access it, in a DLT there is always a delay, implementation dependent, needed to reach the consensus among the DLT nodes. A ledger and a typical DLT implementation are adequate for most cases dealing with e-invoices and supply chains which in general do not have real time requirements , however the suitability of a specific DLT must be assessed on a case by case basis.

Some or all business data can be stored outside a DLT using registry and repository services such as OASIS RegRep[44] for example when the immutability property of a DLT do not allow full compliance with privacy rules. In this case, DLT is linked to the data to guarantee its integrity and authenticity.

A DLT should then:

- Provide a resilient infrastructure for managing in a cost-effective way the expected volume of documents and data;
- Provide a platform supporting the implementation the requirements, in terms of eInvoicing and eProcurement services, the related workflows and access control to the information.

Some requirements to be considered when designing a DLT implementing a ZCM:

- Adoption of a DLT based model that enforces the Once Only Principle[45] extending the concept to all the different actors, it can be called “Provide Data Once Principle (PDOP)”;
- The parties do not send documents, but make them available to the relevant parties and tax authorities;
- Document metadata are stored in DLTs accessible only by authorized users and the integrity guaranteed by DLT;
- Due to the immutability property of DLTs, special attention should be given to avoid that personal data is present in clear in a DLT and appropriate solutions (e.g. cryptography, anonymization, store data externally) should be considered;
- Implement better data control and protection, scalability and performance than centralized hub architecture: privacy requirements fulfilled by “need to know” access to the information;
- Use of common standards is even more important: for example, the development of EN 16931 was key for interoperability (and possible reuse) of the information in electronic invoices.

The figure below is an example taken from the CEF/SCALES project[46]under development in Italy. National platforms data such as credit certification, eOrders, etc. are included in the system and can enable value added services such as factoring, payment reconciliation, etc.

[44] See OASIS ebXML RegRep Version 4.0 Part 0: Overview Document. 25 January 2012. OASIS Standard. http://docs.oasis-open.org/regrep/regrep-core/v4.0/os/regrep-core-overview-v4.0-os.html

[45] https://en.wikipedia.org/wiki/Once-only_principle

[46] https://ec.europa.eu/inea/en/connecting-europe-facility/cef-telecom/2018-it-ia-0053
https://www.agid.gov.it/it/piattaforme/fatturazione-elettronica/progetto-cef-scales

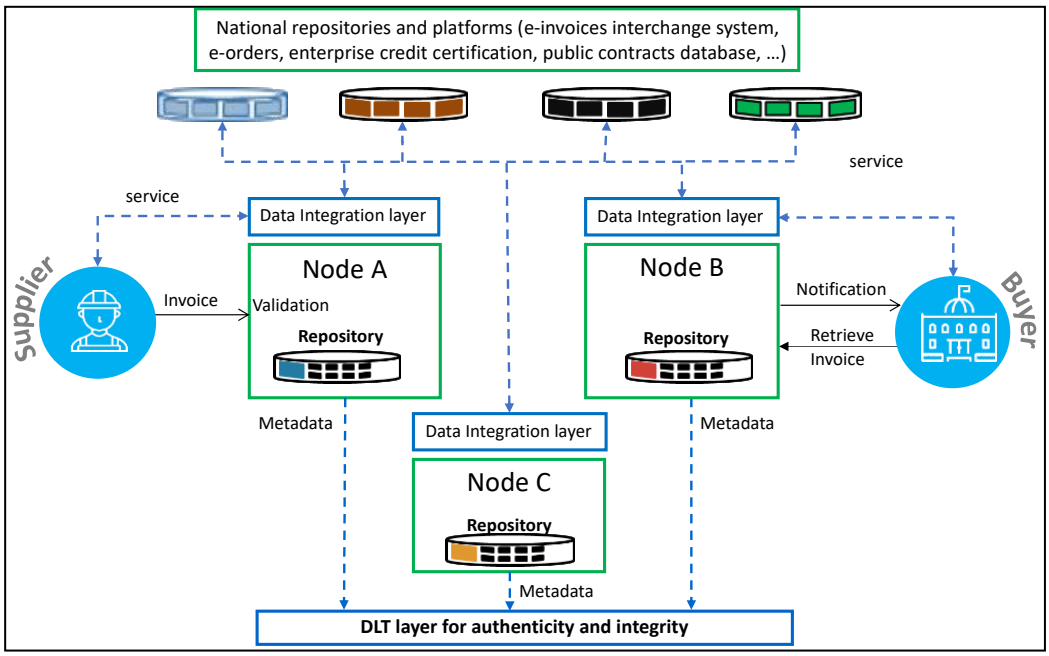


Figure 10

9.2 The relation to the mandate of this paper

Two dimensions should be investigated. One is what it concerns. The Zero Corner Model is dealing with (smart) documents, i.e. the data content in a broad meaning, while the subject of this paragraph is dealing with digital (distributed) identity "only", which is a key issue in case of the ZCM. (Generally, all "hyperledger" type solutions can do the job, e.g. the blockchain.)

The second dimension is how many levels are handled or defined. ZCM is handling the full distributed data transmission is handled in a uniform manner as an infrastructure which is provided for the application/service layer as granted.

ZCM is an abstract model, as mentioned earlier.

The paragraphs in section 9.3 to 9.5 refer to solution based on emerging technology.

9.3 Emergence of decentralized business networks

During the past couple of years, distributed platforms based on distributed ledger technology (DLT) have become more common providing the opportunity to establish new types of business and trust networks across multiple actors. Instead of relying on centralized platforms, there is the means to establish new types of distributed business networks without involving intermediaries and thus vendor lock-in. The required technologies have matured at a rapid pace and today a stage has been reached when they can be taken into use in large-scale production.

Blockchain is a distributed database that holds records of digital data or events in a way that makes them tamper resistant. While many users may access, inspect, or add to the data, they can't change or delete it. The original information remains immutable, leaving a permanent information trail or chain of transactions. In short, blockchain is a record-keeping mechanism that makes it easier and safer for businesses to work together over the internet.

Even though the popularized implementations are mainly based on "permission-less" blockchains – where network access and use are open to anyone – business implementations are mainly using solutions that limit read/write access to the network. These are called permissioned networks and are tailored for specific utility

purpose and business requirements. The need to use permissioned networks come from businesses needing to have the network rules and liabilities clearly defined. This is achieved by keeping the technical infrastructure separate from business network governance.

It is important to understand that the value of using decentralized technologies does not come from implementing the technology, but from the business network created to utilize the technology. Only when there is co-functioning technology and business networks, it is possible to create scalable business solutions that leverage the benefits of decentralization.

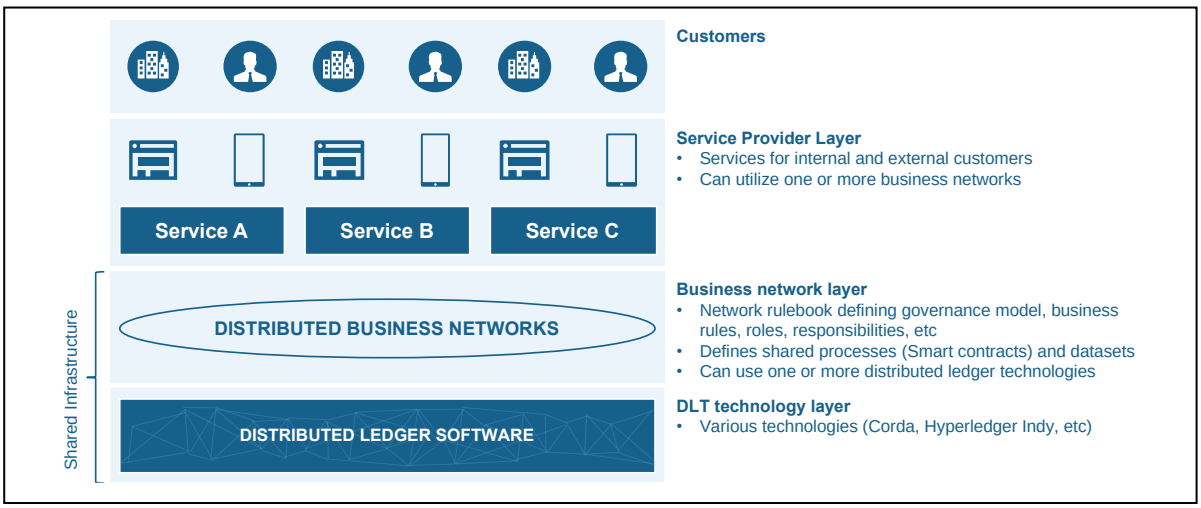


Figure 11 Layers of implementing enterprise decentralized business networks

Decentralized solutions should not be considered as 'one-size-fits-all' tools, but as platforms typically purpose built for various business uses. Many of these capabilities are unique to blockchain platforms, such as multi-party process orchestration, tokenization of assets and decentralized record keeping. The capabilities themselves are the basis for creating new types of decentralized business use cases and models.

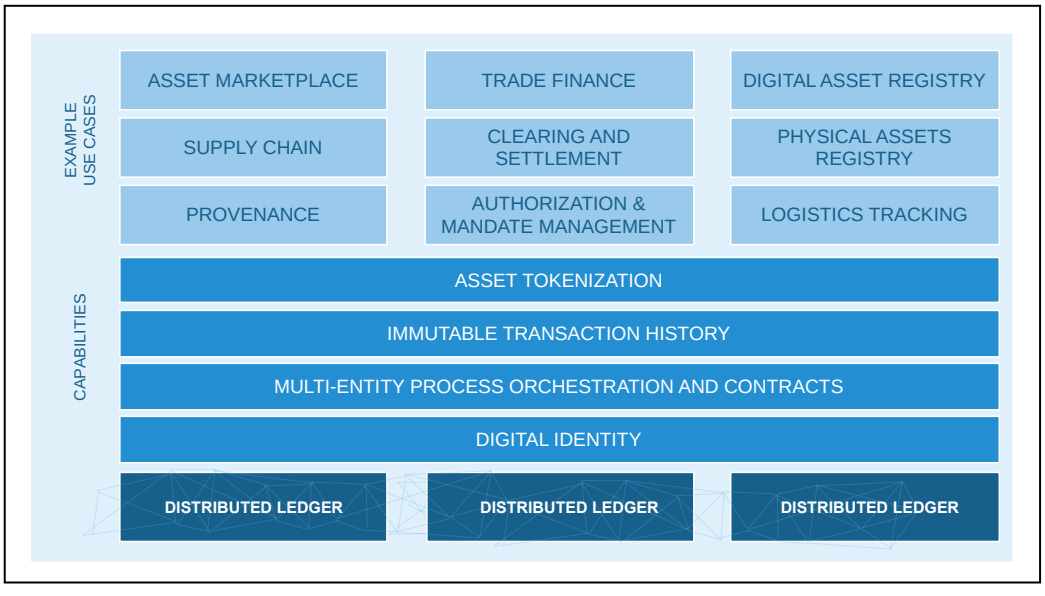


Figure 12 Distributed Ledgers provide capabilities that can be used to build novel business models

Managing today's procurement chains is extraordinarily complex. Depending on the product, the supply chain can span over hundreds of stages, multiple geographical locations, have several entities involved and extend over months of time. Due to the complexity current procurement processes chains, there is significant interest to simplify these processes through automation and improving trust.

Blockchain technology holds benefits for supply chains. Every time a product changes hands, the transaction could be documented, creating a permanent history of a product, from manufacture to sale. Blockchain can enhance supply chain transparency and trust by documenting a product's journey across the supply chain revealing its true origin and touchpoints. This can additionally reduce manual processes by eliminating internal system and process audits.

In addition, use cases involving sharing of data and record keeping within supply chains, DLT-enabled business networks can additionally orchestrate complex processes that involve multiple actors. Furthermore, the technology opens interesting opportunities for business model innovation because it can be used for tokenizing assets – both physical and digital – and trading with those assets.

9.4 Think about context before considering the use of blockchain technology

Blockchain technologies are not a silver bullet by any means. In fact, many use cases don't even need to have a blockchain or decentralization to succeed. One can generally think of blockchain to provide trust between multiple parties. Trust in the network can then be achieved with different approaches, depending on the use case. The promise of blockchain is about creating trust without intermediaries, where it was previously difficult or impossible to achieve.

Error! Reference source not found. The figure 13 provides a decision tree to evaluate a) whether blockchain is needed in a particular use case and b) what type of blockchain should be used. It serves as a quick sanity check for businesses before continuing their blockchain exploration.

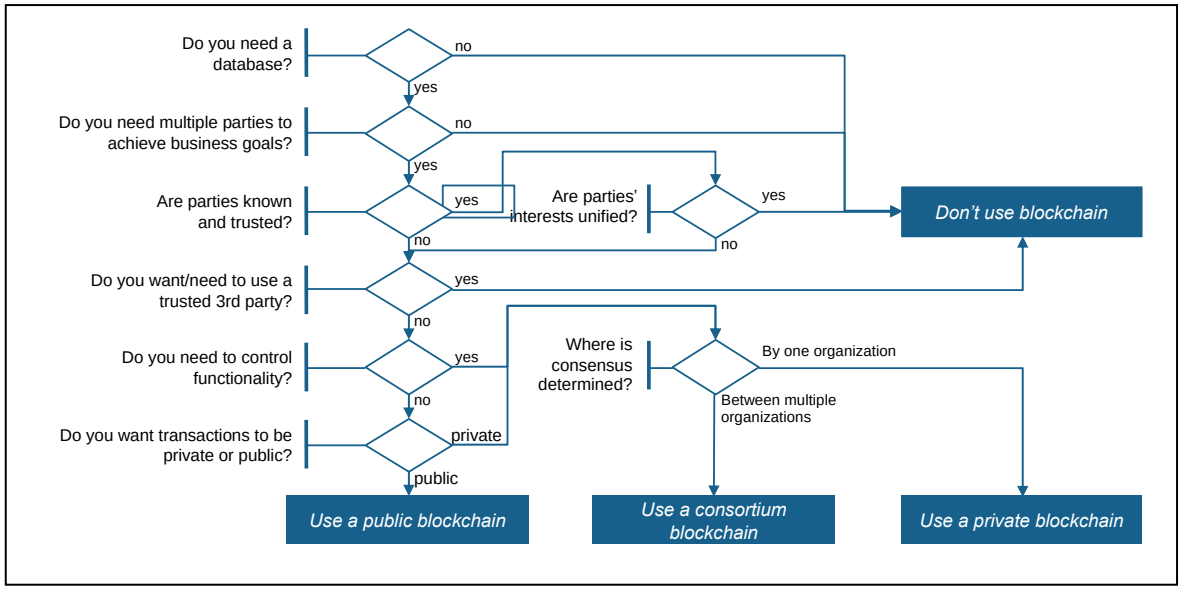


Figure 13 Think about your context before considering the use of blockchain technology[47]

One option to mitigate the lack of trust within a procurement chain would be to commission a trusted third party to establish a central data repository for the purposes of collecting and sharing this data. Centralized data repositories typically present various challenges relating to issues such as data ownership and development roadmap of the centralized service to name a few. As far as data ownership in decentralized networks, by design there is no third party that would control all the data. Generally, within other industries (e.g. financial services) where trusted third parties today exist, there is a growing trend to get rid of such trusted parties due to the great power that they hold and disagreements over a joint development roadmap.

[47] Suichies (2015, December 21). Why Blockchains must die in 2016. Retrieved from https://medium.com/@bsuichies/why-blockchain-must-die-in-2016-e992774c03b4

Blockchain based business networks can however mitigate these challenges by developing new functionalities without requiring every organization to participate and update their respective systems.

9.5 The role of decentralized identity networks

As anyone who has ever bought anything online knows, the main issue with data is not its availability, but instant access to trusted data. Can I trust the merchant to deliver the purchased goods? Can I trust that the goods are not counterfeit? These are just some of the concerns for consumers and e-commerce is but one of many use cases. The W3C Verifiable Claims Working Group has identified many more in domains such as finance, education and healthcare. As more and more of our personal and business activities move to the internet, there is need to make various kinds of claims as part of our everyday activities in transactional interactions. For example, use a driver's license to prove that person can operate a motor vehicle, a university degree to prove education status and government-issued passports to grant travel between countries.

As the amount of digital data has exploded, new platform-based business models have emerged. Due to network effects, this has led to a situation where a relatively small number of platforms control more and more business data, as well as continue to grow and gain more influence. European Union initiatives related to data portability aim to address some of these concerns. Yet whilst doing so, the European Commission takes the former network, infrastructure and trust models as given. The trust and data sharing paradigms present in platform-based business models rely on the existence of trusted counterparty (" the platform"). As instant access to trusted information is becoming increasingly vital for everyday interactions, a new type of approach for exchanging the data is needed. During the past couple of years, a new network and trust model based on distributed infrastructure – namely blockchain – has emerged. One of the reasons why blockchain technology has received significant interest is that it has the potential to transform existing trust models – including how personal data can be handled. Instead of relying on centralized trust platforms, it now has the means to establish new types of trust infrastructures without vendor lock-in.

Until recently, the prevalent way to share identity information has been through a centralized platform with a single point of control. The problem with trusted intermediaries is that when compromised, they pose a massive security risk to many people. As global digitalization moves forward, it has been witnessed a tremendous increase in hacks and personal data breaches that cripple businesses. Recent examples include the Equifax breach, where more than 145 million people were exposed to identity theft and the Facebook leak in which more than 50 million user profiles were handed to Cambridge Analytica.

Handling customer data is clearly a huge risk for organizations, but at the same time, it is the cornerstone of customer relationships and business critical operations. How can organizations then maintain a holistic view of their customers without exposing themselves to increasing risks and regulatory pressures? This is one of the goals of GDPR: to make organizations rethink how to handle customer information. And this is exactly what solutions decentralized identity networks allows them to do.

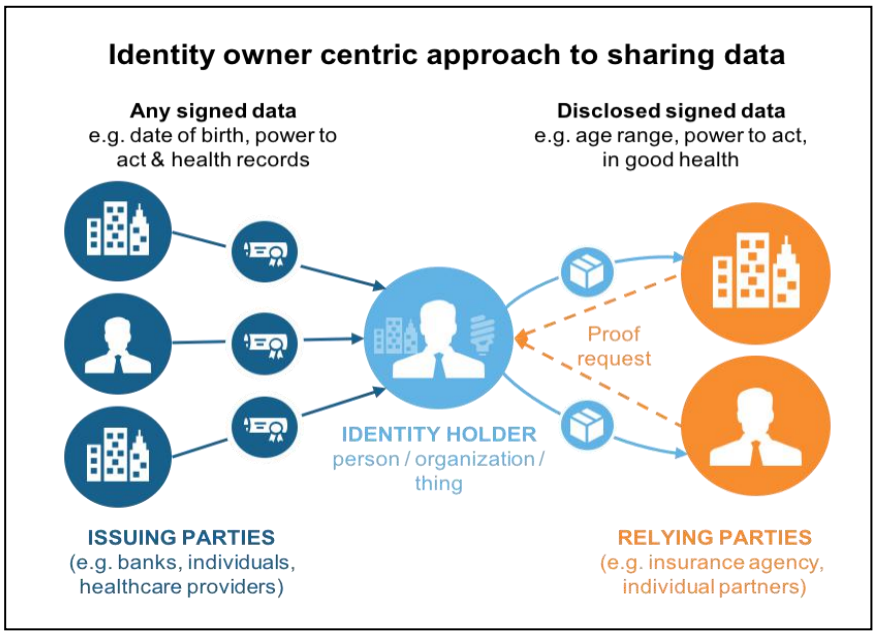


Figure 14

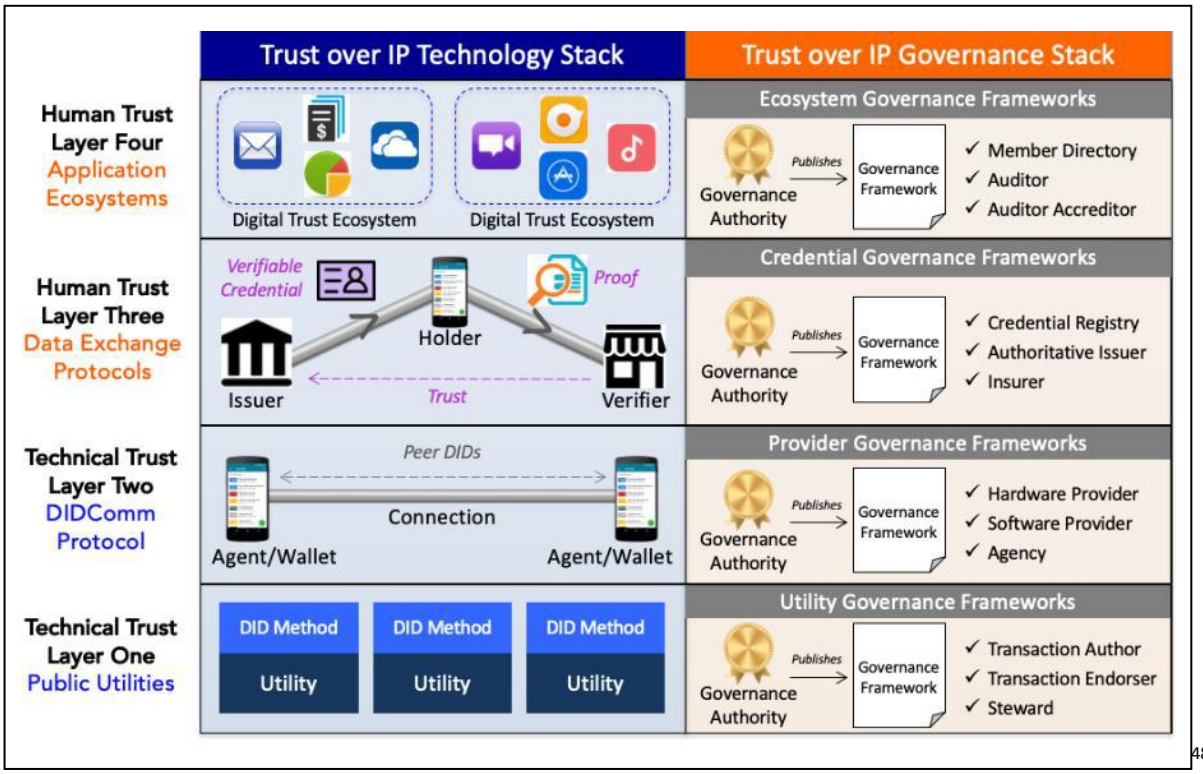
In decentralized identity networks, the identity holder forms secure digital connections with entities (organizations, individuals or things) that can provide information about the identity holder. This information can literally be anything such as a name, government ID, address, power of attorney, driver's license, health information, university degree etc. This verifiable data can then be shared by the identity holder to a party that requires these proofs. This provides for all kinds of rich digital interactions: Know-Your-Customer, contract and transaction signing (B2B, B2C, G2C), permits, insurance claim, job application and so on. Storing identity data on blockchain would be problematic for various reasons, including adherence to GDPR compliance and risk of data hacks. In a decentralized identity network, actual identity data is not stored on the ledger. Instead of identity data, the decentralized ledger only contains pointers to the data. These uncorrelatable pieces of information are related to an identity holder and stored on the ledger to allow entities access, share and verify identity data when authorized.

9.5.1 Identity management using Layering of the Trust over IP Stack

One proposal for Identity Management is architectural Layering of the Trust over IP Stack (ToIP). It introduces a complete architecture for Internet-scale digital trust that integrates cryptographic trust at the machine layer with human trust at the business, legal, and social layers to establish trusted relationships over digital communications networks.

The purpose of the ToIP stack is to define a strong, decentralized, privacy-respecting trust layer for the Internet. It leverages blockchain technology and other new developments in cryptography, decentralized systems, cloud computing, mobile computing, and digital governance to solve problems in establishing and maintaining digital trust.

The ultimate purpose of an "identity layer" is not to identify entities, but to facilitate the trust they need to interact.)



[48]

Figure 15 A diagram of identity layers

Two parallel stacks encompass both technology and governance. This reflects the fact that digital trust cannot be achieved by technology alone, but only by humans and technology working together.

9.5.2 My Data

Other issue is the personal data and how to manage the data. All people should have an easy way to see where personal data goes, specify who can use it, and alter these decisions over time. The purpose of MyData Global [49] is to **empower individuals by improving their right to self-determination regarding their personal data**. The human-centric paradigm is aimed at a fair, sustainable, and prosperous digital society, where the sharing of personal data is based on trust as well as balanced and fair relationship between individuals and organizations. The same data about the same individuals is collected repeatedly and this data is siloed and poorly maintained. Individuals cannot keep track of where data about them is held and it rarely flows between platforms.

9.5.3 The Legal Entity Identifier (LEI)

The Legal Entity Identifier (LEI) is a unique global identifier of legal entities participating in financial transactions. These can be individuals, companies or government entities that participate in financial transaction. The identifier is used in reporting to financial regulators and all financial companies and funds are required to have a LEI[50].

The identifier is formatted as a 20-character, alpha-numeric code based on the ISO 17442 standard developed by the International Organization for Standardization (ISO). It connects to key reference information that enables clear and unique identification of legal entities participating in financial

[48] https://github.com/hyperledger/aries-rfcs/tree/master/concepts/0289-toip-stack
[49] https://mydata.org/
[50] https://en.wikipedia.org/wiki/Legal_Entity_Identifier

transactions. Each LEI contains information about an entity's ownership structure and thus answers the questions of 'who is who' and 'who owns whom'. Simply put, the publicly available LEI data pool can be regarded as a global directory of participants in the financial market.

There are several LEI issuers around the world that issue and maintain the identifiers and act as primary interfaces to the global directory, these are typically financial exchanges or financial data vendors. These are accredited by the Global Legal Entity Identifier Foundation (GLEIF[51]) to issue LEIs.

Whereas the LEI was developed (after regulators realized at the time of the financial crisis of 2007–2008, that a single identification code unique to each financial institution was not available worldwide) so that their financial transactions in different national jurisdictions could be fully tracked, it is relevant briefly mentioning it here as the LEI could in theory also serve other purposes, and be seen as a new technology there.

9.5.4 Decentralized identity ledger Findy

Findy[52] stands for Finnish Indy network, a locally governed and run decentralized identity ledger. Its target is to enable pilot use cases and services with use of self-sovereign identifiers in Finland. A decentralized identity ledger consists of a limited set of public, permissioned nodes that when run together as a decentralized system are responsible for running the cryptographic consensus algorithm. That provides non-repudiation of public identifiers catering the discovery of public decentralized identifiers (DIDs) and their related public statement documents (DID documents).

From technical standpoint the Findy ledger is based on open source decentralized ledger technology from Linux Foundation's Hyperledger Indy project. Technicalities of compatible Wallet apps and so-called Agents are a topic the Findy community will document out in 2020

9.6 DLT examples

SCALES – Supply Chain Architecture Leading to Enhanced Services – is a project co-funded by the European Commission with the Connecting Europe Facility eInvoicing 2018 call (CEF/2018-EN-IA-0053).

The goal of the project is the design and implementation of a digital supply chain architecture enabling value-added services for businesses and public administrations.

The SCALES architecture adopts DiDLT and takes into account a research on the applicability of Blockchain and DLT technologies to the supply chain and to the national electronic invoicing process. It is developed with a multi-chain perspective with a focus on the supply chain cycle and on e-invoicing in a transnational perspective and based on the European standard EN 16931 and a specific focus on GDPR compliance.

The decentralized approach of the CEF/SCALES network in short:

- The digital object is created on a specific node of the DLT network and is visible only to the node that created it and to all the partner nodes involved in a workflow.
- The workflow is distributed among different nodes, where each node participates through signed transaction, when completed its own activity
- The only node that has ownership of the data is the one where the data was uploaded. All other nodes, involved in the workflow, participate by obtaining the data from the source node, processing it and signing their own transaction to advance the workflow.
- The blue nodes are involved on a need-to-know basis: one is the source node, where the data is loaded, the other is invited to participate in the workflow.

[51] https://www.gleif.org

[52] https://www.findy.fi

- Some nodes can always be involved. The Competent Authority node checks the correctness of the data. The Notary node signs the last step of the workflow, to avoid the double spending of the workflow (i.e. the repetition of the workflow on the same instance of data).
- Data integration layer as federated APIs allow to external observers and sources of information to interact with network assets according to the authorizations granted by data owners.

The software components will be published on Github with EUPL license and a white paper will be also published, all to facilitate SCALES adoption and reuse by the public- and private sectors.

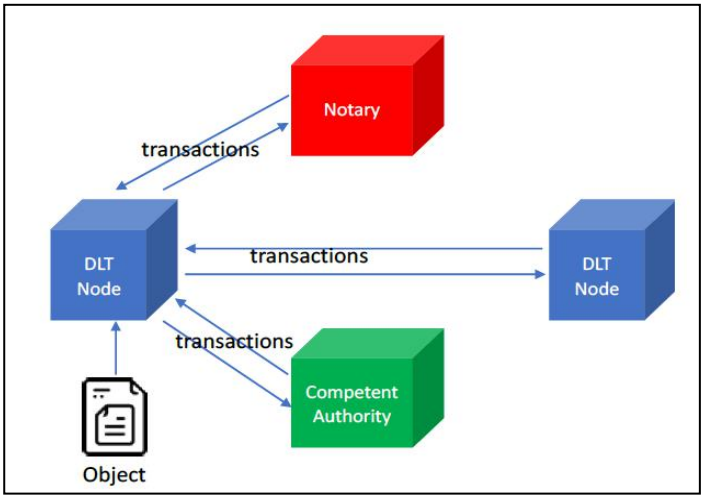


Figure 16

9.7 Standardization activities on Blockchain and DLT

Standardization activities on Blockchain and DLT are ongoing in a number of bodies, mainly at international level in ISO (ISO/TC 307 'Blockchain and distributed ledger technologies'), ITU and all the main international fora and consortia[53].

CEN and CENELEC established a Focus Group on Blockchain and DLT with the primary objective to identify specific European needs and requirements for the implementation of blockchain and DLT in Europe, and to map these needs against the work items of ISO/TC 307. The identification of such specific requirements has been formalized by the Focus Group in the CEN-CENELEC White Paper 'Recommendations for Successful Adoption in Europe of Emerging Technical Standards on Distributed Ledger/Blockchain Technologies'[54].

The White Paper addresses priority topics such as sustainable development, digital identity, privacy and data protection, and highlights specific European use cases. In particular clause 4.2 "Financial & Tax compliance and cross border economic data exchange" led to the recent establishment of CEN/CENELEC/JTC 19, responsible for the development and adoption of standards for Blockchain and Distributed Ledger Technologies, that will proceed with the identification and adoption in Europe of international standards already available or under development and will focus on specific European legislative and policy requirements, in support of the development of the EU Digital Single Market. JTC 19 will focus its initial activities on electronic identification and privacy due to the specific European legislative framework established by the eIDAS Regulation and GDPR.

[53] For a complete overview of the ongoing initiative see dedicated chapter of the Rolling Plan for ICT Standardisation: https://joinup.ec.europa.eu/collection/rolling-plan-ict-standardisation/blockchain-and-distributed-digital-ledger-technologies

[54] Available at ftp://ftp.cencenelec.eu/EN/EuropeanStandardization/Sectors/ICT/Blockchain%20+%20DLT/FG-BDLT-White%20paper-Version1.2.pdf

10 Interoperability

10.1 Reminder

Interoperability is essential for any subject involving transactions, exchange, sharing, network, collaboration, and more generally communications. Applied to e-invoicing or paperless and touchless supply chains, it has a direct impact on adoption by all the players, especially the smallest and more numerous one, here the SMEs.

The EMSFEI published a report[55] dedicated to this subject on e-invoicing, made by working group 4, which defines a few general principles and proposes 16 recommendations, including studying how ZCM and blockchain / DLT can create benefits to this issue.

Today, internet (based) solutions have the potential to provide for the establishment of an open market. This electronic market can provide for new opportunities for information sharing, service and support, and payment. A business process can be set up (not only between businesses, but also between business and government or business and consumer) for specific purposes, defined ad-hoc or for one-time use, as opposed to business processes belonging to established and permanent business relationships. The introduction of new techniques (like 'Cloud', SaaS, SOA and Webservices) for the compilation, exchange, storage and retrieval of data supports these evolving methods and provides an unprecedented opportunity for changes in processes carried out by governmental and private participants in international trade. The new information technology supporting these techniques may, in fact, provide the actual means of delivery for certain trade.

This calls for '**Interoperability**':

> *Interoperability is the capability to run business processes seamlessly across organizational boundaries.*
>
> *Interoperability is achieved by understanding how business processes of different organizations can interconnect, developing the standards to support these business processes efficiently and by specifying the electronic messages exchanged between the organizations to support these business processes in a scalable way.*

The goal of interoperability is to allow information to be presented in a consistent manner between business systems, regardless of technology, application or platform. It thus provides organizations with the ability to transfer and use information across multiple technologies and systems by creating commonality in the way that business systems share information and processes across organizational boundaries. The establishment of interoperability will enable wider adoption of e-invoicing, while fostering improved competition, stimulating network effects.

In current business scenarios, interoperability represents the most complete form of collaboration, enabling companies not only to interact with each other electronically but also to interact as if they were a single 'virtual organization' - a perfect example of the Digital Single Market.

To reach this goal, interoperability is not intended to be limited to a technical level, but also to encompass the business- and process level (in fact the lower three layers in Figure 4), including for example processes related to the relationship between suppliers and buyers and to cooperation with business partners, commercial counterparties, financial institutions and authorities.

Interoperability is central to establishing growth in e-business and e-Invoicing.

Currently the lack of interoperability is the single most important impediment to e-business, particularly to the participation of small and medium enterprises (SMEs). Yet, the development of standards to facilitate

[55] EMSFEI Report on Interoperability & Transmission, with a focus on SMEs, https://ec.europa.eu/cefdigital/wiki/display/EINVCOMMUNITY/Sharing+of+EMSFEI+Sub-group+4+deliverable

interoperability requires a full understanding of the problem, which is usually of an inter-organizational nature. The correct and logical approach towards the development of standards to facilitate international trade would thus be by means of a comprehensive study of all informational and procedural requirements for the execution of trade, followed by the negotiation of – and agreement on – international standards for these purposes. However, this would undoubtedly be a task of the greatest complexity. Therefore, a pragmatic step-by-step approach may be chosen under the condition that it must always be possible to make clear how the individual steps mutually support each other and fit into the larger context.

The subsequent text elaborates the meaning of this; for illustrational purposes, reference is made to the European Interoperability Framework[56] (EIF 2.0) that has been introduced by the European Commission IDABC as a 'tool' to help (build) interoperability between (e-) Governments, but its use is certainly not restricted to that. See figure 17.

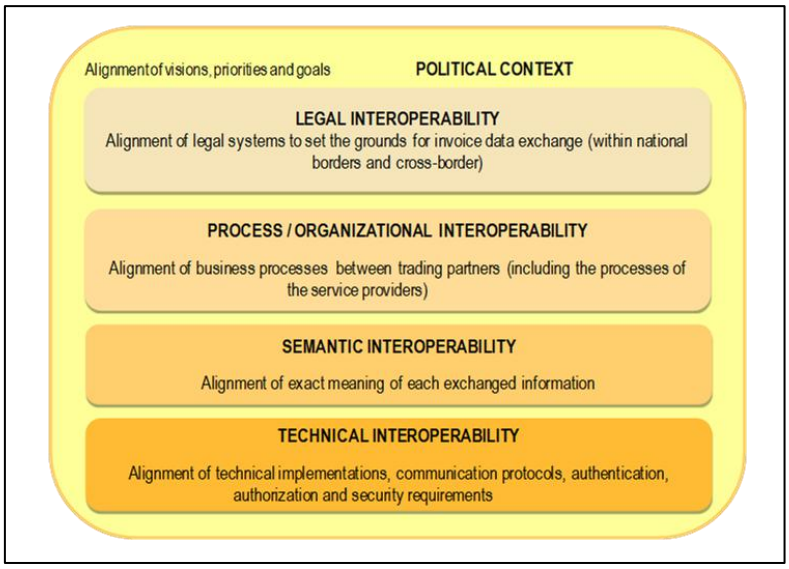


Figure 17

Figure 17 shows the four levels of interoperability within a single political context. When applied to electronic invoicing the trading partners must align all four levels of interoperability mentioned to successfully exchange electronic invoices in the following way (explained from and mostly limited to an e-Invoicing perspective):

Political context is set by various European Commission documents, especially Communication COM (2010) 712 'Reaping the benefits of electronic invoicing for Europe', Communication COM (2012) 573 'Single market act II' which defines a key action to 'make electronic invoicing the standard invoicing mode for public procurement'.

Legal interoperability is established by European VAT directives, 'Council Directive 2010/45/EU of 13 July 2010 amending Directive 2006/112/EC on the common system of value added tax'. As regards the rules on invoicing this is the Directive that applies at the time of writing this document and finds implementations in the national legal systems of the European Union member states.

For this document, the Political Layer and Legal Layer are considered 'out of scope'.

Process / organizational interoperability requirements are usually defined by vertical industries that strive to standardize their business processes to make them more efficient. Process / organizational interoperability requirements should be, as much as possible, independent from semantic and technical interoperability

[56] http://ec.europa.eu/idabc/servlets/Docb0db.pdf?id=31597

because otherwise a uniform level cannot be guaranteed e.g. considering the size and the sector of different companies, their 'digital maturity', private vs. public sector, etc.

Some international work, such as CEN BII, defines 'Business Profiles[57]' as a sequence of business messages needed to implement business processes, connecting Process interoperability level with lower semantic and technical levels.

To establish **semantic interoperability**, both parties must have equal understanding of the meaning of each piece of data contained in the electronic document that is exchanged. This means not only the definition of business information contained in each field of the data format, but also definitions of the values of codes (controlled vocabularies) contained in those fields.

In a heterogeneous business environment, an actor does not need to know in detail how another actor operates (internally); however, the existence of business agreements that set out a common collaborative way of working together is vital.

Technical interoperability deals with questions such as:

- how to express the Semantic Data Model in a syntax ('format');
- how to address the trading partners (parties) and route the electronic messages;
- how to exchange information over the network (web services and/or communication protocol definition);
- how to protect data from unauthorized modification, ensure their integrity and achieve non-repudiation;
- mechanisms for authentication and authorization.

This is further illustrated in the figure 18 below:

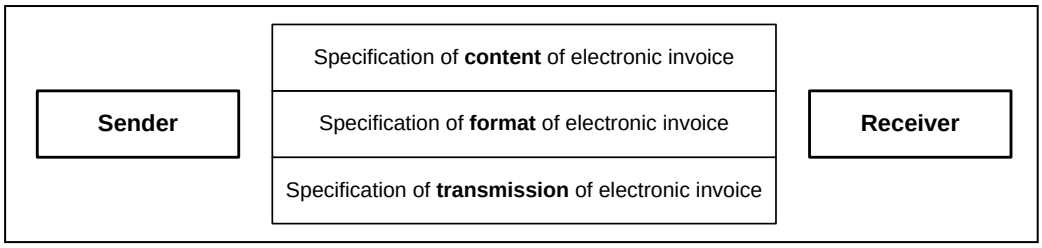


Figure 18

For the receiver of electronic messages to be able to understand and interpret them correctly, agreements must be made in some form with the sender of the electronic messages. This is what figure 3 refers to. From top to bottom:

1. specification of content: what information elements need to be conveyed, e.g. quantity, price per unit, date;
2. specification of format how are the information elements represented, e.g. if a text string is used to represent a date then does it use yyyymmdd or ddmmyyyy;
3. specification of transmission how is the information in electronic format transferred from the sender to the receiver. To this purpose (seen from the receiver side) in fact several options is available[58]:

[57] https://joinup.ec.europa.eu/catalogue/repository/cen/bii-profiles

[58] They will be mentioned only; elaboration in further detail is beyond the scope of this document.

- Electronic data interchange (EDI) e-invoicing: Trading partners send and receive electronic business documents, directly from system to system without human intervention (no manual retyping);
- Web e-invoicing: This allows trading partners to manually fill the relevant information into an electronic form and submit as business document electronically, typically through web portals;
- Scan and capture: Paper invoices are sorted, scanned and then data is captured either through manual keying or optical character recognition (OCR) technologies[59].

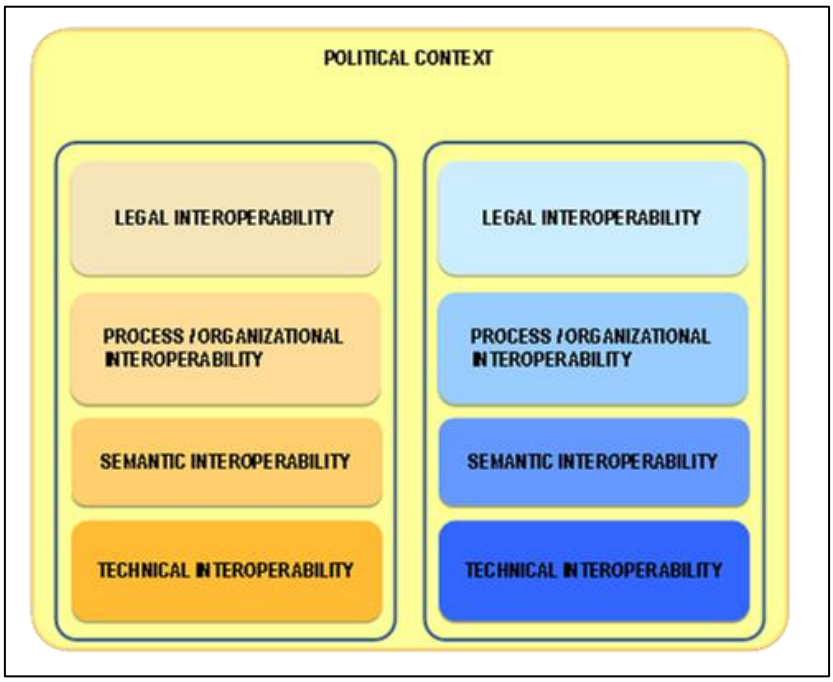


Figure 19

Figure 19 schematically indicates 'interoperability' of two different communities, in different jurisdictions, within a single political context.

It illustrates that, for the communities to be able to do business between each other, agreements[60] must be made on each of the four lower levels.

This is yet another argument underpinning that within a single jurisdiction, 'G' in role of 'B' in post-award environment must not have an own ('proprietary') interoperability stack. There is absolutely no business rationale to develop own standards, process- or organizational requirements, because business cases will be jeopardized by the introduction of the need for interoperability measures that are not necessary

In relation to the additional sub-layers of Technical Interoperability identified above, a few remarks and suggestions are relevant in order to complete the picture.

Owing to the vast diversity of trading party relationships, which may be conducted for e-business either directly on a one to one basis or through the intermediation of a service or solution provider, the feasibility

[59] These solutions have shown benefits for companies with little automation but are not considered true e-invoicing as they are not e-invoices as per art. 217 of Directive 2006/112/EC as modified by Directive 2010/45/EU, since they are exchanged as paper invoices.

[60] Process and organizational interoperability requirements should be kept very minimal as they can hinder the adoption

of convergence on formats and modes of transmission would be very complex, perhaps even difficult to justify due to the heterogeneity of requirements and currently unjustified by a business case.

However, interoperability is increasingly being offered in the context of networks of users and their service providers and in the context of interoperability between networks. In the context of this network interoperability, it becomes feasible to agree on network standards for format (including syntax) and in the aspects of transmission based on the governance arrangements for the network environment.

These standards can be used independently of those used in the user system and in the systems of their service providers, if the latter are utilized. The availability of mapping software allows the smooth functioning on an end-to-end basis. Such interoperability initiatives will benefit from the moves to create a stronger level of semantic interoperability, and at the same time propel interoperability at the other levels of the framework.

Such 'network interoperability' initiatives are common and growing in terms of adoption, both at Member State level and at a pan-European level. Examples of the latter include the PEPPOL initiative (funded by the Commission and several public authorities), the Model Interoperability Agreement of the European E-Invoicing Service Providers Association (EESPA[61]), and the Global Interoperability Framework (GIF) initiated by EESPA, OpenPEPPOL, ConnectOnce and BPC (Business Payments Coalition).

The 'legacy' model for the trade in goods and services, depicted against the Commission's EIF Framework layers can be seen in Figure 20. In fact, it only shows the buyer and the supplier and their banks (for e.g. payments).

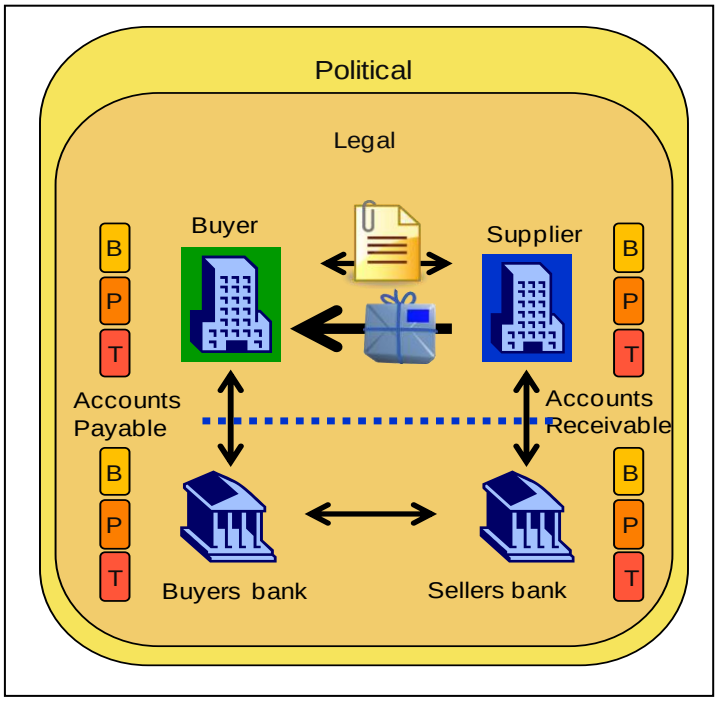


Figure 20

[61] http://www.eespa.eu/

However, taking into account more actors and more characteristics from the 21st century supply chain, the figure develops into the one below:

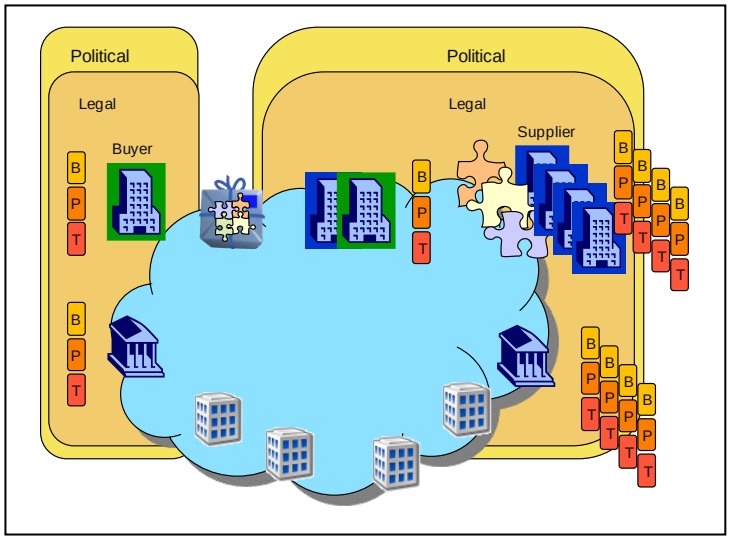


Figure 21

Essential characteristics are:

- More actors (authorities, transporters, ….)
- Dematerialization: from paper documents to e-messages or business data elements
- Information sharing
- Across more jurisdictions

An ever-increasing need for 'Interoperability': *running business processes across organizational boundaries*.

Interoperability is achieved by *"understanding how business processes of different organizations can interconnect, developing the standards to support these business processes efficiently and by specifying the details of the messages exchanged between the organizations to support these business processes in a scalable way"*

This in turn requires greater collaboration:

- (Internally) between sales, marketing, procurement, treasury, receivables and payables management; Interoperability on ongoing process: Interoperability on business transaction status to be shared by end points.
- (Externally) among buyers, suppliers, banks and other actors. Interoperability on compliance: interoperability on the respect of end to end legal and fiscal regulation which are linked to each other.
- Meeting a greater and broader demand for standards and standardization, for Data interoperability.

A holistic and integrated supply chain view, together with re-usable information in electronic format not only allows for further automation and better tracking of physical and financial flows for management and compliance reasons, but also for innovation in (bank's) products and services.

Interoperability:

- on transmission and delivery: how to be sure that the message has been correctly delivered to its destination

- on addressing: how can systems automatically know the address of the receiver (and maybe also secure the sending address)
- on portability: ability to change its solution without having to rebuild all relations with trading partners (like changing a phone service provider or change bank account and keep live all recurring payments).

10.2 How ZCM and DLT brings also a paradigm change on Interoperability

With ZCM and DLT, by construction, if a supply chain business transaction is built by sharing business data elements centrally, on a data-centric principle, where all players synchronize their system, the main issues of interoperability on 3, 4 corner model may be solved "naturally".

However, it implies that a common semantic data model for the whole supply chain transaction is built in order to create a common semantic view of core business data element. EN16931 could be a good start, but must be enriched to cover all B2B business cases. In addition, the same work should be done on Order, Order Response, Order Change, Delivery notice, Invoice Response Message, Payment.

In addition, a special attention should be made on rights and access to each data element, which implies not only a secure identification of each party, but also the management of the right of each person in any organization to access a specific data in addition to the global rights of the Party itself. Identity Management is key and must be extended to each final user, including applications or each Party.

11 Finnish Applications using emerging technologies

The Subgroup 7 noticed some use cases of applications based on emerging technologies and chose to include the example of Finland in this discussion paper.

11.1 Finnish Tax Administration's and CGI's concept to automate VAT reporting through Distributed Ledger Technologies

In Finland companies reporting responsibilities towards government authorities is in over 90% of the cases for the Finnish Tax Administration. The amount of administrative burden that the Finnish Tax Administration causes for companies is ten times bigger than the rest of government reporting requirements combined. Note also that according to a report by OECD (2018[62]), approximately 90 % of companies in Denmark, Finland, Norway and Sweden are SMEs.

There is in Finland a disconnection between receipts, invoices, accounting and VAT reports and it is hard to achieve full transparency in the VAT reporting process. The current overall system does not support real time economy or improve SME companies' visibility into their working capital and how much they must pay VAT. Currently companies compile VAT reports manually based on sales, invoicing and accounting data and send reports to Tax Administration in summarized form and residual payments are paid usually monthly and, in some cases, yearly.

In general, there is no common solution for companies to calculate VAT. Each company builds their own VAT reporting processes and solutions by themselves. This company specific way of working does not support company efficiency improvements or national competitiveness. Tax auditing is a heavy and manual process because tax authorities receive only summary level information from companies and access to full data is cumbersome.

[62] https://stats.oecd.org/Index.aspx?datasetcode=TIVA_2018_C1

The Finnish Tax Administration and CGI implemented a technical proof of concept to research the reporting and residual VAT calculation automation with Distributed Ledger Technology. The solution is called Vatnet.

OP Financial Group and their OP Light Entrepreneurship service and an accounting company Talenom participated in the proof of concept, which was focused on micro, small and medium sized companies.

The idea behind the Vatnet concept solution is that it will not change existing structures and processes dramatically, e.g. e-invoices are sent same way as before.

The VAT automation proof-of-concept aimed to determine/demonstrate if Distributed Ledger Technologies can automate VAT reporting and VAT-payments in the future more efficiently that traditional methods. The R3 Corda DLT platform was chosen due to its capability to interact and share data dynamically in a point-to-point manner only with chosen parties which is a unique feature compared to other DLT.

The proof-of-concept showed that company residual VAT can be calculated near real time from standard format invoices without a centralized platform or a centralized repository for all invoice data. DLT platforms can decentralize residual VAT calculations in a trusted manner. In the future, this could mean that a company subscribes to the service or deploys client software and the Vatnet solution provides residual VAT calculation and reporting for company. The service or deployed solution utilizes invoice data to calculate the residual VAT that is reported to the Tax Administration in reporting cycles specified by company.

Even though the proof-of-concept did not include receipt data and accounting data, it became clear that complementing invoice data with receipt data will not be an issue. Reconciliation of invoices, receipts and accounting data can be arranged for example by utilizing XBRL GL standard.

Automation of VAT reporting and residual VAT payments through emerging technologies like DLT results in added transparency, trust, operational fluidity and cost savings for tax responsible companies.

Benefits of DLT networks are not restricted only to residual VAT calculations; other taxation or real time economy related standard processes could also be digitalized to improve finance efficiency and automation in companies.

Benefit	Realizes as	For
Easy onboarding / Easy to join network	Cost reductions and time saved	All
Scalability and standardation	Cost reductions and time saved	Accounting agencies, Micro entrepreneur services
Real-time and automated residual VAT calculation	Improved operational efficiency and better visibility into company financials	Accounting agencies, Micro entrepreneur services, Companies, Tax Administration(s)
Payment automation	Closer to real-time cash flows	Accounting agencies, Micro entrepreneur services, Companies, Tax Administration(s)
Decentralization	Technical efficiency	Accounting agencies, Micro entrepreneur services, Companies, Tax Administration(s)
Societal trust	Transparency and visibility	Tax Adinistration(s), Society
Steps to real-time (data)economy	Process automation and new business based on data e.g. automated financial reporting for small companies.	Micro entrepreneur services, Start-ups, Accounting agencies, Solution providers, Companies

Figure 22 Benefits of DLT networks[63]

It can be argued that DLT technology is not strictly necessary to automate VAT reporting, however it would not be possible to enable dynamic interactions and to automate trusted and distributed intercompany

[63] Niko Harju, Director Consulting CGI: Vatnet presentation

processes without DLT technologies. DLT applications combine company to company transactions in trusted manner and create common, transparent and auditable book of records over fragmented processes.

DLT also enables application or functionality scalability in business networks to other financial reporting needs unlike traditional software development

11.2 Use cases with other new technologies

11.2.1 Use case Robotic Process Automation technology (RPA)

The Finnish Government Shared Services Centre for Finance and HR (Palkeet) has rolled out Robotic Process Automation technology (RPA) across the organization. 26 robots are now in operation, automating 70 different processes. Procurement processes automated include the processing of purchase invoices and the maintenance of its supplier register. Palkeet deploys RPA technology in order to increase productivity, improve the quality of its services, by reducing human error and increasing predictability. More information can be found in the Deloitte Study on up-take of emerging technologies in public procurement[64].

11.2.2 Use case machine learning

Hansel Oy, the central purchasing body for the Finnish Government, was given access to e-Invoicing data from the state eInvoicing system. It planned to upload this data an open data portal – Explore State Spending. Hansel Oy piloted a machine learning solution to automatically categorize state e-Invoicing data according to the United Nations Standard Products and Services Code (UNSPSC) procurement taxonomy. The key takeaway from the project is the importance of ensuring that adequate machine training data is available for the categorization algorithm (roughly 1000 rows per category).

There are several points that Hansel Oy has taken from the project and learnt from. One of the main aspects that it would like to revise is the integration of the categorization solution with the Qlik Business Intelligence system to develop an interface through which users could manually classify data to be used to train the algorithm. This integration proved to be difficult, expensive, and did not deliver much additional value.

Another general lesson that could be drawn from Hansel Oy's experience relates to the importance of training data. Providing an adequate amount of training data for a machine learning algorithm to perform at the desired level can necessitate a substantial investment. The level of this required investment should be estimated and incorporated into the budgeting process at the beginning of the project.

A final lesson to take from the project relates to whether to outsource the development of AI solutions or develop them internally. Hansel Oy chose to outsource the work, but later considered that the better route may have been to develop the solution itself. Organizations should carefully assess, based on the human resources available to them, which is the better route before starting the project.

Today the OpenProcurement.fi [65]based on this piloted solution service provides citizens and companies with the opportunity to look for information on state and municipal procurement. Citizens are provided with information on the purchases made by the state and Finnish municipalities as well as how public funds are being spent. For companies, the service provides information on current market conditions.

More information can be found at Deloitte Study on up-take of emerging technologies in public procurement[66].

[64] https://ec.europa.eu/docsroom/documents/40102
[65] https://tutkihankintoja.fi/?lang=en
[66] https://ec.europa.eu/docsroom/documents/40102

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