EDI with Blockchain as an Enabler for Extreme Automation

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Extreme automation is the latest initiative to have emerged from several "hands-free" innovations like autonomous ships and submarines, autonomous passenger aircraft, drone freight delivery, autonomous robotic surgery, automated knowledge discovery, currier package delivery, and self-writing software. In such markets, every company is a software company in some way and customers expect software to perform flawlessly and effectively. When it doesn't, the brand suffers.

In the supply chain, everything from attracting customers and securing deals to managing transactions and follow-ups based on B2C (business-to-consumer) or B2B (business-to-business) platforms needs to be transparent, secure, and able to be changed on the fly. Everything needs to happen at lightning speed because winning market share requires the use of highly dynamic, fast-moving environments. Healthcare supply-chain management deals with the informational and physical resources (such as manufacturing, procuring, storing, and transporting different product types such as surgical supplies, medical devices, and pharmaceuticals) needed for delivering services to the end customer (see Figure 1).

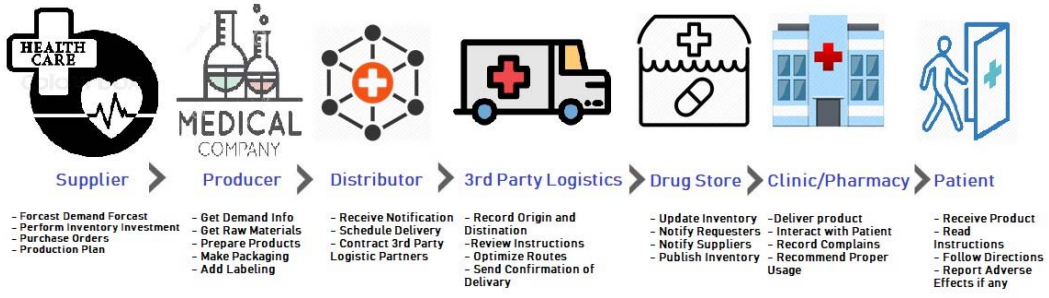

Figure 1. End-to-end healthcare supply chain.

Published by the IEEE Computer Society
1520-9202/18/$33.00 ©2018 IEEE

According to a recent Allied Market Research report,[1] the healthcare supply-chain management market is segmented based on delivery model, software, hardware, end customer, and geography. Based on the delivery model, the market segments covered in the report are cloud-based, web-based, and on premise. In addition, healthcare supply-chain management software includes supplier management software, procurement software, transportation management software, and others. The hardware segment consists of barcode and RFID systems and others. End customers served by the market consist of healthcare providers, suppliers, distributors, and others. The market for healthcare supply-chain management is segmented based on geography: North America; Europe; Latin America, Middle East, and Africa (LAMEA); and Asia Pacific. Similar segmentations are also seen in other industries, as supply-chain management is more complex in the era of globalization and extreme automation.

There are many factors that need to be considered and must be part of more effective solutions, like understanding that outsourcing, product personalization, authentication, and transportation are all part of the new business reality. In this new era, supply-chain visibility must be carefully defined in a consistent way across industries. ERP (enterprise resource planning)-to-ERP connectivity is not the answer when electronic data interchange (EDI) is the only workhorse of visibility. B2B and B2C efforts are now three decades old, yet the primary EDI mechanisms are based on fragmented and manual efforts. However, trying to install a new ERP system and a new EDI system at the same time doesn't double risks—it squares them.[2] Business leaders in the era of extreme automation need to pave a new path to solve these new challenges.

EDI STRENGTHS AND WEAKNESSES

EDI is the universal language for B2B and B2C communication, and has changed the way that companies share information, ensuring that data isn't compromised by human error. EDI has become the common language for interchanging files and information such as product activity data, purchase orders, and shipment and billing notices. Rather than sending faxes or emails for each individual event, EDI allows computers to communicate directly with each other, ensuring greater accuracy and instantaneous notice.[3] EDI can scale to include different collaborating partners by introducing a portal or cloud layer that partners can access securely without a data-integration solution. An example of such a solution is the Edicom portal (see Figure 2).

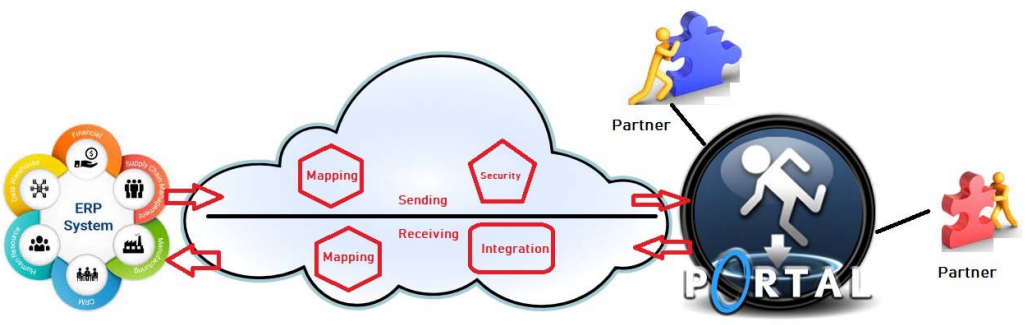

Figure 2. Scaling electronic data interchange (EDI) for collaborating partners through the use of web portals (Source: www.edicomgroup.com/solutions/edi/components/partner_web_portal.html)

However, businesses are moving away from the standardization principles that brought forth greater efficiency in the retail industry and inadvertently introduced more work for vendors that must collect data from numerous retailers. Improving supply-chain visibility is critical as supply chains grow more complex with more collaborating partners. Having different vendor portals will damage the efficiency of B2B and B2C communicating networks. EDI as a universal language is a slow-moving ship and there are no benefits for a single company in a partner network to change unless other trading partners also follow. This was one of the main reasons

XML never really took off, although it was (and still is) a far superior format for electronic business transactions than the clunky 30-year-old flat-file formats used by traditional EDI standards, such as EDIFACT and ANSI X12.[4]

EDI needs a distributed ledger technology (DLT) for shared and synchronized digital data that is geographically spread across multiple sites, countries, or institutions. With a DLT, there is no central administrator or centralized data storage. Without DLT, EDI messages will have major difficulties mapping messages between partners. Each message has many sectors that, arranged in a particular way, constitute the "map" for the message. The segments are populated with data, such as customer number, product number, gross price, and net price. There are numerous opportunities for error—if a product number is changed on the sending or receiving end, data is entered incorrectly, new master data isn't uploaded into someone's system, a suffix or prefix is added to a value in one of the sections, a trading partner changes part of the map and fails to communicate the change, or a required field is blank, other partners will not be informed. Thus, new methods are needed to keep these records—ranging from emails to spreadsheets to third-party services—in sync.

EDI cannot support the complex supply-chain processes of today because the data transfer between the various ERP systems opens up potentially critical situations. Customers and suppliers need a shared view of the actual supply situation and an automated early detection system. This will efficiently control organizations' supply chains, enabling them to collaboratively resolve identified problems and avoid costly bottlenecks. Trust is key to the success of global cross-organization collaboration, and trust comes with transparent processes. DLT promises to share, facilitate, verify, or enforce the negotiation or performance of a contract. This is why a DLT system is needed along with an existing EDI.

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THE BLOCKCHAIN DLT SYSTEM

Blockchain systems form a decentralized ledger, a type of database that is stored in several different physical locations. Processing is distributed among multiple stakeholders, and each party receives real-time updates in a completely secure system. These aspects make a decentralized ledger an ideal system for the creation, issuing, and execution of contracts that can help protect business models and enable collaboration.[5] However, blockchain is not an alternative to EDI systems, although it offers a way for trading partners to communicate quickly and clearly without the risk of errors or repudiation.

Consider how transactions take place through EDI systems, which typically involve a buyer, a seller, and a third-party logistics provider. EDI system transactions hinge upon one-way, point-to-point communication, meaning that two of the three parties can exchange messages with one another, but the third party is left out. Because blockchain is a shared ledger, everyone can see what is going on. Disputes would not happen, repudiation would be unnecessary, and sharing information would be much more efficient.[6] Another advantage of blockchain technology is the security and integrity of distributed networks. Although it started as a disrupting technology in the financial industry for the decentralized digital currency Bitcoin, blockchain finds more and more use cases in other industries such as energy and freight.[7]

A study by IBM found that 16 percent of surveyed healthcare executives had solid plans to implement a blockchain solution this year, while 56 percent expected to by 2020.[8] Healthcare companies, tech innovators, and the rest of the healthcare industry are grappling with what is possible now and what blockchain could solve in the future. The overall vision for blockchain to disrupt healthcare in the future would be to create a common database of health information that physicians and providers could access no matter what electronic medical system they used, provide higher security and privacy, decrease the admin time for physicians so they have more time to spend on patient care, and improve the sharing of research results to facilitate new treatment therapies.[9]

ADVANTAGES OF BLOCKCHAIN

Blockchain won't be a cure-all for the industry today, but it would certainly be a step in the right direction. The healthcare industry is drowning in data—clinical trials, patient medical records, complex billing, medical research, and more. Adoption and implementation of blockchain will be an evolution over time as blockchain applications are vetted and adopted and as the industry comes together to solve collaboration and governance issues. As it always is with new technologies, the full possibility of what might transpire in the future is unknown at this time. However, there are many advantages of using blockchain for an industry like healthcare. Among these advantages are the following.

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- *Transparency and collaboration*. Blockchain is a solid mechanism for documenting a transaction across the supply chain and sharing it with stakeholders. The system works without a central repository or single administrator.
- *Medical data management*. Blockchain has great potential to link medical data across systems and stakeholders. An example of the success of blockchain in managing healthcare data is the MedRec system.[10] MedRec intends to improve electronic medical records and allow patients' records to be accessed securely by any provider who needs it. The goal is to give patients and their healthcare providers one-stop access to their entire medical history across all providers they have ever seen. Additionally, if patients wish to grant researchers access to their personal medical records, the data would be provided anonymously to be used for research, which could make medical breakthroughs happen faster.
- *Scalability and availability*. Blockchain 2.0 is solving the scalability issues for writing transactions. Anyone worldwide can access the decentralized datasets.
- *Security and privacy*. Establishing a trust network depends on the healthcare system as an intermediary to establish point-to-point sharing and bookkeeping of the exchanged data. A node does not have to reveal the physical identity of the person or organization and the payload can have a digital signature with private cryptographic keys.
- *Patient–provider relationship contract*. This contract links two nodes in the system, where one node stores and manages medical records for the other. This relationship could exist between a particular care provider and a patient, but extends to cover any pairwise data stewardship interaction.
- *Summary contract*. This serves as a trail of breadcrumbs, where each participant in the system can locate a summary of their relationships with other participants. The summary contract encodes a list of references to patient–provider relationship contracts, showing current and previous engagements with other nodes on the system. Each relationship also stores a "status" variable, indicating when the relationship was established and whether it has been approved by the patient.
- *Reduced transaction costs*. The use of near-real-time processing would make the system more efficient.
- *Innovation*. The dominance of open source models is a driver for computing innovation. IBM, Microsoft, and Bitcoin published their solutions on the open source repository Github. Blockchain-as-a-Service solutions like Microsoft Azure make it easy for anyone in the world to use the service.

SMART CONTRACTS

Blockchain uses a smart contract, which stores the ground rules of the contract, automatically executes the contract, verifies its compliance, and evaluates the outcome without the need for a third party. Smart contracts are visible to all users and remove the need for a middleman. The supply-chain industry needs smart contracts for the next generation of global distribution systems. As an example, a smart contract starts when a patient schedules surgery. At this point, the contract performs the initial setup of the blockchain and mines for other related caregiver nodes. Caregiver partners join the private blockchain, where no one person is the owner of the

data and all partners are part of a consortium or community of practice. All partners can write and read data into or from the blockchain. When partner A writes data into the blockchain, that data can be validated by the consortium. Once the data is validated it can be shared with other nodes including external repositories. A smart contract is pre-written code that utilizes both EDI and blockchain communication protocols. Figure 3 illustrates the EDI blockchain for a surgery supply-chain cycle.

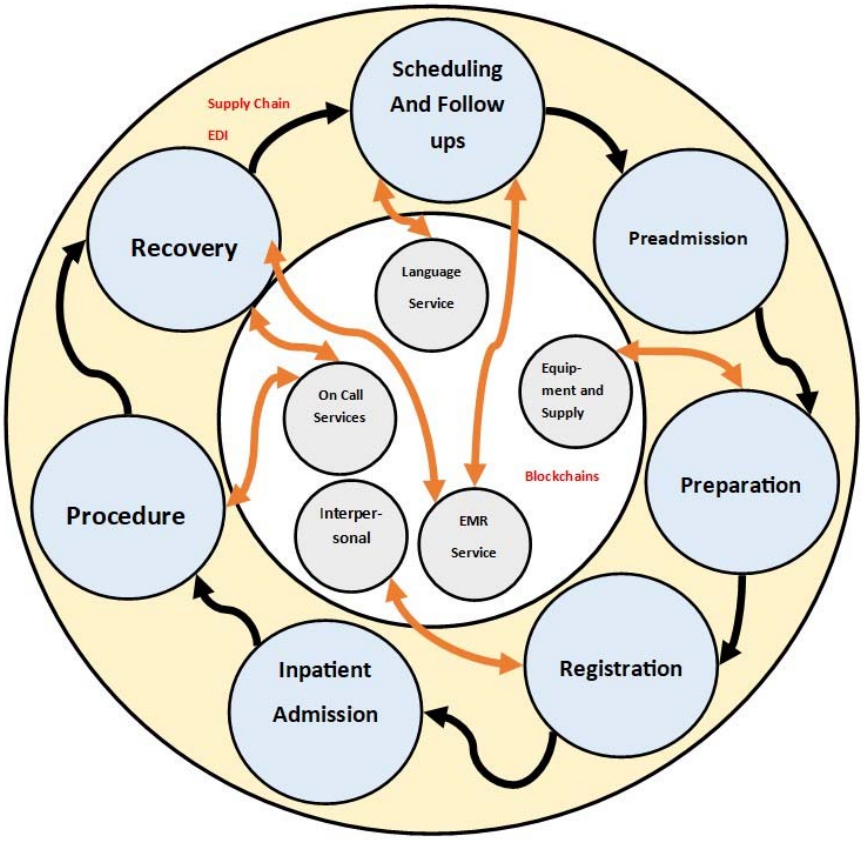

Figure 3. Blockchain with EDI for the surgery supply chain.

Generally speaking, if a business can satisfy the checklist below, it has a good use case for EDI and blockchain.[11]

- Multiple parties need to be able to view, and possibly edit, the same data.
- Parties form a supply chain with the ability to communicate with third parties.
- There is a lack of trust between parties trying to conduct transactions.
- Several of the transactions are sequential in the supply chain, and all parties conducting the transactions need to know the interdependencies of those transactions.
- Middlemen are in the ecosystem mainly because of the lack of trust among the parties that need to conduct transactions.
- Parties would gain financially if transaction times can be reduced.

The use of smart contracts will allow the advancement of multiple services that were suffering from bottleneck delays because of complex logistics and privacy protocols. Suppose a patient has agreed that their clinical or medical data can be used by anyone in clinical research who can satisfy a smart contract by putting this data into a public blockchain. The enforcement of the smart contract can provide add-on services to facilitate collaboration and interoperability, similar

to interoperable electronic healthcare record systems like the Fast Healthcare Interoperability Resources (FHIR) system.[12] In this case, the smart contract would include:

- upfront micro-payment for the access,
- requirement for escrow of the crypto coin to be unlocked to the patient if other terms are violated,
- terms of protection of the data,
- kinds of clinical trials allowed (for example, heart conditions but not brain),
- agreement to keep all research public,
- agreement to contact patient if patient could benefit from new treatment detected,
- agreement to contact patient if some treatable medical condition not previously known is discovered, and
- agreement to not contact patient if a terminal condition is detected.

A clinical trial firm that meets these requirements would satisfy the contract and gain access to the data. If the firm violated any of the terms, the smart contract would automatically transfer the escrow coin to the patient. The possibility of using smart contracts with patients' medical records gives patients control over their data.

According to *Forbes*, pharmaceutical companies incur an estimated annual loss of $200 billion due to counterfeit drugs globally.[13] Using smart contracts, it is possible to trace drugs over their whole lifecycle. Each ingredient and substance is numbered and tracked with geographic and other relevant information. The tracking data is then added to the blockchain (only the metadata is put in the blockchain for efficiency reasons).

CONCLUSION

Although blockchain has enormous potential, it is important to remember that no new technology succeeds with the "rip-and-replace" method. Organizations using blockchain will have a greater impact if they augment existing, well-established technologies such as EDI systems. Using smart contracts that take into account legacy protocols like EDI and blockchain will benefit the ecosystem of every industry, including healthcare. The healthcare industry will need to adapt to the changing care delivery and the new financial model as it will save many billions of dollars, according to recent industry survey.[14,15]

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