



BLOCKCHAIN ECONOMICS: “RIPPLE FOR ERP”

Integrated Supply Chain Ledgers to free \$3.9 trillion in Capital?

BY MELANIE SWAN

Integrated supply chain ledgers are the idea of having open permissioned links in corporate accounting software such that trade partners might automatically post to each other's ledgers. This could allow the net-clearing of accounts, thereby reducing supply chain debt by 95%.

Integrated Supply Chain Ledgers

Integrated supply chain ledgers are the speculative concept of open permissioned links in corporate accounting software packages to allow trade partners to post to each other's ledgers. This could allow supply chains to settle on a net rather than a gross basis, thus

dramatically reducing the amount of capital tied up in supply chain finance. Some sort of net-clearing mechanism is needed to reduce debt, because net clearing diminishes the amount of capital that needs to be transferred (~5% net flows vs. 100% gross flows). The other 95% of capital is freed for other uses. At present, \$3.9 trillion of net working capital is committed in global supply chains.¹ Further, the global trade finance gap (trade finance transactions rejected by banks but needed for global distribution) is estimated to be \$1.5 trillion.² Even with credit terms, the incentive is to play the float and delay payment; it takes 42 days on average

for global supply chain invoices to be paid.³ The transformative technology of blockchains might help. Distributed ledgers are estimated to be storing 10% of global GDP by 2027.⁴ In the supply chain context, blockchains might be crucial for rethinking debt, in the form of integrated supply chain ledgers for credit terms, and also for pre-paid consumption via payment channels.⁵

Blockchains mean that finance is running on a computer graph (a network architecture comprised by nodes (vertices) and connections (edges)). Bitcoin and other digital currency projects implemented the notion of *payment graphs* (payments flowing across network nodes). Ripple created *credit graphs* (automated access to and issuance of cash and credit across participating network nodes). Here, the proposal is *supply chain credit graphs* or *integrated supply chain ledgers* (automated posting to approved trade partner general ledger (G/L) accounts across the supply chain). Network accounting is currently located in data centers, in cloud-based blockchain services (Baas (blockchain as a service)) offered by Oracle, SAP, Microsoft, Amazon,

etc. The adoption path could be that blockchain cloud services vendors implement not only industry *shared*-ledgers but industry *integrated*-ledgers. This is one mechanism by which corporate accounting software could allow account-level posting amongst trade partner ledgers. Just as companies integrate ledgers across internal subsidiaries, supply chain ledgers could have an integrated view across companies in a demarcated supply chain.

Full Suite of G/L Accounts to be Enabled in Integrated Supply Chain Ledgers

Digital currencies are merely the first and most obvious application of blockchain technology. Indeed, so far nearly all of digital ledger operations have only been impacting one balance sheet account, Cash. Activity mostly consists of subledger transactions on the Cash account (Alice transfers money to Bob). When I buy a coffee, it is just the payments side of the transaction that is currently recorded in the blockchain, not the vendor's Revenue, COGS, etc. More G/L accounts start to be included with Ripple. There is now an impact on A/R and A/P accounts (Credit Receivable and Credit Payable), and the more sophisticated accounting requirements of recording credit-related accrual activities. Identity-management blockchain applications are being implemented such as the State of Illinois's birth registry project.⁶ Would a literal interpretation of accounting concepts in the ledger format of a birth and death registry have two transactions, a credit at birth and a debit at death? Property registries on blockchains (such as Mike Arrington's Propy transaction)⁷ are being implemented, but

with smart contracts as opposed to G/L accounting ledgers. Thus, the idea of Integrated Supply Chain Ledgers is that the full suite of G/L accounts is instantiated in blockchain ledgers.

Liquid ledgers across the whole G/L (not just cash ledgers like Bitcoin) suggest that supply chain finance transactions could flow automatically across participating network nodes, just like money and credit now flow automatically across the Ripple Credit Network.

How do Integrated Supply Chain Ledgers work more specifically?

The concept of integrated supply chain ledgers (supply chain credit networks, supply chain graphs, liquid supply chains, just-in-time-money) is that distributed ledger transactions from my approved trade partners can *automatically* post to my company's ledger accounts. Distributed ledger supply chain transactions can flow through the full suite of participating node G/L accounts (all balance sheet, income statement, and cash flow accounts) in an automated way, just as money moves through the Ripple credit network like automated packets of information on the Internet. Smart contract factoring and other financial automation products might be implemented. On the Internet, information packets automatically transit across the network to a destination node (per network validation software). Likewise Ripple cash and credit transactions automatically ripple across the credit graph of participating nodes (246,672 nodes as of December 2016)⁸ to a destination node. Here the idea is that supply chain transactions too could automatically transit through the

supply chain payment graph, debiting and crediting the relevant accounts of multiple entities along the way.

The supply chain credit network is analogous to the Ripple credit network, conceptually, but is more complicated because individual company G/L accounts are flagged for access and flow-through activity by trade partners. Right now corporate accounting ledgers are software-based, and most are also online. The next step is enabling specific accounts with open credit links such that trade partners can ripple activity through their ledgers. The concept is "open supply chain ledgers", likely within private blockchain. Of course this would be executed with limits and restrictions, approvals, parameterisations, and slow test cycles of implementation.

One straightforward example might be processing a Supplier Invoice (auto-debit to Inventory, auto-credit to A/P; increasing inventory and increasing the corresponding payable). In initial implementations, one obvious safeguard could be that the blockchain accounting system creates journal entries, which are then confirmed and posted by humans. The responsibility for actually posting to the company's books remains vested in humans at the beginning. Later, though, blockchain systems might be approved to auto-post to trade partner ledgers. Another example is the Receipt of Inventory. Journal entries are automatically created by blockchain accounting systems when inventory is scanned upon receipt at a facility. This transaction involves two trade partners. The automatically-generated set of transactions to

Liquid ledgers across the whole G/L (not just cash ledgers like Bitcoin) suggest that supply chain finance transactions could flow automatically across participating network nodes, just like money and credit now flow automatically across the Ripple Credit Network.

recognise the delivery could include a debit to my ledger for the received inventory, and a credit to the vendor's ledger for the sent inventory (more technically, the broader set of journal entries for both parties to record this transaction). Integrated blockchain ledgers are essentially a next-generation version of Electronic Data Interchange (EDI) solutions already used by many supply chain partners.

The point is that integrated supply chain ledgers might allow trading partners to not only see each other's ledgers, but also to update them. The radical idea with Ripple is that nodes allow (per the maximum size they specify) completely automated flows through their ledger node on their passage to other nodes. In supply chain ledgers, this could be even safer because the initial implementations might be on private blockchains as opposed to Ripple which is an open network that anyone may join. In private blockchains, users are known and credentialed, so the up-stream and down-stream nodes are my usual trade partners. Integrated supply chain ledgers are just a more liquid form of EDI, but one that might allow the automatic flow-through of information and transactions across the general ledgers of multiple companies in the supply chain.

Decoupled Supply Chain Trajectories: Goods and Finance

Traditionally, it has been a problem that the "goods flow" and the "money flow" trajectories are decoupled in supply chains. Each is a "separate object" with its own behavior and incentives. Goods delivery precedes financial delivery. However, in the world of distributed ledgers, this is a benefit because digital ledgers tie the two together when needed, and otherwise create a disintermediated finance stream. The finance stream can be packaged up as a

financial instrument, as it is already now in factoring (selling receivables, a \$2.1 billion global market)⁹ and supply chain finance (selling discounted invoices, a \$275 billion global market),¹⁰ but there are even more possibilities in blockchain-based credit graph economies. We can derivatise, payment channel-ise, and net clear the finance supply chain in more granular ways with digital ledgers and open credit networks. One idea is simply to implement Ripple for trade finance. The transparency of digital ledgers provides a safeguard against over-derivatisation, to avoid debacles that led to the 2008 global financial crisis such as off balance sheet collateralised debt obligations (CDOs). Overall exposure can be easily tabulated with the Merkle-rooting or synecdoche property of blockchains (the ability to roll up and down arbitrarily-many levels of detail in a single view).

Implications of Integrated Supply Chain Ledgers

Triple-entry Bookkeeping. The term "triple-entry bookkeeping" arises in the blockchain context. It most basically means that blockchains add a third safeguard to the existing double-entry bookkeeping method. The point of double-entry bookkeeping is that two opposite ledger entries not only reduces errors, but also reflects the equal and opposite impact of a transaction on a company's business activity. The blockchain adds a third confirmation to the existing structure of double-entry bookkeeping. For example, there will be three entries if I'm transferring money to you: our cash accounts (i.e. wallet balances) will reflect a debit to my account, a credit to your account, and a confirmation of this transaction via distributed ledger.

The triple-entry bookkeeping concept is deployed in the Balanc3 smart contracts project. This is an open

platform with an XML-based API interface for accounting software packages such that transacting parties (e.g. a supplier and a purchaser) can engage in real-time blockchain-based transactions.¹¹ It is an open ledger in that users confirm that their transactions will be posted on the public blockchain (Ethereum) when submitted. The interface complies with public accounting standards. The integrated supply chain ledgers idea is a more extensive version of triple-entry bookkeeping. Like Balanc3, the practical implementation of this system involves adding blockchain functionality to existing accounting software systems. In integrated supply chain ledgers, though, the further functionality is to have fully open links to G/L accounts for partner cross-ledger posting, which might be on an open or closed basis.

Open or Closed Shared Ledgers?

There is a question as to whether integrated supply chain ledgers would be open or closed. The initial assumption is that shared ledgers would operate on private blockchains within industry consortia, including possibly keeping information private from other parties in the private chain. It has been found, for example, that transactions on open chains such as Ripple are less private than the pseudonymous addressing and other cryptographic features might suggest.¹² However, there is another argument that opt-in open networks might be preferred.¹³ First, in the case of public-benefit organisations that do not have a profit motive, for example hacker spaces, there is little reason not to prefer the transparency, efficiency, and ease of audit afforded by blockchains.

This might seem different in the case of for-profit businesses. However, in one sense, the "Yelp argument" suggests that open accounting (making my businesses books available for

viewing on a public blockchain) is just a formalised version of Yelp, with the benefit of being a more-trustworthy less-cheatable ratings and reputation system. It is easier to check the blockchain than the possibly-gamed Yelp ratings to see if a particular company pays their vendors on time. Also, in another sense, the “value-creation argument” suggests more fundamentally that the dynamics of business competition might be forced to change in favour of demonstrable value creation as opposed to competitive edge based on information control and obfuscation. A favourable advantage might be obtained by those businesses that are radically open and disclosive of all of their financial activity. Profit determination methods could shift to cost-plus models for businesses that operate more like utilities, and require greater justification for the up-charge of value-added services. The ability to measure the contribution of value suggests an inevitable shift to value-based pricing as opposed to what-the-market-will-bear pricing. One great benefit of distributed ledgers is the ability to more closely connect value creation with rewards, which is completely decoupled in many aspects of the current system.¹⁴

Conclusion

Integrated supply chain ledgers are the idea of having open permissioned links in corporate accounting software packages such that trade partners could post to each other's ledgers. Integrated ledgers might be hosted by blockchain cloud services vendors or accounting firms. The implication of every business's books being kept on a distributed ledger is that they could be easily permissioned and pooled for single-ledger views and net settling at the supply-chain level. Net-cleared accounts might reduce supply chain debt and working capital commitments


BLOCKCHAIN



We might wonder if financial systems running on distributed networks (“blockchain ledgers”) might trigger a dramatic shift in how money, assets, and society are structured in the future.

by 95%. Auto-posted net-cleared transactions could automatically ripple across the entire supply chain.

The wider implications of integrated supply chain ledgers are substantial. There is an argument that the ability to measure and report trading activity through bookkeeping mechanisms (“Renaissance ledgers”) is precisely what led to the large-scale accumulation of capital, the industrial revolution, and the modern world as we know it.¹⁵ We might wonder if financial systems running on distributed networks (“blockchain ledgers”) might trigger a similarly dramatic shift in how money, assets, and society are structured in the future.

This article does not discuss the many potential risks involved with this proposal, which are discussed elsewhere. However, two risks specific to integrated ledgers are first, a higher potential concentration of risk if the whole economy trades together like a high-frequency trading vehicle (HFT).¹⁶ Another risk is the diminishment of liberty if all persons worldwide are forced to join a blockchain economy that abrogates diversity and increases precarisation. 



Melanie Swan is a Technology Theorist in the Philosophy Department at Purdue University. She is the author of the best-selling book *Blockchain: Blueprint for a New Economy*. Her background includes an MBA in Finance and Accounting from the Wharton School of the University of Pennsylvania and a Wall Street career.

References

1. PWC. 2015. Bridging the Gap 2015 Annual Global Working Capital Survey. <https://www.pwc.com/gx/en/business-recovery-restructuring-services/working-capital-management/working-capital-survey/2015/assets/global-working-capital-survey-2015-report.pdf>.
2. *The Economist*. 2017. Technology is revolutionising supply-chain finance. <https://www.economist.com/news/finance-and-economics/21730150-squeezed-suppliers-and-big-corporate-buyers-stand-benefit-technology>.
3. Nelson, JS et al. 2017. Sweetbridge White Paper. <https://sweetbridge.com/public/docs/Sweetbridge-Whitepaper.pdf>. Page 8.
4. *World Economic Forum*. 2015. Deep Shift: Technology Tipping Points and Societal Impact. Survey Report. http://www3.weforum.org/docs/WEF_GAC15_Technological_Tipping_Points_report_2015.pdf
5. Swan, M. 2017. "Anticipating the Economic Benefits of Blockchain." *Technology Innovation Management Review* 7(10): 6-13.
6. del Castillo, M. 2017. Illinois Launches Blockchain Pilot to Digitize Birth Certificates. <https://www.coindesk.com/illinois-launches-blockchain-pilot-digitize-birth-certificates/>.
7. Cuthbertson, A. 2017. Blockchain used to sell real estate for the first time. *Newsweek*. <http://www.newsweek.com/blockchain-sell-real-estate-first-time-ethereum-682982>.
8. Moreno-Sanchez, P, Modi, N., Songhela, R., Kate, A., Fahmy, S. 2017. *Mind Your Credit: Assessing the Health of the Ripple Credit Network*. arXiv preprint arXiv:1706.02358.
9. FCI. 2016. Global Factoring Volume reaches all time high. Facilitating Open Account – Receivables Finance. <https://fci.nl/en/news/global-factoring-volume-reaches-all-time-high-2015/3677>.
10. PR Newswire. 2013. Global Business Intelligence Market Report (2013-2018). <https://www.prnewswire.com/news-releases/global-business-intelligence-market-report-2013--2018-237338771.html>.
11. Bitcoin Exchange Guide. 2017. Balanc3 – ConsenSys Blockchain Accounting Software Tool Tokens? <https://bitcoindexchange.com/balanc3/>.
12. Moreno-Sanchez, P., Zafar, M.B., Kate, A. 2016. *Listening to whispers of ripple: Linking wallets and deanonimizing transactions in the ripple network*. *Proceedings on Privacy Enhancing Technologies*. (4): 436-453.
13. Lindsay, J. 2017. *Glider Labs Financial Transparency*. <https://blog.gliderlabs.com/glider-labs-financial-transparency-67631e51bad0>.
14. Y Combinator. 2017. IPFS, CoinList, and the Filecoin ICO with Juan Benet and Dalton Caldwell. <https://www.youtube.com/watch?v=iUVLUxjPAfg>.
15. Gleeson-White, J. 2013. Double Entry: How the Merchants of Venice Created Modern Finance. New York: W. W. Norton & Company.
16. Swan, M. 2016. *The Economist*: Finance Disrupted. <http://www.financedisrupted.com/melanie-swan/>.