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r3 Corda: a distributed ledger TECHNOLOGY for financial services

Michael R. King wrote this case solely to provide material for class discussion. The author does not intend to illustrate either effective or ineffective handling of a managerial situation. The author may have disguised certain names and other identifying information to protect confidentiality.

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In December 2016, David Rutter, founder and chief executive officer of R3, was preparing for an offsite meeting with his management team to discuss the future of his company. R3 was a blockchain technology company with headquarters in New York. The company was leading a network of over 100 banks, financial institutions, and technology companies to develop Corda, a distributed ledger technology (DLT) designed specifically for the financial services industry. Since founding R3 in 2014, Rutter had built up the start-up’s global team to comprise over 180 professionals in nine countries.

R3 had crossed many milestones in its brief history. A first milestone had been the strategic decision not to pursue the traditional Silicon Valley route of partnering with venture capitalists (VCs) but instead create a consortium with banks to collaboratively explore this new technology. A second milestone had been the decision to abandon existing DLTs and build an enterprise-grade blockchain from scratch called Corda. At the end of 2016, R3 was at another turning point. Rutter had to decide on a business model to monetize Corda without alienating R3’s bank members and other partners.

Founding of R3

By early 2012, Rutter had been the chief executive officer of British brokerage firm ICAP Plc’s electronic brokerage businesses for a decade, with responsibility for the fixed income platform Brokertec and the foreign exchange platform EBS. In this role, Rutter’s job had been to convince the banks to adopt new electronic trading platforms that disrupted their traditional voice brokerage business. In March 2012, Rutter had a disagreement on the direction of the business and left ICAP Plc to pursue other opportunities.

In early 2013, Rutter started two businesses: Liquidity Edge LLC and R3CEV (later renamed R3). Liquidity Edge LLC focused on developing an electronic trading platform for U.S. Treasuries. R3CEV was a vehicle for investing in technology ventures and consulting on electronic exchanges. Rutter recruited Jesse Edwards and Todd McDonald as partners for R3CEV where the R represented Rutter’s name, 3 was the number of partners, and CEV captured the focus on crypto, exchanges, and ventures. The term crypto describes the use of cryptography to secure digital assets such as the electronic money bitcoin. The three partners were fascinated by the emerging blockchain technology that underpinned bitcoin and other cryptocurrencies. In November 2016, the CEV initials were dropped and the company became simply R3 (see Exhibit 1).

Explorations in Silicon Valley

In early 2014, the R3 partners went to Palo Alto in California’s Silicon Valley to meet with bitcoin and blockchain startups and scout out potential investments. Rutter was amazed at the number of young and inexperienced entrepreneurs with a PowerPoint deck and shallow business plan who believed they could disrupt huge financial incumbents, such as the Depository Trust & Clearing Corporation, CLS Bank, and J.P. Morgan. Rutter saw that these entrepreneurs were “completely unaware of the crucial role these institutions play in global financial markets.”[[1]](#footnote-1) And yet, despite having no understanding of how Wall Street actually worked, these entrepreneurs were raising millions of dollars from Silicon Valley VCs at ridiculous valuations.

Having spent over half of his career introducing new technologies to the financial industry’s incumbents, Rutter was uniquely positioned to understand the promise of blockchain for solving a major pain point for financial market participants—namely, the clearing, settlement, and record keeping of financial assets. Clearing referred to the process of transmitting, reconciling, and confirming transactions prior to settlement. Settlement referred to a business process whereby securities were delivered in simultaneous exchange for payment of money. Rutter saw an opportunity to move this non-proprietary, back-office function out of individual banks and into the cloud, where the expense could be shared across firms and where cryptographic tools could be used to create trust among participants. Driving back from the meetings along California’s Highway 405, Rutter had an epiphany. He realized that “distributed ledgers could be to finance what the Internet was to media.” When he got back to New York, Rutter started calling his friends in the banks to pitch his vision of a shared, cryptographically-secured ledger. Given his experience and credibility, the bankers encouraged him to put together a business plan.

By the end of 2014, Rutter was a seed investor in several financial technology (fintech) start-ups, including Align Commerce (later renamed Veem), the first global payments platform to use blockchain technology, and Digital Asset Holdings, the DLT company headed by Blythe Masters. Rutter also thought that R3 should create its own solution. Realizing that they lacked the technical knowledge of blockchain, Rutter reached out to IBM’s Richard Gendal Brown after reading his online blogs. After six months of conversations, Rutter convinced Brown to join R3 as chief technology officer in late 2015. Rutter also hired James Carlyle and Mike Hearn as chief engineer and lead platform engineer, respectively (see Exhibit 2).

Creating the R3 Consortium

Rutter chose a creative approach to learn what the banks needed and what they were doing in-house. R3 hosted three roundtables to debate blockchain and its applications with bankers, VCs, technology companies, and other stakeholders. The first roundtable discussion was held in New York in September 2014, the second one in California in December 2014, and the third back in New York in May 2015. These eight-hour sessions were part-education, part-sales opportunity. As Rutter explained, the goal was “to deeply consider what the possible implications of the blockchain were, and what it could possibly do to save money, and time, and to create a better paradigm for the world of Wall Street and finance.”[[2]](#footnote-2)

These meetings led to wish lists of where blockchain could reduce back-office costs, covering everything from security issuance to clearing and settlement. A promising area was smart contracts, which were software programs that converted the terms of financial agreements into executable code secured on a blockchain. Smart contracts took the form of a decision tree: “If X, then Y.” The code executed without human intervention when the terms of the contract were met, such as receipt of payment against a security.

Having spent a career working with banks, Rutter knew that they were hard to convince on a new idea but quick to write a cheque once they got on board. The problem was that they liked to boss around their partners. Rutter also knew that a shared DLT would disrupt bank business models, so he anticipated disagreements along the way. He needed to maintain control and avoid giving any bank too much power. He also had to satisfy their lawyers who were concerned about antitrust and the perception of collusion.

Rutter spent 10 months putting together a complicated but innovative investment deal. R3 would create a joint venture (JV) with the banks to develop a blockchain solution. The banks would buy memberships at three price levels: $1 million, $2.5 million, and $5 million.[[3]](#footnote-3) The largest amount would come with a board seat and other special privileges. The banks would contribute staff to different working groups. Using the analogy of a gym membership, Rutter explained that the JV members would only get out what they put into it. In hindsight, Rutter realized that his smartest decision was *not to sell equity too early*, but to build a viable business first while maintaining control.

On September 15, 2015, R3 issued a press release announcing that nine leading global banks had formed a partnership to build a proprietary DLT for the global financial markets.[[4]](#footnote-4) Speaking to the *Wall Street Journal*, Rutter explained that the collaboration had three main goals.[[5]](#footnote-5) First, develop a platform that could handle the billions of dollars’ worth of transactions that occur in the financial industry. Second, build a sandbox for experimenting with blockchain and DLT tools. And third, learn from these experiments what worked and where the technology could best be used in financial services. By establishing standards and protocols for this emerging technology, they hoped to facilitate broader adoption and generate network effects. The closed-door strategy worked, by year-end 2015, 42 banks had joined the club, each paying up to $5 million for the privilege. In a stroke, Rutter had raised over $100 million and secured the best talent without giving up any equity.

Distributed Ledgers versus Blockchains

From the beginning, the R3 team faced confusion from its bank partners and other stakeholders about the difference between a blockchain and a distributed ledger. Even experienced bankers had little idea how the two concepts were related, and often incorrectly treated them as the same. This confusion arose because most people first heard about blockchain when also learning about bitcoin—the digital currency launched in 2009 that recorded transactions on a public, cryptographically-secured, distributed ledger.

Although the terms blockchain and distributed ledger were often used interchangeably, there were specific differences that made the bitcoin blockchain special. It was a permissionless distributed ledger where *unrelated transactions were batch processed into blocks and secured using cryptography*. Distributed ledgers could be public or private, permissioned or permissionless, encrypted or not. Adding to the confusion, “blockchain” rapidly became a generic term referring to all varieties of distributed ledgers with different properties (similar to the brand name Aspirin becoming a generic term for all headache medications). If a distributed ledger was a car, the blockchain was a Tesla. But not all cars were Teslas.

Centralized, Decentralized, and Distributed Ledgers

A ledger was an accounting term that referred to a record of the ownership of some asset. A cash ledger, for example, showed the amount of cash held by a company and recorded any increases and decreases. In financial markets, ledgers recorded ownership of financial assets, such as the number of shares issued by a company, the names of shareholders, and any transfers of ownership due to purchases or sales. Historically, ledgers were physical books (hence the term “bookkeeping”). Electronic (or digital) ledgers had become the norm with the rise of computers.

A ledger could be centralized, decentralized, or distributed. A centralized ledger was a single complete record of ownership and transactions for a given asset. The ledger was centralized because one true copy was held by a party who maintained it. The ledger verified legal title to an asset, such as a stock or a bond. Typically securities ledgers were entrusted to a third party such as a custodian or securities depository. The shortcoming of a centralized ledger was that it presented a single point of failure – it could be accidentally or maliciously altered, shut down, lost, or destroyed.

A decentralized ledger was a system (or network), where the ledger was broken up into parts held and updated in different locations. Decentralized ledgers needed to be aggregated to create a single, definitive record. For example, a department store chain could have many stores, with each keeping a ledger of its inventory at its location. The head office would then keep a centralized ledger, recording all inventories across these stores for use in accounting and planning. A decentralized ledger created more potential sources of error or points of failure. If any of the decentralized ledgers was inaccurate, the centralized ledger would be inaccurate by extension.

A distributed ledger was a *complete* record of ownership and transactions for a given asset, with multiple identical copies held in different locations. This duplication avoided the single point of failure. However, a distributed ledger needed to be synchronized frequently to ensure its accuracy and alignment across the network. If an entry differed across ledgers, the correct entry could be verified by using the values recorded by the majority of the ledgers. Synchronizing distributed ledgers held in physical books was complex and time-consuming. However, current computer algorithms could synchronize electronic ledgers instantly, economically, and securely without the need for a central bookkeeper. The software and protocols for recording, sharing, and synchronizing distributed ledgers were referred to generically as DLT.

A DLT, therefore, was a type of software called middleware. Middleware acted as a bridge between an operating system (OS) and databases, on one hand, and the applications built to provide functions for users on the other. These software systems were collectively called the “stack” with the OS and databases at the bottom, middleware in-between and applications at the top (see Exhibit 3). Middleware played a particularly important role when running distributed applications (dapps) on a network of computers. From the perspective of a bank, middleware connected easy-to-use graphical user interfaces with the legacy IT systems built in the 1970s and 1980s on mainframe computers using computer languages such as C++ and COBOL. As banks grew organically or through mergers, back-office functions became a hodgepodge of incompatible IT systems with databases siloed in different parts of the organization, making it difficult to get a centralized picture of a bank’s assets and earnings.

Security and Transparency of Ledgers

Two important features of ledgers were how they handled security and the degree of transparency. Security referred to whom had the ability to make changes to the ledger. A ledger was a legal record of ownership, so the level of security reflected the value of the assets and the degree of trust among participants. On a permissioned ledger, participants needed authority to make changes to the ledger. On a permissionless ledger, any participant (or node on a network) could change or update the ledger.

A ledger could have different transparency levels, from public and fully transparent with the contents visible to anyone, to private and closed to the public. Typically, some participants were certified as trusted counterparties (or nodes) and were able to make changes. However, the participants needed to agree to a set of consensus protocols to avoid accidental or malicious alterations. To use a real estate example, municipal records of land titles were public and transparent, but only the land registry office was authorized to make changes to the ownership records.

Most ledgers used for business (i.e., enterprise ledgers) recorded commercially sensitive information that was private. Transactions were recorded privately by a trusted intermediary who maintained the ledger. An example was share ownership records that were used for voting and the distribution of dividends. The shareholders and changes in their holdings were not broadcast publicly. Transactions were only known to the trading counterparties and a depositary institution was delegated authority to modify the corporation’s share ledger.

The Financial Industry’s Shared Pain Point

The main pain point facing banks and other investors was the expensive and time-consuming process of clearing, settlement, and record keeping when trading financial assets. A financial asset could be one of many tradeable instruments that conferred some future economic claim to the owner. Stocks and corporate bonds, for example, were contracts issued by a corporation that entitled the holder to a claim on the corporation’s assets and cash flows. Other financial assets were foreign exchange (or currencies), money market instruments, fixed income securities, property, commodities, and related derivative securities.

Over time, each financial asset had developed its own trading rules, clearing and settlement procedures with some shared conventions but many idiosyncratic characteristics. Some financial assets were traded on exchanges in standardized amounts with the exchange acting as an intermediary between the counterparties. But the majority of financial assets were bought and sold in the over-the-counter (OTC) market directly between counterparties. OTC trades were unstandardized, with no intermediary between the buyer and seller. To complicate matters further, many financial assets were traded cross-border, denominated in different currencies, and with different regulatory and compliance requirements.

Clearing and settlement was the complex process of transferring ownership of a financial asset from one holder to another. Because counterparties did not trust each other, they had to agree on the terms of each trade, sign documentation, and complete delivery versus payment on an agreed settlement date. Some trades were agreed verbally and processed manually, leading to human error and failures to settle. This problem was so pervasive that it had a special name: settlement risk—the risk that a counterparty failed to deliver a security or transfer payment by the settlement date.

Financial market participants spent billions of dollars each year on this complex and time-consuming process. The consultancy Santander InnoVentures estimated that the application of DLT could reduce banks’ infrastructure costs attributable to cross-border payments, securities trading, and regulatory compliance by between $15 billion and $20 billion per year by 2022.[[6]](#footnote-6) According to Capgemini, maintaining legacy IT systems consumed 90 per cent of bank technology budgets, with the 10 largest investment banks employing two middle- or back-office staff for every front-office staff member.[[7]](#footnote-7) Capgemini estimated that automating these processes could reduce back-office costs by 30 per cent annually. These savings were enormous.

Rutter’s goal was to solve this massive industry pain point. He convinced R3’s member banks that it made better economic sense to pool their resources and to collectively develop an encrypted distributed ledger in the cloud for this back-office process, rather than each bank struggling individually through a long, painful and expensive process to develop its own technological solution. After all, trading was a network problem. Therefore, for the trade to be effective, any solution had to be adopted by both counterparties.

Experiments with existing blockchains

Having identified the pain-points and the functional requirements of the member banks, R3 and its partners set about finding a solution. Being a pragmatic business man, Rutter only cared about solving the problem and was agnostic about the technology to do it. Guided by the mantra “adopt, adapt, or build,” Rutter divided the JV members’ staff into two working groups that began sprinting as fast as they could to find a solution. The first working group, known as the Lab and Research Centre (LRC), was based out of New York. Its mandate was to test existing DLTs and blockchains to see if they could be adopted and adapted to meet the banks’ technical requirements. The second working group, known as the Architecture Working Group (AWG), was based out of London, U.K., and began building a new DLT from scratch.

Project Genesis

Between January 19 and February 29, 2016, the LRC ran a trial project code-named Project Genesis, with 42 member banks. The group simulated the issuance, trading, and redemption of commercial paper (CP)[[8]](#footnote-8) on a variety of blockchains.Project Genesis evaluated the strengths and weaknesses of five vendors: Chain, Eris Industries, Ethereum, IBM Hyperledger, and Intel Sawtooth. CP was chosen as the first use-case due to its relative simplicity, allowing a better comparison of the five solutions.

Project Genesis simulated both bilateral trades between two counterparties and multilateral trades between multiple counterparties. The simulation covered four scenarios in the CP lifecycle: the issuer created (or issued) the CP; the issuer sold the CP to a securities dealer; the dealer sold the CP to a trader; and the issuer redeemed the CP to a dealer or a trader. Each of these transactions were recorded on distributed ledgers hosted on cloud computing services provided by Microsoft Azure, IBM Cloud, and Amazon AWS. Project Genesis’s ledgers were permissioned, private and encrypted. Smart contracts updated the ledger when specific events occurred. By using smart contracts on a permissioned distributed ledger, Project Genesis avoided the time-consuming and expensive proof-of-work consensus protocol used by bitcoin and many cryptocurrencies.

Project Genesis provided five valuable insights. First, it demonstrated how DLT could be applied to real-world, financial market processes. Second, as the project unfolded, it became apparent that banks had widely varying expertise and experience with DLT solutions. Project Genesis allowed the participants to share knowledge and insights on the strengths and weaknesses of each of the five blockchain solutions. Third, Project Genesis demonstrated that it was possible, with the right structure and governance, for banks and other partners to collaborate on the development of a shared distributed ledger.

The fourth insight was that R3’s members were not looking for proprietary solutions but rather an open-source industry standard that included opportunities for hands-on development, code review, and testing. Banks were risk-adverse, particularly when it came to risk management, compliance, regulation, and IT systems. Being able to review and modify the code to meet their specific requirements was critical for R3 members. Open source had the advantage of code accessibility, familiarity, and as a result, potentially quicker adoption as an industry standard.

Finally, Project Genesis demonstrated that none of the five blockchains was enterprise-grade or near-production, despite being considered the most advanced. There was clearly an unmet market need. Rutter made the decision to put all of R3’s resources into developing a financial services blockchain from scratch.

A Distributed ledger For Financial Services

Starting in mid-September 2015, R3’s chief technology officer Brown led the AWG as it began putting ideas on a white board for an enterprise-grade blockchain. Brown understood from the start that the bitcoin blockchain would be inappropriate for financial markets, both from a processing capacity and from a transparency point of view. The bitcoin blockchain was permissionless and consensus-based, with costly proof-of-work, slow verification of transactions, and low throughput due to the restriction on the block size. Because it was built to be fully transparent, every node on the bitcoin network saw and received all transactions distributed across the system. This full transparency was anathema to financial market participants, who wanted their transactions and holdings to be private. The bitcoin blockchain was also a self-contained system that recorded transactions in only one asset: bitcoin. It was not interoperable with other blockchain networks. For these reasons, Brown realized that simply “forking” or cloning the bitcoin blockchain was a non-starter.

The AWG began the arduous process of detailing the regulatory requirements that financial institutions had to comply with when managing post-trade processes. To be successful, their blockchain would need to meet three main goals. First, it had to provide an immutable (i.e. unable to be changed) record of past transactions. Second, it had to combine cryptography and smart contracts with features such as privacy and interoperability, which were standard in financial markets. Third, it had to satisfy the risk and compliance requirements demanded in the highly-regulated, financial services industry. Brown explained: “The reality is that solutions based on selecting the design first and then trying to apply it to arbitrary problems never work out well. Every successful project I’ve worked on started with the requirements, not some cool piece of technology, and I was determined to bring that discipline into our work at R3.”[[9]](#footnote-9)

The Problem of Untrusting Nodes

A key problem was how to tackle the *lack of trust* among financial counterparties. This lack of trust was the source of most of the costs and difficulties with post-trade processes. Counterparties kept their own internal ledgers that needed to be reconciled after every trade. When the records did not match, back-office staff from both sides needed to reach agreement. Because one side’s profit often came at the other’s expense, this process was inherently contentious and counterparties invariably disagreed. If these disputes escalated, lawyers and the courts might get involved, making the process expensive, time-consuming, and frustrating for everyone involved.

One solution was to pay a trusted intermediary to maintain a centralized ledger and to verify transactions between counterparties. In securities markets, this entity might be a central securities depositary, such as the U.S. Depository Trust Company. But a trusted intermediary was expensive and still did not solve all post-trade processing problems.

R3’s solution was to design a distributed ledger to reflect the fact that counterparties did not trust each other, which Brown referred to as the problem of untrusting nodes. As he explained, “Distributed ledgers are systems that enable parties who don’t fully trust each other to form and maintain consensus about the existence, status, and evolution of a set of shared facts.”[[10]](#footnote-10) Nodes on R3’s distributed ledger would need to independently verify data they received from each other and only share data they were happy to broadly share.

The Solution: R3 Corda

By March 2016, the AWG had developed a new DLT called Corda. Corda was not a traditional blockchain. It did not bundle transactions in blocks but instead validated each transaction individually, speeding up the processing time. Corda was a permissioned distributed ledger. No wasteful mining was required to reach consensus on transactions; instead trusted intermediaries (called *notaries*) verified transactions. The ledger was immutable and encrypted. Corda was private with no unnecessary sharing of data; only the counterparties to a trade were sent the data. Consensus occurred between counterparties, not between all participants.

Corda featured smart contracts, with an explicit link between human-language legal documents and the smart contract code. Smart contracts allowed settlement to occur directly on the ledger without the need for human intermediaries. Corda’s design allowed regulators to use see transactions and verify compliance. Corda was interoperable with other networks, and could be integrated with private business networks. Finally, Corda did not require a native cryptocurrency or crypto-token to operate.

On April 5, 2016, Brown published a non-technical Corda white paper accompanied by a simple description on his R3 blog.[[11]](#footnote-11) His light-hearted explanation of “The Corda Way of Thinking” illustrated Corda using a bet between two people on whether it will rain on a given day. The bet relied on physical letters, signatures, filing cabinets, the newspaper, and the postal service, with each one corresponding to a feature in Corda (see Exhibit 4).[[12]](#footnote-12)

Making A Decision

By the fall of 2016, R3 had launched the first version of Corda – a blockchain built to meet the demanding security, privacy, scalability, reliability, and throughput requirements of the regulated financial services industry. But two problems still remained. First, Rutter had to decide how best to charge for this product. After the business model was decided, the second issue was how best to finance the future growth of R3. Should he continue with the membership model, sell equity in R3 privately, or take the company public through an initial public offering?

Rutter saw at least three possibilities for monetizing Corda.

* One option was to follow the traditional software product strategy (such as Microsoft) or software-as-a-service strategy (SAAS). In this business model, R3 would sell or license the Corda as a plug-and-play middleware software solution.
* A second option was to go further and pursue a full-stack, vertically-integrated strategy. R3 would provide an end-to-end back-office solution for its customers, developing top-of-stack distributed applications (dapps) and a bottom-of-stack operating system and database, with Corda running as middleware.
* A third option was to pursue a platform-as-a-service strategy built around Corda where R3 would build a technology ecosystem involving 3rd party developers, consultants and other suppliers interacting with banks, insurance companies, and other financial institutions.

All three business models had the potential to generate revenues but they had different implications for costs, staffing, and relationships with R3’s members and partners (see Exhibit 5). Rutter knew this decision would be contentious. Some of R3’s bank members favoured a proprietary solution; others were concerned that R3 might become a direct competitor. Holding the consortium together as Corda was developed had been a difficult balancing act. Rutter realized that this decision could easily open divisions among R3’s members, causing the joint venture to fall apart. Any appearance of dissent or conflict would also jeopardize plans to raise capital, possibly through a private or public sale of equity. Deep in thought, he walked into the management offsite.

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Exhibit 1: R3 Timeline, 2012 to 2016

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| **Date** | **Event** |
| 2012 | David Rutter leaves ICAP Plc, where he was head of electronic brokerage. |
| January 2013 | Rutter founds R3CEV (later renamed R3), a blockchain technology solutions group, with Jesse Edwards and Todd McDonald as the first two hires. |
| January 2014 | R3 founders meet with bitcoin and blockchain companies in Palo Alto, California, with the purpose of finding ventures to invest in. They instead decide to create their own company. |
| September to December 2014 | R3 organizes round-table talks with banks in New York and San Francisco. |
| September 15, 2015 | R3 announces the formation of a partnership to design and deliver advanced distributed ledger technologies to global financial markets with nine banks: Barclays, BBVA, Commonwealth Bank of Australia, Credit Suisse, Goldman Sachs, J.P. Morgan, State Street, Royal Bank of Scotland, and UBS. |
| September 29, 2015 | An additional 13 banks join the R3 consortium. |
| December 31, 2015 | The R3 consortium reaches a total of 42 banks and closes membership for the next 12 months. |
| January 20, 2016 | R3 and 12 member banks execute transactions on a global distributed ledger using Ethereum tools running on Microsoft’s Azure cloud. |
| January to February 2016 | R3 and 40 banks strike Project Genesis to simulate the issuing, trading, and redemption of commercial paper via blockchain technology. The tests trial five distributed ledgers built by technology providers Chain, Eris Industries, Ethereum, IBM, and Intel. |
| June 16, 2016 | R3, Payments Canada, the Bank of Canada, and Canada’s five largest banks complete tests of the viability of Ethereum as the basis for wholesale interbank payment settlements (Project Jasper, Phase 1). |
| July 13, 2016 | R3, Barclays, ISDA, Norton Rose Fullbright, and UCL collaborate to address the challenges of developing master templates for smart contracts. |
| August 10, 2016 | R3 and over 15 banks trial smart contracts for invoice financing and letter of credit transactions for international trade. |
| August 24, 2016 | The first non-technical Corda white paper is released. |

Source: Company documents.

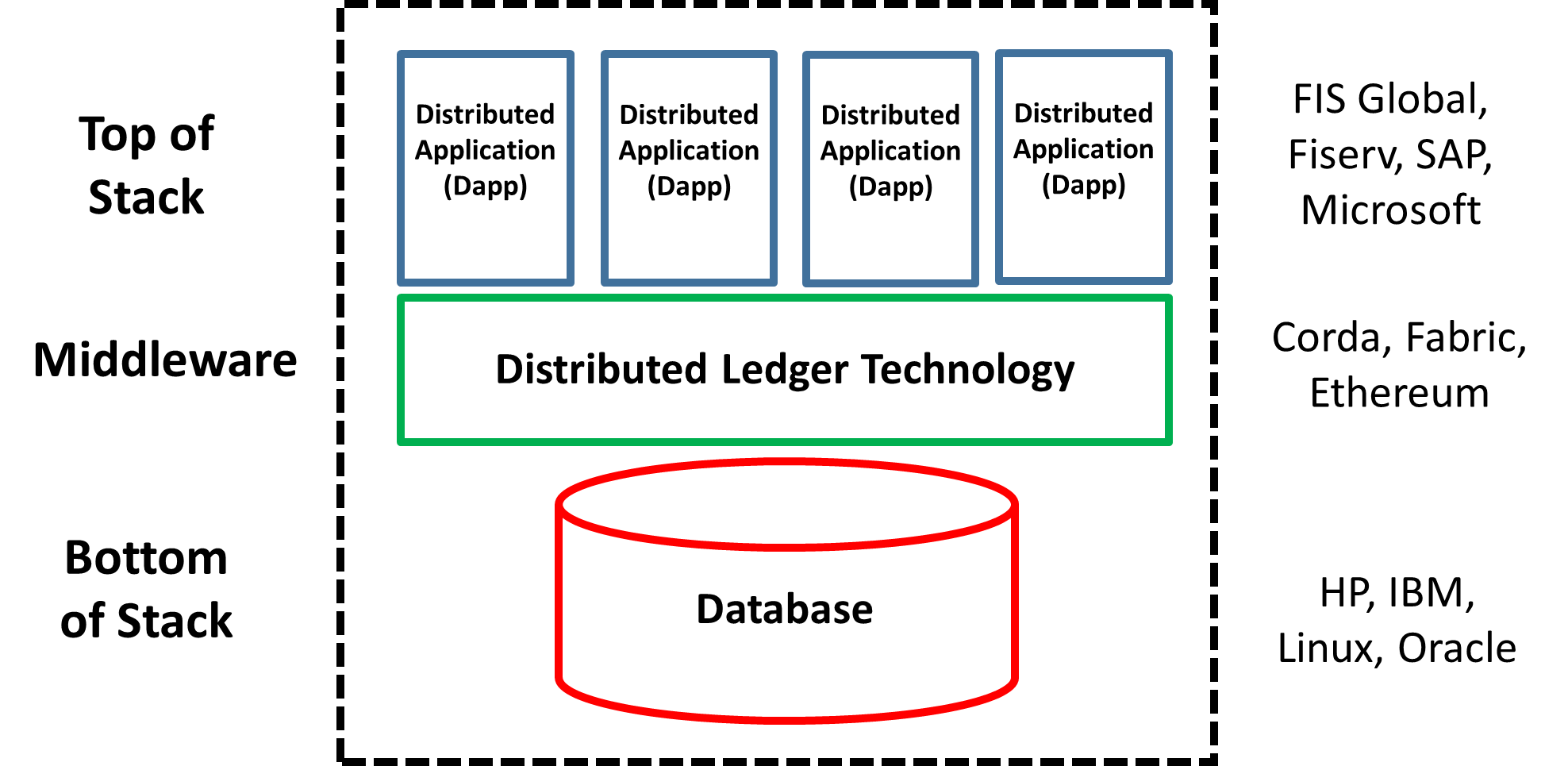
Exhibit 2: R3 Management Team

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| **David E. Rutter: Founder, Chief Executive Officer**  With over 30 years of experience leading some of Wall Street’s top institutions, David Rutter is a long-time creative thought leader in financial markets and innovation and has played a significant role in the adoption of electronic trading in the global over-the-counter derivatives industry. Rutter served for 10 years as the chief executive officer (CEO) of electronic brokerage at ICAP Plc, the world’s largest interdealer brokerage firm, where he led the Brokertec fixed income platform and the EBS foreign exchange platform. Prior to ICAP Plc, Rutter was co-owner and CEO (Americas) of Prebon Yamane. |
| **Todd McDonald: Co-Founder, Head of Partnerships**  Todd McDonald is a co-founder of R3 and head of ecosystem development. McDonald focuses on building the partner application ecosystem for R3’s Corda platform. Prior to R3, McDonald spent 14 years at Standard Chartered Bank as a managing director in the financial markets group, where he held positions such as global head of electronic foreign exchange (FX) trading and head of FX for the Americas. McDonald holds a bachelor of arts degree in economics and political science from Colgate University. |
| **Jesse Edwards: Co-Founder, Head of Corporate Development**  Jesse Edwards is a co-founder of R3 and serves as the firm’s executive vice-president and head of corporate development. Edwards helps lead execution of the firm’s strategic vision and directs investments and partnerships. Prior to founding R3, Edwards was an investment banker at Sandler O’Neill & Partners and more recently at AGC Partners, where he advised large global financial institutions and financial technology companies. Edwards holds a bachelor of science degree and an MBA from Cornell University. |
| **Richard Gendal Brown: Chief Technology Officer**  Richard Brown is the chief technology officer at R3 and is one of the world’s leading authorities on distributed ledger systems and architectures. Previously, Brown was the executive architect for banking and financial markets industry innovation at IBM United Kingdom. His previous roles with the company, for whom he worked for almost 15 years, included lead account architect for a global investment banking client and a consultant for IBM software products. Brown is a chartered engineer and holds an MBA with distinction from Warwick Business School and a first-class degree in mathematics from Trinity College, Cambridge. |
| **James Carlyle: Chief Engineer**  James Carlyle is focused on defining a candidate architecture and building out a collaborative lab for experimentation by network members. Previously, Carlyle was chief engineer within corporate banking at Barclays, where he designed and delivered the bank’s corporate Internet channel and the bank’s US banking and dollar clearing platforms. Before Barclays, Carlyle co-founded two start-ups. He holds patents in mobile data search and directory technology. He is a chartered engineer and holds a degree in engineering science from University College, Durham. |
| **Mike Hearn: Lead Platform Engineer**  Mike Hearn is lead platform engineer at R3. He has over five years of experience with bitcoin, blockchain, and distributed ledger systems. He spent nearly eight years at Google, where he was a senior software engineer. Hearn was one of the world’s first developers of software for the bitcoin platform, including its smart contract capabilities. He developed the world’s most popular bitcoin wallet software. |

Source: Company documents.

Exhibit 3: Illustration of software stack

This figure illustrates a stylized software stack for a bank. At the bottom of the stack sits the computer operating system and databases. At the top of the stack are distributed applications run by users throughout the organization. The middleware is the software that acts as a bridge between the operating system and databases at the bottom and the distributed applications at the top. Collectively, all three levels are known as the full stack. Bank applications were historically developed by Fidelity National Information Services Inc. (FIS) Global, Fiserv Inc. (Fiserv), Microsoft Corporation, and SAP SE (SAP). Mainframe operating systems were developed by Hewlett-Packard (HP), IBM, and Linux.org (Linux) with database software provided by Oracle Corporation and International Business Machines Corporation (IBM), among others. Examples of distributed ledger technology (DLT) middleware were R3 Corda, Hyperledger Fabric, and Ethereum.



Note: Fidelity National Information Services Inc. (FIS) Global, Fiserv Inc., SAP SE (SAP), Microsoft Corporation, Hewlett-Packard (HP), International Business Machines Corporation (IBM), Linux.org, and Oracle Corporation.,

Source: Created by case author based on case information.

Exhibit 4: Corda Key Concepts—The Weather Bet Analogy

Richard Brown, R3’s chief technology officer, used the following analogy to explain Corda:

Imagine that two friends, Richard and Albert, make a bet that it will rain next Wednesday. If it does, Albert owes Richard $10. Otherwise, Richard owes Albert. They agree on the rules: the winner will be decided by looking at the weather report in a specific newspaper next Thursday. They write out the bet on a piece of paper, and both sides keep a signed photocopy in their filing cabinets. On Thursday, the newspaper reports that it rained the previous day so Albert wins the bet. Albert mails the newspaper weather report with a signed letter to Richard asking for payment of $10. Albert’s letter is delivered by postal service to Richard’s address.

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| --- | --- | --- | --- |
| **Analogy** | **Responsibility** | **Corda Component** | **Digital Ledger Technology Role** |
| Bet written on a sheet of paper | Represents contract or deal | State object | Stores smart contract with references to legal prose (i.e., the “rulebook”) |
| Filing cabinet | Keeps track of papers | Vault | Stores state objects |
| Rulebook | Provides rules that govern the bet | Contract Code | Provides verifications and rules that govern the state object’s evolution |
| Newspaper weather report | Provides weather on day of bet | Oracle | Third-party trusted data source referenced for specific deal |
| Cover letter sent with newspaper report | One party updating the other party on the outcome of the bet, with evidence attached | Transactions | Method of evolving the state objects as governed by contract code |
| Signature | Proof that the letter really did come from who it claims to be from | Signature (digital) | Proof that a transaction was really done by who claims to have done the transaction (i.e., prevents repudiation) |
| Postal service | Ensures that letters are sent to the correct parties and delivered reliably | Network Map Service &  Point-to-Point Messaging Network | Provides a reliable way of ensuring that transactions are delivered to precisely the right parties and nobody else |

Source: Company documents.

Exhibit 5: Different Business Models to Monetize Corda

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| --- |
| **Software-as-a-Service Strategy**  The first option is to follow a traditional software product strategy (such as a Microsoft’s model) or software-as-a-service strategy (SAAS). R3 could sell or license Corda as a digital ledger technology (DLT) solution for banks and institutional investors. Customers that buy Corda would need to integrate it into their information technology (IT) systems, replacing their back-office processes with Corda’s state-of-the-art, cryptographically-secure ledger, which can be connected with their trading counterparties. Much like Microsoft, who sells an operating system but does not build the computer, R3 would focus on developing the best DLT on the market but not on building or configuring the hardware. In addition to revenues from software sales and licensing, R3 would earn additional revenues from customer support, training, and customization of the product. And as Corda’s software is improved, R3 can sell or licence the latest release, creating a recurring revenue stream. |
| **Full-Stack, Vertically-Integrated Strategy**  The second option is to go further and pursue a full-stack, vertically-integrated strategy, where R3 provides an end-to-end DLT solution for its customers. This full-stack approach allows R3 to bypass incumbents who provide back-office services (such as depositaries and clearing houses) and deal directly with the end customer. A good example is Apple’s strategy for its desktop computer, the popular Apple Macintosh series. Apple manufactures the computer, develops the operating system (i.e., Mac OS) and software applications (e.g., Apple Mail, iPhoto, iTunes, and Safari), and controls the distribution and support (through Apple stores). By controlling the end-to-end customer experience and the value-chain, R3 would capture a greater portion of Corda’s economic value. |
| **Platform-as-a-Service Strategy**  The third option is to pursue a platform-as-a-service strategy built around Corda. Under this business model, which some call technology ecosystem, R3 would give away the proprietary Corda software to encourage adoption, much like Google did with the Android operating system. R3 would seek to establish Corda as the industry standard DLT and build network effects around a community of users. For this to happen, Corda’s software would need to be open-source and available free to download, encouraging a community of third-party developers and IT experts to modify it to meet their customers’ needs. R3 would monetize the Corda platform by selling add-ons such as technical support, training, reporting, middleware, storage, testing, and other services. R3 could also sell a more sophisticated version of Corda that contains more features. |

Source: Case writer.

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