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Fluidity: The Tokenization of Real Estate Assets

In December 2018, Maggie Hsu (MBA 2012) contemplated the next steps for blockchain startup Fluidity, where she headed business development. Through a process called tokenization—which attached fractional asset ownership rights to units of a digital counter, or token—Fluidity applied blockchain tools to digitize the purchase and sale of physical assets. Proof of concept would occur in January 2019, the closing date on a tokenized offering of approximately \$25 million in debt and preferred equity in Thirteen East+West, a 12-unit Manhattan condominium complex not far from Fluidity’s Brooklyn headquarters.

Not only had Fluidity developed the means to tokenize security issuance, it had also built AirSwap, a peer-to-peer (P2P) network for trading digital tokens—live since April 2018—that provided the underlying technology for secondary trading in Thirteen East+West tokens. In combination, Fluidity had created a way for investors to gain access to direct ownership in the massive but historically illiquid commercial real estate (CRE) market, and to exit that market at the time of their choosing without precipitating the property’s sale (which developers sought to avoid). As Fluidity co-founder Michael Oved explained, “[...]the real estate industry [is] probably one of the most inefficient industries that exists currently, with a lot of middlemen, a lot of lawyers, a lot of bankers. Just being able to create something that has real impact on an industry like that, [...] you are looking at significant disruption.”¹

Thirteen East+West marked only the beginning of Hsu’s work, however. The critical need was to spur adoption of Fluidity’s services. This meant expanding the number of properties whose capitalization Fluidity tokenized. A large pool of tokenized properties could attract investors, who would in turn build demand for new CRE property tokenization and increase the trading liquidity for existing tokenized assets. This could also potentially create multiple fee-based revenue streams for Fluidity—from developers for tokenization, from issuers for servicing and managing the tokens, and from token trading in the secondary market. Hsu and her colleagues needed to decide whether to involve Fluidity directly in some or all of these activities, or to focus on its proven strengths in software development for blockchain applications, and to rely on Hsu and her team to develop partnerships with financiers,^a realtors, or others with pools of illiquid assets—whether CRE, fine art, or timberland.

^a As a technology company, Fluidity was not licensed to issue securities; for this purpose it partnered with the broker-dealer Propellr on the Thirteen East+West deal.

Professor Marco Di Maggio and Senior Case Researcher David Lane and Case Researcher Susie Ma (Case Research & Writing Group) prepared this case. It was reviewed and approved before publication by a company designate. Funding for the development of this case was provided by Harvard Business School and not by the company. HBS cases are developed solely as the basis for class discussion. Cases are not intended to serve as endorsements, sources of primary data, or illustrations of effective or ineffective management.

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Blockchain Technology

A blockchain was a decentralized digital ledger of information, akin to a database, consisting of digital records, or “blocks” of information, each of which recorded, time-stamped, and validated data and were irreversibly “chained” together in chronological order. Each new block contained a piece of information from the previous block to help protect the blockchain from tampering.² Blockchains could store any kind of data, whether transactions or a set of instructions.³

Blockchains’ decentralized distribution was an essential feature. By making all information on a blockchain available to each user,⁴ any alteration to that blockchain’s content became prohibitively difficult. Each user held and updated a copy of the full blockchain, guaranteeing access to complete and consistent information. The network of individual computers that maintained the blockchain also shared responsibility for validating its data.⁵ Users could be compensated for this by being issued digital currency that was convertible to fiat money (physical currency) or other resources.⁶ Blockchain advocates believed the technology had disruptive potential because it offered peer-to-peer interaction without the costs or constraints that real world intermediaries and central authorities could impose.

As a ledger, blockchains recorded transactions, notably including transfers and exchanges of their digital currencies. This allowed users to transact and exchange funds directly on the blockchain (“on-chain”) rather than through a bank or other third party.⁷ To send digital money on a blockchain network, a user created a transaction on her computer, attached the digital address of the recipient, and sent it to the other computers in the blockchain network to verify. After securing verification, the network collectively updated the ledger with the transaction details.⁸

Bitcoin and Ether

In 2009, Satoshi Nakamoto (a pseudonym) introduced Bitcoin as the world’s first application of blockchain technology.⁹ Bitcoin was both a name for the blockchain platform and the digital currency in use there, which succeeded not least because it effectively prevented anyone from spending a given digital coin more than once. Like tokens, bitcoins^b had no physical presence and could be sent electronically between people anywhere in the world by recording the transfer on the Bitcoin platform. All users needed was a digital wallet and their counterparty’s digital address.¹⁰

Inspired by Bitcoin, 21 year-old Vitalik Buterin created the Ethereum blockchain in 2015, along with ether (ETH) as its currency.¹¹ Ethereum became popular because its architecture encouraged the creation and use of “smart contracts” – software triggered to run on top of the blockchain when certain conditions were met.¹² For example, a smart contract could replace a real world escrow service when programmed to hold purchase funds until deal terms were met.¹³ Anyone could build a program on top of Ethereum’s network, just as anyone could build a website to run on the Internet.¹⁴ Developers began building applications and services atop Ethereum and other blockchains, much as they had built software layers upon an underlying computer operating system (see **Exhibit 1**).

Blockchain transactions were verified through a process called mining, in which computers raced against each other to solve complicated math puzzles. The first computer to solve the puzzle attached the latest block to the chain, thereby validating the information it recorded.¹⁵ Miners were rewarded with the platform’s digital currency, such as bitcoins or ether.¹⁶ The mining process required a great deal of computing and electric power. Because each new block lengthened the chain, recording and validating transactions would require increasing computing power over time, creating inefficiency and

^b Lower-case letters distinguished a digital token from the blockchain on which it functioned.

limiting scalability.¹⁷ As of May 2018, miners on the Bitcoin blockchain created a new block every 10 minutes, collectively consuming 2.6 gigawatts of power annually (approaching the power consumption of Ireland).¹⁸ Even so, as of August 2018, Bitcoin could process seven transactions per second to Ethereum's 20.¹⁹ By comparison, the credit card network Visa could process 24,000 payments per second.²⁰

Tokens and ICOs

Bitcoins were used to transfer value on the Bitcoin network.²¹ Ether was used to run programs on the Ethereum network.²² Both were example of crypto-, or digital, currencies.²³ Like their real world analogs, digital currencies and coins were a form of money – they served as an accounting unit and a medium for transferring stored value.²⁴ However, while the blockchain terms “tokens” and “coins” were often used interchangeably, tokens had more varied functionality than coins.²⁵

For example, *utility tokens* conferred a fractional usage right to the blockchain on which they functioned, akin to a membership fee.²⁶ Filecoin, for instance, offered decentralized storage on the blockchain. Individuals wishing to access this service were expected to pay with utility tokens that Filecoin had issued.²⁷ The nominal descriptor “utility” initially excluded such tokens from national securities regulations. Starting in 2013, however, programmers started to raise money to fund blockchain project development by issuing their own tokens and selling them to the public in Initial Coin Offerings (ICOs). ICOs resembled crowdfunding because, unlike an initial public offering (IPO) of corporate equity, ICOs allowed companies to raise money from the general public without giving up an ownership stake.²⁸ In 2014, Ethereum ran one of the first ICOs, using tokens built on its ERC-20 standard, and raised \$18 million to support its development.²⁹

In 2017, the ICO market exploded: developers raised \$7 billion through 552 ICOs.³⁰ In 2018, the number and funds raised through ICOs doubled and tripled, respectively: through mid-December, 1,004 ICOs raised a total of \$20.6 billion.³¹ (Exhibit 2 lists ICOs between 2016 and November 2018.) Little regulatory oversight existed, however, and few ICOs included the anti-money laundering (AML)^c or know-your-customer (KYC)^d provisions that banks typically maintained. As a result, some companies conducting ICOs had no working product; others were exposed as scams.³²

The U.S. Securities and Exchange Commission (SEC) urged investors to be cautious about ICOs and warned that it regarded some utility tokens as securities subject to the disclosure and registration requirements that had so far been avoided.³³ In 2018, the SEC chairman claimed, “Every ICO I’ve seen is a security.”³⁴ At the time, however, little regulatory clarity existed around tokens and ICOs. National rules differed too. Countries including the United Kingdom gave pre-approved blockchain projects permission to play in a “regulatory sandbox.” Others, such as China, banned ICOs outright.³⁵

Blockchain companies therefore began to distinguish between utility tokens conferring usage rights and *security* tokens that represented ownership rights in a real-world asset.³⁶ As such, security tokens were subject to national securities regulation because their value derived from that of a physical asset, such as shares of a company's stock.³⁷ (Exhibit 3 shows existing and expected security token ICOs as

^c Anti-Money Laundering (AML) was a set of U.S. policies designed to help detect and prevent money laundering in support of activities such as terrorist financing, trade of illegal goods, and securities fraud. (Source: FINRA, “Anti-Money Laundering (AML),” 2018, <http://www.finra.org/industry/anti-money-laundering>, accessed November 2018)

^d Know Your Customer (KYC) was a U.S. regulation requiring companies and financial institutions to identify their customers with the goal of preventing money laundering. (Source: Iza Wojciechowska, “What Is KYC and Why Does It Matter?” Fin (Plaid), April 11, 2018, <https://fin.plaid.com/articles/kyc-basics>, accessed November 2018.)

of mid-December 2018.) Their target market was typically also narrowed to accredited investors—individuals with incomes exceeding \$200,000 or net worth exceeding \$1 million, and organizations with assets exceeding \$5 million.^e

Tokenization converted a physical asset into a digital form that could be represented on a blockchain,³⁸ moved proof of ownership from paper to digital form, and could divide asset ownership equally into any given number of tokens. An industry player noted: “With this model, any fund (be it, hedge fund, private equity or venture capital) can offer liquidity. Also, any asset can comfortably offer partial ownership, full ownership or [a share of] revenue.”³⁹

One observer believed that liquidity would drive tokenization of traditional assets because tokenization allowed ownership rights to even unusually large and expensive assets to be divided into many pieces that were less costly to invest in and trade.⁴⁰ “One day you might be able to buy \$10 of a single commercial real estate asset like the Empire State Building, or invest \$100 in the development of a LEED-certified housing project,” he said.⁴¹ Because investors could convert tokens to fiat currency in the secondary market, asset tokenization promised greater flexibility and liquidity at lower cost than other investment vehicles focused on illiquid assets such as private equity funds, for example, which typically locked up investor funds for five to 10 years.

Digital Exchanges

The proliferation of digital tokens and coins quickly led developers to create digital exchanges to buy, sell, or trade them. Exchanges chose which tokens could be traded on their platforms, and came in two types, centralized and decentralized. Centralized exchanges, such as Coinbase, included an operator paid via transaction fees that acted as bank, broker, and clearing agent.⁴² In most cases, users traded on centralized exchange that managed all private keys to the users’ digital wallets.⁴³ This created a focal point for thieves seeking to access digital wallets, however: in the first half of 2018 alone, hackers stole the equivalent of \$731 million in digital currency from wallets linked to centralized exchanges.⁴⁴ Observers also noted the irony of a central authority controlling access to a decentralized technology.⁴⁵

In contrast, decentralized exchanges (DEXs) such as AirSwap relied on P2P transacting, in which users retained control over access to their digital wallets and, via smart contracts, traded directly with others offering a desired bid or asking price.⁴⁶ Unlike centralized exchanges, however, most DEXs traded only in digital currencies and did not convert digital currencies to fiat money.⁴⁷ While DEXs were growing in number as a share of the over 170 live exchanges, centralized exchanges transacted all but 1% of the \$31.4 billion in digital currency traded on January 1, 2018.⁴⁸ (**Exhibit 4** lists selected live and planned decentralized exchanges as of January 2018. **Exhibit 5** summarizes trading activity on the top 10 DEXs during the first two trading weeks of July 2018.)

Fluidity

The idea behind AirSwap, which would become Fluidity’s first product, emerged from a chance meeting. While attending Further Future, a music festival, to celebrate and recharge after the April 2015 IPO of his algorithmic trading firm, Virtu Financial, Oved met Ethereum co-founder Joe Lubin. They bonded over the disruptive potential of blockchain technology.

^e The SEC used this threshold as a proxy for investor sophistication, permitting accredited investors to purchase securities that were not registered with the SEC, including private placements and limited partnerships in private equity, venture capital, and hedge funds. (Source: “Accredited Investor,” Investopedia, <https://www.investopedia.com/terms/a/accreditedinvestor.asp>, accessed November 2018.)

Oved had spent seven years at Virtu Financial, expanding the business to Europe and Asia and rising to partner. Financial trading traditionally consisted of order matching on a physical or electronic platform, and the subsequent clearing and settlement of each transaction. While Virtu Financial provided price quotations, market making, and trading services across diverse asset classes to facilitate rapid-fire order matching, the subsequent clearing and settlement activities could take as long as a week, and involved intermediaries including banks, brokers, clearinghouses, and law and accounting firms, all of which received fees for their services.

Talking with Lubin revealed to Oved how blockchain technology might transform trading. Smart contracts on an open P2P platform such as the Ethereum blockchain could conduct clearing and settlement functions, removing the need for clearing and settlement intermediaries. Trades would therefore be executed in what was termed an “atomic swap” —directly by two parties—and recorded as a block. Thus, trades were either completely executed or did not occur at all, and counterparty risk was nearly eliminated by reducing settlement time to the time miners needed to validate the block and attach it to the chain.

AirSwap

In May 2017, Oved moved to turn his thoughts into reality, co-founding Fluidity with Don Mosites, a former Carnegie Mellon classmate who had worked at Google and Zynga, and Sam Tabar, head of capital strategy for Asia Pacific for Bank of America Merrill Lynch. Fluidity then created a 50/50 joint venture with Lubin’s firm, ConsenSys, to found and build a decentralized P2P trading network: AirSwap. Lubin and hedge fund financier Michael Novogratz served as advisors.

AirSwap would facilitate P2P trading in ERC-20 utility tokens, the type used on the Ethereum blockchain. User access to AirSwap would require the purchase of AirSwap’s AST utility token; AirSwap issued 150 million (of a planned supply of 500 million) AST tokens in an October 2017 ICO that raised 119,511.44 ETH (equivalent to \$36 million).⁴⁹ Purchasers included 9,447 people in 135 countries.⁵⁰ AirSwap used the proceeds to further build out, test, and operate the trading network.

The AirSwap network went live on April 26, 2018, and handled transactions worth \$1 million that day.⁵¹ On the basis of indications of interest hosted on AirSwap virtual bulletin boards, users negotiated their own deals off the blockchain with their identities masked.⁵² Once users agreed to terms on price and quantity, AirSwap used smart contracts to enable and record an atomic swap on the Ethereum blockchain. Atomic swaps created an exchange of tokens between two counterparties with no custodian, escrow, or settlement agent, while also guaranteeing that neither party could default on the trade.⁵³ Before executing the exchange, additional smart contracts running the company’s Swap protocol conducted an AML check and a KYC check (the latter was added in August 2018). A smart contract to run an accredited investor check would be added for security token trading early in 2019. There were no intermediaries and AirSwap imposed no trading fees. The only cost to participants was the “gas” paid in ether that funded the computation time required to execute the transaction, send tokens, or transmit any other information on the network.⁵⁴ At launch, AirSwap conducted trading in 24 different tokens, including EOS and GNO.⁵⁵ The trading network never closed. Oved noted that AirSwap “puts the three main components of trade—execution, settlement, and custody—into the hands of users and computer code rather than middlemen. AirSwap never touches funds or matches orders.”⁵⁶

By June 2018, some 70 different tokens traded on AirSwap, and trading grew steadily to about 400 ETH worth of daily volume. However, a six-month slump in the value of leading cryptocurrencies led to a decline in trading volume across all exchanges. The value of bitcoin fell from \$13,860 to \$7,487 in

the six months ending mid-May 2018; the value of ether fell from \$1,098 to \$452 in the six months ending June 30, 2018.⁵⁷ Total cryptocurrency market capitalization declined from \$822.5 billion early in January 2018 to \$374.2 billion in early June.⁵⁸ The hope had been that software developers would purchase AST in order to run their own smart contracts and decentralized applications (dApps)^f on AirSwap, thereby making its trading infrastructure more robust. dApps adoption of AST remained well below expectations, however. For additional revenues Fluidity turned to advisory services, including consulting agreements for smaller token projects.

By mid-2018, Fluidity employed 25 people across marketing, engineering, business development, and operations. Maggie Hsu had joined Fluidity in January 2018 to lead business development efforts. She previously had been chief of staff to the CEO of online retailer Zappos, and had worked at the consultancy, McKinsey & Co. Like Zappos, Fluidity operated on a flat, non-hierarchical basis. A portion of the AirSwap ICO proceeds paid the company's operational expenses.

With the token market failing to rebound, the co-founders decided that Fluidity should apply its technology to use cases for security rather than utility tokens. The new business line would—as the company proclaimed—“bring real world assets online” through tokenization. Tabar said, “We wanted to build a full-stack solution for bridging traditional institutional finance with blockchain technology.”

In part, the move recognized the ongoing transition of both regulators and market participants to security tokens. Yet focusing on security tokens also offered Fluidity a new revenue model, including fees for tokenization services and fees for every tokenized asset using the AirSwap architecture.

In order for Fluidity to apply its technology to securities, it would need an experienced industry partner licensed to issue them. A mutual friend connected Oved with Todd Lippiatt, founder and CEO of Propellr, an online-only financing platform and fully integrated broker-dealer. After over 25 years spent structuring and trading financial instruments at Credit Suisse and Morgan Stanley, Lippiatt had founded Propellr in 2013 to allow firms to structure, raise, and service capital for discrete and pooled transactions.⁵⁹ To accredited investors, Propellr offered an online platform to access real estate through special purpose entities (SPEs) that Propellr created to pool investors' capital for investment in individual properties. Given his longstanding interest in transforming traditional finance, the addition of blockchain was natural for Lippiatt.

Bringing the World's Assets Online

Commercial Real Estate

In January 2019, Fluidity and Propellr expected to demonstrate the concept by tokenizing the refinancing of a Manhattan condominium project. Commercial real estate was in some ways an ideal test for tokenization and trading because investors seeking direct CRE ownership historically faced an illiquid asset class characterized by high transaction costs, information asymmetry, low concentration/market fragmentation, non-standard products, no secondary trading of individual properties, and unit costs too high for most investors to own directly without violating prudent asset allocation principles.

Yet CRE returns were very attractive. Over the 1992-2016 period, for example, CRE generated returns approaching those of stocks, but with much less volatility and with low correlation to stock and bond returns (see **Exhibit 6**). Investors wishing to own CRE had limited options, however. To bet

^f dApps were software services that could simultaneously run on many nodes of a P2P network, whether on a blockchain or not.

on capital appreciation, accredited investors could participate in private equity (PE) funds specializing in direct CRE investments. However, PE funds locked up investor funds for up to a decade, imposed high fees, shared little information about their holdings or performance, and offered investors no say over the properties they acquired.

Real estate investment trusts (REITs) were a second option. REITs were akin to mutual funds: easily accessible to retail investors, with low minimum investment requirements, daily pricing, and could be sold at any time. They distributed 90% of their income as dividends, and therefore functioned primarily as a source of income, not as a bet on capital appreciation. While REIT returns exceeded those from direct CRE investing over the 1992-2016 period, they were more volatile than direct CRE investing returns, and correlated almost exactly with returns to stocks, reducing their appeal as a diversification vehicle or reliable source of income (refer to **Exhibit 6**).

Since the early 2010s, crowdsourcing platforms specializing in CRE properties had emerged as a third investing option. These pooled investor funds to acquire direct ownership in CRE projects. However, to a greater extent than PE funds and REITs, crowdsourcing platforms were subject to adverse selection problems inherent in the CRE industry. That is, the capital available from crowdsourcing platforms tended to be most attractive to the property developers and managers least able to secure bank loans or equity investment from other sources.

Financing Commercial Real Estate

The U.S. commercial real estate market was massive; new investment in 2016 reached \$266 billion, larger than the amount invested in the next eight-largest countries combined (refer to **Exhibit 6**).⁶⁰ At the level of an individual project, most CRE financing combined equity and debt components, similar to the down payment and mortgages most homebuyers paid to purchase a home. Because CRE properties cost much more than a single-family home to build or acquire, however, a developer (i.e., the project sponsor) typically sought out other investors to contribute additional funds as preferred equity, and borrowed the remainder. Holders of preferred CRE equity received all of a property's cash flow and profits—up to a pre-agreed percentage of their initial investment—that remained after all lenders to the property (e.g., banks) had been repaid. All cash flow and profits exceeding that pre-agreed threshold were then split between preferred equity and common equity investors according to a pre-agreed formula that usually favored common equity (held by the sponsor). Preferred equity holders received repayment of their principal either at a pre-agreed date or when the property was sold. The staggered distribution of returns on CRE investment was called a waterfall. The order in which investors were repaid—lenders first, preferred equity holders next, and common equity holders last—described the seniority structure, or in CRE parlance, the capital stack (see **Exhibit 7**).

Tokenizing Real Estate

In September 2018, Oved and Lippiatt published “The Two Token Waterfall,” a white paper providing “a comprehensive framework for applying blockchain technology to the entire capitalization of a [CRE] transaction.”⁶¹ Fluidity would contribute technology services to create two asset-linked tokens—“A-tokens,” representing debt, and “B-tokens,” representing preferred equity—and embed in both tokens smart contracts specifying the terms and rights associated with each, including AML and KYC provisions. Propellr would conduct due diligence on the developer and property before offering and selling the tokenized securities through its online platform, just as it would a typical private placement. This involved creating an SPE as a limited liability company, whose operating agreement would specify how ownership rights to the deal's debt and preferred equity would map to tokens recorded on the Ethereum blockchain. Propellr also would control the whitelist of investors who

bought into the offering and who opted to receive their ownership rights as tokens. “We are taking private securities and putting a digital wrapper around them, which makes [them] easier to track and easier to transfer,” said Khurram Dara, Fluidity’s general counsel.⁶² Fluidity’s lead engineer, Deepa Sathaye, elaborated:

These tokens are smart contracts that can manage transfer restrictions such as ones related to time⁸ or jurisdiction. What Fluidity does is create the smart contracts that are mapped to cash flow rights generated by the asset, as well as embed logic checks covering investor accreditation and regulatory topics. We then provide a dashboard for issuers to manage asset events such as payments and redemptions, and provide transparency on the digital tokens that are being held. In addition, we offer an investor portal to allow interested parties to onboard compliantly.

The smart contracts Fluidity created would ensure that tokens would only trade in a manner consistent with regulatory and contractual transfer restrictions. This effectively made regulatory compliance with AML and KYC requirements a matter of one-time programming. Smart contracts also would confirm, for example, that parties to every transaction were the whitelisted digital wallet addresses of accredited investors.

Such security token offerings (STOs) were similar to ICOs, but differed from ICOs by linking the tokens to ownership rights in securities. Security tokens also could trade on any digital trading network willing to include them. The issuer would decide on a security token standard and work to get the token listed on different exchanges.⁶³

Secondary trading would be based on Fluidity’s Swap protocol, which enabled peer discovery for digital token transactions without an order book, without order matching, and without transaction fees. A smart contract would conduct simultaneous execution, clearing, and settlement on a wallet-to-wallet basis, with no third-party custodian. The transaction details would then be recorded on the Ethereum blockchain. The October 2018 introduction of AirSwap’s Spaces product allowed a securities issuer or broker-dealer such as Propellr to create its own virtual “walled garden” on AirSwap, replicating the AirSwap trading environment while limiting trading to the issuer’s tokens and incorporating issuer-specific user onboarding requirements and trading parameters.

Fluidity claimed that digitization would save time and expense for both developers and investors. Digitization could save developers months of time by generating private security issuances in days rather than months. Digital compliance checks eliminated third-party service providers; P2P transacting and smart contract clearing and settlement eliminated bank and custodial fees as well as counterparty risk. Blockchain execution made transaction information available to all participants.

Thirteen East+West

Thirteen East+West was a luxury condominium complex on East 13th Street in Manhattan’s East Village for which Fluidity and Propeller partnered to finance. The property consisted of two buildings, each containing six full-floor units of roughly 1,700 square feet each. One-bedroom units were priced at \$2.35 million; the penthouse cost \$3.7 million.⁶⁴ The property was appraised at \$34 million in 2018.

⁸ This referred to holding time and lockups specified in an operating agreement, for instance if a token could not trade in the first 90 days after issuance.

Developer David Amirian had purchased the site in January 2015 and secured a construction loan in January 2016 that would mature in January 2019. Although construction was 95% complete and inspections were beginning in November 2018,⁶⁵ slow summer sales had now created unwanted stress and uncertainty that refinancing could alleviate. Real estate agent Ryan Serhant explained, “We have a bank deadline [up]on us, where we have to sell a certain amount of units or repay the entire loan by a certain date. If construction’s been delayed, if the market turns, if competition pops up and we aren’t going to be able to hit that deadline, what do you do? So by tokenizing the debt, it gives everybody breathing room to sell at a normal pace, with the market instead of against it.”⁶⁶

The property was tokenized following to the two-token waterfall structure with a mix of two types of security tokens, one representing senior debt, and the other representing preferred equity. Propellr conducted the token issuance and would be paid for its broker-dealer services, while Fluidity contributed its work in creating the security tokens as a proof of concept exercise. A 6.5% coupon on both the debt and preferred equity accrued interest monthly, yielding 6.7% following a two-year term, with two optional six-month extensions. The loan to value ratio was 73.5%.⁶⁷

By the closing date in January 2019, the sale of Fluidity’s security tokens (ERC-20 tokens, each equivalent to \$1)⁶⁸ was expected to have raised approximately \$25 million from accredited investors to refinance debt (\$17 million) and preferred equity (\$8 million) in Thirteen East+West. Propellr set a minimum purchase amount of \$25,000. Banks and direct lenders might charge Amirian 10% to 18% for a similar loan amount and duration. Serhant enthused, “If there’s another downturn and banks say, ‘Oh, we have a hard time lending now,’ [that’s] okay. I don’t need you, because I can tokenize my loan that I can use to buy that condo there, and that’s what I’m going to do. So now we don’t need banks any more. THAT is what’s crazy.”⁶⁹

The deal involved both primary issuance and secondary trading: once initially purchased, the tokens could later be converted to dollars or traded on AirSwap for digital currencies. Hsu stressed, however, that the tokens did not represent ownership in the underlying real estate itself, simply the holder’s claim to repayment of principal at 6.7% interest: “Non-token holders have the same rights as the token holders. They have rights in the SPEs used to finance the real estate, but not the underlying real estate itself. It’s not fractional ownership but an alternative custody arrangement that the token offers.”

Building a Revenue Model

Fluidity considered itself a technology company that helped FINRA-registered^h broker-dealers such as Propellr incorporate smart contracts and blockchain technology into their SEC-compliant offerings. In 2018, FINRA reported 3,132 registered broker-dealer firms, most of which did not issue real estate securities.⁷⁰ Hsu considered how to best access relevant broker-dealers, and whether Fluidity’s offerings might appeal to other market players as well. If Fluidity bought a broker-dealer itself, the company could originate private securities directly. Doing so would considerably broaden Fluidity’s addressable market to both realtors and real estate developers, but at the cost of a potential loss of focus. Crowdsourcing platforms specializing in real estate were another potential market; these firms transacted an estimated \$3.5 billion in volume in 2016.⁷¹ (Exhibit 9 lists selected crowdsourcing firms.)

^h FINRA (Financial Industry Regulatory Association) was a private corporation established to protect investors by registering, training, testing, and, if needed, sanctioning, U.S. securities brokers and securities companies. (Source: “Financial Industry Regulatory Authority,” Investopedia, June 18, 2018, www.investopedia.com/terms/f/finra.asp, accessed December 2018.)

Emergent Competition

In April 2018, another Brooklyn-based company, Meridio, became the first to offer fractional CRE ownership through the creation of security tokens. Unlike Fluidity, which was financing a property developer, Meridio's deal was for rights to the rental income in a five-unit Brooklyn apartment building. Token value was reportedly linked to the property's capital appreciation, but investors would also be able to trade their tokens on Pangaea, a platform named for the project. Meridio was working with real estate agents at Cushman & Wakefield to source additional properties, and had ambitions to replicate its model in Dubai and Germany.⁷²

On October 8, the owners of the St. Regis Aspen luxury hotel in Colorado sold 18.9% of the property's equity in a tokenized \$18 million offering. The tokens, Aspen Coins, were offered at \$1 to accredited investors purchasers willing to purchase a minimum of 10,000, using either dollars, Bitcoin, or Ether.⁷³

On November 27, Harbor tokenized ownership of The Hub, a luxury residence in South Carolina that was designed for college students. The offering aimed to raise \$20 million for The Hub's owner, Convexity Properties, with a minimum investment amount of \$21,000 per investor. The security tokens issued in the deal included the right to a 5% dividend.⁷⁴

By late 2018, a growing number of other firms offered investors tokenized access to U.S. CRE, including Alt.Estate, BlockEstate, New York Real Estate Coin, and Slice. Still other players included firms such as Polymath, Harbor, and Securitize that issued tokenized securities. Bancor, IDEX, and Radar Relay were leading digital exchanges (refer to **Exhibit 5**). Online retailer Overstock launched a subsidiary called tZero to create a secondary market for security tokens.⁷⁵ Securrency and Templum more closely resembled Fluidity; they offered products and services for asset tokenization, security issuance, and secondary trading.

Strategic Decisions

AirSwap already gave Fluidity a potential secondary trading solution. The impending Thirteen East+West offering would give the team more evidence for whether to focus on replicating the entire process widely or focusing on particular elements, whether tokenization, issuance, or trading. Publicity about Thirteen East+West had garnered material interest in further tokenization projects, Hsu announced: "We have millions in deals signed. People reach out either as an alternative to bank financing, they are excited about the technology, or they want some of the marketing exposure tokenization created for this deal." The need to vet new clients to minimize Fluidity's risk exposure had created a scaling issue, however, and the company planned to double its staff within a few months.

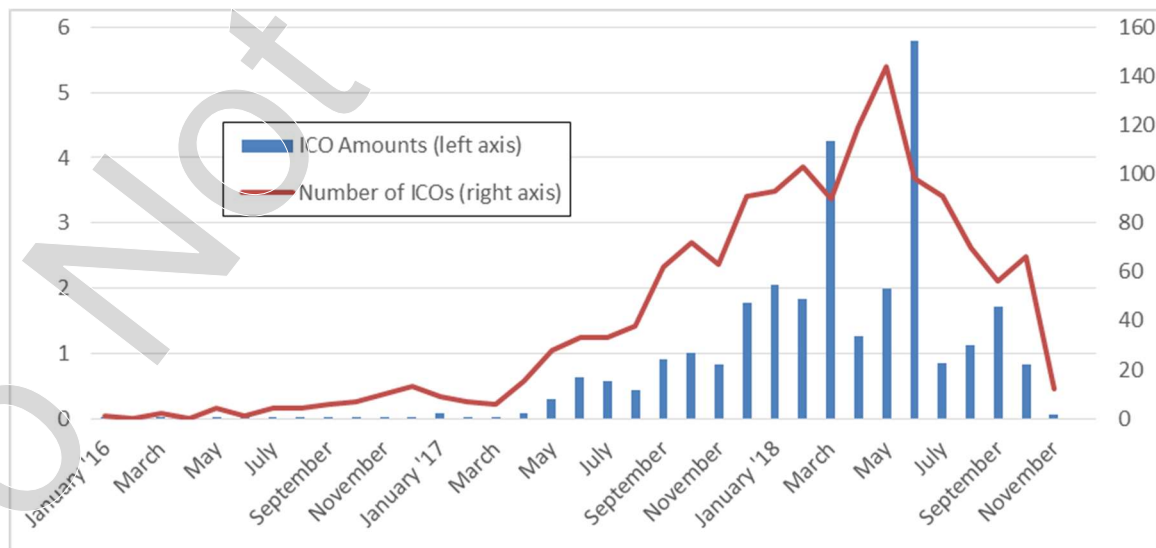
In addition to fielding and evaluating incoming opportunities, Hsu and her colleagues needed to analyze the pros and cons of the multiple growth paths available to Fluidity, and how each could optimize not only financial performance but Fluidity's strategic positioning in a burgeoning market. Where in the real estate tokenization stack should Fluidity focus: tokenization, issuance, or trading? Should Fluidity handle all three pieces? Under what conditions was it best for Fluidity to partner, and with whom? Were partnerships essential or a necessary evil?

Exhibit 1 Schematic Blockchain Stack, 2018

Level	Category	Category Description	Company & Players
5	Exchange	A marketplace for trading security tokens	The Ocean SharesPost AirSwap
4	Exchange Protocol	Software and rules enabling and governing the exchange of tokenized securities	0x Protocol SWAP
3	Compliance Platform	A set of “off-chain” processes, including anti-money laundering and “know-your-customer” checks, to identify investors, match investors to blockchain wallet addresses, and confirm an investor’s eligibility to participate in trading	Harbor Polymath Securitize
2	Security Token	A security token represented the digitization of an asset and could be programmed to conduct compliance checks to ensure all parties adhered to guidelines created by issuers and regulators.	ST20 ERS-20 DS protocol
1	Blockchain	As the foundation of the stack, a blockchain provided security, quick transactions and settlements, and gave issuers and regulators “visibility” while providing investors “connectivity and discoverability leading to liquidity.”	Bitcoin Ethereum

Source: Casewriter research and compilation from Bob Remeika, “Defining the Security Token Stack,” Medium.com, October 4, 2018, <https://medium.com/harborhq/securitytokenstack-e6a273c1104e>; and Deepa Sathaye, “Automatic Regulatory Compliance with Ethereum,” Medium.com, November 7, 2018, <https://medium.com/fluidity/automatic-regulatory-compliance-with-ethereum-892f01ef9eaa>; both accessed November 2018.

Note: This chart describes as a stack the collective layers of software running atop underlying software layers to deliver additional functionality. Unlike the schematic capital stack depicted in Exhibit 7, a software stack describes a hierarchy that is otherwise unrelated to notions of risk, return, or repayment.

Exhibit 2 Initial Coin Offerings, Number of Offerings and Amounts Raised (in \$ bn), 2016-2018

Source: Compiled from CoinSchedule.com, “Cryptocurrency ICO Stats,” 2016-2018, www.coinschedule.com/stats.html, accessed November 2018.

Exhibit 3 Security Token Offerings and Selected Pre-Offerings, as of December 19, 2018

Token Issuer	Status	Target (\$mn)	Raised (\$mn)
tZero	Completed	\$250.0	\$134.0
SPiCE VC	Completed	\$100.0	Undisclosed
Aspen Coin	Completed	\$18.0	\$18.0
Brickblock	Completed	\$50.0	\$13.0
Science Blockchain	Completed	\$50.0	\$12.0
Blockchain Capital	Completed	\$10.0	\$10.0
Atlant	Completed	\$60.0	\$7.0
Protos	Completed	\$60.0	\$5.7
Etherty	Completed	\$20.0	\$5.3
Alt.Estate	Completed	\$15.0	\$5.0
MintHealth	Completed	\$24.0	\$0.2
CityBlock Capital	Live	\$10.0	
EpigenCare	Live	\$20.0	
Robinhood	Live	\$1.0	
Sia	Live	Unknown	\$1.5
Realecoin	Pre-Offering	\$200.0	
Gainfy	Pre-Offering	\$100.0	
BlockEstate	Pre-Offering	\$50.0	
Corl	Pre-offering	\$50.0	
BlockSafe Tech	Pre-Offering	\$27.0	
Elio Motors	Pre-Offering	\$25.0	

Source: Company documents.

Exhibit 4 Existing and Planned Decentralized Exchanges, January 2018

Name	Description	Status
AirSwap	P2P on Ethereum using the Swap protocol	Live on April 26, 2018
Bancor Protocol	Smart contract-based token exchange protocol	Live
Bisq	Crypto-fiat open-source exchange trading bitcoin using a desktop application via Tor	Live
Etherdelta	Cryptocurrency exchange market leader for ERC-20 tokens	Live
Etherex	Open-source exchange built on Ethereum	Live
Forkdelta	Community-driven open source and forked version of Etherdelta, uses the same order book and contract	Live
Heat	Real-time asset-to-asset exchange	Live
IDEX	Instant order placement and execution, free order cancellation, and real-time order book updates	Live
Lykke	Semi-decentralized exchange for crypto- and fiat currencies	Live (centralized); will decentralize
Oasis DEX	Token on-chain market for all Maker token assets	Live
Stellar Distributed Exchange	Open source exchange for the Stellar network	Live since 2015
Token Store	Ethereum token exchange, semi-decentralized	Live
Waves	Crypto-platform for asset/custom token issuance, transfer and trading on the Waves blockchain, with centralized order matching and decentralized settlement.	Live since June 2016
Altcoin.io	Cryptocurrency exchange	Beta testing on testnet
SingularX	Peer-reviewed trading for tokenized IP and ERC-20	Beta testing
KyberNetwork	Exchange and conversion of digital assets, API for payments and derivatives	Beta testing on testnet
Catalyst	Investment platform for algorithmic/data-driven crypto-asset trading without a custodian	Alpha testing, simulation available
Hodl Hodl	P2P cryptocurrency exchange on the Bitcoin Testnet	Testnet
Barterdex	Open source network doing atomic swaps	In production
Blocknet	Cryptocurrency trading and fiat currency gateways using cross-chain atomic swaps and data transfers	In production
Gnosis Dutch Exchange	Exchange for ERC-20 tokens based on the Dutch auction principle	In production
Legolas	Hybrid centralized/decentralized exchange targeting market makers	In production
Loopring	ERC-20 token exchange on multiple public blockchains	In production
OmegaOne	Trade execution platform	In production
OpenANX	Open sourced and governed exchange	In production
Raidex	Exchange using Raiden off-chain state channel technology	In production
Streamity	Semi-decentralized crypto exchange with fiat onramps	In production
Coinffeine	Bitcoin exchange with a "zero trust" algorithm	Down

Source: Compiled from Nathan Sexer, "State of Decentralized Exchanges, 2018," ConsenSys, January 31, 2018, <https://media.consenSys.net/state-of-decentralized-exchanges-2018-276dad340c79>, accessed November 2018.

Exhibit 5 Activity on Leading Decentralized Digital Exchanges, July 2-13, 2018

Exchange	Trades	Token Pairs	Makers	Traders
IDEX	69,339	451	8,701	12,400
Bancor	9,691	121	1	1,147
0x	9,017	131	914	234
EtherDelta	8,887	533	2,382	2,642
Kyber	1,346	45	4	473
OasisDex	1,317	4	55	170
The Token Store	1,269	40	247	186
Radar Relay	1,085	53	94	182
AirSwap	695	33	60	216
ETHERC	307	7	177	73

Source: Leigh Cuen, "Decentralized Exchanges Aren't Living Up To Their Name—And Data Proves It," Coindesk.com, July 23, 2018, <https://www.coindesk.com/decentralized-exchange-crypto-dex>, accessed November 2018.

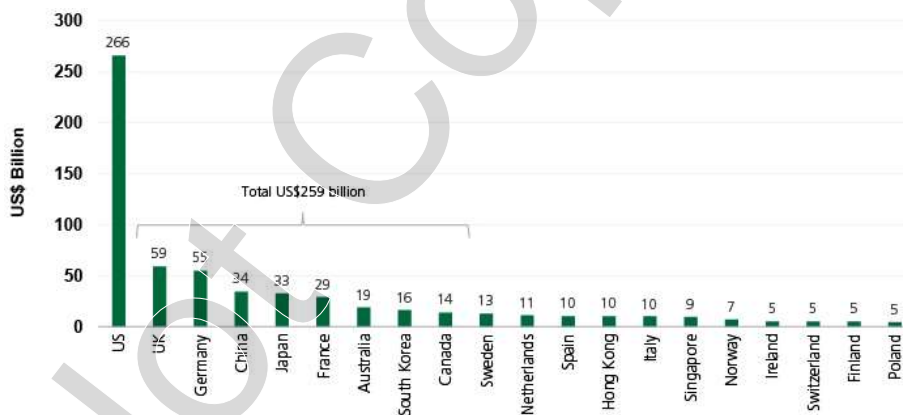
Note: Makers were market makers, exchange participants who named their own bid and ask prices for digital currencies.

Exhibit 6 U.S. Commercial Real Estate, Relative Performance, Correlation, and Size, 1992-2016**Annual Risk and Return Data of U.S. CRE vs. Other U.S. Asset Classes**

Asset Class	Average Return	Volatility	Sharpe Ratio	Lowest Return	Highest Return
Commercial Real Estate ^a	9.2%	8.1%	0.8%	-22.1%	20.2%
Corporate Bonds ^b	6.7%	6.1%	0.6%	-6.8%	23.8%
Equities ^c	10.7%	17.6%	0.5%	-38.1%	49.8%
Real Estate Investment Trusts ^d	13.8%	21.5%	0.5%	-57.9%	106.5%

Correlation between U.S. CRE and Other U.S. Asset Types, Total Quarterly Returns

Asset Class	CRE	Bonds	Equities	REITs
Commercial Real Estate ^a	1.00			
Corporate Bonds ^b	-0.16	1.00		
Equities ^c	0.19	0.13	1.00	
Real Estate Investment Trusts ^d	0.19	0.32	0.56	1.00

Direct CRE Investment, Top 20 Country Markets, 2016

Source: JLL, as of March 2017.

Source: Manulife Asset Management, "An Investor's Guide to US Commercial Real Estate," October 31, 2017, <http://www.manulifeam.com/ca/Research-and-Insights/Market-Views-And-Insights/An-Investors-Guide-to-US-Commercial-Real-Estate/>, accessed November 2018.

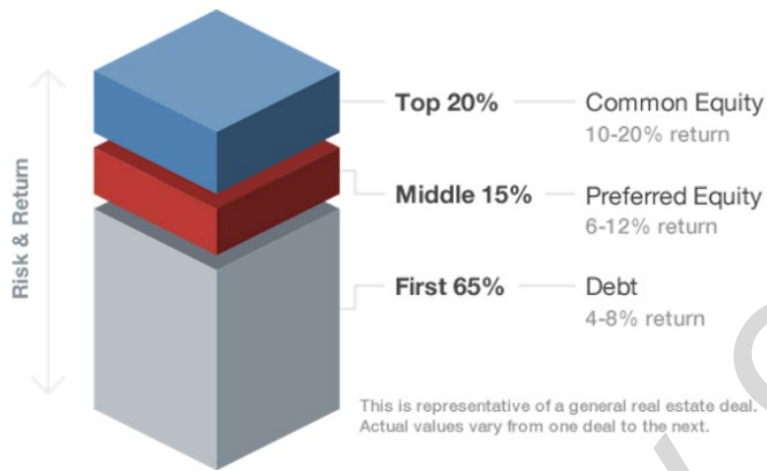
Notes: Underlying data sources are as follows:

^a The NCREIF Property Index—a market value-weighted index of unlevered property-level returns on U.S. CRE.

^b The Bloomberg Barclays US Corporate Bond Index—a market value-weighted total return index of public U.S. institutional quality corporate bonds.

^c The S&P 500 Index—The 500 largest publicly-listed U.S. companies, comprising approximately \$2.2 trillion in assets and capturing approximately 80% of U.S. equity market capitalization.

^d The Dow Jones Equity REIT Index—all publicly-traded U.S. equity real estate investment trusts.
Jones Lang LaSalle for country CRE investment amounts.

Exhibit 7 Generic Commercial Real Estate Capital Stack

Source: Fundrise, "Mezzanine Debt vs. Preferred Equity," 2018, <https://fundrise.com/education/glossary/mezzanine-debt-vs-preferred-equity>, accessed November 2018.

Note: This graphic represents the simplest form of the CRE capital stack. Additional types and layers of debt and equity that are ignored here would introduce further gradations of seniority and risk within each category shown above. Note too that the capital stack is a schematic representation of repayment order, risk, and return, and differs from the blockchain software stack depicted in Exhibit 1, which describes layers of software functionality running atop the preceding software layers to deliver additional functionality.

Exhibit 8 Real Estate Crowdfunding and Investment Companies, 2018

Company	Raised (\$ bn)	Users Registered	Deals Financed	Avg. Deal (\$ mn)	Fee Structure
RealCrowd	\$2.2	20,000	128	\$30.0	No fee
FundRise	\$1.4	200,000	-	\$1.0	0.85% asset mgmt fee; 0.15% advisory fee/yr
Sharestates	\$1.1	-	514	\$0.9	0%-2% set-up fee
PeerStreet	\$1.0	-	-	-	0.5%-1% for investors
RealtyShares	\$0.7	1,200,000	1,000	\$5.0	1% on equity; 2% points on debt
RealtyMogul	\$0.3	157,000	350	\$12.5	0.3%-0.5%
CrowdStreet	\$0.25	99,000	200	\$6.0	No fee
RichUncles		-	2 REITs	-	1%-3%
Origin Investments	\$0.9	500	3 funds	\$150.0	1.5% on equity; 1.5% mgmt fee/yr.; 20% over 9% return
RoofStock	\$1.0 transacted	-	-	\$0.1	0.5%
ArborCrowd	\$0.02	-	6	\$4.0	0.25%-0.5% asset mgmt fee; 1.0%-1.25% acquisition fee; 1% disposition fee; 1% refinance fee
Cadre	\$1.2 in deals closed	-	500+ evaluated annually	\$50+	1% transaction fee on cost; 1.5% annual fee on net asset value; sponsor promote of 22%.

Source: Company documents.

Note: Some figures estimated.

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