

**elphi: A Business Plan to Streamline the Mortgage Lifecycle Through
Blockchain**

By

**Eilon Shalev
David Micley**

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MIT Sloan School of Management
May 10, 2019

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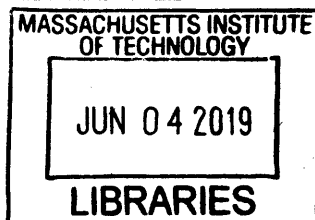
Signature redacted

Adrien Verdelhan
Thesis Supervisor
Associate Professor of Finance

Accepted by:

Signature redacted

Maura Herson
Assistant Dean, MBA Program



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Eilon Shalev and David Micley

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Abstract

The mortgage industry is the largest debt market in the U.S. entailing ~\$10 trillion¹. The average processing time from mortgage application to closing is 45 days². More than 10 different stakeholders contribute to the process of mortgage origination, and they all use different types of technology to perform their parts. As such, coordinating and syncing all stakeholders is a complicated task, and therefore stakeholders revert to personalized yet inefficient communication channels, such as emails and phone calls. We offer a potential solution for this communication problem, leveraging DLT (Distributed Ledger Technology) to create pre-set channels for those stakeholders to communicate and reconcile transactions instantly. We argue that by leveraging DLT to this use case, the process of mortgage origination could go drop to 15 days, saving billions of dollars for all stakeholders.

Thesis Supervisor: Adrien Verdelhan
Title: Associate Professor of Finance

¹ “Mortgage Debt Outstanding.” *Board of Governors of the Federal Reserve System*, Mar. 2019, www.federalreserve.gov/data/mortoutstand/current.htm.

² Strange, Angela. “Making Sense of Mortgages: The Problem, and the Opportunity.” *Andreessen Horowitz*, 14 Apr. 2019, a16z.com/2018/05/19/mortgage-process-players-problems-opportunities/.

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Introduction

elphi is a B2B, DLT (Distributed Ledger Technology) company streamlining the mortgage lifecycle from origination to securitization, using Corda: the leading DLT (Distributed Ledger Technology) protocol built by R3. elphi plans to develop its product, following the chronological order of the mortgage lifecycle: Origination, Whole Mortgage Trading, Securitization, and MBS (Mortgage-backed security) Trading. Today, all the information and value exchanges are handled through different technologies such as on-premise applications, web-based solutions, emails, excel spreadsheets, word documents, PDFs, faxes, phone calls and other archaic methods, all built on different types and generations of technology which are challenging or impossible to integrate. Recent technological advances have made it possible, but not yet the case, that these information and value exchanges could occur through the same technology from start to finish.

We envision a future, in which all the relevant parties have access to the same information stored on multiple, fully-synchronized, and personalized ledgers, where each party agrees with the notion that “what I see, is what you see”³. The innovation that makes this Decentralized Network Consensus possible is the combination of time-stamped, append-only logs, and state-of-the-art cryptography. The growing buzz around the blockchain is a double-edged sword. On the one hand, investors are excited to gain exposure and explore investment opportunities in this space. On the other hand, given the new and esoteric nature of this field, investors face tremendous uncertainty as to whether blockchain is a revolutionary technology here to stay or merely a passing fad. Prior to bitcoin and blockchain, increasing efficiency in back-office processes through digital innovation was not a top priority for incumbents. In a sense, bitcoin and blockchain were a boon to instigate

³ Brown, Richard Gendal. “The Corda Platform: An Introduction.” May 2018, www.corda.net/content/corda-platform-whitepaper.pdf.

interest from incumbents, mostly driven by fear of missing out, or even fear of getting disrupted. The decentralization of business activities in the name of democracy and operational efficiency created a unique sandbox for FinTech startups to innovate and present their Proof of Concepts, while the incumbents have been experimenting themselves. This opened an ephemeral window of opportunity for elphi, which tries to clear historic bottlenecks and inefficient, multi-party transactions in the mortgage industry. elphi's solution should be built and adopted quickly, before the incumbents lose interest and consider blockchain technology a short chapter in the history of the mortgage industry or independently figure out how to create and integrate in-house blockchain technology solutions.

Market overview

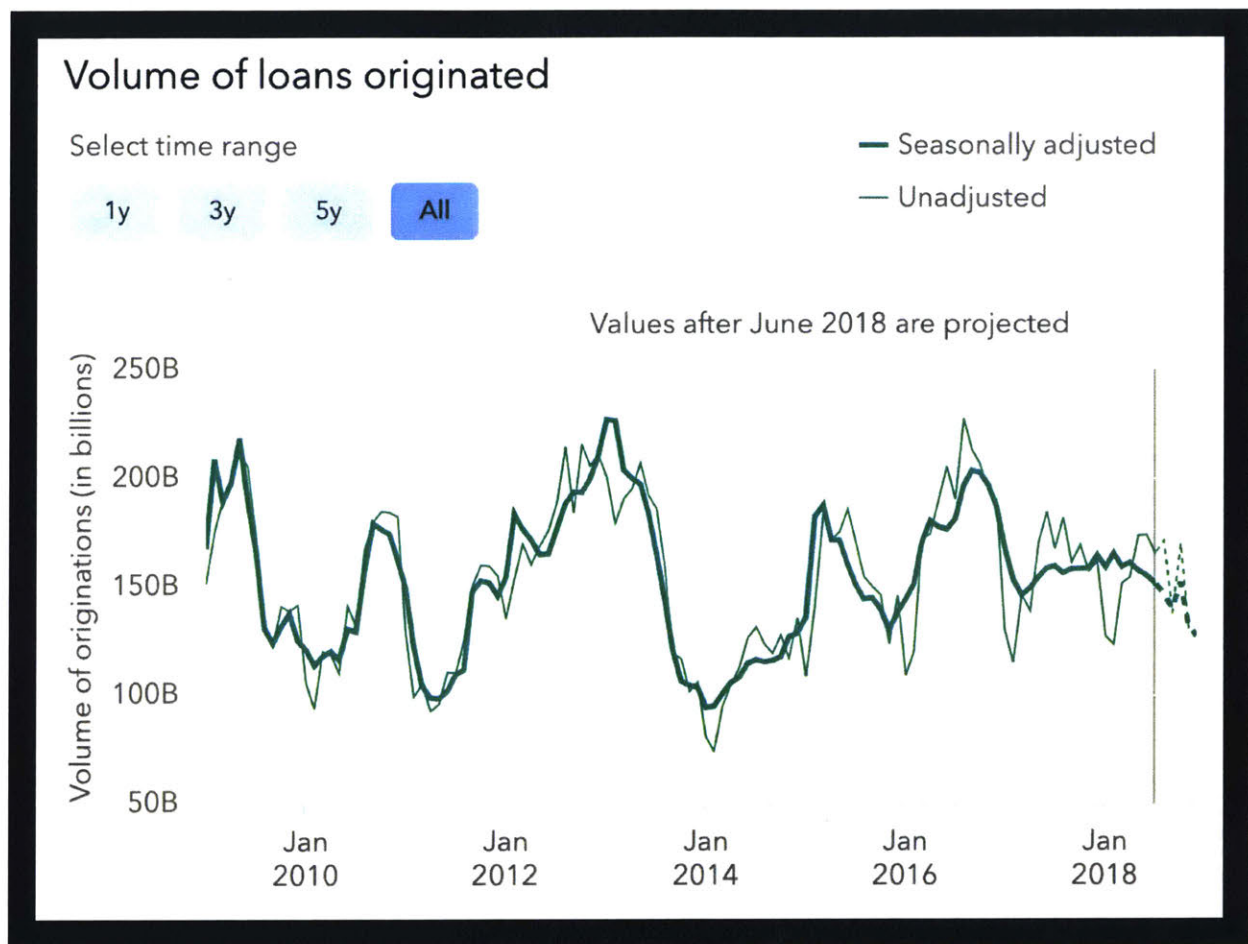
Total mortgage originations every year ranges from \$1.4 to \$2 trillion⁴. As shown below, the increments on the X axis are by month, with an estimated average of \$150 billion a month. With an estimated average of \$1.8 trillion⁵ of mortgages a year, mortgage technology vendors that sell Loan Origination Systems charge around 10 bps from this volume, accumulating a Total Addressable Market of \$1.8 billion. The 10bps is derived by taking Ellie Mae's revenue of \$480M⁶ and market share of 25%⁷.

⁴ "Origination Activity." *Consumer Financial Protection Bureau*, Mar. 2019, www.consumerfinance.gov/data-research/consumer-credit-trends/mortgages/origination-activity/.

⁵ "Origination Activity." *Consumer Financial Protection Bureau*, Mar. 2019, www.consumerfinance.gov/data-research/consumer-credit-trends/mortgages/origination-activity/.

⁶ "Ellie Mae, Inc. (ELLI) Income Statement." *Yahoo! Finance*, Yahoo!, 16 Apr. 2019, finance.yahoo.com/quote/ELLI/financials?p=ELLI.

⁷ "Jonathan Corr." *HousingWire.com*, www.housingwire.com/VanguardAwards/JonathanCorr.



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The mortgage industry has a multitude of players. There are the Primary Market Lenders, which include large institutions such as Wells Fargo, Bank of America, and others. There are the medium-sized institutions such as credit unions and community banks. There are small-sized lenders, mostly non-depository mortgage lenders. There are warehouse lenders that provide credit lines to mortgage lenders. There are also wholesale lenders that employ mortgage brokers that bring clients to the lenders and walk through the mortgage application process with the clients. Mortgage brokers typically get 2-3% commission on any closed mortgage amount.

⁸ “Origination Activity.” *Consumer Financial Protection Bureau*, Mar. 2019, www.consumerfinance.gov/data-research/consumer-credit-trends/mortgages/origination-activity/.

Beyond the primary market lenders, there are the secondary market institutions, which include Fannie Mae, Freddie Mac, and other GSEs (Government Sponsored Enterprises). These institutions dictate the guidelines with which the primary market lenders underwrite the mortgages, because after the mortgages are originated, they are sold to these GSEs to be put into mortgage-backed securities.

Then there are third-party vendors, including verification vendors who are lenders that verify the income, assets, and employment of the applicant. The lenders will not approve the mortgage unless these three aspects are verified. In addition, there are the credit bureaus, institutions that provide credit reports to the lenders. The GSEs will not buy the mortgages from the lenders unless the lenders provide all three credit reports and use the middle score. Moreover, there are timeframes considerations to conduct and deliver these credit reports for them to be eligible.

Another group of third-party vendors are title insurance firms, which include several distinct groups. There are the title insurance underwriters, these are large institutions that bear the risk in case of a title dispute. Then there are title companies, these companies act as agents on behalf of the larger institutions (the insurance underwriters) and practice revenue-share agreements with the underwriter. The title insurance underwriters get 15% of the insurance premium while the title companies get 85% of the insurance premium. Then there are the title software vendors, companies that provide the technology with which title policies are manufactured.

Next in the process is the appraisal. The mortgage crisis in 2008 happened partly because of the fraudulent appraisal practices that led to sky high and overvalued appraisals which allowed

for larger mortgages⁹. Afterward, new regulation came in and bifurcated the communication between lenders and appraisers. There are the appraisers, people who go and inspect houses. They take pictures and compare the state of a house to the state of other houses that are comparable. And then there is the Appraisal software, produced by software vendors that coordinate between lenders and appraisers, serving as a third party to the appraisal order process.

Another important component in the mortgage process is the disclosure documents. The communication between the lenders and the applicants requires the lenders to provide the applicant with disclosure documents, depending on how far along the application process is. These disclosures could differ from state to state and requires attention to details. As such, there are software vendors that provide only this service – document generation.

Another important player is hedging companies. Lenders give applicants an option to lock an interest rate for 30-90 days in advance¹⁰. Because lenders sell their new mortgages to GSEs, and because it takes them several weeks of operations until they close the loan and then complete the sale of it, these lenders need to hedge their risk exposure to the fluctuating mortgage interest rates. The lenders use hedging companies that buy and sell mortgage-specific securities that lock the risk, but for a small premium. These securities are called TBA¹¹ (To Be Announced) and act as forward contracts of MBS (Mortgage-Backed Securities). There is a strong correlation between the prices of TBAs, MBAs, and those that Fannie and Freddie pay to buy individual mortgages. In

⁹ Eaton, Joe. “The Appraisal Bubble.” *Center for Public Integrity*, 14 Apr. 2009, publicintegrity.org/environment/the-appraisal-bubble/.

¹⁰ Vickery, James, and Joshua Wright. “FRBNY Economic Policy Review.” *TBA Trading and Liquidity In The Agency MBS Market*, May 2013, www.newyorkfed.org/medialibrary/media/research/epr/2013/1212vick.pdf.

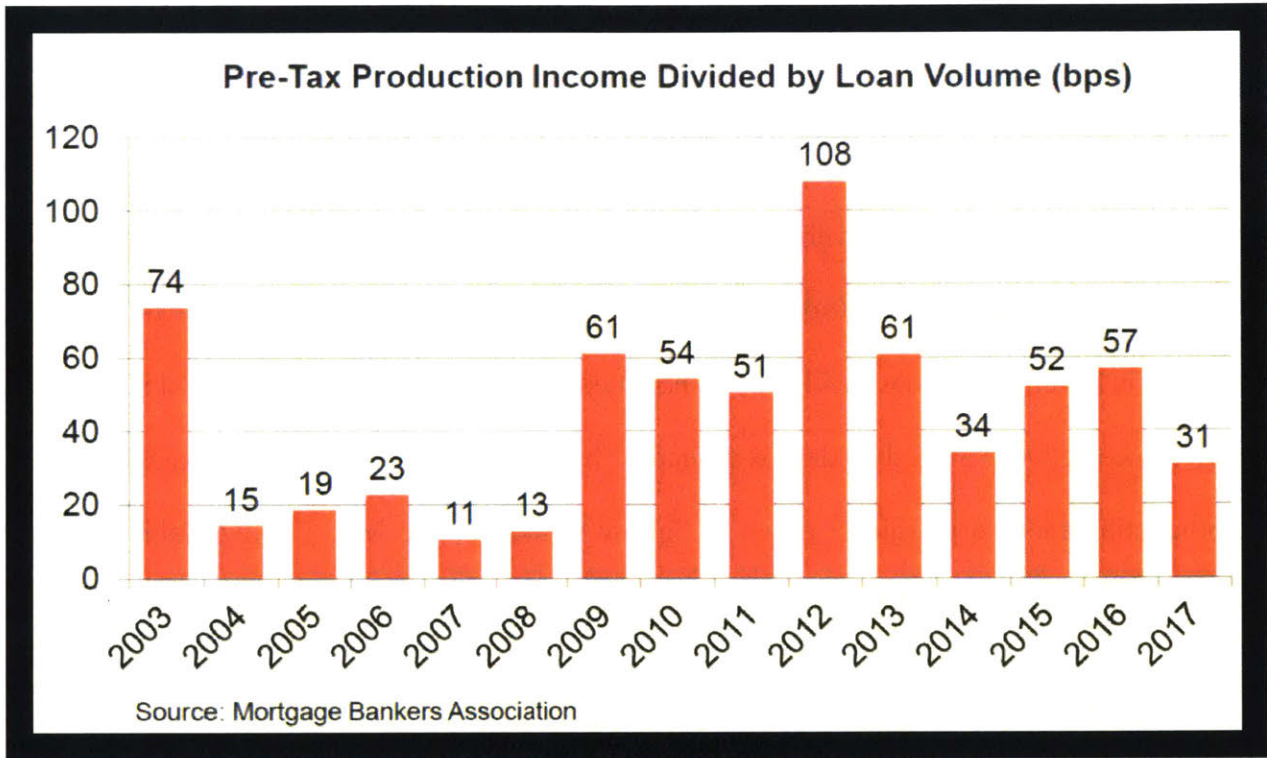
¹¹ Chen, James. “To Be Announced (TBA).” *Investopedia*, Investopedia, 20 Apr. 2019, www.investopedia.com/terms/t/tba.asp.

the following table we share a spreadsheet of premiums that Freddie will pay to buy mortgages with corresponding interest rates and days until they are delivered to Freddie. 100 is par, and anything above 100 is the premium. The columns refer to the amount of time it takes from deciding on the transaction to actually delivering the mortgage to Freddie. Lenders who originate mortgages in 45-55 days will choose the 60-day premium price as a benchmark, and those who originate mortgages is fewer than 30 days will choose the 30-day premium price. As highlighted in the table, the difference between 30 and 60 days is around 11 basis points. Lenders with 31 basis points pre-tax production income margins¹² (chart to follow is the Freddie Mac Pricing Table obtained through field research), would benefit from additional 11 basis points could increase revenues by 35%.

Interest Rate	5-DAY Exp	10-DAY Exp	15-DAY Exp	30-DAY Exp	45-DAY Exp	60-DAY Exp	75-DAY Exp	90-DAY Exp
4	97.691	97.677	97.671	97.645	97.597	97.57	97.528	97.509
4.125	98.433	98.411	98.402	98.353	98.313	98.268	98.218	98.168
4.25	99.171	99.149	99.139	99.094	99.053	99.008	98.961	98.917
4.375	99.75	99.728	99.719	99.677	99.634	99.59	99.546	99.509
4.5	100.396	100.374	100.365	100.326	100.286	100.241	100.201	100.172
4.625	100.964	100.934	100.921	100.854	100.806	100.744	100.696	100.628
4.75	101.534	101.503	101.49	101.427	101.38	101.318	101.274	101.214
4.875	102.108	102.077	102.064	102.005	101.952	101.891	101.855	101.802
5	102.492	102.461	102.448	102.392	102.337	102.275	102.241	102.191
5.125	103.091	103.051	103.034	102.949	102.894	102.815	102.757	102.671
5.25	103.591	103.551	103.534	103.453	103.398	103.318	103.266	103.187
5.375	103.957	103.918	103.901	103.82	103.767	103.688	103.637	103.563

Source: Freddie Mac Pricing Table (gathered through field research)

¹² “Industry Trends: What Caused Lender Profit Margin Compression?” *Mortgage Capital Trading (MCT)*, 14 Aug. 2018, mct-trading.com/what-caused-margin-compression.



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Changes in Market

Regulation in this industry is reactive and complicated. There are several bodies regulating not only different, but also overlapping aspects of the mortgage process within banks and financial institutions. The FDIC (Federal Deposit Insurance Corporation) for example, regulates the banks for all their operations, not only because of the mortgage piece of their activities. The FDIC is an independent federal agency insuring deposits in U.S. banks and thrifts in the event of bank failures¹⁴. The OCC (Office of the Comptroller of the Currency), ensures that national banks and

¹³ “Industry Trends: What Caused Lender Profit Margin Compression?” *Mortgage Capital Trading (MCT)*, 14 Aug. 2018, mct-trading.com/what-caused-margin-compression.

¹⁴ Kagan, Julia. “Federal Deposit Insurance Corporation – FDIC.” *Investopedia*, 26 Feb. 2019, www.investopedia.com/terms/f/fdic.asp.

federal savings associations operate in a safe and sound manner, provide fair access to financial services, treat customers fairly, and comply with applicable laws and regulations¹⁵. The CFPB (Consumer Financial Protection Bureau) is a regulatory agency charged with overseeing financial products and services that are offered to consumers¹⁶.

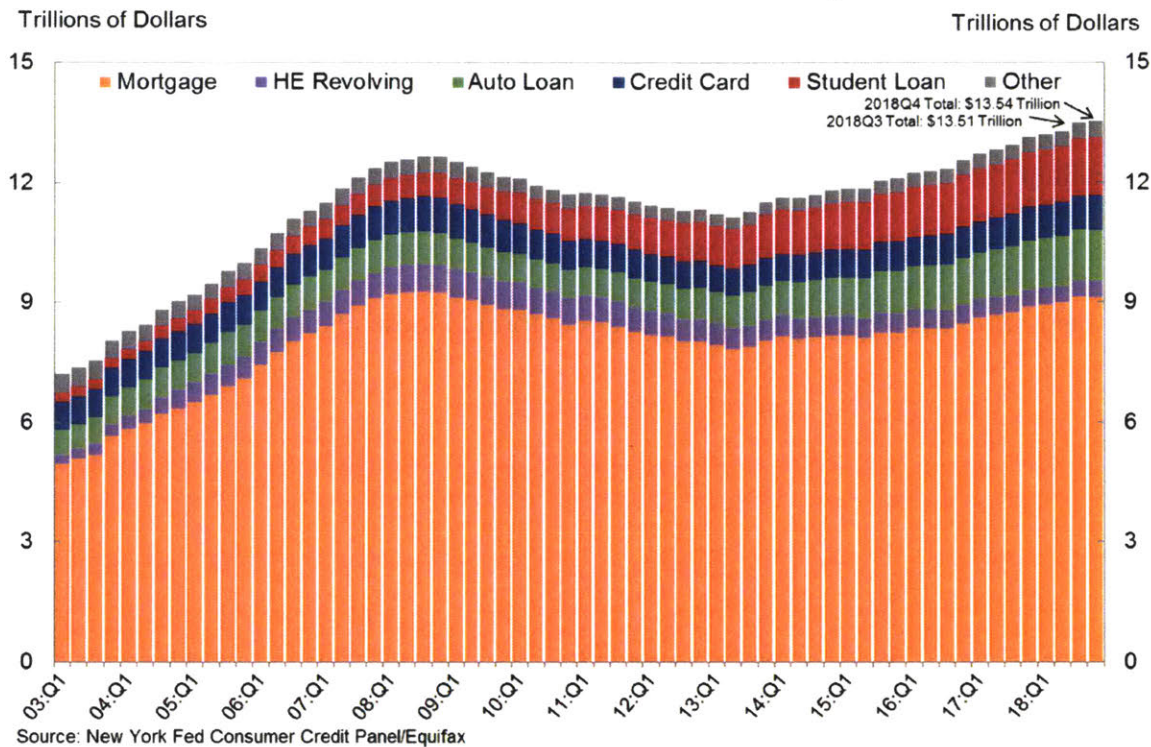
Each of those entities intersects with financial institutions in different roads, and because mortgage lending is the largest activity in the US debt market¹⁷ (see chart below), almost any financial institution with lending activity has to conform to these regulations.

¹⁵ Kagan, Julia. "Office of the Comptroller of the Currency (OCC)." *Investopedia*, 28 Feb. 2018, www.investopedia.com/terms/o/office-comptroller-currency-occ.asp.

¹⁶ Kenton, Will. "Consumer Financial Protection Bureau (CFPB)." *Investopedia*, 11 Mar. 2019, www.investopedia.com/terms/c/consumer-financial-protection-bureau-cfpb.asp.

¹⁷ Research and Statistics Group. "Quarterly Report on Household Debt and Credit." Center for Microeconomic Data, 2018. www.newyorkfed.org/medialibrary/interactives/householdcredit/data/pdf/hhdc_2018q4.pdf.

Total Debt Balance and its Composition



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After the financial crisis, regulation became stricter: “*The Dodd-Frank Wall Street Reform and Consumer Protection Act is a massive piece of financial reform legislation passed by the Obama administration in 2010 as a response to the financial crisis of 2008. Named after sponsors U.S. Senator Christopher J. Dodd and U.S. Representative Barney Frank, the act's numerous provisions, spelled out over roughly 2,300 pages, are being implemented over a period of several years and intended to decrease various risks in the U.S. financial system. The act established a number of new government agencies tasked with overseeing various components of the act and by extension various aspects of the banking system. President Donald Trump has pledged to repeal Dodd-Frank and on May 22, 2018, the House of Representatives voted to roll back significant pieces of Dodd-Frank. The Consumer Financial Protection Bureau (CFPB) is supposed to prevent predatory mortgage lending (reflecting the widespread sentiment that the subprime mortgage market was the underlying cause of the 2008 catastrophe) and make it easier for consumers to understand the terms of a mortgage before finalizing the paperwork. It prevents mortgage brokers from earning higher commissions for closing loans with higher fees and/or*

¹⁸ Research and Statistics Group. “Quarterly Report on Household Debt and Credit.” Center for Microeconomic Data, 2018.

higher interest rates and says that mortgage originators cannot steer potential borrowers to the loan that will result in the highest payment for the originator.”¹⁹

Technology

Mortgage technology has been around for more than two decades. Ellie Mae, the dominant LOS tech vendors started in 1997. In the efforts to reach full digitization in the mortgage industry, various aspects of the mortgage origination process became viable businesses of their own, and companies launch to solve these small but incrementally important areas. These aspects include, but are not limited to, digital verifications of income, assets, and employment; digital ordering of services such as appraisals, title insurance, mortgage insurance, home insurance, flood certificates, and credit reports; and digital recording and closing solutions.

It is apparent that the mortgage industry is ripe for digital innovation, and that large amounts of capital are pouring in. In May 1, 2019, NYSE (New York Stock Exchange) announced its \$335mm acquisition of Simplifile, a firm that facilitates electronic processing of mortgage records²⁰. The MBA (Mortgage Bankers Association) is filled with articles and blog posts²¹ about the digitization of mortgage industry. As such, we identified the next five years as a window of opportunity for innovation, especially in this low-margin market that is waiting for cost-efficient solutions.

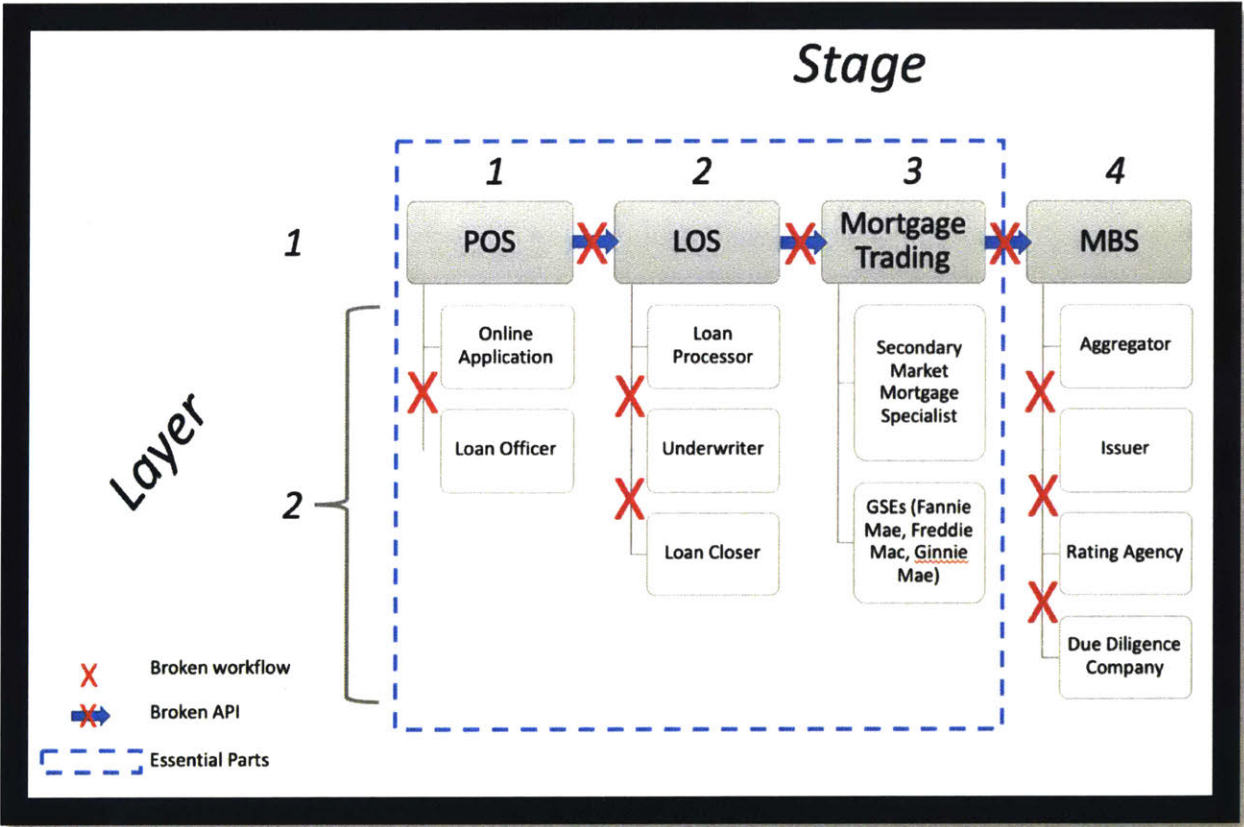
¹⁹ Kenton, Will. “Dodd-Frank Wall Street Reform and Consumer Protection Act.” *Investopedia*, 18 Feb. 2019, www.investopedia.com/terms/d/dodd-frank-financial-regulatory-reform-bill.asp.

²⁰ Osipovich, Alexander. “NYSE Owner Bets on Mortgage Digitization.” *The Wall Street Journal*, Dow Jones & Company, 1 May 2019, www.wsj.com/articles/nyse-owner-expands-deeper-into-mortgage-digitization-with-simplifile-deal-11556749837.

²¹ Shreni, Ashish. “Riding the Wave of Mortgage Digitization | Mortgage Bankers Association.” *Mortgage Bankers Association*, 8 Oct. 2018, www.mba.org/publications/insights/archive/mba-insights-archive/2018/riding-the-wave-of-mortgage-digitization-x240052.

One of the most obvious paradigm shifts is moving out from papers towards electronic disclosures. This includes eNotes, eMortgages, eVaults, eVerifications (of income, assets, and employment), among other electronic activities. Fannie Mae’s approved eClosing Technology Solution Provider List²² consists of 18 distinct companies.

Problem – Broken Down in Two Layers



Layer 1

²² *Eclosing Technology Solution Provider List*, Fannie Mae, 15 Apr. 2019, www.fanniemae.com/content/list/eclosings-emortgages-vendor-list.pdf.

The information exchange from stage to stage is inefficient, mostly because of 3rd party service providers that not only charge 1%-2% from the loan amount, but also create friction and delays of days and in some cases weeks²³. Systems—that are built on different technologies from various generations—are not seamlessly integrated, and the vast majority of the information exchange flows through emails and broken APIs (Application Program Interface). Emails are very good for daily, short communications, but are not suited for facilitating multi-party, convoluted workflows that incorporate complex business logics.

Layer 2

Every step along the mortgage life-cycle entails different and various stakeholders who use a variety of software solutions to perform their activities. The current independent systems are inefficient and create user friction due to broken workflows and incomplete 3rd-party integrations. From our interaction with the market, we construe that users are frustrated with the current systems and go out of their way to generate in-house efficiency with the limited resources they have, all the while asking for software updates that rarely happen. In short, users serve the software and not the other way around.

We are focusing on three distinct stages of problems (MBS is out of scope for this paper, but is mentioned above to illustrate the mortgage lifecycle)

POS – Point of Sale

²³ Pauw, Chrisjan. “How Significant Is Blockchain in the Mortgage Industry?” *Cointelegraph*, 23 Oct. 2018, cointelegraph.com/news/how-significant-is-blockchain-in-the-mortgage-industry.

Information gathered from the applicant is transformed to the LOS. There is an overabundance of systems and user interfaces through which information can be collected from the applicant, and ergo multiple APIs are critical in order to transfer information from the POS to the LOS. Integrating multiple POS solutions to various LOS solutions is complicated and hard to sustain due to software updates. Moreover, the most common problem is that the POS software allows for data integrity issues to happen, e.g. the person's name on the application does not match the person's name in the SSN records, driver's license, utility bills, etc. From the smallest misspelling mistakes to forgetting to write a middle name, data integrity issues are a major issue at the beginning of the loan process.

LOS – Loan Origination System

Software solutions allow for broken workflows to occur here as well. The software allows the loan processors to make mistakes and pass along incomplete files to the underwriters. The underwriters are aware of this problem, and spend much time on finding those mistakes, instead of focusing on underwriting the mortgage. The software allows the underwriters to send incomplete files to the closers, who then double check both the loan processors and the underwriters, wasting time and energy on duplicative and unnecessary work. The closers do so, using in-house, proprietary, and paper-based checklists, instead of creating or using an in-software, properly functioning rules engine. In short: inefficiencies in the origination phase lead to fewer mortgage originations per any given time frame, leading to less profits.

Mortgage Trading – Secondary Market

The secondary market specialists, at best, use a different software from that used by the parties from the LOS stage, or worse, use just an excel spreadsheet to calculate and project trading

performance. In both cases, the integration between the former stage and this stage is far from optimal, creating time lags in decision-making processes that lead to inefficient trading and ergo suboptimal profits. The secondary market specialists use a hedging software to mitigate risk exposure to fluctuating interest rates. These hedging companies provide pricing advice and practical hedging trading on behalf of the secondary market specialists. The hedging companies are not fully integrated into the LOS, and so some of the communications between the specialists and the hedging companies are facilitated via emails, excel spreadsheets, PDFs, and phone calls. It is reasonable to expect data linkage and inconsistency of information between the parties. Another important activity for the specialists is to upload the loan files to Fannie's and Freddie's systems. These files come in a specific format called ULDD (Uniform Loan Delivery Dataset) that is generated from the LOS.

Solution

As established above, all stakeholders across the lifecycle rely on the data created in stage 2 through the LOS. As such, we consider the LOS the neck of the hourglass, which is the key driver for efficiency/inefficiency in the entire mortgage lifecycle. Thus, we offer a blockchain-based Loan Origination System that allows multiple parties to transact with pertinent writing and reading permissions, all the while conforming to the traditional way of doing business. We believe that while the reasoning and workflows behind doing business in the industry should not change, the underpinning technology must. The benefit from implementing a new LOS is transforming the time from mortgage application to closing from the current 45 days²⁴ to 15 days.

²⁴ "Purchase Market Heats Up While Time to Close Shrinks to Shortest Duration Since Early 2015." *Ellie Mae*, 19 Apr. 2017, www.elliemae.com/about/news-reports/press-releases/purchase-

Industry expert, and former CEO of Barclays, Antony Jenkins, suggests a day could come when the mortgage origination process could be complete in as fast as 10 minutes²⁵. While a 10-minute process is an ambitious goal, we believe that our estimated 15-day process is achievable. Speaking with industry stakeholders and front-line employees, we found the following breakdown of the 45-day process:

1. Several title companies' executives claimed to spend more than 40% of their time on communicating back and forth with Loan Processors, sending the same emails with the same files, multiple times, a potential waste of 3-7 days.
2. Loan Processors spend more than 50% of the time re-engaging with the applicants to correct any data integrity issues, a potential waste of 10-20 days.
3. Loan Underwriters spend more than 50% of the time on double-checking the Loan Processors work, and communicating file corrections back and forth, a potential waste of 5-10 days.
4. Loan Closers spend 95% of their time correcting mistakes made by Loan Processors and Underwriters, using paper-based checklist, a potential waste of 5-10 days.

In sum, a new LOS must have a powerful rules engine and well-functioning multi-party workflows. These features will eliminate the above-mentioned data integrity issues, reducing at least 50% of the processing time. In a medium-sized bank originating \$1B a year, with a lending team of 120 employees averaging \$45K annual salary, annual cost savings are estimated at \$2.7M

market-heats-up-while-time-to-close-shrinks-to-shortest-duration-since-early-2015-according-to-latest-origination-insight-report-from-ellie-mae.

²⁵ Browne, Ryan. "Banks Could Get Be Left behind in Momentum towards Blockchain, Says Ex-Barclays Boss." *CNBC*, 24 Aug. 2017, www.cnbc.com/2017/08/24/ex-barclays-boss-antony-jenkins-banks-fintech-momentum.html.

$(\$2.7\text{M (cost savings)} = \$45\text{K (average salary)} \times 120 \text{ (# of employees)} * 50\% \text{ (time saved)})$. If employees are not repurposed, we assume that 50% decrease in processing time will turn into 20% increase in originated mortgages due to existing pipeline bottlenecks, originating additional \$200M worth of mortgages. On a 1% marginal revenue assumption, the lender would increase annual revenues by \$2M $(\$2\text{M (increased annual revenue)} = \$1\text{B (volume of mortgages a year)} * 20\% \text{ (increase of volume)} * 1\% \text{ (marginal revenue)})$.

Implementation

elphi needs to integrate to many vendors before introducing a superior product in production. Assuming that the product is ready, including more than 20 different integrations with third-party vendors, implementation will involve setting up agreements among all relevant vendors to the customer, going through the risk-assessment protocols within the customer, and integrating to the customer's core system. Then, there would be benefits from piloting the software for two to three months, and afterwards full implementation.

Challenges to Implementation

As mentioned, lenders have various vendors supporting their operations, and the relationships with those vendors are complicated. One challenge could be a political challenge: a customer insists on a specific vendor that is not integrated with elphi's LOS. From there, elphi could either integrate with this vendor or convince the customer to switch to an existing vendor within the elphi LOS ecosystem. If elphi needs to integrate to a new vendor, that could become a technical challenge and create time lags that can lead to operational cash flow problem for elphi, as well as quality risk—if the vendor's solution is inefficient. A solution to this challenge would

be choosing the “winner” vendors in the first iteration of the product development, minimizing friction with customers.

Another challenge could be failing the risk-assessment protocol that the customer has; in this scenario, elphi either loses the deal or faces time lags in preparing again and overcoming this procedure. A solution to this challenge would be either outsourcing or hiring professionals to help in this process.

An additional challenge could be internal adoption. This involves users unwilling to adopt the new solution and failing to learn it quickly. A solution to this challenge would be choosing forward-looking customers at the first stages of the company.

Technology of Product

Blockchain boasts three key features:

1. Cryptography – communications in the presence of adversaries. Blockchain protocols use hash functions to encrypt information. A hash function is a one-way function used to map data of any size onto data of a fixed size. The outputs returned from a SHA-256 (Secure Hash Algorithm, 256 bits) hash function are 64-alphanumeric strings. These outputs cannot be decrypted backwards, which is why SHA-256 is a very powerful hash function. If one encrypts relatively similar strings, [*e.g. elphi, ELPHI, elphi1, ELPHI1*], the outputs would be completely different, as shown in the picture hereunder, generated by an online free tool²⁶:

²⁶*SHA256 Hash Generator Online*, passwordsgenerator.net/sha256-hash-generator/.

This online tool allows you to generate the SHA256 hash of any string. SHA256 is designed by NSA, it's more reliable than SHA1.

Enter your text below:

```
elphi
ELPHI
elphi1
ELPHI1
```

Treat each line as a separate string

SHA256 Hash of your string:

```
D988425DEA5CF31B5AD2939F15719ED7ECDB97C8696CD6AB421A1AF42B55F8B2
E774236311EEE2BE72405BF5540D2A304F3A47976E212B2ECE353B18D3ECEDD8
F95176651D9BDD0953A3D261DFDDEFFED0B9301A83A4620547FE2D094DFE53DA
7AA982C8E53F90106005D2A5FB5A4F02447E1983253637F014B5C5CCF657E630
```

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2. Decentralized Network Consensus Protocols – These protocols use either economics incentive structures to ensure adherence to veracity or best practices for traditional contracts, in both cases no centralized authority is involved in the transactions. However, a centralized authority created the protocol, which is why it is important to discern decentralization of data from decentralization of governance.
3. Ledgers – Time-stamped, append-only logs that record either transactions or balances. These ledgers serve as an immutable record of the data, in a way that allows for multiple parties to take part in multi-lateral transactions, dramatically reducing reconciliation time and thus cost.

²⁷ *SHA256 Hash Generator Online*, passwordsgenerator.net/sha256-hash-generator/.

Public and private blockchains promote trust in two types of networks: trustless, and somewhat trusted, respectively. In both cases, parties do not trust each other when they join the network. In a purely trustless, public blockchain network, anyone can join the network and transact with any counterparty, while in a private blockchain network, all parties must go through a centralized gatekeeper/doorman in order to join the network, ergo the participants are somewhat trusted after joining the network.

For elphi's use case we believe that Corda is the appropriate technology: a private-blockchain or DLT (Distributed Ledger Technology) protocol given the nature of the transactions that will go through elphi's Dapp (Decentralized Application). The targeted parties that will use elphi's Dapp prefer to hold their own private databases for proprietary, privacy, security, and regulatory reasons. We imagine an ecosystem where all parties use the same underlying protocol on which a variety of micro services will be built, allowing multiple parties to use multiple Dapps that interoperate with each other seamlessly.

From Corda's platform white paper:

*"...the vision is one in which a large number of firms, suppliers, customers and third parties manage a large and diverse range of agreements on the same platform, through deployment of a large range of Corda Applications, or CorDapps, across a common, shared, openly governed network. Corda is designed to allow information and assets gained through usage of one CorDapp to be used in a different context with different counterparties in a different CorDapp. This stands in contrast with other enterprise-focused blockchain platforms, which are designed to be deployed as isolated instances for each supported application."*²⁸

²⁸ Brown, Richard Gendal. "The Corda Platform: An Introduction." May 2018, www.corda.net/content/corda-platform-whitepaper.pdf.

Market Entry Strategy

elphi's go-to-market strategy entails short- and long-term strategies. The short-term strategy is to target small-sized lenders that have minimal resources to innovate by themselves, and as such are looking for third-party innovative solutions, trying to stay relevant in the crowded and competitive mortgage industry. These lenders could be credit unions or community banks that have \$1bn to \$10bn of total assets under management, originating \$100mm to \$3bn of residential mortgages a year. The long-term strategy is to target medium-sized and large banks that on the one hand have the capital to support Research and Development projects, but on the other are slow to innovate due to reputational risks. These large institutions are incapable of innovating on their own, and at the best-case scenario are successful in copying the things FinTech companies are doing²⁹. This is why some of the large institutions prefer to buy software solutions from third parties which are focused only on building and supporting their technology, and as such enjoy economies of scale.

Short-term strategy:

1. The MVPs (Minimum Viable Products) would provide the following functions:
 - a. Customizable online mortgage application interface.
 - b. Pipeline management sorted by client's chosen metrics.
 - c. Verification of income, assets, and employment.

²⁹ Garcia, Adrian D. "JPM, Big Banks Spend Billions On Tech But Innovation Lags." *Bankrate*, 27 July 2018, www.bankrate.com/banking/jpm-big-banks-spend-billions-on-tech-but-theyre-still-laggards/.

- d. Orders of services: credit reports, title, appraisal, mortgage insurance, home insurance, flood insurance, disclosure documents, eClosing, eVault, eMortgage, eNote, eSignatures.
 - e. Automated Underwriting System integration with Fannie Mae and Freddie Mac.
 - f. Integration to mortgage accounting software and servicing software.
2. First 10 clients:
- a. Credit Unions, small-sized, and medium-sized mortgage lenders. These institutions will originate between \$100mm and \$3bn mortgages a year. As such, we expect them to pay us between \$100k and \$3mm a year respectively.

Long-term strategy:

1. The full production product would provide all of the above and the following functions:
 - a. Expanded list of integrations of the above-mentioned list. Lenders could have a choice of which vendor they want to use from elphi's ecosystem.
 - b. Integration to mortgage servicing solutions, including trading MSR's (Mortgage Servicing Rights).
 - c. Mortgage trading – lenders would be able to trade whole mortgages on an online market place that is connected to the loan repository of each lender's node.
 - d. Loan syndication – lenders could collaborate on a loan level basis and diversify their risks on a loan-level basis.
 - e. Mortgage securitization – lenders could issue securities and offer them on a primary market. As mentioned above, this paper will not discuss the economic benefits of this function. This function is here to illustrate the market opportunity for growth.
2. Long-term target clients

- a. Large institutions such as Wells Fargo, Bank of America, Credit Suisse, Citi, JP Morgan Chase, etc. These institutions are expected to generate tens of millions of dollars for elphi, with five-year contracts, especially because they spend \$260 billion a year on IT³⁰.

Financing Strategy

Seed Investment Requirements and Pro Forma Assumptions:

1. MVP costs associated are ~\$4mm
2. Average client pays ~\$240K and is locked for 3-5 years
3. 6-12 months sale cycle for small clients³¹
4. 12-18 months sale cycle for large clients
5. First 100 clients follow quickly the existing satisfied clients (Credit Unions)
6. Conservative gross margins of 55-65%
7. Required R&D team for the first 12-18 months – 13 people
 - a. 10 engineers: 1 director, 2 front-end, 2 back-end, 1 security, 3 integrations, 1 DevOps. 2 Product Managers. 1 UX/UI designer

The challenges of staggered funding and why we are not pursuing that:

1. The problem with staggered funding is that progress is made in series instead of parallel.

As such, milestones must be achieved in order to unlock the next block of capital. In fact,

³⁰ Garcia, Adrian D. “JPM, Big Banks Spend Billions On Tech But Innovation Lags.” *Bankrate*, 27 July 2018, www.bankrate.com/banking/jpm-big-banks-spend-billions-on-tech-but-theyre-still-laggards/.

³¹ Vaswani, Anoushka. “So You Want to Sell to Banks?” *VentureBeat*, 2 Oct. 2016, venturebeat.com/2016/10/02/so-you-want-to-sell-to-banks/.

we contend that the ask of \$4mm is staggered, though untraditionally high. It is not only staggered, but also the minimum amount for a sustainable staggered financing. The next milestone for elphi would be a functioning MVP with the above-mentioned functions. According to our research, the process of building two MVPs of a POS and a LOS will take us 12 to 18 months and given the complexity of the products we would need the above-mentioned 13-person R&D team.

Financial Exhibits

Pro Forma:

Year		0	1	2	3
Clients growth: 1, 30, 100, 500					
Year 3 - signing a few large clients	Revenues	\$240,000	\$7,200,000	\$24,000,000	\$120,000,000
Margins grow 5% YoY from 55% to 65%	Cost of revenues	\$240,000	\$3,240,000	\$9,600,000	\$42,000,000
	Gross Profit	\$0	\$3,960,000	\$14,400,000	\$78,000,000
	Operating Expenses:				
	Sales and Marketing	\$21,960	\$1,206,000	\$3,290,400	\$12,204,000
	Research and Development	\$2,858,400	\$4,042,080	\$4,800,096	\$12,297,715
	General and Administrative	\$471,600	\$2,058,000	\$3,192,000	\$5,609,400
	Total operating expenses	\$3,351,960	\$7,306,080	\$11,282,496	\$30,111,115
	Income from operations	-\$3,351,960	-\$3,346,080	\$3,117,504	\$47,888,885
	Other income, net	0	0	0	0
D&A = \$0 for simplification	Earnings Before Interest & Taxes	-\$3,351,960	-\$3,346,080	\$3,117,504	\$47,888,885
	21% Income tax provision (benefit)	-\$703,912	-\$702,677	\$654,676	\$10,056,666
	Net Income	-\$2,648,048	-\$2,643,403	\$2,462,828	\$37,832,219

Discounted Free Cash Flow, 50% discount rate: Valuation ~\$49mm:

	0	1	2	3	4	5	6
	2019	2020	2021	2022	2023	2024	2025 SS
Clients growth: 1, 30, 100, 500, 1000, 2000							
Net Income	-\$2,648,048	-\$2,643,403	\$2,462,828	\$37,832,219	\$90,605,133	\$213,551,416	\$128,264,400
EBIT	-\$3,351,960	-\$3,346,080	\$3,117,504	\$47,888,885	\$114,690,042	\$270,318,248	\$162,360,000
Taxes	-\$703,912	-\$702,677	\$654,676	\$10,056,666	\$24,084,909	\$56,766,832	\$34,095,600
D&A	0	0	0	0	0	0	0
CapEx/Revenue (%)	28%	25%	22%	19%	16%	13%	10%
CapEx	\$67,200	\$1,800,000	\$5,280,000	\$22,800,000	\$38,400,000	\$62,400,000	\$49,200,000
Change in WC	0	0	0	0	0	0	0
FCF/Rev (%)	-1131.35%	-61.71%	-11.74%	12.53%	21.75%	31.49%	16.07%
FCF	-\$2,715,248	-\$4,443,403	-\$2,817,172	\$15,032,219	\$52,205,133	\$151,151,416	\$79,064,400
50% NPV per year	-\$2,715,248	-\$2,962,269	-\$1,252,076	\$4,453,991	\$10,312,125	\$19,904,713	\$6,941,182
SUM NPV 0-5	\$27,741,235						
perpetuity						\$166,451,368	
NPV TOTAL	\$49,660,757						

Discounted Free Cash Flow, 20% discount rate: Valuation ~\$267mm:

	0	1	2	3	4	5	6
	2019	2020	2021	2022	2023	2024	2025 SS
Clients growth: 1, 30, 100, 500, 1000, 2000							
Net Income	-\$2,648,048	-\$2,643,403	\$2,462,828	\$37,832,219	\$90,605,133	\$213,551,416	\$128,264,400
EBIT	-\$3,351,960	-\$3,346,080	\$3,117,504	\$47,888,885	\$114,690,042	\$270,318,248	\$162,360,000
Taxes	-\$703,912	-\$702,677	\$654,676	\$10,056,666	\$24,084,909	\$56,766,832	\$34,095,600
D&A	0	0	0	0	0	0	0
CapEx/Revenue (%)	28%	25%	22%	19%	16%	13%	10%
CapEx	\$67,200	\$1,800,000	\$5,280,000	\$22,800,000	\$38,400,000	\$62,400,000	\$49,200,000
Change in WC	0	0	0	0	0	0	0
FCF/Rev (%)	-1131.35%	-61.71%	-11.74%	12.53%	21.75%	31.49%	16.07%
FCF	-\$2,715,248	-\$4,443,403	-\$2,817,172	\$15,032,219	\$52,205,133	\$151,151,416	\$79,064,400
20% NPV per year	-\$2,715,248	-\$3,702,836	-\$1,956,369	\$8,699,201	\$25,176,087	\$60,744,364	\$26,478,508
SUM NPV 0-5	\$86,245,198						
perpetuity						\$451,796,571	
NPV TOTAL	\$267,812,107						

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