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### Headwinds and Tailwinds for Fintech In Equipment Financing

*By Levon Goukasian, PhD, and Bill Ullman*

Financial technology, or fintech, has emerged as a sub-industry to the financial services industry. It offers marketplaces for financial transactions, alternative data collection and analysis, and much more. This article explains the factors and trends that have helped fintech evolve, discusses regulatory issues and developments, and offers various corporate strategies for incumbents.

### Using Artificial Intelligence Technology to Remain Competitive in a Fintech Environment

*By William S. Veatch*

Recent developments in mathematics, logic, and data science are leading to advances in artificial intelligence and the law. Speed and efficiency are paramount to the new breed of lessors and lessees, and data is king. This article explains the benefits to lessors that embrace the new technology to remain competitive. The appendix offers a primer on logic, both traditional and the Boolean lattice, to illustrate how leasing attorneys may be performing their jobs in the future.

# Headwinds and Tailwinds for Fintech in Equipment Financing

By Levon Goukasian, PhD, and Bill Ullman

Financial technology, or fintech, has emerged as a sub-industry to the financial services industry. It offers marketplaces for financial transactions, alternative data collection and analysis, and much more. This article explains the factors and trends that have helped fintech evolve, discusses regulatory issues and developments, and offers various corporate strategies for incumbents.

Technology is shaking the foundations of traditional businesses, including financial services. A new type of competition is emerging from the financial technology, or fintech, sector. The rise of the fintech sector is a global trend, reaching both developed and developing economies.

Fintech describes the evolving intersection of financial services and technology. Fintechs integrate finance and technology in ways that disrupt traditional financial models and businesses and provide new services, or access to services to businesses and consumers, and do so with significantly lower cost. Fintech disruptors are expanding into online lending, alternative data collection and analysis, credit underwriting, digital deposits, mobile payments, wealth management, robo-advising, and other areas of the financial services industry.

Emerging technologies such as cognitive computing (CC), machine learning (ML), artificial intelligence (AI), and distributed ledger technologies (DLT) have the potential to change the financial services industry. They are used by fintechs as well as by established incumbent financial institutions (incumbents).

## FACTORS BEHIND THE FINTECH EVOLUTION

Wide-scale tech disruption is happening in many industries, including the financial services industry. Recent advances in online encryption technologies, such as cybersecurity, e-signing, electronic funding and electronic or mobile payments, have empowered fintechs to underwrite and manage financing risk and their operations on a highly automated basis.

One of the factors behind fintechs' successful evolution is their ability to collect and process data from internet-based sources, including social networking sites and third-party credit-scoring agencies. Fintechs also use sophisticated algorithms to make faster credit decisions than traditional scoring agencies using manual underwriting.

Below we summarize some of the most important factors and trends that have contributed to the successful evolution of fintech and its penetration into the financial services industry:

### Favorable Economic Environment
The post-crisis economic environment of low interest rates, the economic recovery from the recession, and low delinquencies of consumer loans made alternative investments in online lending platforms, with potentially higher yields, attractive to yield-searching investors.

### Changing Demographics and Consumer Behavior
Millennials, the "digital natives" generation, have strong preferences for online or mobile platforms, automated processes, and transparency of data and information. Millennials also have a perception that peer-to-peer (P2P) or multi-lender

marketplace (MPL) lending is of greater social value than conventional banking.

> Fintech lenders often use information in credit underwriting algorithms that comes from nontraditional sources, such as information from social networking sites.

### Big Data, Cloud Technology, and Automation

These factors are driving cost advantage and ease of use and have helped make credit determination and funding decisions faster. They encompass social networks, advances in analytics, big data analytics, cloud technologies, mobile accessibility, electronic applications, marketplace funding models, e-signatures, e-documentation, and proprietary credit-scoring algorithms.

Fintech lenders often use information in credit underwriting algorithms that comes from nontraditional sources, such as

information from social networking sites (not used by traditional banks in their lending decisions).

Some fintech lenders have developed their own online lending platforms that use big data in their own proprietary algorithms to evaluate the credit risk of borrowers. Through this new approach to credit risk evaluation, some consumers, who would otherwise be underserved, potentially could get access to funding.

### Regulatory Advantage

Most MPLs, being largely unregulated, can operate with almost no regulatory overhead. MPLs enjoy the "regulatory arbitrage" in the sense that traditional financial service companies have high barriers to entry, such as state licensure laws, capital requirements, and regulatory compliance, but MPLs are not directly regulated.[1] This allows them to successfully compete with incumbents or even to be in an advantageous position by comparison.

### Serving an Underserved Market

Many fintechs entered the marketplace to provide financing to those small businesses (or

individuals) that could not get funding from traditional incumbent lenders in the post-crisis time period because of the flight to quality.

## FINTECH ECOSYSTEM

The online lending market has evolved rapidly over the last decade and continues in its growth trajectory. Fintechs approach financial services from a technology and customer experience perspective. Many of them have focused on payments.

Digital ecosystems or marketplaces operate in nonpayment spaces, providing platforms for merchants and consumers. For these firms, the focus is on financial transactions occurring within their own marketplace. Some of the digital ecosystems operate balance sheet lending, peer-to-peer lending, or multi-lending platforms.

Another category is data providers such as Equifax, FICO, Orchard Platform, PeerIQ, and PayNet. These companies facilitate new lending activity by providing access to new data sources or by aggregating data on the online lending industry.

**Balance sheet lenders.** These are companies that lend directly from their balance sheet and retain the loans and their risks. This model of lending has yielded to another one, a hybrid model of lending, in which fintechs borrow from other sources of capital to lend on their platforms.

**Peer-to-peer marketplaces.** The P2P model was established in the consumer lending market, to match investors with borrowers. As P2P small business lending evolved over time, the market became dominated by institutional investors and P2P and B2B marketplaces were born.

**Multi-lender marketplaces.** Another emerging online segment in small business lending is multi-lender marketplaces, in which small business borrowers can comparison shop among many loan offerings. These loans can be offered by alternative lenders or even traditional lenders. These MPLs are helping consumers in their search for the best source of funding, by offering the convenience of seeing most offers in one place to compare, select, and fund.

**Payments/e-commerce platforms.** Existing payments or e-commerce platforms are entering into the online lending market, by targeting small business loans (for now). These platforms are offering loans to their existing small business customers.

*Invoice financing.* Invoice financing is a process by which businesses can receive payment up front for outstanding invoices.

**Data providers.** Alternative lending platforms or fintechs apply new underwriting practices that use data from sources that would not be used by the traditional banks, thus making faster credit decisions and in many cases widening their scope of customers to include underserved ones. There are new types of data providers — to either platforms or to institutional investors — that collect, compile, and standardize data and then provide it to others for decisionmaking.

## UNDERCURRENTS

Recent advances in online encryption technologies, cybersecurity, documentation preparation, e-signing, and electronic

funding and payments have created an environment for fintechs to grow and penetrate the financial services industry. The ongoing fintech disruption is built on the following undercurrents:

- A lower-cost operating model due to lack of regulatory overhead or other costs, such as loan processing or servicing costs. Most fintechs are not regulated, and therefore they do not have the regulatory overhead burden. Because of this lack of regulations, the barrier to entry has been very low for fintechs.

- The ability to use alternative data and sophisticated credit scoring algorithms to make the credit determination and funding decisions faster.

- Superior customer experience, driven by speed and convenience, as a result of incorporation of technological innovations.

- The low-interest rate environment since the financial crisis of 2008.

- Timing: Fntech developments have happened during the expansionary part of the business cycle, where delinquencies have been low, the risk appetite has been increasing,

and there have been shortages in high-yielding investment opportunities.

- Strong investor demand for online-originated loans due to their high yields. This has been fueled by credit agencies' involvement with MPL asset-backed security transactions, such as DBRS and Moody's ratings of CommonBond's loans and Kroll's rating of Lending Club's MPLs, which increases the credibility of online-originated loans.

- Innovations in and availability of new technologies.

- Shifts in consumer preferences toward virtual Banking 2.0, Banking as a Platform (API), and mobile banking.

## FINTECH RISKS

Marketplace lending is evolving so rapidly that it is difficult to make predictions about its more mature state. As with any new and untested market, there are such issues as lack of performance histories through full economic cycles, financial stability, operational risks, or its ability to comply with new and ongoing regulatory requirements such as the Financial CHOICE Act or the fintech bill intro-

duced by Congressman Patrick McHenry. (These are described below in Ongoing Regulatory Changes.)

### Lack of Performance Histories Through Full Economic Cycles

How will the fintech industry perform in high interest-rate environments? In an economic slowdown? In a credit or liquidity crisis? Development of risk measures and risk management tools — especially under the scenario of substantial increases of default rates in a major business downturn — are important for the long-term survival and growth of the industry.

Unlike more traditional lenders, the marketplace lending business model heavily relies on loan originations and the subsequent sales of the loans. Generally, the primary sources of marketplace platform providers' revenue are the loan-origination fees and loan-servicing fees.

In case of a major economic downturn, a massive number of loan defaults could result in large losses for fintech, and that could easily exhaust any default reserve funds that they might have.

The financial services industry needs both to quantify the risks of losses in case of a downturn and to educate investors about these risks. Not only will servicing revenue be lost due to a rising number of defaults but loan origination fees will also be adversely affected.

Loan originations could decline or even be interrupted for other reasons, too, including regulatory restrictions, lack of investor interest, increased competition, or loss of a relationship with the originating partner institutions. Potential decline of loan-origination fees will likely limit revenue and, in turn, lead to operational difficulties for marketplace platform providers.

In more established sectors, historical data from various economic and business cycles help to better anticipate collateral performance and compare individual pool performance with that of the whole sector or a typical benchmark pool. The marketplace lending sector, however, is relatively new and untested in business cycles.

## OTHER RISKS

Several other forms of risk merit describing.

### Operational Risks

Potential credit risk concepts should be considered here: risks of platform failure, bankruptcy following large financial losses, or the possibility of operational failure.

> Unlike more traditional lenders, the marketplace lending business model heavily relies on loan originations and the subsequent sales of the loans.

### Regulation

The objective of regulators is to ensure appropriate oversight without blocking financial innovation and the use of MPL platforms to provide credit to borrowers that are unable to borrow from traditional lenders. However, the uncertainty about future regulations or deregulations (depending on the political parties in control) may hurt the innovative developments in this market.

### Cybersecurity Risk

Cybercrime is at an all-time high for financial services, and cyber-

> The key to assessing the impact of rising interest rates on fintechs is to estimate what part of the cost of funds for fintech is interest-rate sensitive. That is, what part of the overall cost will be impacted due to rising interest rates?

attacks are more sophisticated than ever. Although fintech offers real benefits and efficiencies to individuals or small businesses, it also creates security vulnerabilities and new risks — cybersecurity risks — for consumers of digital financial services. Fraud, cybersecurity, and money-laundering operations are three other situations that require MPL platforms' readiness, to prevent such actions and comply with regulations.

### Monetary Policy: Tightening of Credit

The Federal Reserve System is expected to tighten monetary policy over the coming years. The Fed Funds Futures at the CME Group price-in multiple interest rate increases in the near future, and such changes will affect cost of capital and access to capital for fintechs.

MPLs had low operating costs and relatively low customer acquisition costs because of the low interest rate environment in the last nine years. But this cost advantage may quickly diminish depending on the interest rate environment; therefore, we analyze the impact further below.

The key to assessing the impact of rising interest rates on fintechs is to estimate what part of the cost of funds for fintech is interest-rate sensitive. That is, what part of the overall cost will be impacted due to rising interest rates?

Deloitte, in a recent report, "Marketplace Lending: A Temporary Phenomenon?" examined the costs incurred in originating and servicing a loan through the traditional bank model with an equivalent loan that was originated and serviced through online lenders. Deloitte's analysis does not compare the total costs of operating a bank to the total costs of operating an MPL. It analyzes only the cost of funding an unsecured personal loan at banks and at MPLs, in both the current environment and in a hypothetical higher interest-rate environment. The findings suggest that:

1. The total funding costs for banks are lower than for MPLs.

2. The non-interest-rate-sensitive component of an MPL's funding profile is proportionately lower than it is for a bank. Therefore, MPLs' costs will rise significantly more than banks' costs, 25% versus 13%, as interest rates increase.

Thus, these estimates and analysis demonstrate the higher sensitivity of MPL-generated loans to interest rate increases compared to loans originated by the banks.

### FINTECH-RELATED REGULATIONS

The growth of fintech is challenging regulators to create new regulations to meet the demands of the growing industry. The fintech industry in the United States attracts a sizable number of investments. As it becomes a crucial part of the financial system, the largely unregulated nature of fintech at some point is likely to invite regulatory scrutiny.

The marketplace lending industry has been subject to recent cautionary guidance issued by many federal regulators. (Examples are the Consumer Financial Protection Board, or CFPB, releasing a request to explore the impact of alternative data sources in 2017, and the OCC's recent white paper, "Supporting Responsible Innovation in the Federal Banking System.") While the regulating agencies have acknowledged the potential benefits of online lenders to consumers, they have also pointed to certain risks, particularly as related to fair lending and compliance with the Equal Credit Opportunity Act (ECOA).

Consumer loans are highly regulated. Loans made through the online platforms are subject to extensive rules and regulations, entailing licensing and examination by federal, state, and local governments. For example, regulation limits the loan fees, requires many forms of disclosures, and imposes licensing requirements on lenders.

Many lending platforms collect data from borrowers' social networking activities and apply that data to their proprietary algorithms to determine borrowers' creditworthiness, which may not be compliant with the ECOA. The Department of the Treasury's May 2016 report on marketplace lending referenced the use of alternative data in underwriting by marketplace lenders as an area of both promise and risk.[2]

Traditional lenders, on the other hand, use credit scores from the established credit agencies or other information that is not related to the borrowers' characters, and they therefore are compliant with the ECOA.

### ONGOING REGULATORY CHANGES

Although there currently is no comprehensive regulation of online marketplace lending in the United States, lenders are subject to various federal and state laws and regulations. These include federal and state consumer-protection statutes and regulations, lender and broker licensing and usury laws, data-privacy laws, and securities regulation.

## Consumer Financial Protection Bureau

In 2017 the CFPB released a request for information to explore the impact of alternative data sources, including data from mobile phones, rent payment histories, electronic transactions such as deposits, withdrawals and transfers, building credit histories and increasing credit access. The potential risks posed by these data sources are of concern because they may be biased and could have an adverse impact on credit access to low-income and underserved communities.

### Madden v. Midland

On June 27, 2016, the U.S. Supreme Court declined to hear the case of *Madden v. Midland Funding LLC,* letting stand the decision of the U.S. Court of Appeals for the Second Circuit that the National Bank Act does not protect against state usury law claims if the bank's assignee is not located in the state in which the loan was originated. The Second Circuit Court of Appeals reversed a century of "valid when made" precedent by letting a state apply its interest rate cap to a loan made in another state that was bought by a third party.

The U.S. House of Representatives recently passed H.R. 3299, the Protecting Consumers' Access to Credit Act of 2017. This act ensures that bank loans that fall within the maximum rate of interest allowable under federal law when made will remain valid regardless of whether a bank subsequently sells or assigns the loan to a third party.

This bill, now with the Senate Banking Committee, essentially overturns the Second Circuit's ruling in *Madden.*

## Financial CHOICE Act

The U.S. House of Representatives passed the Financial CHOICE Act in 2017. The FCA repeals financial regulations harming consumers, investors, and entrepreneurs. Moreover, it helps to clear the regulatory uncertainty about peer-to-peer lending. The FCA includes many bills that help startups and small businesses access the capital they need to launch, scale, and compete. The bill also clears barriers in the financial technology sector. The FCA has direct potential effects on securitizations, marketplace lending, and commercial lending.

## Fintech Bill

Congressman Patrick McHenry, vice chair of the House Financial Services Committee, has introduced the Financial Services Innovation Act of 2016, which is intended to provide a streamlined regulatory process for innovative fintech products and greater certainty about compliance requirements.

The federal agencies covered by the bill include the CFPB, Federal Reserve, Federal Deposit Insurance Corp., National Credit Insurance Administration, Office of the Comptroller of the Currency, Federal Trade Commission, and Office of Housing and Urban Development.

## Innovation Initiative

The Office of the Comptroller of the Currency issued a white paper, "Supporting Responsible Innovation in the Federal Banking System," in March 2016, in which the OCC solicited feedback on its innovation initiative to develop a comprehensive framework to identify and understand trends and innovations in the financial services industry.

## Special Purpose National Bank Charter

On December 2, 2016, the OCC announced its plans to move forward with a proposal to consider applications from fintechs to receive charters as special purpose national banks. The OCC's white paper expresses three reasons why the agency believes it is in the public interest to provide the special interest charter. They are to ensure that fintech companies operate "in a safe and sound manner," to promote "consistency" in governing law and regulation, and to "make the federal banking system stronger."

This proposal is significant for the fintech sector because a national bank charter could relieve fintechs of needing to register or obtain licenses in various states, with their differing sets of laws and restrictions.

There are, however, questions about how the fintech banking charter would change the market, particularly considering capital adequacy and compliance requirements. There is also an open question whether a bank charter would constrain the innovation that has differentiated

the fintech industry from the traditional banking industry.

> The Second Circuit Court of Appeals reversed a century of "valid when made" precedent by letting a state apply its interest rate cap to a loan made in another state that was bought by a third party.

In addition, a national bank charter will not help the fintech industry to obtain more stable funding unless fintechs are permitted to take deposits, which would require regulatory oversight by the FDIC.

## Deregulation

There is a widespread belief that the Trump administration may reduce existing regulations in the financial services industry. Assuming no other changes in industry regulations, deregulation will be positive for the early-stage fintechs because they will not have (almost any) regulatory barriers to entry. The administration's goal is to reduce the financial burden on banks by

repealing and reducing various provisions of the Dodd-Frank Act, replacing them with new policies and regulations.

> Even though fintechs may cause potential threat to incumbents, they also create opportunities for them to differentiate themselves and become more competitive.

Deregulation in the banking sector, however, will also reduce any regulatory arbitrage that fintech companies have been enjoying for some time, compared to their more established incumbents. However, while the possibility of deregulation in the whole financial services industry is expected, fintechs may be subject to new regulations for consumer protection purposes.

## CORPORATE STRATEGIES

In a report published by the Economist Intelligence Unit titled "The Disruption of Banking," more than 100 senior bankers and 100 fintech executives were interviewed to predict the future of the banking industry over the next five years.

When bankers were asked how fintech may disrupt the banking industry, more than 90% of them believed that fintech firms will have a significant impact on the future of banking, with more than one-third believing that fintech will gain a share equal to the incumbents (24%) or an even larger share of the market (20%).

When asked about banking industry's response to the fintech challenge, a majority of bankers (54%) believed that banks are either ignoring the challenge or that they "talk about disruption, but are not making changes."

Should the incumbents respond to fintech disruption attempts? How should they respond? What are some of the suggested strategies for them to follow? It is our opinion that the lenders that will be best positioned to face ongoing marketplace disruptors are those that take advantage of technological advances and invest in them, as part of their corporate strategies for growth, and gain of more

market share, through a more efficient and more customer-oriented approach, equipped with disruptive business models.

Strategic partnerships are among the most promising ways for incumbent financial institutions to work with technology innovators to strengthen and improve existing business models, and keep or increase market share. For incumbent financial institutions, a suggested strategy would be to utilize alternative lenders' technologies for speedy online application, origination, underwriting, and servicing of loans.

Even though fintechs may cause potential threat to incumbents, they also create opportunities for them to differentiate themselves and become more competitive. To improve their operational efficiency, not only can incumbents form joint ventures with them or acquire the fintech firms but they also can learn from fintechs and adopt their new technologies.

So how can market participants, both incumbents and fintechs, best adapt themselves to the competition?

Following EY 2017 findings and suggestions from 2017, we compile a list of corporate strategies for incumbents and provide the pros and cons of these suggested strategies, to deal with the ongoing fintech disruption.

- **Strategy 1: Invest in fintech.** Banks and other companies invest in fintechs many different ways, such as creating their own venture capital or strategic investment arms. (e.g., GV, formerly Google Ventures, investing in tech startups, including fintech).

- **Strategy 2: Partner with fintechs.** Banks enter into various types of partnerships with fintechs, such as the use of their platforms. They may partner with fintechs to develop new technologies or to refer unqualified (to the incumbent) applicants to their fintech partners.

- **Strategy 3: Develop technologies in house.** Although most banks have plans for facing fintech competition, another of their strategies is internal innovation. Banks are accelerating their in-house development of fin-technologies.

- **Strategy 4: Merge with or acquire a fintech.** Acquiring

or merging with a fintech company can increase a bank's digital presence. Acquisitions have also become a common trend for large financial companies.

- **Strategy 5: Join a fintech program with other incumbents.** Some of the biggest banks in the United States joined forces to create the so-called clearXchange network a few years ago. Now known as Zelle, it is a platform that allows consumers to transfer funds from their bank accounts to another person's bank account using a mobile device. It has grown to include many smaller banks or credit unions.

It is not an easy task to determine the superiority of any of the above five strategies. The decision depends on the pros and cons of the strategies under consideration that are relevant to the firm.

## FINTECH IN EQUIPMENT LOANS AND LEASES

In 2015, total public and private investment in equipment and software totaled $1.5 trillion, of which 68% or $1.02 tril-

lion was financed, according to an estimate based on data from IHS Markit and the U.S. Department of Commerce Bureau of Economic Analysis. Of the 68% of equipment that was financed in 2015, 39% was leased, 16% used a secured loan, and 13% used a line of credit (LOC). Banks, Captives, and Independents financed only about $270 billion of all equipment purchases.

By the estimates of ELFA's U.S. Equipment Finance Market Study: 2016–2017, the total investment in equipment and software is expected to grow to $1.8 trillion by 2020, of which about $1.2 trillion is expected to be financed. Given the (relatively low) rate of financing by Banks, Captives, and Independents, this provides opportunities to new (fintech) entrants to penetrate this market and capture market share by providing financing to the underserved market.

We studied the potential of fintechs to penetrate the equipment loan market either by serving the underserved market or by gaining market share by refinancing existing equipment loans.

We estimate the size of the equipment loans and leases market that is susceptible to refinancing to be under $5 billion — which is less than 4% of the total amount of new business origination in FY 2016.

Thus, using our estimates (based on subjective metrics that would determine susceptibility of loans to refinancing by third parties, including fintechs), we find that the existing equipment loan market is not very susceptible to disruption.

It is estimated that about 43% of the $1.6 trillion equipment purchases — about $688 billion — is financed by cash, credit cards, or LOCs. While that 43% seems to be a sizable market for penetration by fintechs, and probably a part of it could potentially be tapped by fintech lenders, it is difficult to apply our criteria or otherwise estimate the size of this market (cash, LOC, and so on) that is susceptible to financing by fintechs.

There are many unknowns here, such as the characteristics of cash buyers, that would not allow us to estimate the possibility of fintech penetration. One

important characteristic could be cash buyers' risk aversion, which may make their opportunity cost lower than the potential financing costs (even for prime borrowers). For such risk-averse borrowers, it may be challenging for fintechs to offer services or even attractive rates to change their purchase-financing decisions.

LOC-funded equipment acquisitions, however, could potentially be disrupted by fintechs, given that they are frequently refinanced with a permanent equipment loan. Bank leasing companies accommodate equipment purchase transactions first through the bank LOC, then shift it to a permanent lease/loan upon project completion.

What about the future business of the incumbent Banks, Captives, and Independents?

Since the banks finance the majority of the equipment loans, we will consider the banks as incumbents and compare them with fintech disruptors. When considering the next five years, we will use a more "normalized" credit environment, which means higher interest rates.

Thus, assuming the rates increase, we would compare how fintechs will fare against the banks in gaining market share in the equipment financing area. Fintechs do not have much room to disrupt the banks in the equipment financing area. In the case of higher interest rates, we think the banks will have more cost advantages and therefore will be better positioned to keep the expected market share (barring a fintech-disruption threat).

## OTHER TECH IN EQUIPMENT LOANS AND LEASES

Other technology-related disruptions of the equipment research/purchase/financing market should be considered when analyzing fintech disruption of the equipment loan market. For example, new companies are developing and implementing innovative technologies or new business processes that improve operations and enhance customer experience. Some of the new (tech) companies are digitizing various aspects of logistics, including booking transportation and finding warehouse space.

Some fintechs are creating platforms to connect buyers to vendors and financing companies, in addition to origination systems, credit scoring, pricing, decisionmaking, documentation, and so on. Mintaka Financial is an example of such a company. Other tech companies are focusing on online shopping, financing, and e-documentation as well as on improving the customer experience by speeding the entire process of buying and funding the purchase.

> Since the banks finance the majority of the equipment loans, we will consider the banks as incumbents and compare them with fintech disruptors.

Fintech disruptors also impact the means by which business is processed, by offering such services as document fulfillment, digitization, document storage, payment processing, and credit decisioning, thus improving the operating efficiencies of existing equipment finance companies.

Thus, technology (or fintech) companies are actively pursuing their entry to the equipment market, by targeting all related areas — researching, purchasing, origination, funding, or identification of marketplaces for used equipment. Therefore, there are areas that fintechs can penetrate (and have already), and there are areas that are not prone to fintech penetration.

While the equipment financing industry is not as susceptible to fintech disruption through refinancing, there could be threats to the industry affecting retention of existing or future business.

New tech developments — those that make equipment research, purchase, funding, servicing, or remarketing and reselling more convenient, effective, efficient, faster, and less expensive — have the potential to penetrate the equipment financing market and possibly take away market share from those incumbents that do not respond to the changing environment in a timely manner.

However, those incumbents that act in a timely manner, taking appropriate steps to have strategies in place to hedge against

such disruptive forces, will be well positioned to retain their current or anticipated future market share.

## CONCLUSION

Fintech companies take the latest developments and innovations and commercialize them in the equipment loan and lease industry. They thus make operations more effective and efficient, improve customer experience, and provide convenience during the entire researching, buying, funding, servicing, remarketing, and reselling process.

To a certain extent, there is a threat to fintech disruption for the incumbents in the financial services industry, but we do not believe that fintech could be so disruptive as to become the main source of funding.

While the fintech disruption may not threaten incumbents with the loss of most of their market share, nevertheless incumbents should act to hedge the risks of losing their market share to fintech disruptors.

To hedge the risk of losing existing business, the corporate

strategy of any incumbent, whether a financing company, a manufacturer, or a vendor, should be to closely follow the developments in new and potentially disruptive technologies, adapt them, or invest in them in a timely manner.

Those incumbents that act in a timely manner and have strategies in place — to hedge against the risks of losing business that result from not operating to match with the new and disruptive technological developments — will be well positioned not only to retain their current business share but also gain more market share in the future.

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## Endnotes

1. Some of the marketplace lenders' regulatory advantage comes from working with issuing banks, such as WebBank or Cross River Bank, and effectively outsourcing the regulatory compliance to WebBank or Cross River Bank, which are regulated financial institutions.

2. U.S. Treasury, "Opportunities and Challenges in Online Marketplace Lending" (May 2016), available at https://www.treasury.gov/connect/blog/Documents/Opportunities_and_Challenges_in_Online_Marketplace_Lending_white_paper.pdf.

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# Using Artificial Intelligence Technology to Remain Competitive in a Fintech Environment

By William S. Veatch

Recent developments in mathematics, logic, and data science are leading to advances in artificial intelligence and the law. Speed and efficiency are paramount to the new breed of lessors and lessees, and data is king. This article explains the benefits to lessors that embrace the new technology to remain competitive. The appendix offers a primer on logic, both traditional and the Boolean lattice, to illustrate how leasing attorneys may be performing their jobs in the future.

This article examines how advances in mathematics, logic, data science, and artificial intelligence are beginning to impact the way attorneys draft equipment lease and loan documentation, and how those documentation changes in turn are affecting how parties do business in the finance world.

Without being overly technical, we review some of the latest developments in mathematics, logic, and data science that have enabled advances in artificial intelligence and the law. (The appendix goes into more detail, and the related endnotes provide references to extensive resources for readers interested in learning more.)

For those readers questioning the current sense of urgency, the answer is that we see a surge of interest in applying the latest technology innovations to the finance world through a convergence of fintech, regulatory technology, and legal technology.

Whether we like it or not, the finance world is changing. Technology companies are partnering with financial institutions to develop innovative products and services that change the way we do business. As we proceed through the article, three trends emerge:

- New breed of lessees: A new generation of tech-savvy college and business school graduates is emerging, resulting in a new class of technologically demanding customers.
- New breed of lessors: New classes of competitors for equipment lessors have appeared. These include internet marketplace lenders that are expanding product offerings to include equipment leases, and internet retail giants that are offering financial services.
- Data: Data is king. The predominant focus of fintech companies is the collection and use of data. Equipment lessors also have an opportunity to collect customer data, and by so doing create a new, potentially extremely valuable asset.

Those lessors that do not adapt and learn to use the new technology may wake up one day to find that a new hybrid fintech lessor has emerged and captured a significant portion of the equipment leasing market. The question is not, What can fintech companies do for us? but rather, How can traditional equipment lessors use artificial intelligence technology to avoid being rendered obsolete?

## WHO ARE THE LESSEES AND LESSORS OF THE FUTURE?

The world has changed in terms of how we contract for goods and services and how we pay for them. Consequently, electronic contracts and forms of electronic payment are continuing to evolve at a rapid pace.

As is often the case, a new generation of individuals brings with it a change in how business is transacted. Speed and efficiency are paramount to the current new generation of lessees: "I want it, and I want it now."

If the leasing industry can standardize the lease and loan boilerplate terms, lessees will be able to quickly enter into a lease or equipment loan and

trust they will be treated fairly. The negotiation then shifts to the material business terms, rather than interpretation of obscure lease agreement provisions. From a lessee's perspective, greater transparency is highly desirable.

> There is a "new logic of the law" that has the potential to serve as a springboard for the development of artificial intelligence software applications.

The other radical change that we are seeing is the emergence of new classes of competitors to traditional equipment lessors. Now, in addition to bank-owned leasing companies and traditional nonbank equipment lessors, we are seeing internet marketplace lenders and other fintech companies expand their target asset classes from unsecured consumer loans to include small and medium business secured loans, auto loans, and equipment leases.[1]

Keeping in mind the changing profile of the lessee to a tech-savvy customer looking for speed and simplicity, the new breed of fintech lessor offering almost instantaneous credit through a software application has considerable appeal.

The other class of financier to watch is the internet retailer. It has been projected that before long, some of the behemoth internet retailers will be the largest lenders in the world. We have already seen the impact on the consumer credit business, where a retailer acquires a bank in order to take deposits and offer consumer credit on a 50-state basis.

We are also seeing internet retailers purchase fleets of trucks, planes, and recently ships in order to enhance the flow of goods worldwide and capture the financing revenue. All signs indicate that this trend will continue, posing a greater threat to traditional financiers.

From both a lessee and a lessor perspective, moving to data-driven contracts would help the parties achieve their respective goals of speed, cost efficiency, and maintaining a competitive advantage. In fact, traditional equipment lessors have an opportunity to be technological leaders rather than followers.

## WHAT IS ARTIFICIAL INTELLIGENCE?

The term "artificial intelligence" is defined in different ways when used for different purposes. In the context of applying artificial intelligence to lease and loan documentation, we mean developing software applications that can (1) analyze legal issues under the Uniform Commercial Code (UCC) Article 2A and Article 9, and "think like a lawyer," and (2) assist with document origination, as well as modification, reporting, transfer, and securitization.[2]

Artificial intelligence is closely related to the study of logic, which is defined as the study of how we think and reason. Therefore, to develop artificial intelligence software applications in the law, we first need to understand how lawyers think and reason.

For those who are interested and have some background in logic, we review in the appendix, very briefly, the various forms of traditional logic and their limitations, and then introduce a new form of "logic of lattices" that is robust enough to support the development of artificial intelligence in the law.

There is a "new logic of the law" that has the potential to serve as a springboard for the development of artificial intelligence software applications. These software applications include the development of a new breed of smart contract, including equipment leases and loan agreements in a new digital, data-based format.

It is not necessary for most readers to understand the logic in detail. Everyone should understand, however, that advances in legal logic have developed to the point that now we can create truly useful artificial intelligence software applications for use in the practice of law.

Just as you need not be an engineer to drive a car, you need not be a mathematician to use the new logic of the law in the everyday drafting and negotiation of contracts.

## VIEWING THE SUBSTANTIVE LAW AS DATA

In simple terms, the new logic of the law does two things: (1) it breaks down ideas – legal concepts and rules in this case, into their component parts (a "partition") and (2) it helps us understand the relationships among ideas where there is an order to the ideas (a "chain").

As we become proficient in analyzing legal concepts by breaking them down and sorting them with partitions and chains, we begin to see that we can analyze the substantive law as fields of "data."

While due to space limitations we can provide only a few examples in the appendix, it is possible to interpret any provision of the UCC as a combination of partitions and chains.[3] In fact, efforts to create such a digitized map of the UCC are underway. We can store this data in a database in a "cloud" storage medium – that is, on a remote server – in a form that we refer to as a "knowledge representation structure."

Once we have the substantive law stored as data, we can create software applications using IF-THEN statements that reflect the logic inherent in partitions and chains.

## Creating a Map of the UCC to a Knowledge Representation Structure

There are two important points for the reader to remember about our ability to view the substantive law as data. First, we can create a map of the substantive law to a knowledge representation structure resembling a giant sphere of data. Second, there is a logic inherent in the knowledge representation structure that allows us to define legal terms, and create legal rules or tests that are defined with precision.

It is this internal logic and level of precision that opens the door to the creation of artificial intelligence software applications. Before long, for example, if you want to know how to perfect a security in a particular type of collateral, or what the elements are of the test for a finance lease, there will be a software application to guide you through the reasoning process.

## VIEWING CONTRACTS AS DATA

Just as we can analyze the substantive law as fields of data sorted by partitions and chains, we can do the same with a contract. In fact, there are three relevant databases of information:

- boilerplate terms of the contract
- deal-specific contract terms
- data regarding modifications, transfers, and performance over the life of the lease or loan

In its most basic application, we use logic to help us draft documents with greater precision and clarity. With the new logic tools, however, we can also create artificial intelligence software applications that can sort and summarize the data contained in portfolios of contracts.

## Creating a New Form of "Smart" Lease Agreement

When we speak of "smart contracts" as a form of data, we are not talking about paper files scanned to electronic format, nor are we talking about electronic contracts that are organized as if they were paper contracts. Rather, we are talking about an entirely new way of viewing contracts. We can always choose to print the smart contract to paper or to an electronic file format, but the contract terms are actually stored as fields of data (Figure 1).

## Modular Approach to Building a Smart Lease Contract

To create the "smart lease contract," the new logic of the law supports the concept of a "modular approach." This means that we can analyze each of the following as a separate module expressed in terms of partitions and chains: defined terms, representations, warranties, covenants, events of default, and remedies. Then, we can combine the modules to form a complete lease contract. Figure 2 illustrates the modular approach.

One of the advantages to a data-driven modular approach is that we can view on the screen, or print, the provisions that relate to any particular topic that we want to review. For example, if we want to view the payment, tax, insurance, default, or remedy provisions, we can retrieve the data relating to that particular topic. We no longer need to flip from one part of the contract to another in order to find the relevant definitions.



**Figure 1.** Evolution of a Contract

Lease Agreement → Lease Agreement

**Paper Contract**

**Electronic Contract** (When printed out, the electronic contract looks the same as the paper contract.)

**New Breed of Digital Smart Contract**

Software Application to View the Data ↔ Database Stored in Cloud

- Contract boilerplate terms can be hard-wired into the executable file
- Database of contract boilerplate terms (opt.)
- Database of deal specific terms
- Database of performance data, modifications, transfers, reporting, etc.



**Figure 2.** Modular Approach to Building a Digital Smart Lease Contract

Representations and Warranties

Indemnities

Payments / Covenants

Parties

**Contract Terms**

Events of Default

Equipment

Remedies

**Equipment Lease**

Timeline

Accounting

Tax

*Note:* Each module represents a discrete subject area relating to the lease contract. We can develop each module or submodule separately, and then combine them to form the complete contract.

Also, by storing lessee payment history in a related database, we can retrieve contractual payment terms and related actual payment history all in one report.

> Portfolios of form contracts can be analyzed, compared, differences summarized, and reports generated without needing to scan and interpret the scan as is currently done.

The process of building smart lease contracts will likely be an iterative process. As lessors working with technology companies become more familiar with the artificial intelligence capabilities, more features can be added, with the end result that over time smart lease contracts will become more complex, offering more features.

## BENEFITS OF "SMART" LEASE AGREEMENTS

### Automation and Speed of Origination of Equipment Leases

*Automation of Document Origination*
The use of artificial intelligence techniques will lead to improved efficiency in the origination of leases through automation of processes. Greater efficiency means lower cost.

*Standardized Lease and Loan Terms*
Over time, conversion of lease and loan documents to a data format will likely lead to standardization of terms. Many lessors have observed that there is a tendency for lessees that contract electronically in consumer and small business transactions to not read the online contract as closely as they would have read a paper contract in the past.

Legal standards have yet to develop, but to avoid attack as a contract of adhesion, it would be prudent for the leasing industry to continue developing standard forms of lease and loan documentation, which if adhered to will be deemed to be commercially reasonable. Conversion of lease and loan documents to a data format will make it easier to standardize legal documentation.

This does not mean that every lessor's form of lease needs to be identical. For example, two leases could contain exactly the same legal terms, but be drafted using a different style and wording in order to create a more competitive lease form.

Under the current approach, a lessee would ask its lawyer to review and compare two or more lease forms from different lessors and summarize the material differences. The attorney would bill for his or her time, and the end product would likely vary considerably depending on the skill and experience of the particular attorney who performed the review. The lessee could then decide which lease it prefers.

Under the new proposed data-driven approach to lease documentation, provided that standards have developed and are adhered to, a computer could compare the leases at the idea level and generate a comparison of the two leases almost instantly.

An attorney would still need to review and interpret the data comparison, but much of the work of reviewing and comparing leases could be automated, resulting in lower cost to the lessee and, in many cases, a better quality work product.

### Operational Efficiencies Over the Life of a Portfolio
Perhaps the greatest economic benefit to a lessor would come as a result of operational efficiencies.

*Portfolio Management and Improved Reporting*
Portfolios of form contracts can be analyzed, compared, differences summarized, and reports generated without needing to scan and interpret the scan as is currently done. When we transform a contract to a data format, we no longer are restricted by the four corners of a piece of paper.

We can view the data, and sort and report on the content of the lease contract, in a variety of different formats. We can select "print standard format to pdf" to create the electronic format that we are used to, or we can do something entirely different.

For example, if we are interested in insurance covenants and stipulated loss value, we can display only those provisions that relate to that topic. There is no limit to the number of possible reports or views of the data that we can create.

*Modifications and Amendments*
Currently, modifications and amendments to contracts can be a tedious and expensive process, particularly where a large portfolio of contracts has been securitized. With data-driven contracts, the amendment process could be simplified and reporting enhanced. Much more of the process of amending, summarizing, and reporting could be automated, resulting in lower cost, not to mention fewer errors.

*Litigation Support*
Data-driven contracts could be summarized almost instantaneously, since the logic inherent in the contract could be used to generate customized reports. With data-driven contracts, it becomes much easier to extract

whatever data is required in the litigation, whether the issue at hand relates to choice of law, choice of forum, waiver of jury trial, collection of fees, or some other provision in dispute.

*Collection and Use of Data*
With the application of artificial intelligence techniques to lease and loan documentation, it will be possible to collect data relating to customers over the life of the lease or loan, creating a valuable asset in the process.

While many equipment lessors may not have explored this opportunity yet, with the growing "internet of things" and collection and storage of massive amounts of data about everything we do, data has become the primary focus of attention in the business world. It is important to understand that equipment lessors are also in a position to collect data about their customers.

Of course, there are legal issues concerning who owns the data, and precautions must be taken to avoid violating a customer's legal right to privacy. Still, with these caveats, data can be an extremely valuable asset that can be used for marketing

purposes or monetized in other ways.

## Sale, Transfer, and Securitization

*Monetizing Portfolios*
Sale, participation, financing, and securitization of lease and loan portfolios could be streamlined through the use of artificial intelligence technology. The diligence process for reviewing a portfolio of contracts can be a tedious process. Junior attorneys and paralegals spend significant amounts of time reviewing and summarizing material contracts, and verifying principal economic and legal terms, including negative covenants, restrictions on assignment, consent requirements, and confidentiality provisions.

Significant advances have been made in terms of developing artificial intelligence software that can scan and summarize legal contracts, but there are limits on how much a computer can do before escalating the process to review by a human. Depending on the type of contract, current artificial intelligence technology could be anywhere from 60% to 80% efficient before human intervention is required.

With data-driven contracts, however, the level of efficiency could begin to approach 100%, because the "logic" is inherent in the data format of the contract.

*M&A Diligence*
A similar diligence issue exists in mergers and acquisitions. Currently, there is either human review of contracts or semiautomated review using artificial intelligence software, where escalation to human review is required for nonstandard provisions, or where there are gaps in information in the contract.

Once again, with data-driven contracts the level of efficiency of portfolio review could be greatly enhanced, not to mention the fact that much more data would be available to sort and summarize.

## ONE POSSIBLE VISION OF THE FUTURE OF EQUIPMENT LEASING

No one can predict the future with certainty, but here is one possible vision of the future that incorporates many of the emerging new technologies.

### Reformatting the UCC as Digital Data Content
The UCC does a great job of codifying commercial law in a way that reflects the commercial reality of how people transact business in the real world. It is not always easy, however, for non-experts to understand the UCC and all of its intricacies. Reformatting the UCC in a data format using the new logic of the law would open the door to the development of software applications that could assist with the interpretation of the law.

In simple terms, if we use partitions and chains (which form the essence of the new logic of the law, and which anyone can learn) to define legal concepts and articulate legal tests, then we can create an artificial intelligence software program to assist with legal reasoning.

Examples of questions that an artificial intelligence software program could answer include: How do I perfect a security interest in a certain type of collateral? Given certain facts, what are the UCC remedies for a lessee default? and, Given certain facts, are restrictions on assignment enforceable?

The software would guide the user through a list of factual questions, then provide a preliminary answer to the legal question together with the backup reasoning. In the process, artificial intelligence software applications could make the law more accessible to non-experts.

> Depending on the type of contract, current artificial intelligence technology could be anywhere from 60% to 80% efficient before human intervention is required.

### Delivery of Legal Advice by Software Application
Legal advice of certain types is well suited to the use of software applications. For example, a 50-state survey relating to a particular financial regulatory issue could be available as a web application backed by a database stored on a cloud server. The database could be updated for new developments in the law and would become available to the client automatically; 50-page memoranda would be a thing of the past.

Pricing could be based on a license fee, with a discount for clients meeting certain volume thresholds.

> We urge industry leaders to begin the effort now to develop best practices for the application of artificial intelligence techniques to the equipment leasing and finance industry, and to develop open standards that can be applied by all.

**Development of Standardized Lease and Loan Documentation in a New "Smart Lease/Loan Contract" Data Format**

With lease contracts transitioning to a data format, a likely consequence will be greater standardization of lease and loan terms. As a result, it is crucial that the legal profession focus more attention on best practices and standardization, along with options for "standard" exceptions to the form to meet special needs.

As discussed earlier, even with standardization of boilerplate contract terms at the data level, lessors may continue to customize the wording of their contracts for competitive reasons. Data-driven contracts will simply make it easier for a customer to compare contracts from different lessors and understand the substantive differences.

## CONCLUSION

Recent advances in mathematics, logic, data science, and artificial intelligence are about to transform how we document equipment lease and financing transactions. Often when writing about artificial intelligence, authors keep the discussion light and superficial.

In this article, we have attempted to take a very difficult subject and make it accessible by not including too much detail, but at the same time helping the reader understand the importance of some of the new developments in mathematics, logic, and data science.

The benefits to integrating artificial intelligence techniques into the lease and loan documentation process are many, including greater efficiency in document origination, standardization and transparency of lease and loan terms, and more efficient management and reporting on lease and loan portfolios over the life of the portfolios.

Most importantly, however, those lessors and lenders that fail to keep up with innovation will be at a serious competitive disadvantage in a fintech environment. We urge industry leaders to begin the effort now to develop best practices for the application of artificial intelligence techniques to the equipment leasing and finance industry, and to develop open standards that can be applied by all.

Traditional equipment lessors have an opportunity to be leaders rather than followers in integrating new technology. We have a choice of either hoping for early retirement before the changes become mandatory, or embracing the new technology and using it to our collective advantage.

*The appendix to this article begins on the following page.*

# APPENDIX. PRIMER ON LOGIC

## OVERVIEW OF TRADITIONAL LOGIC

To truly understand what artificial intelligence is, and why it has taken so long to infiltrate the practice of law, we need to start with a brief overview of traditional logic as applied to the practice of law. By understanding the limitations of traditional logic together with the impact of new advances in mathematics, logic, and data science, it becomes obvious why we are on the verge of a flood of technological innovation in the legal profession.

### Classical Logic – The Categorical Syllogism

A categorical syllogism consists of two premises, together with a conclusion that flows naturally from those premises. When we think of the categorical syllogism of classical logic, we most often think of the classic syllogism set forth in Table 1.

### Table 1. The Classic Syllogism

|  | "Socrates Is Mortal" | Generic form |
|---|---|---|
| Major premise | All men (M) are mortal (P). | All M are P |
| Minor premise | Socrates (S) is a man (M). | All S are M |
| Conclusion | Therefore, Socrates (S) is mortal (P). | ∴ All S are P |

There are, in fact, 19 valid forms of the categorical syllogism, although the example in Table 1 is by far the most common.[4] Whether attorneys realize it or not, the form of reasoning represented by the categorical syllogism is used commonly in the practice of law.

### Propositional Logic

In propositional logic, logicians study generic propositions p, q, r, … and their negatives (NOT) ¬p, ¬q, ¬r, … connected by "AND" and "OR" to form a "well-formed formula." These three basic logic operations, along with the "implication" operation, are defined in Table 2.

### Table 2. Propositional Logic

| Logic operation "OR" | | | "AND" | | | "NOT" | | Implication "IF x THEN y" | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $x$ | $y$ | $x \lor y$ | $x$ | $y$ | $x \land y$ | $x$ | $x$ | $x$ | $y$ | $x \to y$ |
| T | T | T | T | T | T | T | F | T | T | T |
| T | F | T | T | F | F | F | T | T | F | F |
| F | T | T | F | T | F |  |  | F | T | T |
| F | F | F | F | F | F |  |  | F | F | T |

A proposition "p" represents a sentence that is either true or false, but beyond that, the logician does not care what the sentence is about. The subject and predicate of the sentence are irrelevant. The theory is that the truth value of the well-formed formula is determined by the truth values of the component propositions. The following is an example of a well-formed formula and the resulting truth values:

$$\underbrace{T}_{p = \text{"The sky is blue."}} \to \underbrace{T}_{q = \text{"Equipment is a type of goods."}} = \underbrace{T}_{p \to q}$$

We use an absurd example on purpose, in order to illustrate that the meaning of the sentence is irrelevant. Clearly, it makes no sense to reason: If "the sky is blue," then "equipment is a type of goods." This example highlights the primary limitation of propositional logic — that is, that the meaning of the premises is irrelevant; any appearance of a causal connection in an "if-then" statement is coincidental.[5]

The principal limitation of propositional logic, from the perspective of a lawyer, is that as lawyers we are interested in the relationships among the subjects and predicates of the propositions, but propositional logic looks only at whether the proposition is "True."

### Compound Arguments

One of the most pervasive forms of argument is *modus ponens*: If x is true, then y is true. X is true. Therefore, y is true.
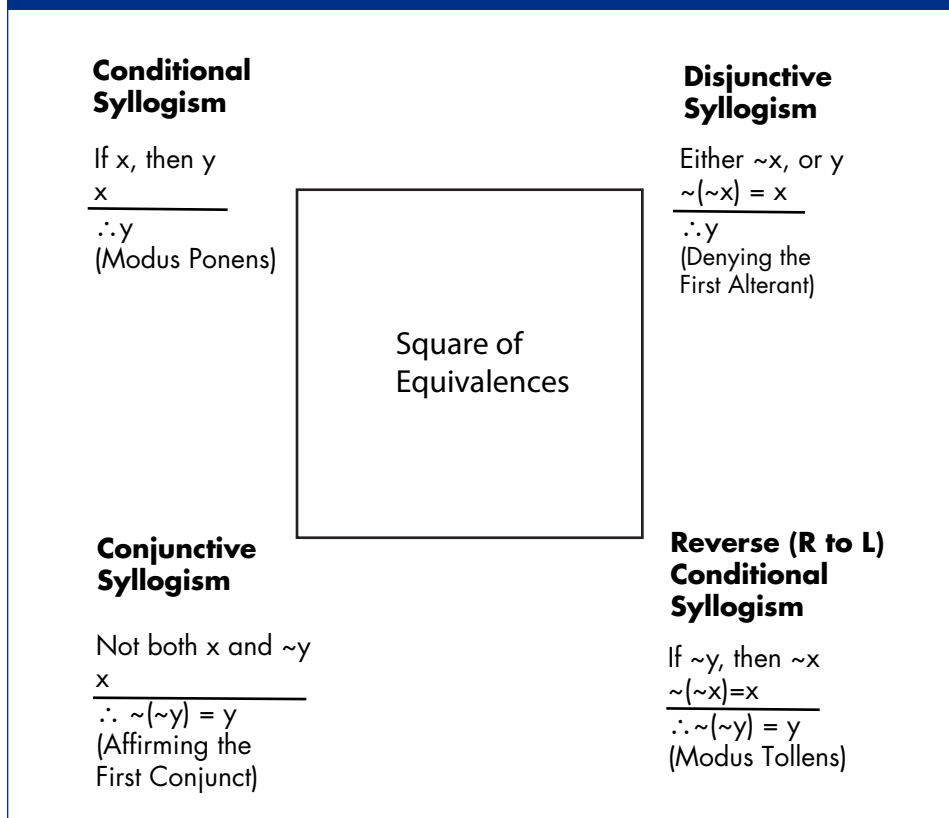
*Modus Ponens:*

$x \to y$

$x$

∴ $y$

Compound arguments like *modus ponens* are also a form of propositional logic, meaning that "x" and "y" in the example are propositions. The only relevant attribute is the truth value; the subject and the predicate are irrelevant. Figure A.1 illustrates four equivalent forms of argument. *Modus ponens* is equivalent to each of the disjunctive syllogism, conjunctive syllogism, and reverse (right to left) conditional syllogism — that is, "if x, then y" = "either not-x or y" = "not both x and not-y" = "if not-y, then not-x."

Although understanding compound arguments is useful when formulating arguments, this form of logic, without more, is not robust enough to support artificial intelligence in the law.[6]

## Predicate Logic

In predicate logic, we use symbols to represent ideas, together with "∀" meaning "for every" and "∃" meaning "there exists."[7] Therefore, when representing propositions in predicate logic notation, we use "∀" to represent "all" and "∃" to represent "some." In this way, we can write the A, E, I, and O propositions of classical logic as follows:

- A: $\forall x: (Rx \rightarrow Sx)$:        All R are S.
- E: $\forall x : (Rx \rightarrow \neg Sx)$:        No R are S.
- I: $\exists x (Rx \wedge Sx)$:        Some R are S.
- O: $\exists x (Rx \wedge \neg Sx)$:        Some R are not S.

Predicate logic is more powerful than the other three forms of traditional logic that we have examined so far, but it has not gained wide acceptance by practicing lawyers. Its usefulness in the practice of law, arguably, is dwarfed in comparison to the new logic of lattices that we examine below.

The problem with the various forms of traditional logic is that they are not robust enough to support our desired form of artificial intelligence. They are all valid forms of reasoning insofar as they go, but they do not go far enough. With advances in logic and data science, we will soon see that a new, comprehensive form of logic is emerging that subsumes the four that we have reviewed so far and goes much further. With the new logic, we have a foundation for artificial intelligence in the law.

## INTRODUCTION TO THE EMERGING NEW LOGIC OF THE LAW

Now that we have a basic understanding of traditional logic as applied in the law, we turn to the latest developments in mathematics, logic, and data science that open the door to a new, exciting form of logic that lays a foundation for the development of artificial intelligence software applications.

### The Logic of Lattices

With advances in mathematics, particularly in the fields of lattice theory and formal concept analysis,[8] a new "logic of lattices" is emerging. While the underlying mathematics is complicated, it is possible to distill the mathematics of ideas into a handful of key principles that are easy to apply.

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**Figure A.1.** Square of Equivalences — Modus Ponens

**Conditional Syllogism**

If x, then y
x
―――――
∴ y
(Modus Ponens)

**Disjunctive Syllogism**

Either ~x, or y
~(~x) = x
―――――
∴ y
(Denying the First Alterant)

Square of Equivalences

**Conjunctive Syllogism**

Not both x and ~y
x
―――――
∴ ~(~y) = y
(Affirming the First Conjunct)

**Reverse (R to L) Conditional Syllogism**

If ~y, then ~x
~(~x)=x
―――――
∴ ~(~y) = y
(Modus Tollens)

## Every Idea Is Either an Atom or a Compound

The starting point in our new logic is the concept that every idea that we are capable of thinking (an "idea") is either an "atom" or a "compound." In Figure A.2, the idea "goods" is a compound, and each of equipment, inventory, farm products, and consumer goods is an atom (or "deemed atom"). (Often, we use deemed atoms, if we .do not care about breaking down an idea into smaller parts.)

### Figure A.2. An Idea Is Either an Atom or a Compound

**Goods**

Equipment
- Manufacturing equipment
- Car used in business operations

Inventory
- Computers held for sale or lease

Farm Products
- Crops
- Livestock

Consumer Goods
- Radio for personal use
- Car for personal use

Compound Idea

Deemed Atoms

Atoms

*Note:* Every idea is either an atom or a compound, although we often use "deemed atoms," which could in theory be broken down further, but there is no need to do so.

## Every Idea Can Be Defined by Examples of the Idea (Objects) and Properties of the Idea (Attributes)

Another fundamental principle is that we can define any idea by listing examples of the idea, which we call "objects," or by listing properties of the idea which we call "attributes." In our example of "goods," examples or objects would be equipment (e.g., manufacturing equipment), inventory (e.g., computers held for lease), farm products (e.g., crops), and consumer goods (e.g., car held for personal use); and properties or attributes would include movable, personal property, not real property, and tangible.

## A "Partition" Breaks Down an Idea Into Its Object Parts

A "partition" breaks down an idea into its component "object" parts, provided that two rules are adhered to: (1) the component parts must be mutually exclusive, and (2) the partition must be exhaustive, meaning that the component parts make up the whole with nothing left over. In our goods example, we have the following partition:

$goods = (equipment + inventory + farm\ products + consumer\ goods)$

$(abcd) = (a) + (b) + (c) + (d)$

The power of partitions from an artificial intelligence perspective results from the fact that there is a binary logic inherent in the structure of a partition. This binary logic allows us to create IF-THEN statements that we can use in a software program. For example, we can convert the above partition into the following:

    IF goods,
        AND NOT inventory
        AND NOT farm products
        AND NOT consumer goods,
    THEN equipment.

## A "Chain" Breaks Down an Idea Into Its Attribute Parts

A "chain" breaks down an idea into its component parts in terms of "attributes," provided that two rules are adhered to: (1) the component parts must be ordered by inclusion (i.e., each element in a chain is a subset of the element above it in terms of sets of objects), and (2) the sorting of attributes by the chain must be exhaustive, meaning that the component parts make up the whole with nothing left over. In our "goods" example, we have the following chain:
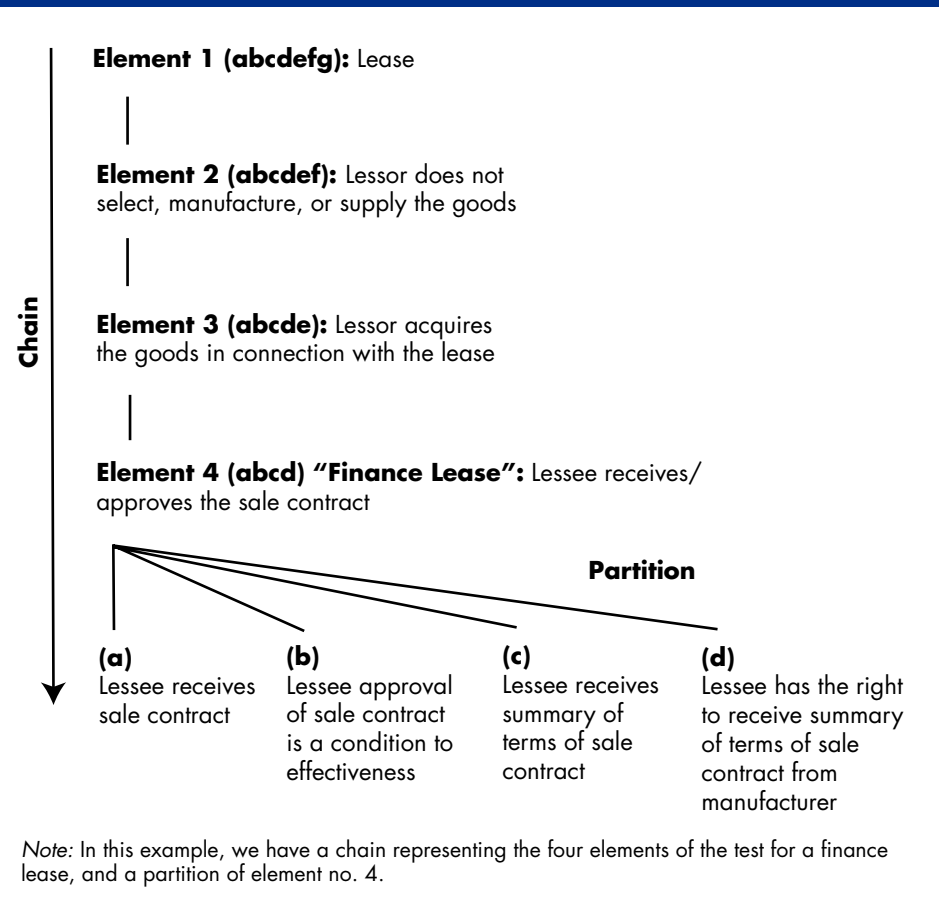
$equipment \subset goods \subset personal\ property \subset property$

$(a) \subset (ab) \subset (abc) \subset (abcd)$

We can also use a chain to represent the elements of any "legal test" or "cause of action," often in combination with partitions. Figure A.3 provides an example of such a chain for the definition of "finance lease," taken from UCC Article 2A.

As with a partition, there is a binary logic inherent in the chain structure. For example, we can convert the above chain into the following:

    IF lease,
        AND lessor does not select, manufacture, or supply goods
        AND lessor acquires the goods in connection with the lease
        AND lessee receives/approves the sale contract:
            {lessee receives sale contract
            OR lessee approval of sale contract is condition to effectiveness
            OR lessee receives summary of terms of sale contract
            OR lessee has right to receive summary from manufacturer
            }
    THEN finance lease.

**Figure A.3.** Using a Chain to Represent the Test for a Finance Lease



**Element 1 (abcdefg):** Lease

**Element 2 (abcdef):** Lessor does not select, manufacture, or supply the goods

**Element 3 (abcde):** Lessor acquires the goods in connection with the lease

**Element 4 (abcd) "Finance Lease":** Lessee receives/approves the sale contract

Chain

Partition

**(a)** Lessee receives sale contract

**(b)** Lessee approval of sale contract is a condition to effectiveness

**(c)** Lessee receives summary of terms of sale contract

**(d)** Lessee has the right to receive summary of terms of sale contract from manufacturer

*Note:* In this example, we have a chain representing the four elements of the test for a finance lease, and a partition of element no. 4.

**Figure A.4.** Partitions and Chains Together Form a Boolean Lattice



*Note:* In the structure on the left, we can more easily see one example of the chains and partitions that make up the lattice structure. A Boolean lattice contains elements representing all possible combinations of atoms.
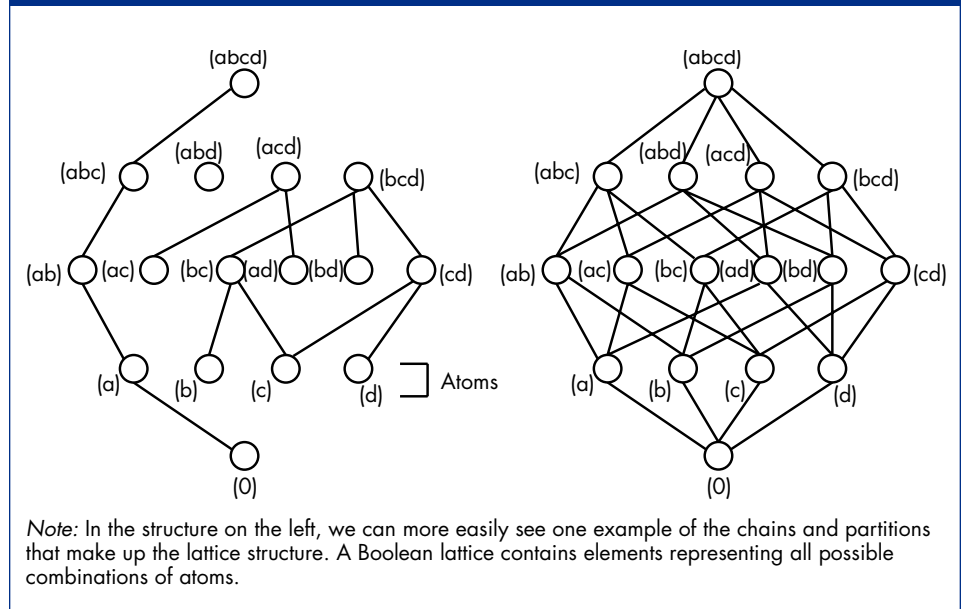
## Partitions and Chains Together Comprise a Boolean Lattice Structure

Together, partitions and chains combine to form a Boolean lattice (Figure A.4).

Using these same techniques, we can convert any statute, case, or contract into partitions and chains from which we can build a Boolean lattice that we refer to as a "knowledge representation structure." In the process of creating the map to a knowledge representation structure, we convert the statute, case, or contract into data governed by a specific binary logic inherent in the Boolean lattice structure.

Traditional logic covers relatively simple scenarios with typically one to five atoms, whereas the new logic of lattices relates to scenarios that are orders of magnitude more complicated with potentially very large numbers of atoms. As the knowledge representation structure grows in size, it begins to resemble a giant sphere of data when viewed in three dimensions. The binary logic that is inherent in the Boolean lattice structure makes artificial intelligence possible.

One of the features of the new logic of lattices is that all of the existing forms of logic remain valid, are subsumed by the new logic, and can still be used. Therefore, we lose nothing when we move to the logic of lattices, since we can continue to use categorical syllogisms, propositional logic, compound arguments, and predicate logic.

We gain a lot, however, because the Boolean lattice structure is scalable to handle much more complex factual and legal scenarios, and lends itself to the development of artificial intelligence techniques.

## Endnotes

1. *See, for example,* Brett Boehm and Patricia M. Voorhees, "FinTech Pressure on Equipment Finance Companies Serving SMB Markets," Law Journal Newsletters' *Equipment Leasing Newsletter* (March 2017).

2. For more information about artificial intelligence generally, see: Ertel, Wolfgang, *Introduction to Artificial Intelligence,* 2nd ed. (Weingarten, Germany: Springer, 2017); Brachman, Ronald J., and Hector J. Levesque, *Knowledge Representation and Reasoning* (San Francisco: Elsevier, 2004); Sowa, John F., *Knowledge Representation* (Pacific Grove, CA: Brooks/Cole, 2000); and Jackson, Philip C., *Introduction to Artificial Intelligence,* 2nd ed. (New York: Dover, 1985). For more information about artificial intelligence and the law, see: *Legal Knowledge and Information Systems, JURIX* 2000–2016: *Annual Conference, Foundation for Legal Knowledge Systems* (Washington, DC: IOS Press, 2000–2016); and Artificial Intelligence and Law, Springer, vol.1 (1992) – vol. 26 (2018).

3. From time to time, the author intends to post on his website more examples of the application of artificial intelligence to lease and loan documentation, as well as applications to the UCC generally.

4. For more information about classical logic, see: Kreeft, P., *Socratic Logic* (South Bend, IN: St. Augustine's Press, 2010); and Aldisert, Ruggero J., *Logic for Lawyers – A Guide to Clear Legal Thinking* (South Bend, IN: National Institute for Trial Advocacy, 1997).

5. For more information about propositional logic, see: Smullyan, Raymond M., *A Beginner's Guide to Mathematical Logic* (New York: Dover, 2014); Burris, Stanley N., *Logic for Mathematics and Computer Science* (Upper Saddle River, NJ: Prentice Hall, 1998); and Langer, Susanne K., *An Introduction to Symbolic Logic* (New York: Dover, 1967).

6. For more information about compound arguments, see: Shenefelt, Michael, and Heidi White, *If A, Then B: How the World Discovered Logic* (New York: Columbia University Press, 2013); and Cothran, Martin, *Traditional Logic – Advanced Formal Logic* (Louisville, KY: Memoria Press, 2000).

7. For more information about predicate logic, see: Tall, Aliou, *From Mathematics in Logic, to Logic in Mathematics: Boole and Frege* (Boston, Docent Press, 2014); and Quine, Willard Van Orman, *Methods of Logic* (Cambridge, MA: Harvard University Press, 1982).

8. For more information about lattice theory, see: Grätzer, George, *General Lattice Theory,* 2nd ed. (Boston: Birkhäuser, 2003); and Davey, B.A., and H.A. Priestley, *Introduction to Lattices and Order,* 2nd ed. (London: Cambridge University Press, 2002). For more information about formal concept analysis: see Ganter, Bernhard, and Rudolf Wille, *Formal Concept Analysis* (New York: Springer, 1999); and also the website of Uta Priss at http://www.upriss.org.uk/fca/fcaintro.html.

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