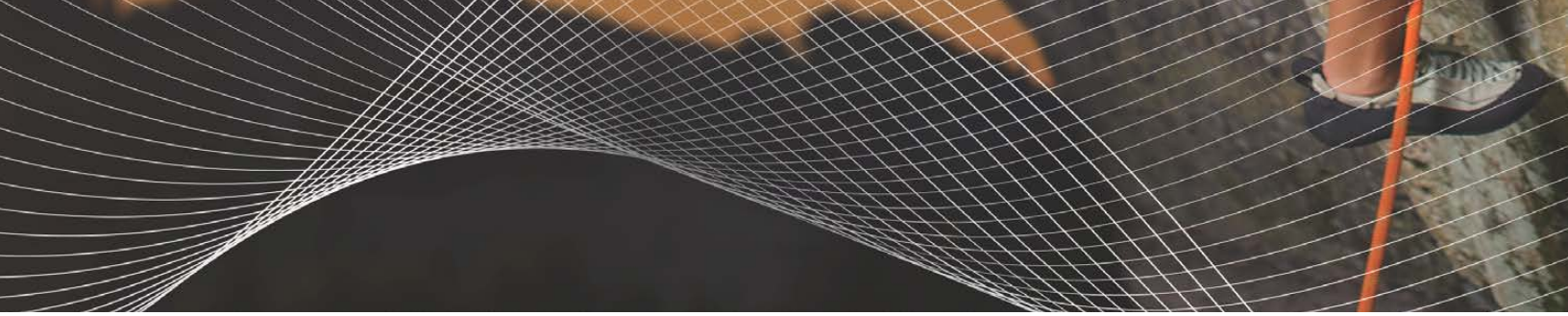
Whitepaper

AI ushers in the next generation of risk management for equipment finance

Tamarack™



Overview

Risk management, and specifically credit risk management, is a core function of any equipment finance business. AI is at the heart of the next generation of risk management, and leaders who adopt AI to change how they manage business operations will reap greater rewards.

In this executive whitepaper we define risk and risk management as well as how probability and judgment play a role in decision-making where risk is involved. Then we examine how AI not only helps with risk management but also simplifies and accelerates risk-based decisions. We look at managing credit risk with AI and how it transforms the five C's. Finally, we review some examples of how AI can reduce risk and help equipment finance companies achieve better outcomes faster.

1. What is risk management?
2. AI simplifies and accelerates risk management
3. Managing Credit Risk with AI
4. Better outcomes faster
5. Getting started with AI

Risk management has been a central business function of finance operations since the invention of currency enabled lending with a fractional return on capital. In equipment finance, the primary focus of risk managers is called credit risk, which is the risk of repayment that a funder takes on when they extend credit, i.e., allocate capital to individuals or organizations who then buy or lease equipment. Both borrowers and the industries in which they operate – e.g., construction, transportation, food service, hospitality, healthcare, agriculture – present the finance business with not only specific borrower credit risks, but also ever-changing risk environments due to dynamic socio-economic and industry-specific conditions.

The fundamental steps in risk management have evolved over time to address these conditions. But technology, as is always the case with business processes, has become a double-edged sword: it provides new tools to measure and monitor borrowers, but also accelerates and amplifies the impact of unwanted borrower behavior. The speed and magnitude of the Silicon Valley Bank collapse in early 2023 revealed a new level of risk in this current technology era and provided an unfortunate example of how not using the same technology to counter that risk creates an even greater vulnerability.

Fortunately, the same technology ecosystem has provided new tools that not only counter the risks that connected digital systems introduce but also dramatically improve the process and tilt the balance of risk-reward to greater rewards for risk takers.

Risk is the chance (probability) that an outcome will differ from that which was expected.

What is risk management? Probability and judgment.

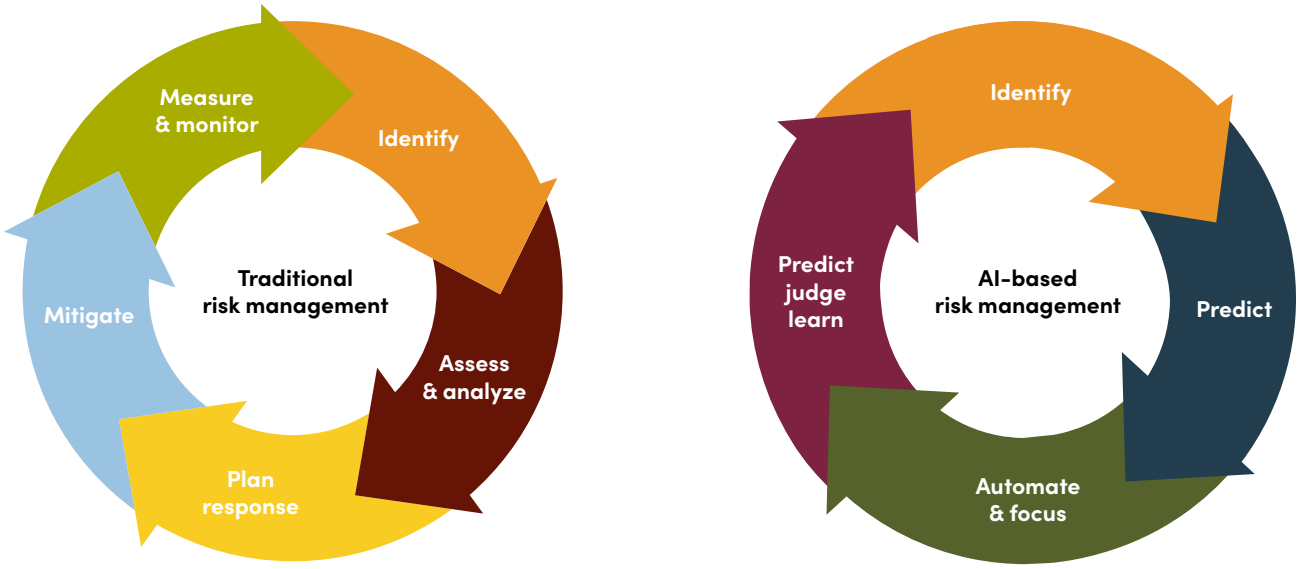
Understanding the fundamentals of risk management begins with the definition of risk. The canonical view of risk requires prediction. To manage risk, one must understand the ***probability*** of an unexpected or undesired outcome. In most real-world endeavors, and specifically in lending money, there is a spectrum of outcomes and a range of relative returns. The management of the risk of a lender decision that triggers those outcomes depends upon understanding the probability of each outcome and the ***judgment*** of its relative return.

Risk management as a discipline traces back to the application of mathematics in early games of chance. Measuring and assessing the risk of a given wager was an exercise in probability theory made more difficult by a variety of parameters that influenced the outcomes. Understanding the risk of rolling a "5" when one needs a "6" to win a bet is straightforward. But even simple games also include mathematically challenging elements like behavior of the roller of the die, the environment in which the die is rolled, and, most difficult of all, the betting behavior of other gamers.

Understanding risks that involve human behavior, like receiving payments for a finance contract, is beyond simple scoring models like those for games of chance. But when the risk taker has data from past experiences and the related human behaviors, and the ability to continue to gather more data, models can be built and predictions can be made that better inform the probability of each outcome. Data provides the ability for machines to learn and introduces AI as the basis for the next generation of risk management.

AI transforms risk management – simpler and faster

Traditionally, risk management has had five steps. These steps define a process for initiating the management of the risk as well as define a cycle for continuous monitoring and mitigation. Prior to digitization, the speed and scale of the cycle was limited by human constraints. Data, machine learning, and AI prediction machines redefine the cycle by both condensing and accelerating the steps. The result is a next generation of risk management that is simpler, faster and more effective.



Identifying risk remains unchanged

Identifying a risk is a process wherein all possible outcomes of a given decision are considered, and rewards of each are determined. The core of risk identification is judgment. As described by Agrawal, Gans and Goldfarb in their seminal work on AI, *Prediction Machines*, judgment is a skill uniquely attributed to humans. Machines can capture and analyze data that is generated during the measurement of outcomes, but the judgment of that data by the AI is dependent upon rules or policies defined by the human authors. So, while AI can accelerate judgment of data, it can only do so relative to the risk patterns identified by the human authors of the code. Risk identification remains a human-performed step in the risk management process whether you are using AI or not.

Assess and Analyze *becomes* Predict

After identifying the risks and returns of the pending decision, the next step is to assess the circumstances and analyze the impact. The figure below shows a traditional process for jumping over a ditch. Such approaches traditionally rely upon rough estimates and few measures compared to the quantity of information available in today's digital ecosystem. As a result, decisions are typically made with policies as opposed to risk-reward calculations performed in real time, accommodating up-to-date conditions.

Assessment of risk exposure = Risk probability = Impact
(Severity = Likelihood x Consequence)

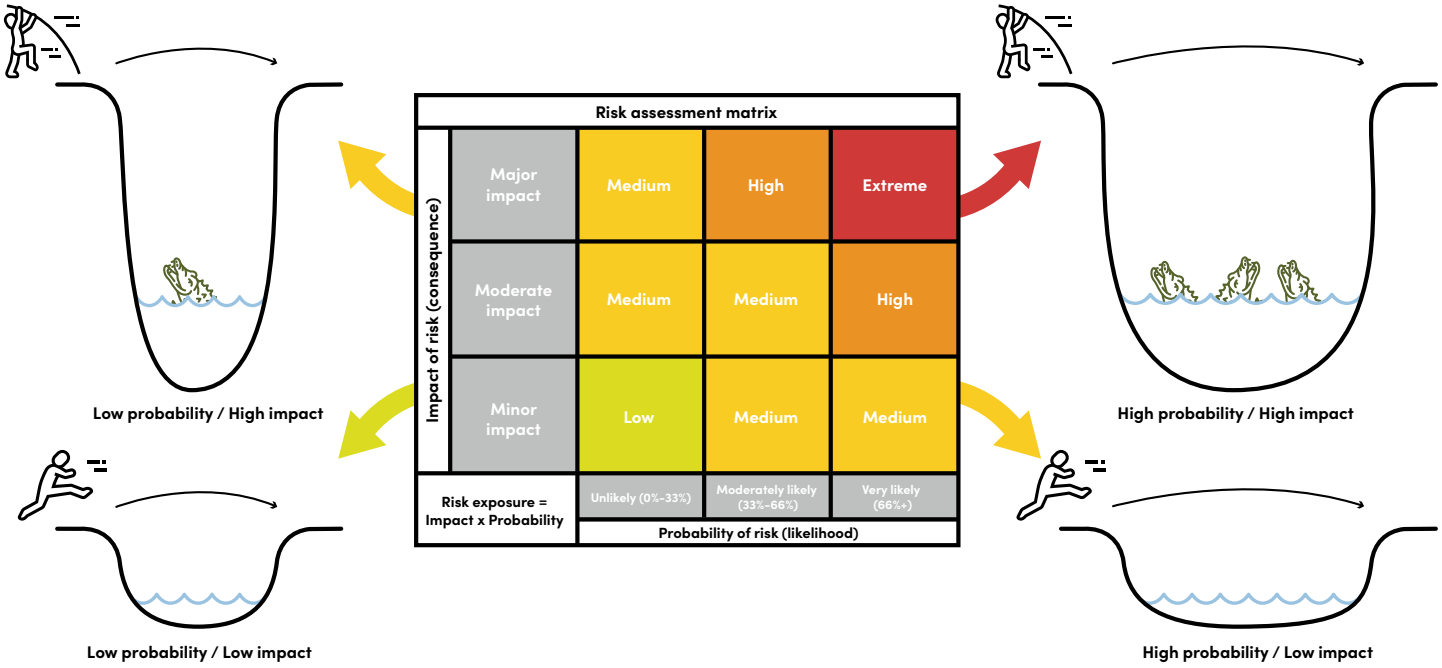


Figure 1 Traditional risk assessment considers historical experiences.

AI transforms this step of the process by replacing observational assessment of the level of risk with the prediction of the probabilities of each possible outcome. The traditional assessment of the risk of falling into the ditch considers historical observations of similar jumps and must make assumptions about the individual's jumping skills, the individual's toughness, as well the overall jumping conditions, i.e., hot, cold, windy, raining, etc.

> "Having better prediction raises the value of judgment. Prediction machines don't provide judgment. Only humans do, because only humans can express the relative rewards from taking different actions."
>
> - Ajay Agrawal

An AI approach to managing the risk of the jump evaluates not only the level of risk presented by the ditch, but also the ability, i.e., probability, of the individual successfully jumping across the span based on all conditions for the jump as well as the consequences of making or failing the jump. A predictor provides a quantified probability for all jumpers' separate outcomes, i.e., consequences. These probabilities of the associated consequences are then provided to the next step of the process: judgment and action. Prediction thereby increases the value of judgment.

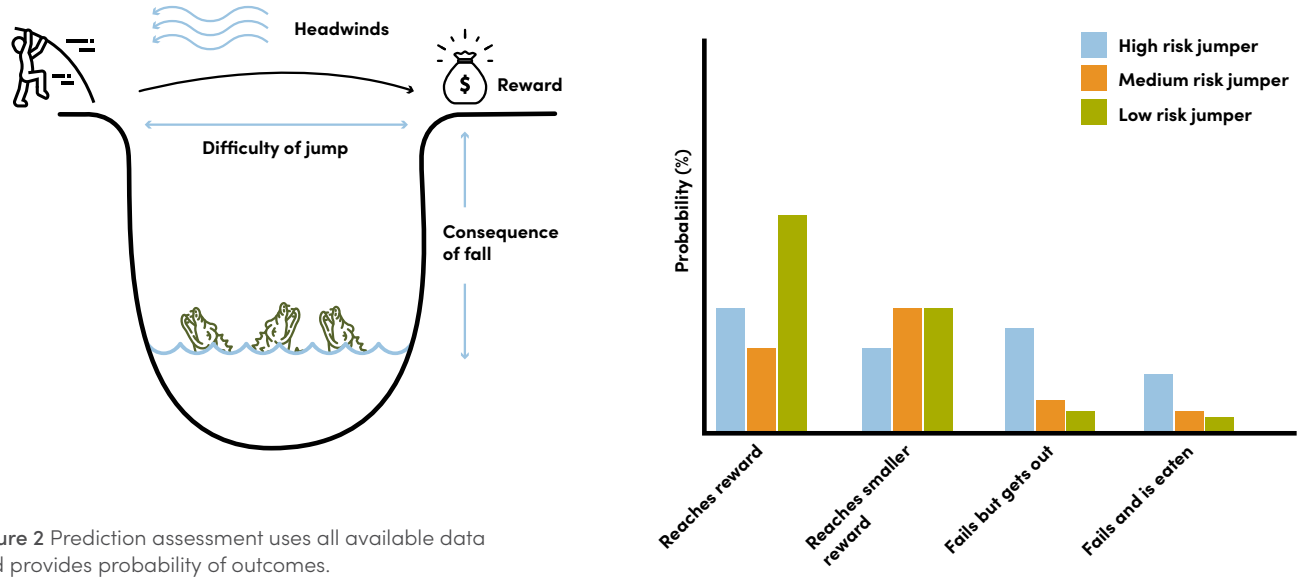


Figure 2 Prediction assessment uses all available data and provides probability of outcomes.

Mitigate Consequences *becomes* Automate and Focus

Consider the AI predictions for the jumper above. The high-risk jumper has a material probability of not surviving even though there is still a probability of reaching the reward. The mid-risk jumper has an acceptable failure probability, but also has material probability of not reaching the full reward. Only the low-risk jumper has both a low risk of failure and high probability of reward. An AI-driven risk management process uses the predictor to automate the low-risk jumpers (approve) and high-risk jumpers (deny) and focus the judgment of the human decision-makers on the medium-risk jumpers.

Perhaps the most common form of risk mitigation in finance is not engaging risk at all, i.e., avoiding borrower defaults by only engaging very strong credit applications. Layered mitigation techniques -- insurance, deal structure (down payments), collateral, hedging with funding participation, etc. -- add costs and reduce returns. But in economics, risk and return are indelibly linked, and mitigation via avoiding risk delivers lower overall returns. More important, avoiding risk slows and even prevents the learning that the complexity and diversity of risk decisions offer to a finance business.

AI predictors provide probabilities for the distribution of decision outcomes and enable the organization to set Quantified Risk Policies (QRPs). QRPs implement the risk-reward judgments that the enterprise has determined are appropriate. These policies can then automate specific outcomes which allows the enterprise to focus the judgment skills of its people on deals or circumstances that are more complex or have probability distributions that are less certain.

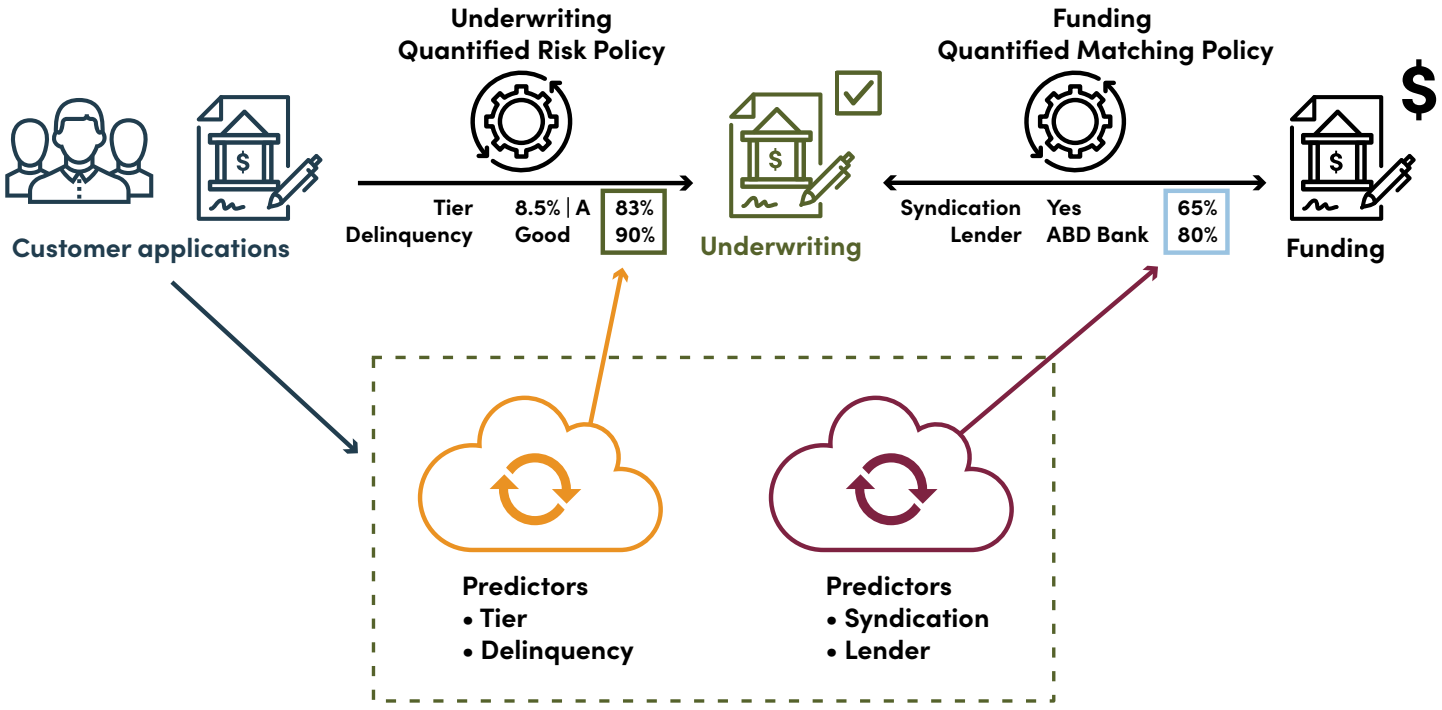


Figure 3 AI predictors enable Quantified Risk Policies that implement risk-reward judgments.

AI-based mitigation process can be described as management-by-exception which highlights how AI-based risk mitigation can be both more efficient and effective. Deals that are predicted to fit the risk policies are auto-approved and those that do not – the exceptions – receive additional human judgment. Prediction accelerates the exchange of information with those involved in the review process while driving faster reviews and faster approvals without relaxing scrutiny of the risk. AI risk management requires and uses more enterprise-specific data than market-level credit scores or small parameter credit models. AI training models are repeatedly tested to provide the confidence necessary to effectively **automate and focus** the judgment of the enterprise.

Measure and Monitor *becomes* Predict-Judge-Learn

Once a decision has been made, the next step in the traditional risk management process is to measure the outcome of the actions taken thus far and then further monitor the situation. Monitoring can take many forms, including anything from manual interaction to automated alarms, but with the objective of seeing if any further additional actions or mitigations are needed. Monitoring is usually slow and passive. AI brings a new focus to this step of the process that leverages the cycle of the process – **learning**.

Build-measure-learn was introduced by Eric Ries in 2011 as a process for continuous innovation and technology adoption for startups. The key was an iterative process of action and learning until the desired objective is achieved. In the case of a startup this is adoption of their new offering by customers; a change of behavior that defines innovation.

Build-measure-learn as a technology adoption and innovation methodology becomes predict-judge-learn in an AI prediction machine.

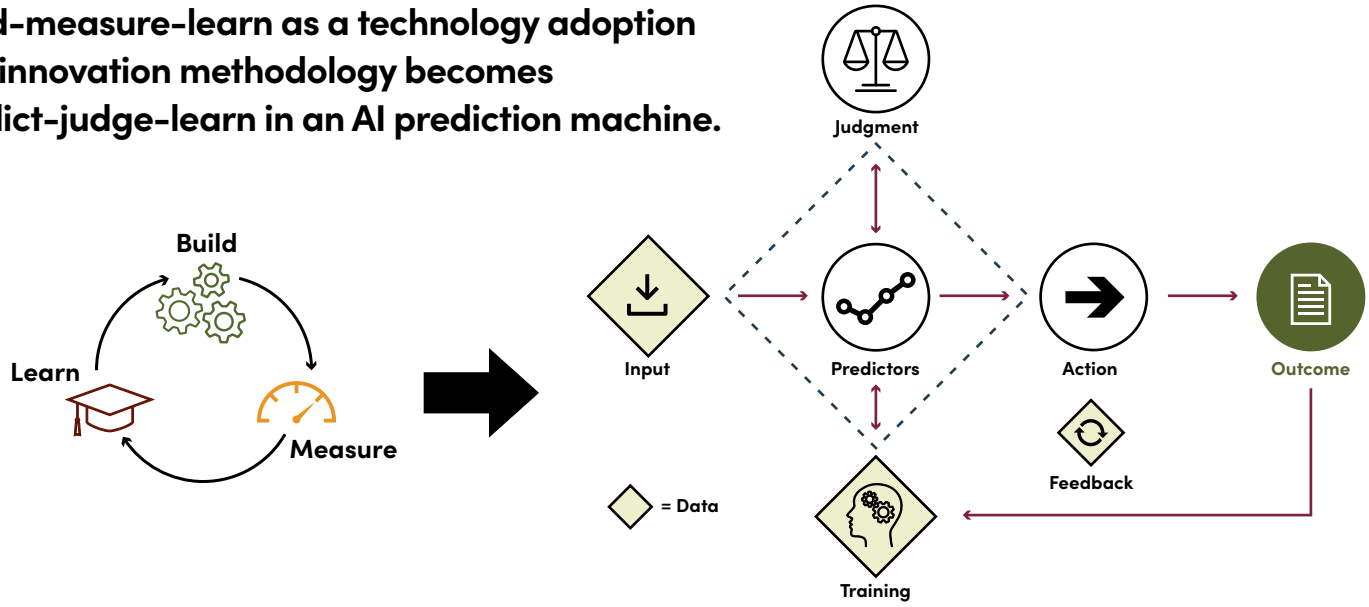


Figure 4 Eric Reis' build-measure-learn as a technology adoption and innovation methodology in his book *Lean Startup* becomes train-test-adjust-repeat as described by Agrawal, et. al., in *Prediction Machines: The Simple Economics of AI*.

AI prediction machines digitally implement this fundamental learning process to affect continuous improvement in the productivity of a digital enterprise. A predictor is built by identifying a desired outcome and collecting its historical values, relevant inputs are associated with those outcomes, and then machine learning models are built, trained, and tested against actual results. Prediction machines' integration automates building and learning by automating decisions for action and then continuously judging actual results of the action against the desired outcomes predicted. AI implements Reis' build-measure-learn as predict-judge-learn.

The addition of continuous improvement and learning completes the transformation of the risk management process. Fully automated processes using predictions and QRPs learn through ongoing retraining of the predictors as each iteration of the cycle creates new outcomes. Even when the predictions are used as recommendations by human decision-makers, those human decisions generate outcomes that become part of the next retraining.

An AI-based risk management process continuously learns and self-improves from the experiences of its operation in the workflow.

Building a predictor

1. Identify the target outcome
   - How measured
   - Possible states
2. Collect inputs, model, train, and test
3. Predict, judge, learn

Managing Credit Risk with AI

Credit risk is an instance of general risk with a specific undesired outcome: the failure of the borrower to repay the loan. The figure shows how AI predictors quantify credit risk via payment behavior, i.e., delinquency, by predicting delinquency outcomes in 10-day increments. Loss in a finance contract is often defined by policy as any time a payment is 90 days or more delinquent. As the payment delinquency distribution on the right shows, when a given group or individual borrower has a significant probability of 90-days-plus delinquency, the deal is risky because there is a material probability of loss. The middle chart shows a low-risk deal even though the probability of some delinquency is high, because the probability of greater-than-90-day delinquency is very low. Human behavior, like most things in nature, presents a distribution of outcomes, so its assessment is particularly well suited for AI prediction.

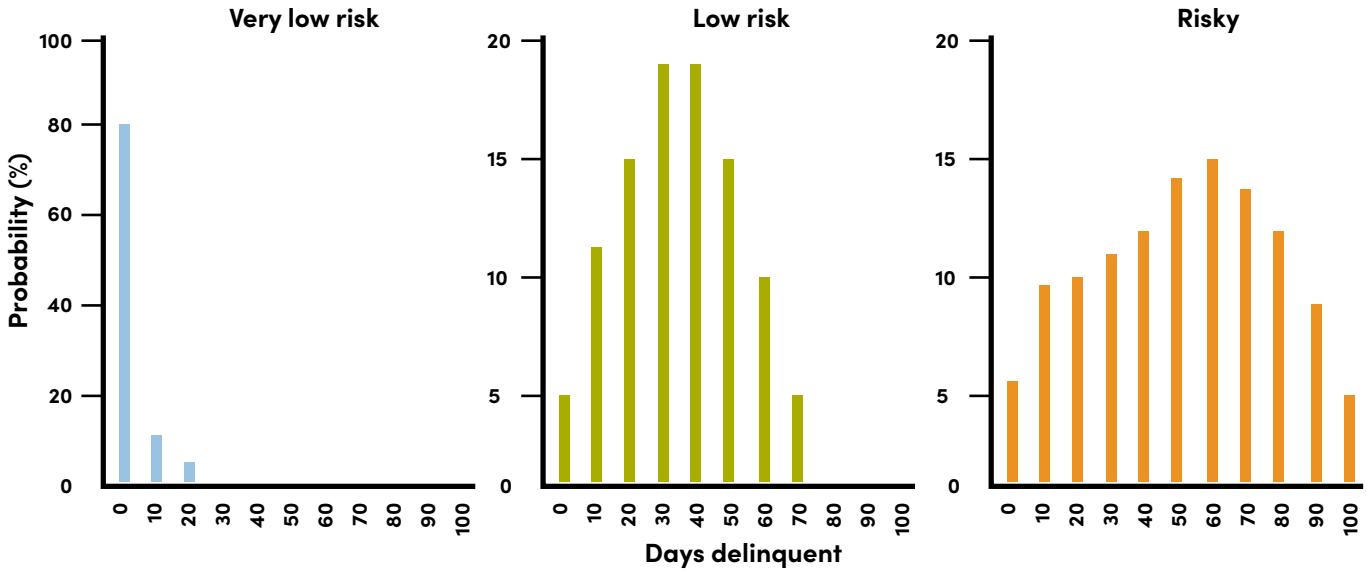


Figure 5 Distribution of outcomes assessed for AI prediction

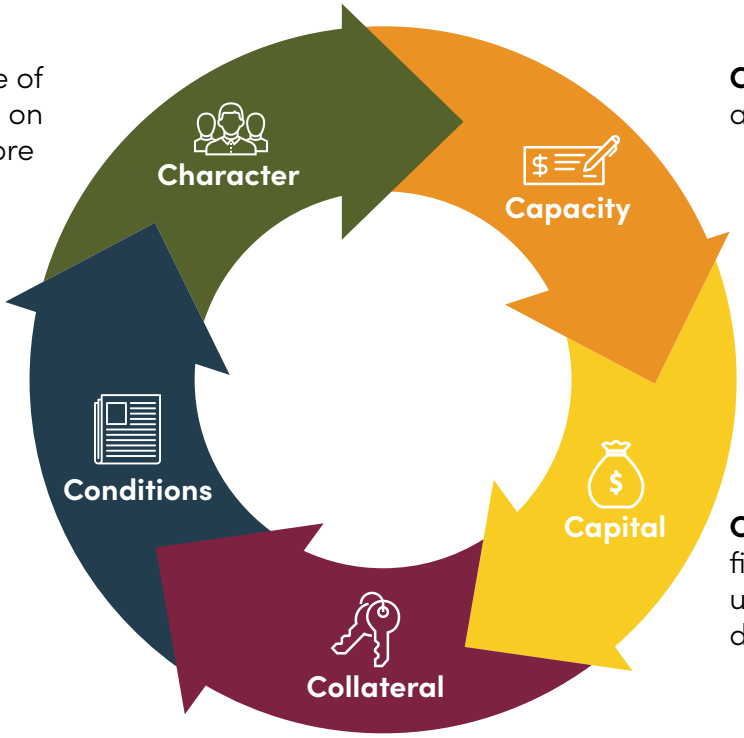
What is credit risk?

Credit risk is the probability of financial loss resulting from a borrower's failure to repay a loan. Essentially, credit risk refers to the risk that a lender may not receive the old principal and interest, which results in an interruption of cash flows and increased costs for collection.

AI transforms the Five C's of Credit

Credit risk is often measured with the Five C's of Credit – Capital, Capacity, Collateral, Conditions, and Character. The first four C's are objective measures, but Character introduces human behavior. Credit risk is fundamentally a behavior risk – the risk that a borrower does not make contractually required payments either by choice or due to unforeseen circumstances that negatively impact one of the other C's. AI risk management transforms the use of the Five C's by training models using the objective C-measures to predict the payment behavior, the Character of the borrowers. The AI training uses past and present data and then continuously predicts and learns as environmental and borrowing conditions change.

Character is a measure of creditworthiness based on indicators like credit score and credit history.



Capacity is a measure of ability to pay the lender back.

Conditions is a market analysis of business industry trends.

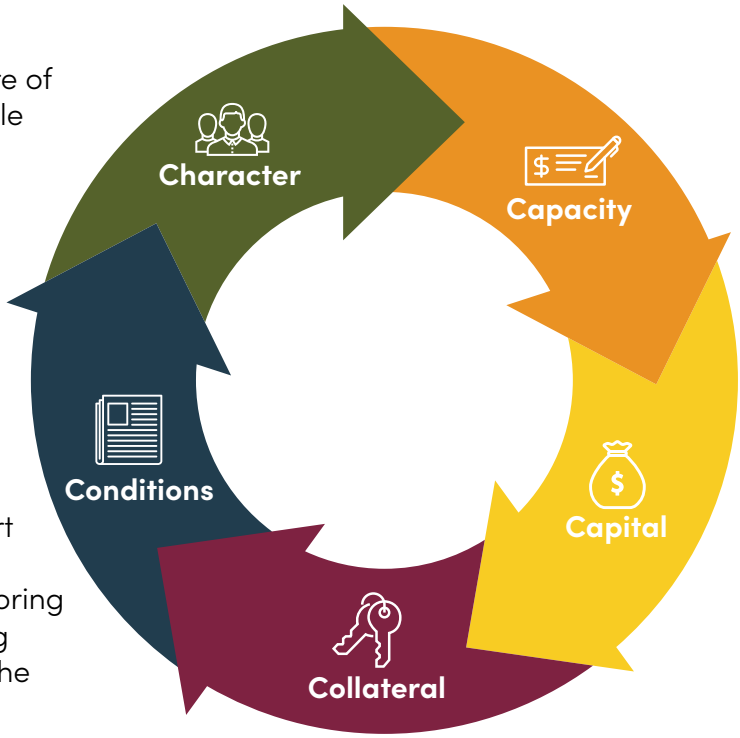
Capital is a measure of financial contribution, usually in the form of a down payment.

Collateral is a measure of assets used to back the loan.

Figure 6 Five C's of Credit (source)

The figure below shows how AI transforms the Five C's into real-time, adaptive measures and indicators of payment behavior based on changing environmental conditions and on learning from related decision outcomes.

Character is a measure of the likelihood of multiple behaviors that lead to payment and is updated over time.



Capacity is a measure predicted continuously over time and is combined with a prediction of willingness to use that capacity to make payment.

Conditions are the part of the AI training data and automated monitoring that enables predicting changes in the risk of the deal over time.

Capital is a term of the deal included as an input to predictors of future borrower behavior.

Collateral is a term of the deal whose value changes over time and is predicted repeatedly as a model input to the predicted risk of the deal.

Figure 7 AI-based Five C's of Credit

The Five C's will remain at the core of credit analysis in a next-generation, AI-based risk management model. Indeed, the indicating measures will be part of the data that trains predictors of borrower behavior. But AI risk management focuses on predicting borrower behavior, predicting Character, rather than simply using historical objective measures. AI's inherent Predict-Judge-Learn process introduces continuous updates to the Five C's and learning via measured outcomes for how those indicators accurately predict borrower behavior. AI continues to learn and adjust, which refines and extends the use of the C's to deliver preferred outcomes throughout the financing life cycle for the enterprise.

Better outcomes, faster

Risk management is the process by which finance companies pursue better business outcomes, so if AI improves risk management, it must deliver better outcomes. Two unquestioned preferred outcomes in equipment finance are yield – the borrowing rate less the cost of money – and rate of renewals in a portfolio. Renewals typically improve the profitability of a given customer engagement by as much as 75%. AI prediction has demonstrated improvement of both yield and renewal within portfolios.

Improving yield: "Make more than we lose" vs. "Avoid all losses"

"We work hard to get funding – I don't want to lose any of it" is a common message from lender CEOs. The message to employees becomes "Avoid all losses." But what happens if the organization uses AI to switch the desired outcome from avoiding losses to making more money than we lose? AI-based credit management focuses on all outcomes and enables the enterprise to avoid those that are not desired, i.e., excessive delinquency and loss as shown in the figure below.

Customer	Credit
Irving Langmulr	C
Max Planck	C
Marie Curie	C
Hendrik Lorentz	C
Albert Einstein	C
Paul Langevin	C
Charles-Eugene Guye	C
C.T.R. Wilson	C
Owen Richardson	C
Peter Debye	C
Martin Knudsen	C
William Lawrence Bragg	C
Hendrik Kramers	C
Paul Dirac	C
Arthur Compton	C
Louis de Broglie	C
Max Born	C
Niele Bohr	C

Data category	Data element	
Customer data	Legal entity	★
	Home ownership	
	Time in business	
	Bank relationship	
	Trade references	
	Lease/loan secure debt	
	Business location	★
	Asset type/class	★
	Asset new/used	★
Business data	Length of relationship	★
	Current balance/exposure	★
	Deliquency counter	★
	Lease/loan type	★
	Contract gain/loss	
	Accrual/non-accrual	
Financial data	Business size	★
	Business/asset size	
	Income tax return	
	Balance sheet leverage ratio	
	Debt coverage ration	
Credit service scores	Credit score	★
	D&B financial ratios	
	D&B composite rating	
	Experian/Paynet	★
	Moody's risk score	
Industry	SIC/NAICS code	★
	Business type	★
Public standing	Bankruptcy/legal action	
	Adversarial actions	

		Delinquency				
Customer	Credit	0	30	60	90	Loss
Irving Langmulr	C	1				
Max Planck	C			1		
Marie Curie	C				1	
Hendrik Lorentz	C			1		
Albert Einstein	C		1			
Paul Langevin	C	1				
Charles-Eugene Guye	C					1
C.T.R. Wilson	C		1			
Owen Richardson	C			1		
Peter Debye	C	1				
Martin Knudsen	C				1	
William Lawrence Bragg	C	1				
Hendrik Kramers	C		1			
Paul Dirac	C	1				
Arthur Compton	C		1			
Louis de Broglie	C			1		
Max Born	C	1				1
Niele Bohr	C				1	

Eliminate this part of the distribution to improve the overall results

Figure 8 AI delinquency predictors are used to identify and remove the undesirable members of the typical C-credit borrower distribution to create an AI-reviewed C-credit distribution.

Make more than we lose embraces the risk associated with occasionally losing on some deals and, when done with AI, captures an excess of the reward associated with that risk:

- **Total Available Market (TAM)** for lending increases because the business engages riskier customers, e.g., C-credits, who are shunned by risk-adverse competitors.
- **Deal yields** increase because the riskier market segment knows it must pay more to get access to capital.
- **Profitability** increases because the portfolio is managed to engage risk for greater returns.

The table below shows how this works when a portfolio is broken down and analyzed by credit tier.

Credit tier	FICO	# Leases	# Losses	$ Loss %	# Loss %	GM %	Adj GM %
A	850-750	4947	23	0.44%	0.46%	19.6%	19.6%
B	749-700	3582	28	0.18%	0.78%	24.2%	23.8%
C	699-601	1978	68	2.79%	3.44%	29.4%	29.0%
AI-reviewed C	***699-601***	***1978***	**-**	**-**	**-**	***29.4%***	***36.2%***
D	<600	347	26	3.23%	7.49%	30.3%	28.1%

Table 2 Adjusted Yield (GM%) vs Loss % shows value of winning more than losing (~13k lease sample) with AI-reviewed decisioning.

AI-based risk management enables an enterprise to engage higher risk portions of the market without suffering the full consequence of that action. The percentage of funding lost lags the number of deals lost, showing how the business uses deal size limitations to mitigate the expanded Credit Tier risk, i.e., smaller deals are made in the higher risk tiers. The table shows that one cannot blindly embrace high risk credits because the yield rolls over, i.e., adjusted GM% for D-credits is lower than C-credits. An A-credit portfolio, safe money, has no risk management opportunity – the GM% and Adj GM% are equal. But engaging "winning more than losing" enables a company to engage a higher risk market, C-credits, and make 80% more money – 36% GM vs. ~19% with A-credits – while also growing faster via a larger TAM. The key, of course, is consistently making the right C-credit decisions which is where AI-based risk management solutions separate delinquency from losses and tilt the balance to making more money.

AI enables engaging risk without suffering unwanted consequences.

Increase profitability: Seek renewals instead of avoiding delinquency

In baseball, the key to winning is runs. Moneyball strategists Billy Beane and Paul DePodesta switched their focus from batting averages to runs and on-base percentages because a player can't score a run if they are not on base. Equipment finance CEO interviews reveal the widely held belief that the most valuable leasing customers are those who renew. Simple math regarding acquisition costs and extended cash flows explains this fact. Yet the industry's risk management focus is on the unwanted outcomes – delinquency and loss. Why not focus on a desired outcome – increasing the percentage of customers who renew?

When renewals are the focus of the business, deals must be true leases so that renewal is an option. The business must still find acceptable customers who are more likely to renew. Perhaps it's not surprising that D-credits have a higher renewal rate as they are more likely to get true leases (lower monthly payments) and more likely to stick with the deal once they have it, because finding lenders is expensive for a D-credit business. A, B and C credits are statistically flat, but if one then considers the asset type, another opportunity arises. Forklifts renew at twice the rate of similar heavy equipment assets, so a focus on forklift-centric business can improve profitability via increased renewals.

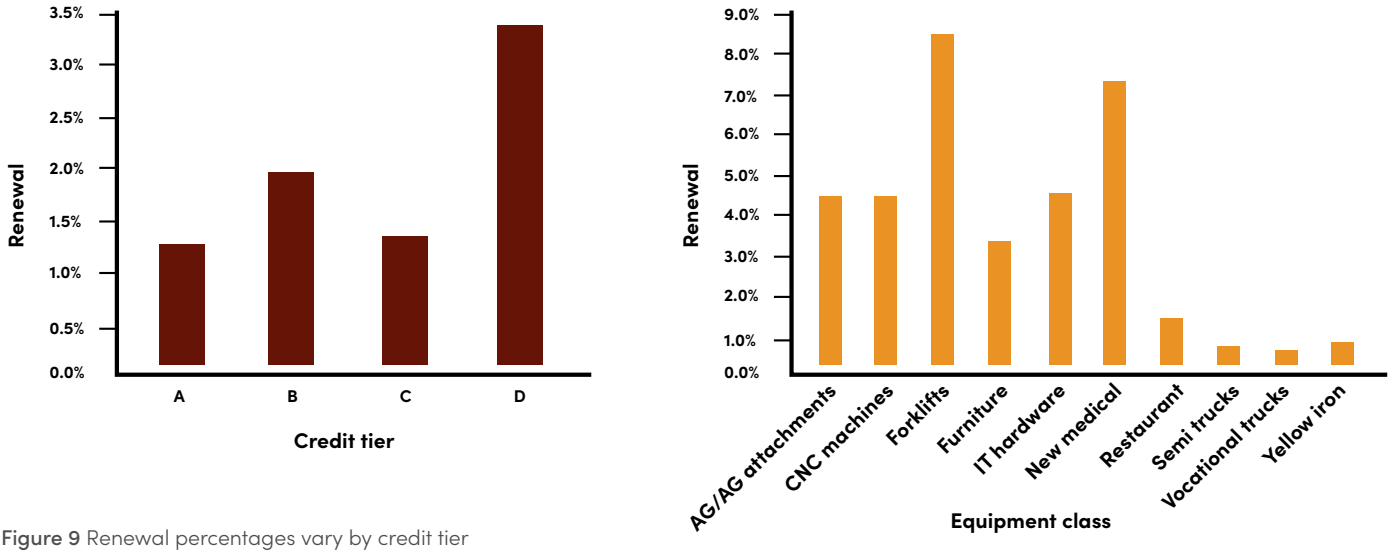


Figure 9 Renewal percentages vary by credit tier and equipment class (~1900 lease sample).

The data in the figure above comes from the aggregation of several portfolios, but any finance company with tenure likely has enough "dark data" to train a renewal predictor for both customers and assets. Credit scores and background checks do not provide insight into renewals, but renewal is a relatively easy prediction for an AI agent because it is a clearly defined outcome. Renewal prediction percentages could be the on-base percentage of a "Moneyball approach" for finance. The B-credit forklift-centric portfolio will generate more profit.

Next generation risk management tilts risk-reward balance in favor of reward.

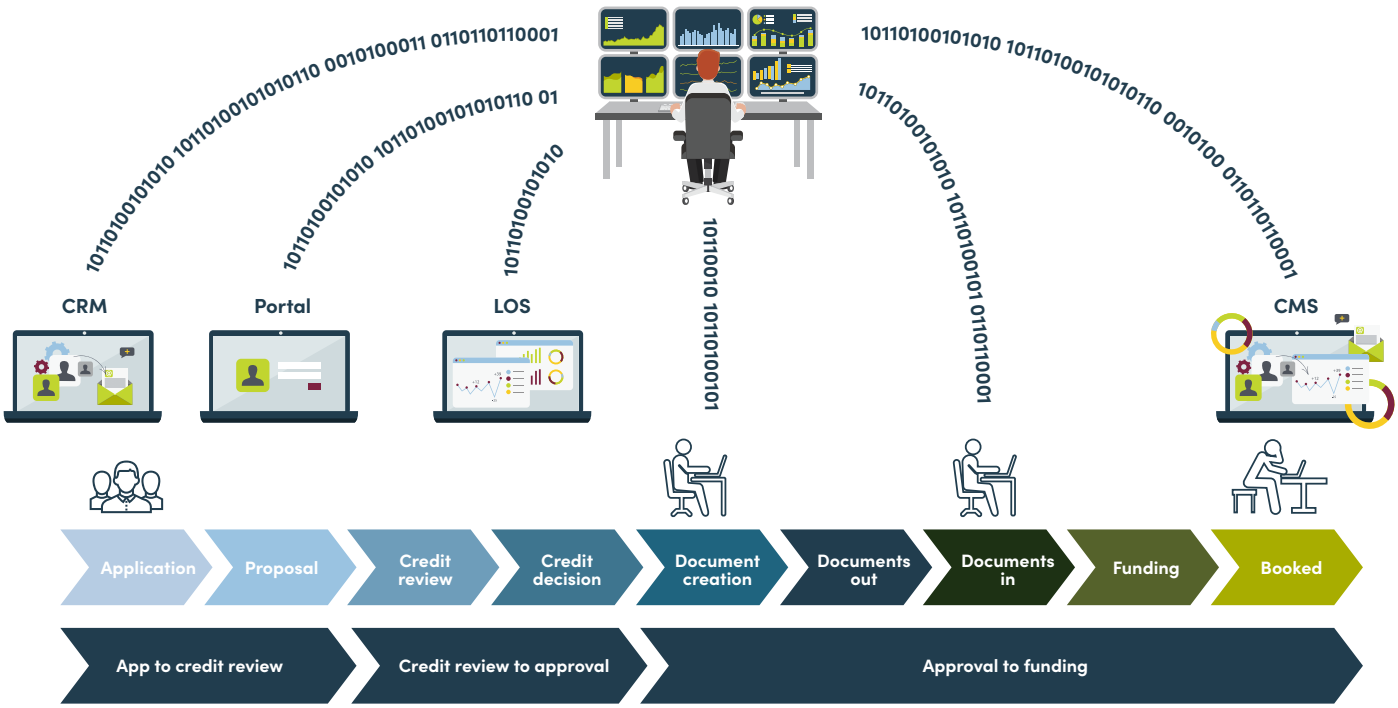


Figure 10 Data is generated from every step of the workflow but it must be collected and structured for analysis and action.

Getting started with AI-based risk management requires two commitments from the organization. The first is becoming data centric throughout the organization. Each function of a financing workflow generates data that the organization must capture for use. The second commitment is understanding that this data cannot "go dark" – it has great value to an AI approach to running the business because it "knows" every risk the business has taken and whether it suffered or benefited. To avoid "going dark" requires the organization to start analyzing and using the data for every part of the business. This means business intelligence, customer communications, internal training and communications, and the implementation of prediction technology.

Humans still required.

Risk management is the most critical function of financial performance for an equipment financing business and is often central to the competitive strategy of the enterprise. As such, improved risk management increases not only profitability but also competitive advantage. AI is changing both the fundamentals of risk management as a discipline and credit risk management through the integration of borrower behavior and accelerated learning. As is the case with other human skills – creativity, numerical analysis, matchmaking – AI can dramatically increase both the speed and production of ideas or examples, but humans are still required to convert AI to value through the integration of judgment. In equipment finance this has already been shown by using AI to automate "easy" underwriting decisions and then focus the human critical thinking on the more complex, difficult and important decisions, thereby dramatically increasing the productivity and competitive position of the enterprise.

AI will not replace humans in the application of risk management; it will make them more valuable.

Guiding financial innovation™

As the equipment finance industry continues to evolve, Tamarack will be here at every turn to help lessors embrace change and explore risk in order to meet the changing business requirements needed for success.

Contact us today to get started.

About Tamarack Technology, Inc.

Tamarack Technology is the leading provider of AI-based automation and risk management software along with professional technology services specifically for the equipment finance industry. For more than 20 years, Tamarack has been helping lessors protect their investments, improve business performance, and provide customers with access to solutions that enhance operations and financial performance. Tamarack's suite of AI products connect and integrate key ecosystem applications using historical and real-time data to automate burdensome manual processes, drive operational efficiency with better, faster decision-making, and improve organizational productivity. The company provides professional services including integration, implementation, and data migration services for the leading industry portfolio management platforms.

In 2020, Tamarack identified the need to help customers improve their operational and financial performance through the integration of equipment finance software platforms with emerging digital technologies. To support its vision, Tamarack developed a suite of artificial intelligence (AI) products that leverage a lessor's historical and operational data to predict financial outcomes and improve operational performance. The benefit: automation of the burdensome and often manual processes that weigh down workflows and slow financial decision-making. Through AI, Tamarack is further helping lessors protect their investments, improve business performance, and provide customers with access to solutions that enhance operations and financial results.

For more information, please email us at discover@tamarack.ai or visit Tamarack.ai to learn more.

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