

REINVENTING YOUR BUSINESS WITH AI

WHITE PAPER FROM OPEX ANALYTICS, A DIVISION OF LLAMASOFT

INTRODUCTION

The recent rise in AI (Artificial Intelligence) has changed how businesses solve problems. In fact, we believe it gives businesses a chance to reinvent themselves, a lot like the Lean movement did many years ago. Yet, with the hype surrounding AI growing daily, businesses are often left with more questions than answers.

Opex Analytics, now a division of LLamasoft, has been in this space for the last seven years and we've seen the AI movement evolve. In this paper, we want to cut through the hype and explain what the AI movement actually means to business leaders and how they can make the most of this opportunity.

BUSINESS LEADERS SHOULD THINK OF AI AS AN UMBRELLA TERM

“AI” is a tech buzzword that seems to take on a new meaning each time you hear it. This causes confusion for many business leaders who struggle to put it into perspective for their specific needs. A good way to add clarity is to closely examine how the industry's thought leaders define it.

Jeff Bezos, CEO of Amazon, is convinced AI's amazing advances will generate improvements for every business. He [discusses](#) two layers of AI.¹ The first layer: the “showy” new things people see and are amazed by— AI recognizing people, driving vehicles and



understanding spoken language. The second layer: all the algorithms and changes happening “beneath the surface” that allow operations to run more efficiently— things like better recommendation engines for online shopping and better forecasting for inventory management.

Andrew Ng, a professor at Stanford University and a Thought Leader in the AI space, [uses the term “AI”](#)² as an umbrella term to encompass a whole range of algorithms, accomplishing things like optimizing web search, targeting advertisements, approving consumer loans and routing delivery drivers.

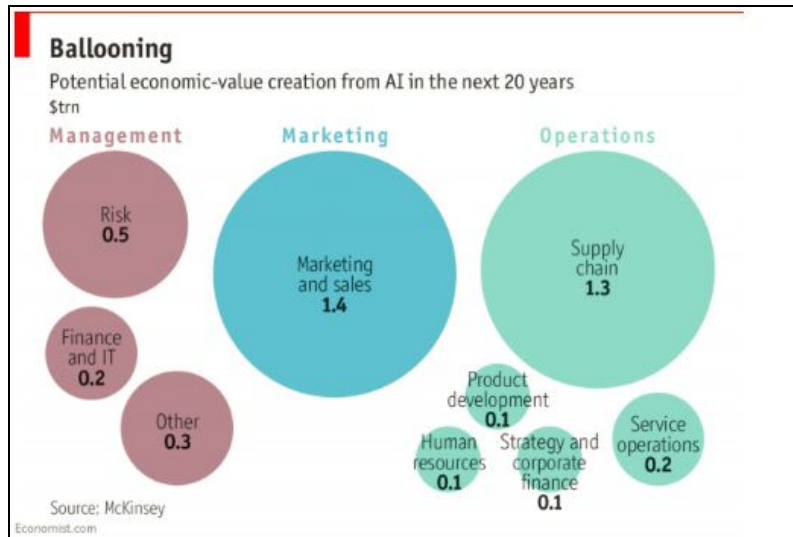
Amy Webb, a professor of strategic foresight at the NYU Stern School of Business and the Founder of the Future Today Institute, published a [document](#) on AI trends that defined AI as having a computer “do things that normally require human intelligence.” She admits that this is an “extremely large, broad field.”

The 2018 book [Prediction Machines](#) uses the term AI to encompass all algorithms that allow us to make better predictions. The book’s authors define predictions very broadly and make a strong case that almost all decisions have some element of a prediction. They claim that the AI movement is about drastically reducing the cost of making these predictions. This will lead to a much wider use of AI. The implication is that business leaders need to adjust to this reality so that competitors or start-ups don’t beat them to it and take away market share or profit margins.

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[Tom Davenport](#) played a key role in the rise of the term “analytics”— more on that later— and in recent years has begun writing more about the role of AI. In 2015 (before the term “AI” was widely used), he wrote an [article](#) about how Schneider National (a large trucking company) was augmenting human planners with intelligent machines. This was done solely with optimization technology. In 2018, he wrote another [article](#) about the uses of AI in the real world for process automation, cognitive insight, and cognitive engagement. If you look under the hood, you’ll find many different types of tools and algorithms working together to enable each of these transformations.

A recent [Economist](#) article addressed AI in the supply chain. The figure to the right shows the value that can be unlocked from AI in Operations (according to a McKinsey study). In the article, the Economist lumps many different algorithms and approaches into AI. This includes inventory management, forecasting demand, better routing and predictive maintenance.



As we can see from these examples, AI is being used as an umbrella term to encompass a wide variety of algorithms and approaches. This comes as no surprise. The field is moving rapidly, and so many tools and algorithms seem to fit well within definitions of “intelligence” that it makes sense to include them under this same umbrella.

The most important realization to be aware of is that the definition of AI that suits your business may be entirely different for others. For example, computer vision may be an essential AI advancement at Google while Amazon’s key AI application could be demand forecasting. Your business might be transformed by a different AI algorithm altogether. The bottom line is that AI is behind many of the most influential transformations in business but exactly how it is applied in each instance is unique. The power behind AI is what you make of it.

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HOW DID WE GET TO “AI” AS THE UMBRELLA TERM, AND WHY IS THIS A GOOD THING?

A decade ago, “analytics” was widely used as an umbrella term to refer to quantitative approaches to decision making. “AI” is the popular term today. How and why did the terminology change?



The term “analytics” became popular due to the 2006/7 *Harvard Business Review* article and book by Tom Davenport called “Competing on Analytics.” The content made companies realize they should be doing more to ensure they were making data-driven decisions across their entire enterprise. Davenport made the case that if companies weren’t using data to continually make better decisions, they risked losing out to competitors who did. Business leaders took the message to heart and the term “analytics” took off.

For a while, the term “analytics” was co-opted to refer mostly to data reporting (also called Business Intelligence), which greatly diluted its potential value. As important as data reporting is, it can only take you so far— there is much more to using data than just dashboards. As a reaction to this, serious thinkers presented us with the terms “descriptive analytics” (which includes reporting), “predictive analytics” (forecasting the future or classifying data), and “prescriptive analytics” (using data to suggest actions). With these terms, we then had a more sophisticated way to think about obtaining value from data, well beyond reporting and business intelligence systems.

Around 2014, the term “machine learning” became a more recognized term in business settings as companies began to realize the value these new, readily available, algorithms could provide. The business community knew that machine learning algorithms could lead to better predictions, or even to predictions in new areas. This created a lot of new business value. However the term “machine learning” always referred to the algorithms; it never became an umbrella term.

However, back in 2012 and unbeknownst to the business world, the term AI began gaining steam in the research community. There was an important breakthrough that year in algorithms for image recognition. Part of this was because of improvements in

hardware— specifically the use of GPUs for massive parallel computing. But another big driver was advances in deep neural networks (really just advanced machine learning algorithms). In 2012, for the first time, it became clear that these deep neural networks could recognize images better than people could. Researchers and application developers doubled-down on this approach and invested heavily.

Historically, people generally give credit to the [1956 Dartmouth Conference](#) for the original rise of the term AI. The term has come in and out of favor in the intervening decades with a variety of different approaches claiming to be on the verge of AI. In 2012, researchers had a good reason to revive the term AI: the underlying algorithms were neural networks. Neural network algorithms are loosely based on our current understanding of how the brain operates (through a network of neurons). If these algorithms truly do work like the human brain, then the term “AI” is a natural (and fun) way to describe the algorithms.

From 2012 onwards the research efforts paid off and the advances were impressive: better image and video recognition, realistic autonomous vehicles, great language translation and understanding plus well-publicized victories in board and video games. By 2017, it was clear these advances could dramatically change many industries and alter how a business was run. The term really caught on, and it captured our imaginations.

At the same time, more algorithms were placed under the umbrella term “AI”— even if the algorithms didn’t use a neural network. Of course, as the term “AI” became more of an umbrella term in the general business community, the research community needed to differentiate it from the ongoing goal of building machines that “think” in ways more human-like. Today, the research community sometimes uses the term “artificial general intelligence” (AGI) to describe systems that learn and react just like a human. Think of this as the self-sufficient robots of science fiction. In our view, AGI is still in the very early stages.

For researchers, this leaves the term “AI” (or “narrow AI” in some circles) for all the other associated technology that exists today. For example, when an AI algorithm identifies an image as a cat, we don’t expect general intelligence from that algorithm to decide whether to feed or take the cat to the vet.

Despite differentiation by researchers, we think the today’s general business use of AI as the umbrella term it evolved into is actually a good thing. Used in this way, the term AI better reflects how you should be thinking about the various algorithms and new advances that are now being implemented by the world’s leading businesses. The use of the overarching term keeps things simple by embracing many types of algorithms rather

than debating where an algorithm may fit or creating new terms like “advanced analytics” to differentiate it from reporting.

We also think “AI” is a great umbrella term because it represents a greater call for action than the term “analytics” did. “Analytics” perpetuated a misinformed view that reports, dashboards, and insights might be enough while “AI” clearly implies that you have to *think* more carefully about how to change your business, your workflows and the jobs people do. In other words, if you are not reinventing your business with AI, your competitors will be.

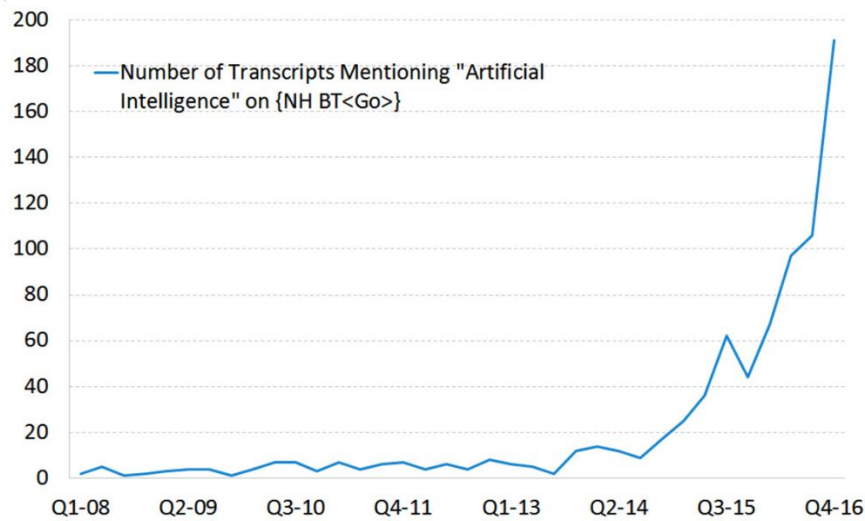
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WHAT OPPORTUNITIES ARE THERE TO REINVENT YOUR BUSINESS WITH AI?

With the many advances in AI and the public success of companies who embrace it, CEOs are now under pressure from their investors to state their AI strategy. Take, for example, the following graph from Bloomberg which displays the number of companies using the term “artificial intelligence” in their earnings call.



Companies Mentioning 'Artificial Intelligence' Rising Rapidly



Source: Bloomberg

CEOs, and by proxy their business leaders, need to have an AI strategy and be able to articulate it. And they need to show results from these AI initiatives.

This strategy can come in many different forms. AI can be part of your plan to revamp your entire business or AI can be used in smaller ways that add up to large savings.

You can use AI to improve operations, find revenue opportunities, delight your customers, understand risks in your business, predict service failures, improve speed and a host of other applications.

A recent [article](#) highlighted a quote from the CEO of Walmart's Global ecommerce business, Neil Ashe: "When asked by a board member how long its ecommerce strategy would take and how much it would cost, Ashe responded: 'It will take the rest of our careers and as much money as we've got. This isn't a project. It's about the future of the company.'"

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This is a great quote highlighting that AI (AI is heavily embedded in ecommerce) is not just a project, but a mindset. And, this is not just Walmart. You can bet that based on what Amazon says publicly, they also do not treat AI as a project with a finite duration.

Here are a few practical examples of companies turning the AI mindset into reality:

We won an [award from Nissan](#) for helping them better plan the transportation of finished vehicles from their plants in Mexico to their dealers. This is an example of AI helping both plants and dealers make better decisions as they automate part of the process, freeing up planners to work on more important tasks. (In the [2018 article by Davenport](#), this would be categorized as “AI for process automation.”)

We’ve also worked with an online retailer to help them better track down the root causes of service failures and predict potential service failures. This allowed them to fix problems to prevent them from happening again as well as take action to avoid an issue in the first place.

A couple of years ago, we spoke at a conference with WhiteWave Foods (now part of Danone North America) about creating an optimization model and an automated front-end interface for production planning. This is a great example of helping automate a difficult process— deciding what products should be made where and when— and has big implications for overall cost. To make it work, you need the right design for the user interface, the right data engineering for pulling data together, the right machine learning algorithm for detecting problems with the data and the right optimization method to determine the best production plan. In the end, this is a process like [Davenport described](#) in which AI and a human work hand-in-hand to make better overall decisions for the organization.

We hosted an [educational event](#) on marketing analytics. Combining AI with better information about your customers, you can determine how to better allocate marketing dollars, prevent customers from churning, and improve pricing and margins. But you can also use these same insights from AI to change your business operations, providing the services your customers actually want.

We’ve worked with several companies in the area of forecasting and inventory planning. In fact, we highlighted our learnings with a [3-part webinar series on inventory](#). The series covers the science of inventory and how machine learning enhances the process; it ends with a discussion about how we’ve implemented reinforcement learning in the context of the classic supply chain game, the [Beer Game](#).

We've also used text analytics to extract data from purchase orders that we could then use in other analyses. Although simple, this was the kind of data that would have been impossible to systematically use ten years ago.

AI projects can involve a mix of different algorithms. For example, we've worked on projects in which we've predicted the price curve of a product (using predictive algorithms) and then determined what action to take with that price curve (using optimization algorithms) and what price to charge, given the available capacity and likely moves from other competitors.

HOW CAN YOU REINVENT YOUR BUSINESS WITH AI?

This list of real-world examples demonstrates AI's vast practical possibilities. To reinvent your business with AI, you first need a strategy. Think about Walmart's CEO's quote: AI is less like a project and more like an ongoing effort.

As an ongoing effort, you want to figure out how AI can impact every aspect of your business. You want to understand how it affects your businesses' core decisions, how it changes your overall strategy and business model, how you can get it into the hands of your frontline employees so they can better do their jobs, how it automates processes that don't really need human interaction and how roles in your organization need to change to best complement what AI can do for you.

There is certainly an IT and software component to this. You will end up building AI software tools and possibly buying off-the-shelf software for point solutions. But you don't want to fall into the trap of buying an off-the-shelf tool that claims to do AI and then think you are done. Off-the-shelf software is meant to solve a point problem; it is not your AI strategy, and it is not how you are going to reinvent your business. It might look like the easy way out, but you won't come up with creative ways to change your business by buying a point solution.



Instead, you want to create the mindset and capability for AI to impact all aspects of your business and decisions. A good analogy is the Toyota Production System (now known as Lean Production). The Toyota Production System worked for Toyota because they spent decades working on it and sticking with it. The mindset was ingrained in their culture. When other firms tried to reap the benefits by just implementing a few of the techniques, they did not see anything close to the potential value that Lean Production can offer.

Here are three main ways that companies are working to create this mindset and reinvent their business with AI.

One: Build your team internally. Amazon made this approach popular; they want to control their own destiny and build their AI solution to fit their business. They're famous for redesigning how their distribution centers work (moving from wave picking to a flow system in which goods come to their pickers) and buying the robot company Kiva (to bring the expertise in-house rather than outsource it and risk others stealing their ideas). Plus, they're well-known for their risk taking. They likely treat AI investments like they do other systems as they're willing to take big bets and try ten things, not knowing the ROI of any of them. Of these ten things, they know most will fail, but one or two of them may pay off big. Companies on the AI journey would do well to think about this process. Marc Andreessen, the co-founder of Netscape and now a Silicon Valley investor, has a great saying for this kind of bet: "Huge, if true." You have to try it to see if it is true.

The difficult part of growing your internal team is that not every company is Amazon. It can be as simple as not having the right talent pool in your local market. It can be more subtle, like not being able to convince the talent to join your firm or having the right structures in place to be able to keep the talent. Or it could be that your current team needs to actually learn to work in an AI environment. Think about the Lean movement—organizations didn't learn how to work this way overnight.

Two: Build a lab organization in Silicon Valley. Building a separate lab organization in Silicon Valley is popular with large companies. This helps them solve the local talent problem by residing in the heart of the AI activity. It also creates a separate group to allow AI activities to flourish without being crushed by your current culture and processes. Google is famous for their internal labs generating novel ideas. And, lucky for them, they are already in Silicon Valley.

The two big downsides of this approach are cost and risk. Once you go this way, you are in the game for tens, if not hundreds, of millions of dollars. The risk of setting up a separate organization is that you won't actually be able to get the innovation into your business, even if the lab comes up with something for your business. In other words, the

risk is not like Amazon's bets because the lab is separate from the day-to-day business. At Amazon, the bets are being made directly with the people in the business.

Three: Partner with an AI firm. In this approach, you are working with a partner firm that can help you on your AI journey. This partner can work with you to come up with the right AI strategies and projects, help you build out and test new ideas, and help you grow your internal capabilities.

Obviously, not all firms can help you with this. To make this work, you need to find the right partner. You should look for the following characteristics:

1. A partner that can help you create AI ideas that will work or have a chance to change your business. This comes with experience in the area and a mix of business and technical skills. This can be difficult when growing an internal team simply because of its small size. A software vendor is also not likely to help you create ideas beyond the ideas of their particular application.
2. A partner with a wide range of business and technical experience. As you rethink your business, it's likely you'll need a diverse range of skills to help you come up with innovative solutions.
3. A partner with a willingness to be transparent and share. You need to learn how AI works, and you need to own the overall solution moving forward. The AI journey will not be static, especially if you are shifting your business mindset, and you need to know as much as possible about how the solutions were built.

HOW IS OPEX ANALYTICS POSITIONED TO HELP YOU REINVENT YOUR BUSINESS WITH AI?

Opex Analytics, a division of LLamasoft, can help you reinvent your business with AI. We've even had some of our clients model their own internal AI teams based on how we've structured Opex Analytics.

We're built to work on specific, temporary projects with you or partner with you to be your analytics center-of-excellence. And, as you'll see, we are not a typical consulting



firm. We will change how you think about consultants and what it means to partner with a true AI firm.

We're equipped with technology that we can use to help deploy your AI solutions. This includes our self-service rapid deployment platform which allows you to quickly deploy AI scripts with an easy-to-use interface. We'll also help you stay on top of the latest AI technology. We regularly use open-source software like Python, R, TensorFlow, Postgres, and H2O. We work with commercial software packages as well, especially in the optimization and data engineering departments, where the commercial packages are still much better than the open-source alternatives. Plus, we have ongoing internal education as well as strong ties with leading universities.

In the space of AI, solutions typically require a combination of several different types of skills and algorithms— you'll rarely find a single algorithm solves every issue. This is why we've assembled a diverse set of technical skills geared to solve your particular problem. We understand the science of AI, and we have expertise in machine learning, deep learning (and its offshoots), optimization and simulation. We also understand how to write and deliver code. Plus we understand data engineering— how to get the data from your existing systems and into a clean format for your AI applications.

Our range of experience is diverse and robust. We've worked in many industries, including CPG, retail, transportation, distribution, airlines and aerospace, automotive, chemical and mining, banking, and quick-serve restaurants. We have the business skills to help you translate the technical side of AI into practical applications within your organization.

We also bring a focus to the science of making decisions with the AI models. Fast Company recently wrote an [article](#) on Google's creation of a Decision Intelligence Engineering group. It's not enough to predict a value; you also need to figure out how to automate and scale the decision-making. We have deep expertise in mathematical optimization (linear and integer programming)-- one of the workhorses of automating decisions. We also know how to develop heuristic approaches to decision making. Plus we incorporate different or multiple objectives, considerations of risk and robustness and our team's practical business experience into the decision making process.

Last, but certainly not least, we have a team of intelligent, dedicated people you'll enjoy working with. If you're going to reinvent your business with AI, you need a team with a wide range of diverse skills. We've assembled just such a team.

We are positioned to help you reinvent your business. Let's find the solutions together.

Notes

1. For the Bezos quote, see this video: <https://youtu.be/fj-0ZJ5apO8>, from the 21:00 to the 23:15 minute mark. Note that he uses the terms “AI” and “machine learning” almost as synonyms.
2. For the NG quote, see this video: <https://youtu.be/21EikfQYZXc>, from about the 4:50 to the 5:35 mark, where he defines web search, advertising, approving a consumer loan, and estimating the time and routing a driver to your home for take out food delivery as all being powered by AI. The talk goes further and hits other industries.