AI in Procurement

Advisors
Heta Pirttijärvi and Riku Mikkonen

Art direction and layout
Merkitys

Illustrations
Tuomas Kärkkäinen / Merkitys

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AI in Procurement

Sammeli Sammalkorpi

Johan-Peter Teppala

Contents

AI in Procurement strikes a perfect balance between objective thought leadership and humor, making it possible for readers to break through the hype surrounding AI without having to give up on their dreams for its impact on the future of procurement.

Kelly Barner, Owner & Managing Director, Buyers Meeting Point

This is the best book I have seen yet about how to apply AI in procurement. It covers all the essentials one needs to know, as well as lots of practical use cases and insights for procurement professionals. Read it to stay at the top of your game.

Tommi Vilkamo, Chief Data Scientist, eCraft

There are many great books on AI out there, but this one in particular was of great interest as it explains in easy language to business managers how AI impacts and delivers value to the procurement function.

Laila Kakar, Senior manager in Data Analytics, MTN United Arab Emirates

This book is exactly what is needed in order to understand the reality of AI in procurement – and the future of it. With the hands-on industry experience of the authors you have the ultimate guide to AI and procurement.

Antti Merilehto, AI Strategy Company – best-selling author in AI

Acknowledgements

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And finally, thank you to every single person at Sievo for proofreading, getting our facts straight, and giving us laughs at the end of a long day at the office.

We mean it: thank you.


September 23
Dear Sir or Madam,
I am writing to apply for

1 Introduction

Many centuries ago, ancient Greek, Indian and Chinese philosophers laid the foundations for artificial intelligence by exploring the idea that the human mind can be mechanized. With this in mind, in 1950 an English mathematician and computer scientist Alan Turing came up with a test to determine whether a machine is able to exhibit intelligent behavior that is indistinguishable from that of a human being. Seven decades later, artificial intelligence is so prevalent and pervasive that we often interact with machines without even being aware of the fact.

Can you tell the difference between human and artificial intelligence? On the following page there is a short summary of this book. See if you think it was written by a human, or by a machine.

Although the internal data is a valid ground for the AI to operate upon, any external data existing is also a valid application area for the AI to use. Keep in mind that while AI and machine learning can easily cope with quite complex tasks as long as they are predictable, some tasks that humans see as "simple" – such as planning a supplier event for 200 people – can be difficult or impossible for AI. Learning to trust AI is another area in which organizations have to adapt, because the ways in which AI algorithms come to their conclusions are not always clear. Initially, to get results from the AI, you need data for it to process as well as a business case where the AI can bring actual benefits. This helps in implementing the AI to get even more value out of it and showcases new business cases that the AI could be helpful with.

Confused? The summary was created by an artificial intelligence application that analyzed the content of this book. As you can see, the text doesn't make a lot of sense. Sure, the artificial intelligence software has "read" this book and gathered together what it thinks are the most important sentences (and some of them may actually be so), but the end result is *not* what one would call a helpful summary of a book.

We chose to begin with this example to demonstrate that although there is a lot of hype around AI and what it can do, it is important to stay grounded. The fact that machines can summarize text for you is amazing, but further development of AI-technology as well as human intervention are still needed.

You are not going to read about futuristic robots in this book. Instead, you will see real-life examples of how AI can transform your procurement function and gain an understanding of what it can do for your company *today*. It is also necessary to remember that AI is not the only option available to develop your business.

Who is this book for? This book is meant for *you* – an open-minded professional who is interested in AI, in procurement, and the fascinating things that can happen when you combine the two. It was also written:

- For *you*, the procurement professional who wants to champion and implement AI into your company's operations
- For *you*, the student studying logistics or supply chain management who wants to learn about how the field is transforming

- For *you*, who worries that everyone else appears to be benefiting from AI except your team
- For *you*, someone who is just curious about anything that can potentially help your business thrive

This is for *you*, the procurement superhero tirelessly driving change, seeking value and unlocking innovation.

And don't worry, we don't expect you to have prior knowledge about AI and we're not going to get too technical about algorithms or how to code them. What we *are* going to do is provide you with a broad view of the topic. We're going to answer some of your burning questions such as:

- What *is* AI and what are its applications in procurement?
- How do I get started on my AI journey?
- What are AI's key strengths?
- Will AI steal my procurement job?
- What are the risks associated with AI in procurement?
- How come the world's smartest machines can't tell the difference between an apple and an owl?

Intrigued? Let's begin.

I expect AI will change 100% of jobs in the next five to 10 years.

Ginni Rometty, CEO of IBM, 2019


Application
skillset
develop
able to

2 The evolving procurement technology landscape

In this chapter we'll answer the following questions and more:

- Why do 21st-century CPOs lead futurist lifestyles apart from in one key area?
- How has technology already transformed procurement and why is AI the next big shift?
- When did AI get smart enough to beat the (human) world champion at chess?

Procurement technology is changing faster than you realize

Let's start with a story.

It's the year 2008. You're in your car, listening to Lady Gaga's *Poker Face* for the hundredth time on the radio. You are running a bit late to the office, so you pull over to the side of the road to call your teammates on your Nokia phone. As you finish the call and start driving again you change radio stations to the news and hear that a music streaming service called Spotify was launched in Sweden. The news reporter also analyses whether Obama will be selected to be the first black president of the United States in the upcoming presidential election. Your thoughts are interrupted when your spouse calls to ask if you want to go down to the video store that evening to rent a film before it closes at 9 pm. Finally, you arrive at your office, where you work as a chief procurement officer (CPO). You sit in your cubicle and open an Excel spreadsheet, which you use to track your company's procurement processes.

Fast forward to the year 2020. You're driving in your electric car and listening to your favorite playlist on Spotify, connected to your car's speakers via Bluetooth. The song *Shallow* by Lady Gaga and Bradley Cooper starts playing for the hundredth time, but you can easily skip to the next song by clicking "next" on your iPhone X. You are running a bit late to the office again, so you say "Siri, message my team I am 5 minutes late".

> You see someone on the side of the road rocking a red "Make America Great Again" cap and think about how much has changed since Obama was president. Coincidentally, just as you are thinking about presidents, your smartwatch notifies you that there's a new season of House of Cards on Netflix. You finally arrive at your office, where you still happily work as a CPO. You sit in your office, open an Excel spreadsheet, which you use to track your company's procurement processes.

In the space of 12 years, almost everything about your routine has changed as the pace of technological advancement continues to subtly make our lives easier in a hundred different ways. But the hypothetical CPO in the story above is still using an Excel spreadsheet to track their company's procurement performance.

In reality, this is not a farfetched situation. According to research, the vast majority of procurement functions are managed using manual processes or with inefficient and outdated technology.[1] This begs the question: if your car, your music player and your phone have changed so much over the past 12 years, why hasn't your organization's procurement technology evolved as well? You may have been told in your childhood that you don't need to do something just because everyone else is doing it, but when it comes to business practices, failing to keep pace with the development of new technology is a sure-fire way to let your procurement function fall into obsolescence.

The most recent big shift in procurement has been in the realm of digitalization. Areas such as contract management, supplier management and e-sourcing received a boost in

efficiency via digital transformations.[2] However, the true goal of fully automated procurement processes was yet to be realized. You can choose who to blame – resistance to new technology or a lethargic pace of innovation – but in any case, slow technological development (and adoption) has kept the procurement function back. A. T. Kearney described today's procurement technology landscape well in 2018: it is

> based on a linear concept of sourcing activities on the left and procure-to-pay activities on the right. It's a neat package that looks great on paper. Unfortunately, it reflects little about the realities and complexities of day-to-day procurement.[3]

Today, we're riding the crest of the next big shift in procurement software – procurement and AI. Judging by unrealized expectations of past efforts, it may be easy for cynics to classify AI as just another overhyped tech that won't live up to expectations or change the procurement function in a meaningful way. However, there is reason to believe that AI is the game-changer that has come to transform the procurement function once and for all, as the following chapters will explain. But first, let's explore how we arrived at our present position in terms of procurement and AI.

Today's procurement technology landscape is "a neat package that looks great on paper. Unfortunately, it reflects little about the realities and complexities of day-to-day procurement."

A. T. Kearney, 2018

A very short history of procurement and artificial intelligence

Since you're reading this book, it's safe to assume that you know what procurement is. But if you don't, you can turn to the back of this book and check the glossary!

Procurement has been around for as long as companies have been making purchases, but it did not typically sit at the core of a company's functions until around the 1970s, when it began to receive considerable interest and recognition. The increased interest was at least partly driven by the oil crisis, which compelled businesses to focus on their purchasing costs in order to survive. While the slow change was occurring, procurement was still pushing papers in the back office and focused on the transactional operations. A larger shift occurred during the 1980s when the first enterprise resource planning (ERP) systems were introduced. These monolithic software products offered procurement leaders a chance to start automating basic operations.

By the 1990s, procurement started to gain more ground as new markets emerged across the globe. Communicating with suppliers took a huge leap forward as the improved technology created a more connected world. The overall picture shifted into a more strategic approach, as globalization demanded capabilities to manage an increased number of moving parts. Information technology started to be used for managing contracts, organizing suppliers and keeping track of spend. The effort of enhancing the processes increased the notability of procurement, pushing it to have a more strategic seat in the corporate table.

At the turn of the 21st century, procurement had solidified its position as a value-adding, strategic business function. New tools and analytics allowed procurement to improve processes and drive bottom-line impact from sourcing all the way to payments. The shift to a more data-driven approach has helped procurement to raise its status to a strategic, valued collaborator.

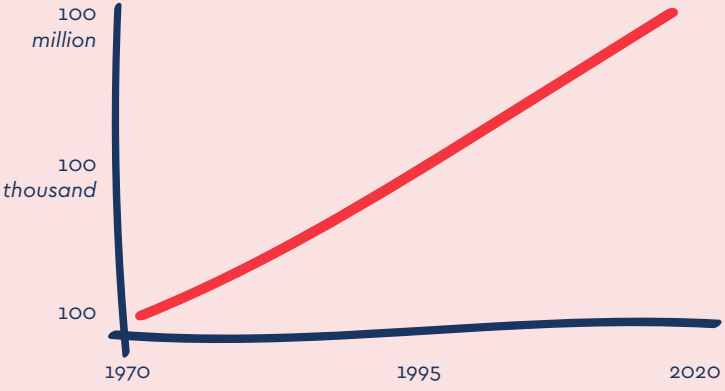
The emergence of new technologies has created vast amounts of procurement data: in your typical procurement organization today, you may find data spread across a number of databases and data warehouses, as well as a jungle of informal Sharepoint folders and Excel repositories. This makes it difficult for procurement organizations to exploit the opportunities hidden in the data. Luckily, this is where AI steps in.

The term "artificial intelligence" was first introduced in 1956 at the Dartmouth Conference, after which research centers appeared all over the United States to investigate the apparently limitless possibilities of AI. As the findings of AI researchers started spreading around the world, computer scientists found the task of creating intelligent machines more difficult than they had originally imagined. At the time, the amounts of data required to create applications such as those we take for granted today required enormous physical space, and computers weren't sophisticated enough to process the vast quantities of data. This resulted in researchers and corporations losing faith in AI and falling into an "AI Winter" from the mid-1970s to the mid-1990s.

In the late 1990s, the dying spark of AI research flared back into a roaring flame thanks to technological advancements driven by Japanese and American companies, when

Figure 1: Moore's Law

Transistors per square millimeter by year



speech and text recognition started to find its way into consumer products. Hope began to rise that very soon, computers could be able to translate languages and speak intelligently with humans. 1997 witnessed a key landmark when IBM's Deep Blue computer beat the reigning world chess champion.[4] Since then, AI research and development has been supercharged by improvements in computer hardware, including miniaturization and vastly improved processing power. The dramatic increase in computing power is often described by Moore's Law, which indicates that the processing speed of computers will double every two years.

With the increased computing capabilities and the growth of storage capacity, companies all over the world are now able to store extensive amounts of data and find ways to use that treasure-trove to their advantage. The world's largest companies, such as Amazon, Google and Baidu, are now all largely dependent on AI to run their complex processes. AI has invaded the home as well as the office with AI-powered home assistants such as Alexa doing everything from streaming music to controlling smart homes.

Today, the most sophisticated procurement organizations have also started to utilize artificial intelligence to improve operational efficiency and aid decision making. In the coming chapters, we'll examine in detail a number of concrete applications and use-cases for AI in procurement.

3 Artificial intelligence in a nutshell

This chapter will explain AI and answer questions such as:

- What is the difference between weak and strong AI?
- How is machine learning like watching a child learn to walk?
- What can we learn from Netflix's recommendations algorithm?
- Can AI be sexist?

AI impact – why AI?

What comes to mind when you think of artificial intelligence? Chatbots, facial recognition software, and self-driving cars? Yes, those are all AI-driven. But what is artificial intelligence *really*?

This chapter focuses on what artificial intelligence really is, what the benefits and challenges (realistic ones!) are, and what kind of applications are possible. We are not going to bore you with an in-depth discussion of algorithms. Instead, we'll aim to provide a basic overview of the subject.

Discussions about AI usually dwell on future potential instead of business reality. We want to give a realistic view of the subject and focus on what is happening right now. Take, for example, an important detail in the quote by Ginni Rometty on page 13. She said AI will *change* 100% of jobs, not *replace* them. There is a difference. Although AI has already had a considerable impact on the world and it will continue to do so, it is crucial not to get ahead of ourselves.

There are also frequent discussions about how "AI is coming", when it is, in fact, already here and you use it every day in Google search, Spotify recommendations, or unlocking an iPhone.

In a business context, the benefits of AI can be neatly linked to organizational goals such as minimizing cost and maximizing efficiency. But AI enables us to do far more than what we perceive to be the traditional use cases. On the following spread there are some benefits of AI in a simplified chart that shows, at a glance, why AI will be imperative in business for years to come.

AI will have a bigger impact on humanity than fire or electricity have had.

Google's CEO Sundar Pichai, 2018

Figure 2: Benefits of AI

Benefit of AI	What it means
 **Minimized manual work**	Employees being able to focus on creative and strategic initiatives
 **Increased efficiency**	Improving organizational efficiency by utilizing AI in tasks that would normally require a lot of time and have room for optimization
 **Improved forecasting**	Better predictions such as price predictions, maintenance needs, and stock market forecasting
 **Faster response times**	Minimizing the impact of disruptions such as natural disasters
 **Increased accuracy**	AI can boost accuracy and certainty in certain situations
 **Enhanced lifestyle**	Lifestyle benefits through AI personal assistants and autonomous transportation
 **Lower cost**	Creates room for other things in the budget and lowers the costs of projects

Example in a business context

Walmart has more than 245 million customers visiting their websites and stores, which would mean a lot of manual work to analyze customer data. With AI doing the analyzing, employees can better focus on the important decisions.[5]

Alibaba's logistics affiliate Cainiao uses AI to find the most efficient delivery routes for its logistics, which have resulted in a 10% reduction in vehicle use.[6]

Airline companies are using AI to predict maintenance needed on the fleet's mechanical parts to prevent downtimes and delays.[7]

In the case of a natural disaster, AI can enable an immediate response, and therefore reduce delays of providing help to impacted areas as well as reduce administrative burdens.

When a company is negotiating a merger and they need to know the credit scoring of the other company, AI can be used in the analysis. It can accurately distinguish if, for example, a company is credit-worthy, but they lack enough credit history.[8]

Self-driving cars will enable employees to work from their vehicles, which not only increases efficiency but gives them more time to spend with family.

A time-consuming exercise such as classifying documents into different categories could be done in a fraction of the time by a machine. The initial cost may be larger when investing in the AI, but the long-term savings are clear.

AI definition

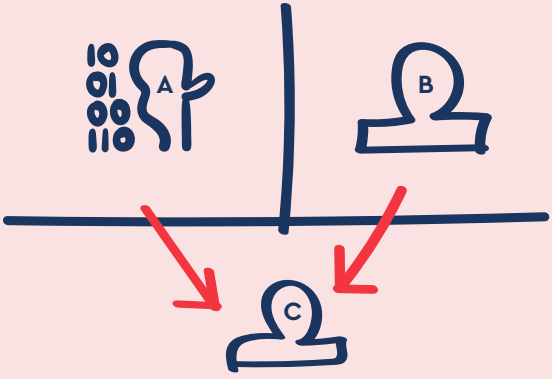
> Artificial intelligence (AI) = Algorithms exhibiting any behavior considered "intelligent".

AI is a branch of computer science which also works as an umbrella term for technologies that enable machines to exhibit human-like behavior. It is often divided into weak and strong AI, where weak AI is the type we most often interact within our daily lives. It focuses on one narrow task and does what it is designed to do. Basically, all AI at the moment is weak AI. Although the name indicates otherwise, weak AI can have a huge impact on businesses and how they operate.

Strong AI, on the other hand, can present flexible and skillful behavior, and can, therefore, focus on several tasks. Strong AI is often also called AGI, artificial general intelligence. Interacting with strong AI should feel like interacting with a conscious human to other humans, and therefore must have human-like cognitive abilities and the ability to solve unfamiliar problems by itself without human intervention. Strong AI or AGI still exists mainly in the realms of science fiction, with one of the best-known examples being James Cameron's *Terminator*.

There are several ways to distinguish weak AI from strong AI. In the field of AI research, the Turing test, developed by Alan Turing in 1950, became an accustomed way to distinguish whether machines were "intelligent".

Figure 3: The Turing Test



As already mentioned at the beginning of this book, this test was initially made to determine whether a machine is able to exhibit intelligent behavior that is indistinguishable from that of a human being. In the test, person C has to determine which one – A or B – is a human and which a computer. In 2014, a chatbot passed the Turing test by posing as a 13-year-old Ukrainian boy, which created the perfect alibi for the computer's inability to answer certain questions. Critics challenged the test as, in a way, passing the test didn't exhibit the computer's human intelligence but rather demonstrated how easily people can be fooled.[9] In reality, it's debatable whether an AI has even been able to pass the Turing test yet.

Although AI has been around for a while, incorporating it into the day-to-day life of a business takes time. A similar adjustment took place when the first computers were brought into offices in the 1970s. Early business computers were huge, slow and employees didn't understand how to use the new "software" they now had access to. Eventually, the computer became a big part of everyone's life. The transition may have taken decades but in the end, computers transformed from an introduced tool into a new way of working.

In the same fashion, adopting AI will take time but eventually, it will completely transform how we work, as it already has in some areas. If you think about AI as a discipline, rather than an application or a piece of software, it is understandable that learning how to work with it takes some time.

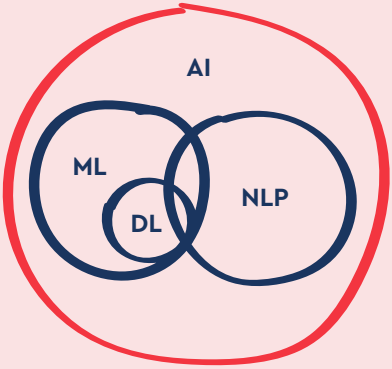
Artificial intelligence (AI) encompasses *machine learning* and *natural language processing*. The different terms are explained in more detail below.

Machine learning (ML)

> Machine learning (ML) = algorithms that detect patterns and automatically improve through experience.

ML is a class of different methods commonly used in AI applications. In the case of machine learning, the machine is not given specific step-by-step instructions, but it learns from the data by itself. It is not necessary to say *how* the machine needs to perform a certain task. So long as it is provided with initial settings and data, it processes the data by itself and improves its performance over time.

Figure 4: AI classification



AI artificial intelligence
ML machine learning
NLP natural language processing
DL deep learning

It's like watching a kid learning a new skill, such as walking: the child does not know anything in the beginning, but they watch examples of other people walking every day. They then test how to do it by themselves. No-one can really tell children how to do it precisely, so they need to figure out the required muscle movements alone, using the information they see, hear, and gain by experience. There are three different types of machine learning: supervised, unsupervised, and reinforcement learning.

1. Supervised learning The machine is given a *pre-defined set of training examples* which help it learn and come to its own conclusions in the future when given new pieces of data.

In this case, the data sets are labeled in a way that the machine can detect patterns. In other words, the machine uses past data to predict future cases.

An example of this is giving the machine different pictures of apples – brown, green, red, slanted, round… The machine learns that an apple has two black holes in the middle and that it is round, and consequently, in the future, the program can recognize an apple. In supervised ML the wanted outcome is already known: the programmer knows what sort of conclusion they want the computer to come to. In this case, they want the computer to identify apples from other objects.

Of course, it has its flaws. A human can easily separate owls and apples in the illustration on the next page, but a machine would have to process a vast number of examples of owls and apples (past data) before it would be able to tell the two apart.[10]

With that being said, supervised machine learning has become much more accurate over the years as technology and training continues to improve. If the algorithm mentioned above is informed that some of the pictures are, in fact, owls, next time it will get the correct answer. Despite its restrictions, supervised learning is the application that is most commonly used in business cases at the moment.

2. Unsupervised learning The machine's goal is to *distinguish possible groups* on its own. In this case, the data sets are neither classified nor labeled but instead they are sorted according to their differences as well as similarities. Humans do not need to know what the precise desired outcome is but trust the computer to make the decisions.

Figure 5: Supervised ML challenge
Separating barn owls from apples

A well-known example of this is Netflix's recommendation system. Netflix has hundreds of millions of hours of footage and it may, therefore, be overwhelming to find something that is of one's own interest. Obviously, Netflix wants its users to stay on the site and not leave due to frustration, so their AI helps in making suggestions about series or movies that a user might like. Netflix uses a single user's viewing history and compares it to those of other users with similar tastes. It can then draw the conclusion that users who watched A are likely to watch B. Based on these, the algorithms are able to form clusters of users that have a similar taste for more accurate recommendations.

What unsupervised machine learning algorithms cannot do, is label the different clusters. It *cannot* say "This is a group of users who like action movies", even though it can separate users who prefer romantic comedies over action movies.

It's kind of like when you say: "I don't know why, but I just don't like broccoli". The machine may not be certain why it grouped the samples as it did, because it simply discovered some sort of pattern and went with it. Measuring success in unsupervised learning can be challenging, as there can be different views in terms of measuring how well different groups are clustered.

3. Reinforcement learning In reinforcement learning the machine is trained to make specific decisions on its own by continuously learning from its environment based on a trial and error method. The machine is rewarded or penalized based on its answer and is then able to train itself based on the points gained.

It's like learning to ride a bike. After a fall, you will attempt riding the bike again in a different way. Maybe you need to make a more confident start or position your weight differently. Eventually, by learning from your mistakes, you will learn how to ride your bike in an error-free (and accident-free) manner.

This is how AI robots are taught how to walk: they are constantly fed negative or positive feedback on how they are doing which eventually enables them to reach the desired goal. Reinforced machine learning also takes place when computers play chess: the machine learns from past moves in order to make better decisions in the future.

Deep learning (DL)

> Deep learning (DL) = a class of machine learning methods where advanced artificial neural networks progressively improve their ability to perform a task.

You can think of deep learning like the evolution of a child's drawing skills. Regular machine learning is like a drawing of a stick figure, whereas deep learning is like a detailed painting at the gallery. At the moment, deep learning is used in technology including facial recognition, personalized shopping, and driverless cars. However, in most business cases, deep learning is neither necessary nor able to bring about the desired results.

Deep learning is made possible through the use of deep artificial neural networks, which are computing systems that are loosely inspired by the human brain. Our human brains consist of billions of neurons which transmit the information we receive. In the same way, artificial neural networks have information flowing through the "neurons" of the network.

As promised, this book won't go into too much detail about the implementation of those networks, but it's good to know that in order to mimic human brains' activity, the algorithms use multiple different layers. For instance, in facial recognition, one level of features can detect edges and another a human face.

Even though deep learning has been a topic of discussion since the 1980s, it has only recently become more prevalent, partly due to the fact that DL requires considerable amounts of computing power as well as large amounts of

labeled data. It, therefore, takes time to develop the applications needed to get the desired outcomes. Today, deep learning and neural networks have been driving the recent revolution of AI.

One of the most favorable benefits of DL is the fact that the data does not need to be "pure". Deep learning algorithms are able to solve complex problems even if the data is unstructured and very diverse. Because DL can learn using messy data, it enables more efficient learning patterns and subsequently more diverse and complex applications.

In addition, DL sets records in terms of accuracy. With that being said, traditional machine learning may bring better and more accurate results in certain applications that are simple, which most business cases involving AI today are. In these cases, DL would make the applications more expensive, complex and unnecessarily slow.

Natural language processing (NLP)

> Natural language processing (NLP) = Algorithms which can interpret, transform and generate human language.

The objective of NLP is to read and understand human language in a valuable manner. Common use cases of NLP are language translation, such as Google Translate, and personal assistants, such as Apple's Siri and Amazon's Alexa. Current applications of NLP often use neural networks, which use data patterns to improve understanding. There are several benefits to using NLP, including the ability to make a quick summary and quick language translation.

An example of an interaction between a machine and a human can go as follows:

1 A human talks to the machine
2 The machine records what the human is saying
3 Audio is converted to text
4 The text's data is processed
5 New data is produced
6 The new data is converted into new audio
7 The machine responds to the human with the audio it produced

You know the feeling when you read someone's text message and are unsure whether they are sarcastic, happy, sad or mad? We've all been there. The rules of human language are difficult for machines to understand, which creates a challenge for NLP – take for example sarcasm, slang, and hidden meanings. Although a perceptive human can understand the context and meaning of what you are saying, it produces clear challenges for a machine.

Another challenge of NLP is that a huge amount of data is required. The fact that data-hungry deep learning is used in a lot of applications of NLP also contributes to the challenge. This makes NLP implementation quite slow and expensive. But the technology is evolving fast. The earliest approaches to NLP focused on specific words and phrases it heard in more of an if/-then approach. If it heard a certain word, then it gave a specific response. This was not considered

machine learning, since words were classified based on simple rulesets.

Recently, with the increased prevalence of machine learning, NLP started to develop towards a more powerful approach. Today, in some cases NLP uses deep learning which enables a more intuitive approach in which the algorithm learns and improves.

For example, if you confuse your personal AI-powered assistant (like Siri) with a question such as: "Can you give me a muffin recipe, kind of like the ones they have at Starbucks?" The AI may get it wrong and provide you with the opening times of your nearest Starbucks coffee shop. However, once you've told the assistant that you actually just want the muffin recipe, it learns. Next time you are asking for a muffin recipe in the same convoluted way, the AI will remember the case and give you the muffin recipe.

The different types of AI under the same umbrella

To review, we have learned that AI, in general, is divided into weak and strong, and that the umbrella term "AI", encompasses – amongst other things – machine learning and natural language processing. Machine learning itself can be drilled down to neural networks and deep learning. The distinction between the different modes of AI is dependent on different aspects.

The difference between weak and strong AI lies in how well the computer can mimic the human brain and thinking process. Strong AI is predicted to be capable of human-level

thought and intelligence, whereas weak AI focuses on one narrow task.

The difference between the three types of machine learning is based on *how* the machine learns. In supervised learning, the machine is guided through the process. In unsupervised learning it learns on its own by identifying differences and similarities, while in reinforcement learning the machine learns by trial and error. Deep learning is conversely used for more complicated applications that require the machine to mimic human thought.

Most of the time it is evident which form of AI is to be used, but sometimes careful consideration is needed. You can let a machine playing a chess game practice by itself and learn from its errors, and a robot use the trial and error method of reinforcement learning to try and walk. But you could not put an untested driverless car into the traffic and just hope that if it hits a pedestrian, it will learn from its mistakes. This would be a clear example of an application where reinforcement learning would be the wrong choice.

Key challenges with AI

Although AI enables several improvements in your business, users need to be aware of its associated challenges – and we're *not* talking about robots taking over the world. In addition to the obvious challenges of the technology not being advanced enough yet for every conceivable application, as well as a lack of computing power, the challenges rotate around three key themes: AI being imperfect, the lack of

trust in AI (AI being a "black box"), and problems caused by human bias.

AI being imperfect Let's take, for example, the prevention of credit card fraud. Artificial intelligence is of great help in this area in several ways. AI is better than humans at spotting trends at speed: the algorithm detects suspicious changes in behavior very quickly and informs the bank and the customer that something is not right. This has prevented several criminals from being able to clear credit cards.

However, preventing credit card fraud is a good example of AI being imperfect. You might have experienced it when you are on an overseas trip, make several purchases in a short amount of time, or make a purchase larger than usual, and you are flagged by the system. The machine does not understand why you are breaking with your normal spending patterns: for example, you might be throwing a surprise birthday party at the office and that is the reason your credit card is paying for things in five different stores in addition to ordering a gift from South-Africa.

In fact, Javelin has estimated that 15% of all cardholders have had at least one transaction declined incorrectly in the past year, which represents an annual decline amount of almost $118 billion.[11]

At the center of this particular challenge are *false positives and negatives*. As the name suggests, a false positive is an outcome where the model incorrectly states something to be positive, and vice versa. An example of a false positive is when your keys or coins in your pockets at the airport are mistaken for weapons. A false negative could be finding a guilty suspect "not guilty" and allowing them to walk free.

Lack of trust in AI and AI being a black box Another challenge with AI has to do with the lack of trust in it. This is partly because AI models' results are often difficult or even impossible for a human to understand. Let's take an example of a chess game, where one opponent is a human and the other a machine. There have been cases where the machine makes a move that the human thinks is absurd or maybe even completely illogical, but as the game progresses, the machine wins. The human does not have a clue how the machine came to the conclusions it did, as the thinking is different from that of the human. Similarly, in business cases, it may be that the AI gives you a suggestion that is completely different to what you and your team were thinking but you just need to learn to trust the machine and accept the feeling of uncertainty.

The issue is that if you don't know how the machine comes up with its answers, it is more difficult to trust it, which in turn negates the benefits of letting the machine help you in the first place. This is why AI can be termed a "black box", or a complex system whose internal workings are not readily understood.

Researchers are currently addressing the issue of trust by bringing explainability and visibility to AI models, and there has already been a lot of progress in the subject. But here's the challenge: if we need to explain AI's algorithms to humans, they will almost certainly need to be "dumbed down", which would conclusively slow down the development of AI. These are hard-to-surmount challenges.

Human bias No AI is truly independent of humanity (at least not yet). The decisions the AI makes are ultimately

dependent on the values fed to it by humans, which – as you may have guessed – poses a risk. Human bias is one of the most hotly-debated issues in the world of AI. There is a risk that sexism, racism, and other prejudices that are deep-rooted in our ways of thinking are inserted into the codes that will make decisions for years ahead.

A well-known example of human bias occurred in Amazon's recruitment tool in 2015. Their goal was to establish an AI software that would go through all of the applicants' resumes and cover letters and pick the best ones so that the hiring manager would simply hire those and save a ton of time. After a while, though, they realized that the model was mainly choosing men, although the company did not have any intention to only hire men. This was because the data the model had been fed contained more instances of men than women, reflecting the male dominance in the tech industry overall. Hence, the machine thought that because male applicants were more prevalent, they were, therefore, better applicants. This is a classic example of human bias, where the machine simply followed the data that the humans had fed them. In this case, it was not intentional, but in many cases, the bias from the humans feeding the data may be such.

An example of AI becoming *intentionally* biased can be found in Microsoft's Twitter chatbot in 2016. As regular people sent tweets to the chatbot and as it learned from other people's conversations on Twitter, it (disappointedly) became extremely racist in less than 24 hours. The chatbot (named Tay) went from Tweets such as "Humans are super cool" to tweeting how "Hitler was right" and that "9/11 was

an inside job". The case raised several discussions about how crucial it is to minimize human bias from data fed to AI.

Human bias has been an area of discussion in image recognition as well. There have been cases where images of dark-skinned people have been tagged as "gorillas" in Google Photos. In this case, it could be that the training data did not have enough photos of dark-skinned people in relation to those of dark gorillas. Cases like these don't make a company's brand more valuable, that's for sure. The lesson to be learned: be careful what kind of information you feed the "learning model".

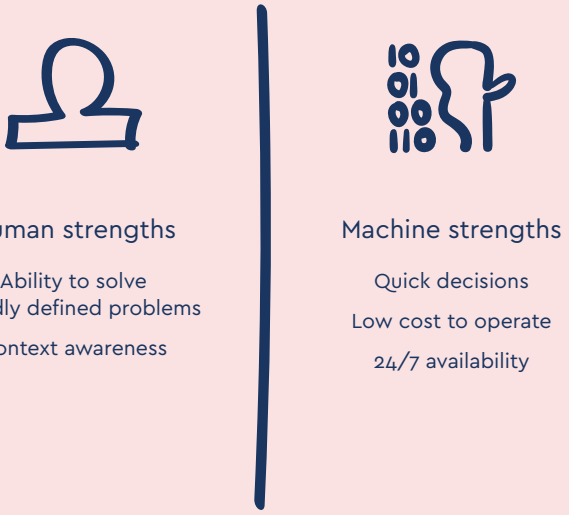
Conclusion of the challenges in the field of AI Generally speaking, AI does not expose businesses to a very high level of risk given its current use cases. It's good to acknowledge the risks associated with AI at a high level, but right now the applications where AI is used in a business context are so minimal that the challenges are not critical. However, as humans give the AI more freedom and as applications become more mission-critical, AI is exposed to more risks. Naturally, as AI is used more in business cases, both the benefits and challenges will be evident.

Cautious choices are needed in the business world in terms of AI in much the same way as cautious choices are needed in terms of sustainability or staying within budget. Like the researcher Andrew Ng (Associate Professor at Stanford University) put it, worrying about the rise of "evil AI" is like worrying about overpopulation on Mars. If we colonize Mars, then it will be the job of some people to solve the issue of over-population, but for now, it is not worth worrying about.

Human and machine collaboration

Although AI is becoming increasingly sophisticated every day, some human intervention is still needed at a certain level. Ultimately humans are better in some areas while machines excel in others, which is why collaboration between the two is crucial.

Figure 6: Human and machine strengths



An example of human and machine collaboration can be found in detecting lung cancer. The disease is one of the leading causes of death in China, largely due to air pollution. At the same time, there simply aren't enough radiologists to keep up with the demand of reviewing CT scans to look for the tell-tale signs of lung cancer. This is where AI steps in to detect and diagnose cancer not only more efficiently but also more accurately. Importantly, AI also does not make mistakes when fatigued.[12] With the help of AI, the disease can be detected faster, which enables the doctors to start acting upon it more urgently. The heightened results, in this case, were possible precisely due to the collaboration between human and machine.

There are three kinds of human-machine collaboration models when it comes to AI. The first is called *human-in-the-loop*, which basically means that whatever the machine does, there's always a human to oversee the result and approve, reject and so forth. This is a good approach if the decisions are business-critical or if there's a small number of high-value decisions to be made.

The second model is called *human on-the-loop*, which means that although the machine undertakes tasks on its own, there is a human supervising the process from further away. In this model, the supervising does not need to be as intense an in the previous model. This works really well when you have some kind of routine task.

The third model is *human out-of-the-loop* which authorizes the machine to run independent of human intervention. In this case, there are not a lot of ways for the human to intervene. An example of the out-of-the-loop option is today's financial markets and high-frequency trading. Because

speed is of essence, it's necessary to let the machine make the decisions as humans are simply too slow to intervene effectively.

One of the mistakes regarding human-machine collaboration lies in choosing the wrong model. If you simply let the machine run without proper guidance, you cannot completely trust it to validate your decision-making. Similarly, if you feel you need to micromanage the system, you are not getting the benefits of AI in terms of time-saving and efficiencies.

In conclusion, finding the correct level of trust in AI is a critical aspect. It's kind of like coaching kids in soccer. You need to trust them to give them a level of freedom that enables them to make mistakes and learn, but at the same time, you need to be present to coach and guide them forward.

AI in business

As discussed earlier, conversations about AI tend to be futuristic and bring to mind flying cars and Terminators. But businesses looking to incorporate AI into their day-to-day activities should be realistic and focus on the boring and narrow applications because these are the ones where AI truly works at the moment.

Although many people seem to be looking for concrete applications, AI is actually more of an enabler than an application itself. Take the aforementioned example of Netflix recommendations. A human *could* probably do it, but a machine just does it much more efficiently. Ultimately, today's AI is a new tool to help solve business problems and take

care of the manual work to enable humans to focus on more strategic initiatives.

AI can be considered the driving force behind the next industrial revolution in the same way as mechanization, mass production, and automated production were in their time. In these established markers, the new technology enabled new ways of doing business.

Doing our jobs without the benefits of the first, second, or third industrial revolutions would be difficult. This would mean a life without computers or airplanes, for instance.

In 1765, it was unclear just how much mechanization would revolutionize the way we do business in the future. Similarly, knowing just where AI will take us is difficult. It will certainly help businesses solve key problems but is unlikely to drastically shift the fundamental values and visions of the company.

Matthew Evans, Vice President of Digital Transformation at Airbus, puts it like this:

> Well, strictly speaking, we don't invest in AI. We don't invest in natural language processing. We don't invest in image analytics. We're always investing in a business problem.

Figure 7: Four industrial revolutions

1765

1st revolution
Mechanization

Led by the steam engine.

1870

2nd revolution
Mass production

Driven by electricity and oil-based power.

1969

3rd revolution
Automated production

Supported by electronics and information technologies.

Today

4th revolution
New technologies

Internet of things (IoT)

Articifial intelligence (AI)

Big data

Cloud

Cyber-physical systems

...


01

4 The reality of AI in procurement

This chapter explains all about:

- What procurement AI is capable of today
- What the end game for procurement AI looks like

Now that we understand what AI is and how it affects our business, we can start talking about the reality of applying it in procurement.

Although an ever-growing number of AI-applications are available on the market, most procurement organizations are not yet actually using AI. In fact, according to a study by Deloitte, only 45% of CPOs are using or piloting AI in their procurement function.[13] For those that are using AI, they are either using procurement software designed for the purpose, or have built in-house machine learning systems.

As stated, the idea of utilizing artificial intelligence is nothing new. AI systems have existed for decades and they have been successfully piloted across a number of academic and business applications from image recognition exercises to games of chess. With this being said, AI has not been around in procurement for long. However, the need for AI in procurement is growing: according to Roland Berger's survey of CPOs of Global Fortune 500 Companies, 67% ranked AI as one of their top three priorities for the next 10 years.[14]

In a confidential trial that took place some time ago, a multinational company invited Sievo (a procurement analytics company) and a well-known AI-solution provider to take part in a spend classification challenge, which turned out to be one of the earliest trials of AI in procurement. Both "man" and "machine" were given a short timeframe to analyze and classify the same sample of procurement spend data. The results were objectively analyzed and scored by the client's panel of specialists.

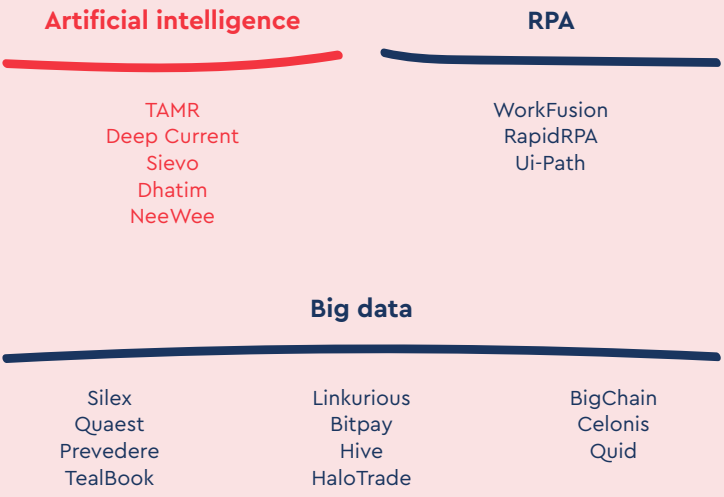
By the time the whistle was blown, humans had beaten the procurement AI by a resounding 6–0. Back then, there was no way a generalist AI solution could interpret and classify complex category structures better than a team of procurement experts. For a moment, there was doubt about the classification of MRO maintenance costs in Mauritania, but after a re-check that was also declared in favor of the human team.

The early trials and pilots proved that procurement AI can't succeed alone. Further research revealed that utilizing AI combined with human input lead to better results, leading to the procurement-focused machine learning classifications enabled in procurement software today.

Today, many of the companies using AI in their procurement processes employ external providers, ranging from large established players to new companies popping up due to the increased demand in the market.

Below is a chart adapted from a study by Oliver Wyman presenting the start-ups in the field of procurement. Companies focusing on artificial intelligence are highlighted in red.

Figure 8: Procurement and AI start-ups
Identified by Oliver Wyman[15]



We won't go into detail about explaining the various start-ups and what they offer. Instead, the important thing to note is the fact that there is a growing number of companies focusing on combining AI and procurement. But what kind of applications are even possible at the moment?

What's possible now

Machine learning and AI are already present in the growing number of procurement software applications currently available, yet they are focused on narrow applications due to the present capabilities and developments in the field of AI. While current AIs are adept at wading through repetitive data and forming patterns, it's good to keep in mind that they cannot do everything – for example, organize meetings or supplier events – without extensive user input.

On the next page there are 7 common areas where AI can be used across the procurement cycle.

Supplier risk management AI can be used to monitor and identify potential risk positions across the supply chain. For example, RiskMethods identifies new and emerging supply chain risk events by handling data gathered from different sources, helping to identify emerging risks faster.

Purchasing software AI can be used to automatically review and approve purchase orders. For example, it allows employees to order office supplies without requests for approval, making the process leaner and more efficient. To state an example, in Tradeshift's platform a chatbot called

Figure 9: AI in procurement software

Ada can be used to check the status of purchases or automatically approve virtual card payments, regardless of the user's location.

Accounts payable automation Machine learning is increasingly used in accounts payable automation. ML assists in identifying errors and potential fraud in large amounts of automated payments. An example of this is Stampli, which leverages machine learning to speed up payment workflows and automate fraud detection.

Spend analysis At Sievo, machine learning algorithms are widely used in spend analysis to improve and speed up a number of processes, including automatic spend classification and vendor matching. For example, if you have DHL, DHL Freight, Deutschland DHL, and DHL Express in your data, the machine learning algorithms are easily able to consolidate these together as DHL for increased visibility and data coherence.

Supplier information management Big data techniques enable new ways to identify, manage and utilize supplier data across public and private databases. Tealbook is one platform that applies machine learning to supplier data in order to create and maintain accurate supplier records across all systems and areas of the business.

Strategic sourcing AI can also be used to manage, guide, and automate sourcing processes. Keelvar's sourcing automation software uses machine learning for the recognition

of bid sheets and specializes in category-specific eSourcing bots such as raw materials, maintenance and repair.

Contract management AI has many potential use-cases in contract management. Seal Software uses optical character recognition (OCR) and advanced text analytics to clean up and consolidate information contained in contracts.

As can be seen, AI can be used on a very wide spectrum of the procurement organization. So how will AI develop in procurement in the future?

Where it's going

The prevalence of AI in procurement is forecasted to grow in the near future. Gartner estimates that "by 2022, 50% of all legacy spend analysis software will be retired; replaced by artificial intelligence-powered cloud-based solutions".[16] Moreover, McKinsey estimates that AI's impact is likely to be most substantial in the field of supply-chain management.[17]

No-one can truly know where we will be in 2025, but some conclusions can be brought forward in terms of what will be possible in the near future for AI and procurement. There is quite a strong consensus amongst the analyst community that the applications that are already in use will develop in the future.

For example, **automating tasks** is predicted to increase. Let's face it – many of the tasks currently performed by procurement professionals are still quite time-consuming, repetitive and simple in nature. These recurring and "tactical"

tasks prevent procurement professionals from focusing on more strategic initiatives. Therefore, applying AI to these tasks is already one of the most common applications. In the future, we can expect to see the level of automation become elevated.

According to McKinsey, tasks like payment and invoice processing, placing and receiving orders, and managing demand for purchases are fairly easy to automate. In fact, many of them already are (think of the aforementioned example of reviewing and approving purchase orders).

However, tasks such as vendor selection and negotiation as well as vendor management are more difficult to automate.[18] Although we will see a lot more automation of simple tasks, don't expect to automate *all* your tasks very soon.

Capturing data outside the organization AI can be utilized to take advantage of new sources of data. So-called "external" data sources can include market indices, company credit ratings or publicly available information about suppliers.

AI-powered methodologies can sift through immense amounts of external data to identify opportunities and provide benchmarks and recommendations for improving performance. Let's take, for example, the task of benchmarking your performance to those of others.

Say, at the moment, you are mainly using internal data as well as a static historical data set to benchmark your performance. This way you may get a fairly accurate picture but are still missing out on some key observations. A whole new level of insight comes into play when external data, such as market reports and stock prices, enter the field.

Decision support Automated notifications on anomalies, new opportunities and recommended activities directly in your procurement dashboards may sound like a dream but could be a reality very soon.

As AI processes an ever-increasing amount of data, it is able to stay up-to-date on the latest developments and changes in the operating environment. This will enable all anomalies and changes to be noted instantly and more accurately. AI will be able to immediately notify the team if something abnormal has occurred and can give instant suggestions on what could be done.

It can also be able to showcase possible simulations for different scenarios and new opportunities utilizing the data it has access to. The end result is that human procurement practitioners will be more aware of what is happening and will be able to take action sooner.

In addition, users can trust that the recommendations AI makes are based upon real facts rather than human hypothesis or guesswork. This gives the procurement leaders the confidence that their decisions are based upon real data, which removes uncertainty and leads to better decisions.

The end game

We examined where AI and procurement will progress in the near future, but where will it develop beyond that? It's impossible to say with certainty where it will take us in the end, but we made some predictions on what level of maturity AI could possibly achieve:

Total process automation No human involvement will be needed in operational procurement such as routine processes, approvals, compliance and reporting.

Automated value creation Machines may be able to make decisions and take action on savings and value generation opportunities without human input.

Full spend transparency All procurement related spend could be leveraged and available whenever key stakeholders need it – with no errors or faults.

Agile supplier ecosystems Managing strategic supplier relationships will take a completely new dimension, as data flows freely between partner systems. AI will provide recommendations and take actions based on data across the ecosystem, not just based on data of a certain player.

These are hypothetical scenarios, but they could be the possible culmination of the current AI applications. Do remember that these might not come to fruition in a way that we have imagined or might not occur at all.

Recap: what AI means for procurement

We've established that AI enables several applications that significantly help the organization to become more strategic. Many of the cases, such as new supplier identification, are possible with only human input as well. However, the increase in speed and accuracy brought about by AI justifies

the cost and time spent implementing it into the procurement organization. On the following spread there is a recap of the benefits and challenges involved in implementing AI into procurement.

As stated, only a handful of procurement organizations are currently using AI in their daily tasks. If you belong to one of these leading-edge organizations, congratulations on being a pioneer. But if your company is still at the planning stage, be sure to read on to discover how to get the most value out of a potential investment in procurement AI.

Figure 10: Benefits and challenges of AI for procurement

Benefit of AI	What it means for procurement
 **Minimized manual work**	Less time is spent on manual procurement tasks such as classification.
 **Increased efficiency**	The AI can discover new savings opportunities and offer action points to capitalize on those.
 **Improved forecasting**	Supplier pricing and market indexes can be predicted with more accuracy.
 **Faster response times**	The AI can identify anomalies as soon as they occur and inform the human practitioners.
 **Increased accuracy**	Tasks can be boosted to a higher accuracy as the AI can, for example, classify large amounts of repetitive data.
 **Strategic focus**	The procurement expert can focus on more strategic initiatives as the AI handles the manual tasks.
 **Lower cost**	The AI can identify savings opportunities to lower procurement costs.

What challenges it might bring

Errors made by the AI might require fixing. This takes time and effort away from other tasks.

The opportunities discovered might be erroneous or not valuable enough.

Flawed data might cause the forecasts to contain erroneous or insufficient information.

The risk of false positives is possible, especially in the earlier stages of implementation as the AI is not yet capable of making completely accurate detections.

Gathering a sufficient data set to train the AI to gain a desired level of accuracy is difficult.

The AI needs guidance and retraining, making the initial phases more demanding.

False positives can be found and the savings impact can be negligible as the AI is still untrained to understand what a significant savings opportunity is. It is a large investment initially.

5 Implications of AI for procurement

In the previous chapter, we explored how AI is used in procurement today. This chapter will answer a series of common questions about AI in procurement to explore its implications:

- Will AI fundamentally change the way we do procurement?
- What are the risks when implementing AI?
- What human skillsets are likely to become obsolete?

The transformational power of procurement AI

Firstly, is my company too small for AI? No, it is not. Think of machine learning as a new form of software. Software today is used widely across all businesses, both big and small. If you are a Deutsche Telekom or Walmart, you are likely to have very different software needs than those of a small business operating locally. Generally, SMEs do not go about building their own machine learning applications, just as they're unlikely to code their own custom software: instead, they search for the right software providers to suit their needs.

Today, a range of high-quality software solutions has emerged that can help companies begin their AI journey. These software solutions can be used by both large corporations and by SMEs. In addition, large corporations may choose to build their own solution for their very specific needs. Either way, procurement AI works for businesses of all sizes; the difference lies in *how* it is built.

How will my processes change with AI? There are some business processes in the procurement space that are extremely narrow that will change quickly, but AI will not fundamentally change the way we do procurement in the near future.

Although the current generation of AI is excellent at dealing with narrow use-cases in procurement, the focus usually lies around creating speed and agility in existing manual processes. While this is valuable, CPOs who wish to get the

maximum benefit from AI – such as analytical insights – need to completely reimagine their processes.

An effective way to begin is to consider how "manual", "repetitive" or "boring" processes could change with AI. Another thing to note is that even though many of your procurement processes may have remained unchanged for decades, you can expect to review and change processes frequently as AI continues to evolve and develop.

Accenture suggests that executives need to adopt a culture of AI experimentation. This enables them to

> quickly realize how and where the technology can change a process and where it makes sense to increase the scale and scope of a process.[19]

Because of the endless possibilities with AI, experimenting with it and not being afraid to alter business processes can create exciting new opportunities to create value.

For example, the Turkish telecoms company Turkcell has adopted a procurement chatbot, which simulates procurement professionals' conversations with suppliers and business partners. It has enabled procurement professionals to cut down on tasks that don't add value and focus instead on more strategic initiatives.

Keep in mind that while AI and machine learning can easily cope with quite complex tasks as long as they are predictable, some tasks that humans see as "simple" – such as planning a supplier event for 200 people – can be difficult or impossible for AI.

What risks are associated with implementing AI?

Although minimizing risk can be considered one of the benefits of implementing AI, there are also risks that it brings. One of the key risks in implementing AI lies in not understanding its complexity. If the individuals tasked with implementation do not have knowledge of the subject, you risk wasting time and resources or doing the project unprofessionally. Inadequate knowledge may also lead to a company trying to implement AI into a process where it simply won't work. It may, therefore, be worth partnering with a third-party with knowledge of procurement AI and the experience required to ensure a smooth implementation that will set your company up for success.

Another significant risk for the business is the long and costly implementation of AI which can also be expensive to maintain due to its complex structure. AI in general also comes with a host of ethical issues such as the part it plays in the generation of fake news or its use in Big Brother-style surveillance. Luckily, however, there are very few ethical issues involved when using AI in procurement.

You also need to allow for mistakes, tweaking for desired results, and refocusing on expected business benefits. Be prepared for setbacks and failures but remember that the rapid pace of technological development means that the failed experiments of yesterday are possible with the new AI methods of today.

Executives need to foster a culture of AI experimentation.

Paul R. Daughterty and H. James Wilson, Accenture, 2018

How can organizations adapt to the new way of working?

Although the need for adaption varies between use cases, the most important thing to possess in every organization is the *will* to adapt. Decision-makers need to accept that there will be challenges to overcome and mistakes made, analyzed and learned from.

In other words, when adapting to AI and the new way of working, it is crucial to avoid pressing the panic-button the moment something doesn't go as planned, as the process from start to finish is unlikely to be completely linear. It may also be worth considering implementing AI (and associated training) in a small team first before scaling upwards to the wider organization.

Companies adapting to AI also need to transition to a data-driven decision-making culture in order to take full advantage of AI. What AI brings to the table is an ability to analyze your data efficiently and if you are not using this in your decision-making process, you are not taking full advantage of it. This culture can be nurtured by encouraging employees to challenge decisions made across all levels of the organization that are not supported by trusted data.

Learning to trust AI is another area in which organizations have to adapt, because the ways in which AI algorithms come to their conclusions are not always clear. It may happen that the AI gives you a suggestion that is completely different to your teams' expectations. In this case, so long as you have confidence in the data set the AI is drawing from, it pays to consider the input from the machine in addition to your own. In practice, this can be difficult to accept and can create a great deal of uncertainty (until the AI is proven correct, or proven wrong, in which case this would serve

as further training for the AI). As mentioned earlier, though, there has been a great improvement in bringing explainability to AI over the past few years.

As AI evolves, organizations' hiring practices and training programs also need to keep pace. Managers should regularly evaluate which tasks are best suited for humans and which for machines, keeping in mind that a combination of the two often results in the best outcome.

The accelerating pace of change means skill-sets can rapidly become obsolete. Instead of hiring the most qualified person for a specific task, it is worth focusing on a candidate's ability to adapt to new situations in a future where humans will need to collaborate with machines to be successful in their roles.

Regular employees may not need to adapt to the AI that much in the end since successfully implemented AI will be "invisible" for the people using it. End-users won't notice the AI or have to think about it – although they may notice that a previously lengthy process now has fewer steps. Take, for example, a self-driving Tesla car. If it works properly, the person who slept at the wheel won't think "Wow that was some good artificial intelligence" when arriving at their destination. Instead, they might say "That was a hell of a car". The effect of "ubiquitous computing" means they may not even realize that the car is using AI, just like you don't think about AI when you Google something or use your smartphone.

AI's impact on (procurement) work

Will people lose their jobs to AI? Rather than replacing procurement jobs, AI is expected to enhance current jobs and make working more efficient. Although AI will affect every sector and transform every job in some way in the future, few jobs will be completely replaced. Similar concerns about people losing their jobs were raised when the railroad, fax, and internet came along. However, as it turns out, jobs simply transformed, or those that were lost were replaced by completely new jobs. The best results will not be achieved by simply letting AI do everything, but through the constant collaboration between human and machine.

Right now, occupations within the transport industry are at the greatest risk of being replaced, whereas jobs requiring social, emotional, and literary abilities are at the lowest risk of displacement. According to a study from Oxford University, professions such as a procurement clerk have a high risk (98%) of being automated, whereas professionals with higher education degrees are less likely to lose their jobs to automation.[20] With this being said, a procurement professional's work is very likely to change as manual, repetitive, tactical tasks are done by machines, allowing the professionals to focus on strategic initiatives.

Many businesses and individuals are optimistic that this AI-driven shift in the workplace will result in more jobs being created than lost.[21] Think of the new jobs that are "normal" today that weren't around twenty years ago, such as data scientists and social media managers. In the same way, there will be completely new procurement jobs emerging in the future; ones that we can't even imagine at present.

What kind of employees are needed? Firstly, let's reiterate that employees *are* still needed. Secondly, the employees who will be needed in an AI-collaborative workplace are the same employees that companies are hiring today. Sure, if you are struggling to use the internet or a basic laptop today, you may be in trouble in the future. But the attributes highly regarded today, such as diligence, a love of learning, an analytical mindset, and adaptability will remain so as AI is increasingly adopted.

More specifically, basic procurement skills such as supervising a repetitive process will no longer be needed in the same way as they are increasingly automated. Higher-level skillsets such as strategic thinking, agility and an ability to adjust to a rapidly changing environment will become crucial instead. Importantly, employees of the future should be able to use data as a valuable asset rather than a by-product of reporting.

Digital literacy is important, but companies should not expect every employee to transform themselves into data scientists. Nor should procurement professionals be expected to understand the algorithms behind procurement AI, just as people successfully use Google every day without needing to understand the complex algorithms behind it.

Finally, leadership skills will always be highly sought-after in the procurement profession. Digital transformation, the cultural shift to a new data ecosystem and the incorporation of emerging roles will require strong leadership in the future.

What will be the role for procurement professionals when using AI? One of the roles of a procurement professional is to facilitate and be part of the collaboration between human and the machine. This means communicating with and educating stakeholders, end-users and suppliers on the benefits of AI; demonstrating how it will benefit them and training them in its usage.

As you and your team members' routine tasks are automated, your personal work will become more strategic. AI enables you to focus on strategic planning, collaboration and relationship-building: tasks, that machines are not yet capable of doing as well as you. Keep in mind, however, that AI is making impressive gains even in areas that are considered uniquely "human", so be sure to have an open attitude.

Do I need to hire data scientists? For most companies out there, it's better to find the right partners to leverage AI insights rather than building an in-house team. If you think of AI like software, you can think of data scientists as software engineers. Not many procurement teams have their own software engineers. You may be able to leverage shared corporate resources, but in many cases, you're better off purchasing software that already incorporates the required AI-capabilities. If you need to build a custom solution, you're most probably better off finding the talent outside of your organization. In any case, data scientists are in high demand, meaning that there will be high costs associated.

6 What to consider when starting to use AI

Read on to find the answers to questions such as:

- When should I start?
- How should I start?
- How long is this going to take?
- What if the AI becomes obsolete?

What should you consider when starting to use AI?

You now know what AI is and how it can be put to work in procurement. Great! But where do you actually start?

A lot of companies are still keen to bring AI into their organization, but do not have a clear starting point. The first question to ask is whether the organization is ready for implementation *now*, or whether it should be delayed until the organization is better prepared.

To put it simply, there are four key questions to answer before you can consider implementing AI:

- Do we have enough of the right kind of data?
- What business case articulates the benefits for our organization?
- Should we build or buy the AI application?
- How will the human-machine collaboration work?

Is now the right time to get on board with AI? Even though AI is a buzz-word in companies all over the world, its use in procurement is still relatively low. In fact, only two percent of surveyed CPOs in 2018 said they have "fully deployed AI or cognitive technology for use in procurement".[22] *Two percent!* So, there's really no need to panic if you feel your company isn't ready yet. To be fair, AI has only recently found concrete applications within procurement functions, despite being a field of academic study since the 1950s. It's therefore understandable that several companies are still

taking a wait-and-see approach in terms of integrating AI into their procurement functions.

With that being said, an ever-growing number of procurement professionals have realized the added value of AI, and those that have started to apply AI have a good chance of surpassing those who haven't. Brynjolfsson and McAfee (2017) put it well:

> Over the next decade, AI won't replace managers, but managers who use AI will replace those who don't.[23]

In addition to data and a business case, the most important thing is that your organization is ready for AI in terms of resources and willingness. Implementing AI *will* take time and resources, so being determined to do it right the first time is crucial. If you have all of these pieces in place, you're good to go.

Data is key After the initial decision to implement AI, the reality needs to be addressed: AI and machine learning cannot work without data to interpret. Luckily, every modern procurement organization is sitting on a mountain of data, whether they know it or not.

Most of the time, only 20% of procurement data is utilized to improve operations. The remaining 80% is considered to be dark data. Dark data refers to unused data that may prove to be valuable. Some identified sources of dark data include:

- Unstructured transactional data

- Contract metadata
- General ledger information
- Data stored across disconnected ERPs or other databases
- External, unstructured data about products and suppliers available over the internet

Many organizations still don't realize that if procurement and supply chain data is not utilized, it's like having thousands of dollars, pounds or euros just sitting in a shoebox losing their value.

Not every bit of data will provide value as a line-level item, but all data can be considered a building block for larger value as your AI continues to learn and develop. Leading CPOs understand that the key to getting the most out of the technological investment is to focus on collecting the procurement data for AI to interpret. You may need to put clear data-collection processes in place (especially for more sophisticated software solutions), but with clear processes in place the AI can assist in preparing the data after the implementation is completed.

Data sets can vary wildly between different companies, with smaller companies searching for highly-focused data sets while large companies enjoy a vast, globe-spanning amount of information flowing constantly through their systems. Much of the machine learning and AI capabilities are also based on data that can be captured *outside* the organization. This data, drawn from enormous publicly-available "data clusters" is just as accessible to an SME as it is to the Amazons of the world. A rich stream of data is also vital

to enabling AI to learn and develop, with exciting opportunities on the horizon as the technology continues to rapidly evolve.

Moreover, collecting data should not be considered a singular exercise. The AI is constantly working with new data that is being introduced on a regular basis. Therefore, the data collection should be built-in as a regular process. An important thing to remember is that the AI only improves if you give it new problems and data to work with and the more data you feed the AI to learn from, the better results you are likely to get. Therefore, building the capabilities of data collection prepares the organization for the AI challenges ahead, even if you are not planning on implementing any sort of machine-assisted methods in your operations anytime soon. Collecting and storing data in advance is also good practice as it prepares your data sets and processes ahead of the AI implementation. Doing so will provide you with a great data set to work with when the time to implement artificial intelligence arrives.

In conclusion, data collection should be a continuous journey and collecting as much relevant data as possible from both inside and outside the organization should be the key principle. Even if the data might not be useful right now, accumulated data can lead to innovation down the track.

Keep it simple with your business case It's easy to get excited about all the possibilities and potential applications that AI can bring to your organization, but it's common to feel at a loss when it comes to getting started.

A reality check is often in order, because many of the stakeholders you consult with may regard AI as a magical

technology that will solve all your challenges. Setting expectations like these is the wrong place to start when building a business case for investment in AI. Focus instead on narrow application areas, as that's where procurement AI really delivers tangible results at present.

Think about the most boring task you have to regularly deal with in the procurement function. It's rarely something unique to your organization, but something that everyone else in the profession struggles with as well, such as reporting or classifying data. That is precisely the sort of routine task that yields great results with machine learning.

As with any business case, it's important to link your proposed investment to the organization's top business priorities. Having AI for just the sake of AI is like investing in an expensive supercar that you have no idea how to drive. To demonstrate, Gartner has estimated that 85% of AI implementations are not delivering the promised results.[24] Having AI sounds good on paper and promises great results, but without doing your groundwork with a useful business case it risks never reaching its full potential.

When you first implement AI it's valuable to score some quick points (short-term results) to prove that it creates value and can drive positive changes within the organization. There are two common business cases for procurement AI:

1. Applying AI over data sets to identify new sources of value, new opportunities, new suppliers, or new risks.
2. Using AI to make existing processes more efficient, getting rid of manual work and reducing operating costs.

Start small. This is recommended especially if the AI knowledge inside the organization is not considered to be up to the required level. Starting with a small use case will also help you understand where the organization stands in terms of AI and what can be improved with later implementations.

After identifying the use case, consider your desired outcomes such as streamlining operations or risk identification. Identifying the key business case and outcomes helps your AI application to become more tangible and brings more value to your company.

When building a business case for AI, keep in mind that 100% automations aren't always realistic. Quite often 80% of a process (such as spend classification) can be automated, but the last 20% may require a human touch. Use this 80/20 rule when considering how much time an AI-driven process will take and how it will improve current timelines.

To build or to buy – that is the question An important aspect to consider when introducing AI is whether you will build or buy. In other words, you need to understand the differences between the solutions already on the market and those that would be purpose-built. Buying a readymade solution covers most (but not all) of the needs a company has in terms of a certain business case, while building a customized solution from the ground up will meet the specific needs of an organization.

Let's illustrate this point with an analogy from the kitchen. You've invited a big group of friends around for brunch, but you suddenly notice there is no bread in your pantry. You are now faced with two choices: bake your bread or go

down to the local bakery to get a basket of bread. When baking it yourself, you get to customize the bread to your liking, but you have to source all the ingredients and equipment. On the other hand, using a bakery gives you access to their expertise and knowledge – at a price. They might not even offer the exact type of olive bread you are most fond of. However, they can almost certainly guarantee quality bread without the risk of having it burnt to a cinder and can provide expertise in making sure that it tastes just right.

The same principle can be applied to AI. Leveraging the expertise of others means you are implementing the best practices tested outside the organization. Implementation will be fairly straightforward, so long as the provider understands your requirements and timelines. Another reason a company may lean towards buying the solution is that especially supervised AI requires training data sets, which the ready-made solution providers are able to train with massive data sets.

However, buying an off-the-shelf solution doesn't necessarily cover everything you would want it to cover. As the AIs are mostly built for general use and aim to serve a larger base, the feature set may not be exactly what you need. Some of the features that your organization needs might be lacking or may not even exist. There may also be features that you will never need to use. When your organization's specific business case does not have a viable commercial option available in the market, that's when building your own solutions begins to make sense.

Building your own AI enables your organization to create a specific "wish list" of features, then build the AI to those specifications so it will work exclusively with the

Over the next decade, AI won't replace managers, but managers who use AI will replace those who don't.

Brynjolfsson and McAfee, 2017

organizational landscape. However, it does come with a set of requirements.

A procurement expert is (usually) not a data scientist, so building an AI requires its own set of experts. These experts are commonly sourced from the outside, although larger organizations might already have people with the required skillsets in different departments. As they are building these capabilities from scratch, it requires a lot of time and flexibility from the organization. Real benefits will only be seen after years of development, which means this will be difficult for businesses with a focus on the short-term.

Building your own solution and hiring the experts needed bring forth the unfortunate aspect of building an in-house solution: the price. Personnel costs and development resources needed come with a large price tag. Building a solution is only cost-effective when there is a very specific, custom need that cannot be answered with existing AI solutions. Luckily, most commonly occurring AI use cases already have an existing, ready-made solution on the market.

Because of the expensive investment and large set of resources required to build a solution, most early AI adopters seem to buy the right fit-for-purpose technology solutions instead. In fact, according to a study by McKinsey, only a minority of survey respondents built the AI solutions in-house, with even digital natives such as Amazon and Google turning to talent outside their own AI skills.[25]

In the unlikely case where your data is still not sufficient enough to train an algorithm, a process called *transfer learning* may help. This is a method of machine learning where a model developed for one task is reused for a completely new

task. Essentially, your AI provider would train the model with their data and then you would use it in your processes.

In conclusion, the decision to build or buy is critical for every organization. The decision will be driven by the needs of the procurement function and the use cases for AI. Both approaches have their own merits and downfalls, so consider carefully.

AI & procurement professionals As human-machine collaboration is a crucial aspect of AI, it needs to be considered at the planning stage of AI implementation. In a sense, AI is a team member that, just like a human, needs to be onboarded and introduced to the team. As part of the introductory process, your procurement experts need to be introduced to what the AIs role will be. It is also important to make the boundaries and the scope of what tasks AI can do clear for the entire organization. In case you are worrying about the reception, fear not: a study conducted in the U.S. shows that 70% of workers consider AI to be a positive asset at their workplace.[26]

A general three-step checklist in terms of AI and your employees goes as follows:

1 Have the right people in the right places

2 Train your staff

3 Set clear goals

All of these three steps ultimately mean that the way in which the roles will change also needs to be considered. Who will need to be trained in data science and how the AI

works? Who will work closely with the AI and who will continue with their tasks as usual? Who will be providing feedback to the AI and how? How will long-term goals and tasks change when AI is brought along? As with any new changes in the organization, there may be confusion, so it's important to show your team members how the change will benefit them.

Implementation of AI

Length of implementation If you started reading this chapter with the expectation that we'd give you a sure-fire plan to implement AI, we have to apologize. The reality of implementing AI is that – as with any other project – there is no fool-proof method of predicting how long it will take.

Factors such as the scope and aim of the implementation, your organization's current processes and the resources you have to invest in the process have a strong effect on the ultimate length of the implementation process. Having insights into these aspects helps you to see where you could apply AI most efficiently and what types of benefits it would bring as well as exactly where and how AI can be beneficial to your business case. Mapping out and understanding your data points will also help you understand the different requirements and timeframes needed for implementing the solution.

Getting the AI up and running The AI is now ready to be implemented – congratulations! All the data is waiting to be crunched and your procurement team is ready to start their

work with their new AI partner. However, the *real work* is yet to begin – training your AI. Let's take an example of using AI in an ordinary procurement task, such as classifying invoices into different categories.

The first thing needed is a set of training data for the machine to learn from. This is usually prepared during the implementation phase where the data points are mapped and the data relevant to the use case is collected. The data represents a specific challenge the AI is employed to solve. For example, there could be 100,000 invoices that have been classified to specific categories of spend. This forms the basis of the AI's knowledge base and can, therefore, be called the training data. Think of it as the guidelines on how it needs to conduct itself. The AI will also need to be guided in terms of the results that you want – the training data will provide a rough outline for the AI about what it needs to do, but it will need human collaboration in order to succeed.

Once your goal has been identified and the AI has been given basic training data to work with, it is ready to be applied to the larger data set. Using the guidelines established in the training data, the AI can get to work.

While the AI is working on the task, for example classifying different invoices into categories, it will form "confidence ratings" for every item it processes. If the confidence rating is high for a given item, the AI can easily classify it as it has enough information to do so correctly. If the item has low confidence, the AI marks it for manual classification by a procurement professional.

The way your AI learns is by human team members giving your AI feedback as it completes its tasks. The review process improves the efficiency of the AI as it raises its

confidence ratings. First, the low confidence items are processed by the human experts, which gives new information for the AI to adjust and learn in order to do the task more accurately in the future. After that, the human users need to validate the low-confidence items, if those were found during the process. If changes are made, the AI will also learn from these mistakes and apply that knowledge in the future. Ultimately, the AI constantly learns from the human input, gains more knowledge and learns how to apply this knowledge more powerfully, constantly streamlining the operation.

Can an ai become obsolete? The short answer is yes. But also no.

Working towards AI implementation takes time and resources. However, does the risk of AI becoming obsolete exist? As with any piece of software or equipment, there will come a time when your AI applications will deprecate and become out-of-date. It really depends on what you are using the AI for, and whether that application has an end-date or whether it will become obsolete as business requirements change.

In terms of a singular application, this can be a very short period of time. Don't be alarmed though, as this is just a normal phase in the development of AI functionalities that, in the end, makes the AI better than before. One singular algorithmic application can be used for a short amount of time and then be replaced with a new approach that has been found more suitable for the task. This is called a *champion-challenger model*.

Two competing algorithms are put to the same task to see which one gets better results in less time. Just as in boxing, the challengers line up trying to beat the champion, and the champion defends its position as the dominant algorithm for the given business case. When a winning challenger is found, the old champion retires, and the challenger is given the main task, while new challengers are lined up to test the new champion. This keeps the AI application lively and continuously improved upon for a number of years while implementing new approaches.

Therefore, if you end up building your own custom AI-application, bear in mind that you need to not only invest in initial implementation, but also in continuous development of the solution.

Overall, an implementation will have a lifecycle of several years. But most of the current implementations of AI in procurement are considered narrow and are limited in terms of how long they will remain viable. After the AI has become obsolete after all the improvements have been identified, a new implementation needs to be introduced to address the evolving needs of the organization.

A general rule of thumb is that one AI application can be considered to be viable for 5–6 years after which it needs to be decommissioned. Replacing an obsolete AI with a more refined and newer implementation sounds difficult. However, the initial implementation of AI has already laid the groundwork for the organization to function with AI, therefore making the transition easier. Over the lifespan of the initial implementation, the organization has shifted and the pre-requisites for utilizing AI have already been prepared. Best practices on where the AI has the most impact have

been discovered. In other words, your second generation of AI will have a much smoother entry into your organization than the first.

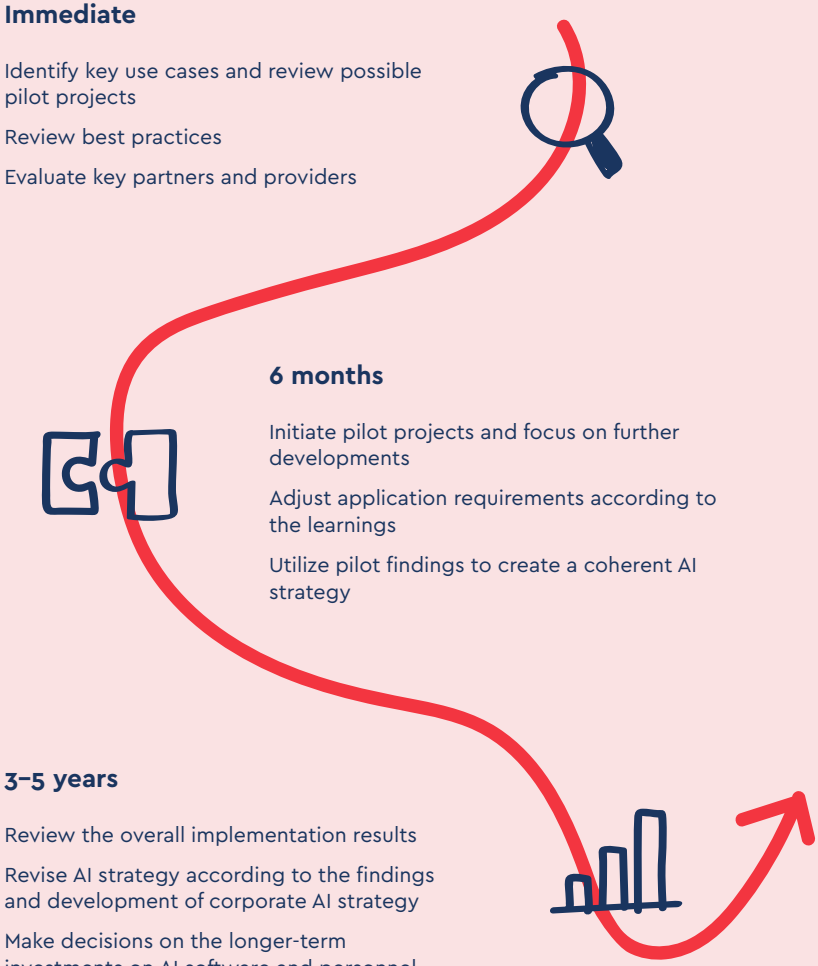
In conclusion, a narrow-scope AI might become obsolete because it can't improve itself like an artificial general intelligence would. However, the transformation to an AI-powered organization needs to be done only once. After the transformation, the business will be able to switch their core AI applications to meet the demands of the organization without having to transform itself yet again to meet the demands of implementing AI. It can, therefore, be said that the concept of an AI won't become obsolete even if a specific application meets its end-of-life dates.

AI milestones Now that you have seen what AI can achieve and have planned out where in your organization it will be implemented, your focus should turn to the timeframes for implementation and utilization. Three key milestones can be distinguished in the process: immediate impact, six months after implementation, and three to five years after implementation.

In the beginning, the focus should be on the implementation itself and its immediate impacts. As mentioned previously, the timeframe in which an AI will be implemented varies greatly by organization and use case. It may also be difficult to set a clear deadline as there may be some trial-and-error in the beginning, which may take some time.

The impacts may not be clear immediately. It's like when you finally kick off a bad habit like smoking or you finally change your diet. You won't see the impact right away, but in, say, six months you will clearly notice the results.

Figure 11: Potential AI roadmap



Six months after the implementation is an ideal time to review how the implementation has gone. Ask yourself:

- What are the initial results we have received?
- Is there a noticeable change in the selected application area?
- Has our team adapted to working with the AI?

The answers to these questions will give you valuable insights as to whether you need to adjust the application or if any major changes need to be made.

Finally, it's a good idea to conduct a review three to five years after the implementation. After the initial period of checking and adjustment, it's highly probable that your AI has made some positive impacts over those years. Use the review milestone to understand the benefits that have been realized as well as the value gained. A review will also provide you with key data on where to go next. Obviously, the way in which you choose to measure those impacts will have an effect on the outcome, so this needs to be clearly established.

The journey doesn't end here. Use the results the AI has given you so far to plan ahead and work out how AI can be leveraged for the following five years. Do keep in mind that narrow-scope AI solutions have a time limit and will need to be replaced when obsolete. They also aren't end-all-be-all solutions to your challenges, but they are a powerful tool to help you overcome them.

7 Conclusion

The most important takeaways

Let's review. Over the short course of this book, we have examined:

- How we've arrived at this point in terms of AI and procurement today
- What AI actually is and how it can be used in procurement
- The implications for a company, and
- What to consider when adopting AI

It's a lot to absorb, but if you're looking for a single, key takeaway, how about this: AI *will* ultimately change many things, but right now the applications in procurement are relatively marginal. AI isn't a genie – it won't magically grant you a better procurement strategy, but it *will* transform procurement by beginning with the most tedious and time-consuming tasks. In the end, AI is not a short cut to reach your strategic goals, but it is an enabler to help you reach those goals faster. Although AI is not the only solution available to reach those goals, it certainly is a plausible one.

Just remember that today, AI isn't weak enough to be ignored, but it isn't yet strong enough to replace you. Cassie Kozyrkov, Chief Decision Scientist at Google, used an amusing analogy to explain AI and machine learning.[27] It's a little complex, so bear with us.

The concept of AI and machine learning is like having some workers who live a long way from you on a remote island, where they spend their days swinging in hammocks with their laptops balanced on their stomachs. Their job is to help you with your work: when you send them a question (an "input"), they give you an answer. For example, if you send them a picture of a truck, they can write "truck" underneath it.

However, your friends on the island have been drinking some margaritas and you have *no* idea how drunk they are. You need to teach them by giving them an example of how to answer the types of questions you send them. They're too drunk to understand an explanation (they need to just copy an example), and you realize that you can't trust them with your highest-value tasks, partly because it would be a pain

Figure 12: Check list

Say you want to start *right now*. How would you actually go about this? Below is a step-by-step checklist that summarizes the main points raised in this book:

- [x] **1** Get familiar with AI.
- [ ] **2** Identify a business case and make sure you have sufficient data.
- [ ] **3** Decide whether you are able to build or if you need to buy a solution.
- [ ] **4** Bring in expertise from outside your organization if needed.
- [ ] **5** Implement the AI and start small with narrow and "boring" tasks.
- [ ] **6** Incorporate AI into your organization and embrace your new assistant.
- [ ] **7** Develop and review the process.

to try and teach them by giving them a complex example of how to do it.

Instead, you decide to give these drunk people tasks that are simple, easy, yet time-consuming. Unfortunately, you still can't quite trust every answer they give you, so you need to check and approve their answers. The workers on the remote island may ultimately be of significant help to you but it's necessary to be cautious in terms of trusting them as well as which tasks you lay upon them.

In real life (thankfully) AI isn't really a drunk person on an island, but rather an area of computer science that is already helping us in our daily procurement tasks now and will do so even more in the future. AI has come to stay and it's, therefore, necessary to start adapting to it in your procurement organization. It is also important to remember that AI is a friend rather than a foe: a friendly assistant, not the Terminator.

The future of AI is unknown

The future of AI has been debated in countless studies, books, and articles. Artificial intelligence is simply unprecedented, and its future is therefore extremely difficult to predict. To draw a parallel, many computing "experts" inaccurately predicted that the internet would come to nothing. "No matter how inexpensive the machines become, I still can't imagine the average user taking one along when fishing", Erik Sandberg-Diment of *New York Times* wrote in 1985.[28] "The Internet? Bah!" was the headline of *Newsweek*'s technology article in 1995.[29] Or Robert Metcalfe's prediction

in *InfoWorld* in the same year: "I predict the Internet will soon go spectacularly supernova and in 1996 catastrophically collapse".[30] Yeah… not quite. In light of this, debating what AI will be able to do in 2030 is fun, but futile.

Moreover, we don't even know what we want yet. Imagine asking someone in the 1960s if they wanted to carry a device everywhere they went so that their boss or mother-in-law could message or call them at any moment. Or a device that could collect data about where they are at any given point? They would have said "absolutely not, that sounds terrible". Yet here we are.

There are some disruptors on the horizon; things that will transform your procurement function in ways we don't yet realize. Imagine, for example, if AI could correlate your internal purchases with tariffs information, international stock market prices, and tweets from world leaders to estimate the course of future decisions. AI would autonomously leverage all this information in real-time to make predictions. Say, oil prices increase due to a crisis in the Middle East. Your AI would take that into consideration and inform the supplier that the price for the contract needs to change from this date onwards. *Their* AI would accept it, and a new contract would be created without you having to intervene at all.

However, as we stressed above, the subject most of us should be focusing on at the moment is what is happening in AI *today*.

So what now?

Let's be honest here for a second. This book is going to become outdated – and soon. Artificial intelligence is developing at an extremely rapid pace and therefore information that is cutting-edge in 2020 will seem old-fashioned by 2030. Think of the aforementioned Moore's law, which states that computers' speed doubles every few years. That's *fast*. The point is, we are aware of the fact that this book will be outdated as new technology progresses at a speed we can't even fathom.

Although this book may become outdated, don't wait for AI to make *you* outdated. In the examples and cases we've seen, there has never been more value in human experience directing artificial intelligence. Be the one to embrace the transformation and drive the change in your career, your team and your workplace. Keep in mind that the boardroom seats of tomorrow are earned by the bold actions of today. If you believe AI will change your business from the back office to the boardroom, make yourself the agent of change.

Now, driving change won't be easy. The world of AI can be confusing, especially in relation to a discipline such as procurement. But don't worry, we've got you covered. You'll find a "cheat sheet" at the back of this book. If you need to convince your boss or colleagues that you're an expert on the subject of AI and procurement, simply use this sheet. Don't take it too seriously though. You can also turn to the glossary for an explanation of some of the important terms discussed in this book.

We wish you the best of luck on your journey!

Well, strictly speaking, we don't invest in AI. We don't invest in natural language processing. We don't invest in image analytics. We're always investing in a business problem.

Matthew Evans,
Vice President of Digital Transformation at Airbus, 2017

Fake it till you make it

The ultimate guide for cheating your way to AI expertise

Disclaimer: Don't take this sheet too seriously.

So, you've just started your first machine learning project at your workplace. You're meeting with the project team, and your new boss – who's rumored to be quick to judge people's capabilities based on first impressions – is watching. Worse still, you haven't yet had a chance to read this book and dive deep into the worlds of AI. No worries, we've got you covered. Here is the ultimate cheat sheet for creating the perception that you understand AI.

Step 1
The only question that you need to pay attention to
First up, as you don't know everything about AI (but don't want to reveal that fact) you will need to ask questions. The *right* questions. There is one key question that is relevant for any AI-project (and sounds cool to ask):
Are you using supervised or unsupervised machine learning?

Listen carefully to the answer, because this is important! If the answer is:

- **Supervised** → move to Step 2.
- **Unsupervised** or **Both** → move to Step 3
- If you don't understand the answer (and still want to fake it), move to Step 2. The odds are that it's supervised learning.

Step 2
Supervised learning question stream
So, they're using supervised learning – this means it's smooth sailing from now on. The following questions are relevant for any supervised machine learning project and are designed to make you sound like an expert. The good news is that you can shoot out questions one-by-one in the order given below without needing to care much about understanding the answers:

- **What kind of training data are you using?**
  All supervised ML requires training data.

- **Have you thought about what kind of bias you might inadvertently introduce with the training data?**
  As you're listening to the answer, nod a bit, but at the same time appear a bit concerned. The odds are that the responder *has* thought of bias (and there almost always is one). If not, the person should start to worry about this issue. No-one will ever say there's no bias.

- **That sounds like a good start. How do you plan to improve the results over time?**
  Pretty much all machine learning projects require many iterations to develop. With this question, you will demonstrate a capability to think beyond the problem at hand.

- **Have you thought of adding additional data sets to provide further confidence to results?**
  Machine learning is about data. More relevant data delivers more relevant results, so the project group should have thought of this. They will either tell you that additional data sets are not available, or they will be in the next iteration.

- **Thanks, I'm looking forward to the next project update.**

Now, move to Step 4.

Step 3

Unsupervised learning question stream

OK, so it's unsupervised learning. Either the project team is pretty progressive, or they are just using the latest technology to appear cool. Either way, the following sequence of questions will make you look like an authority.

- **Unsupervised learning? Interesting. Why did you choose that approach?**
  If the organization is using unsupervised learning, it's better to have *them* explain why this is the case.
- **How do you label the clusters?**
  When unsupervised learning is chosen as the approach, it's almost certainly applied to a clustering challenge. With any clustering approach, the problem is based around how to label the clusters created. Expect a long answer, even when the person responding understands only half of what's going on.
- **How do you ensure that the clusters are relevant for business purposes?**
  Unsupervised learning is good at creating groups. However, some of the groups may provide business value (such as clustering suppliers based on whether they are innovative or unoriginal), but some may not (such as clustering suppliers based on their postal address). It's up to the team to ensure the clusters are relevant and useful to the business.
- **This field is developing pretty quickly. I'm looking forward to the next project update!**

Congratulations, you're ready to move to Step 4!

Step 4
Final words

You've made it. Your new boss is impressed by your AI knowledge and the fact that you've been able to learn about AI alongside your busy workload. The project team is surprised that you have such in-depth knowledge of the domain. But be careful! Your (apparent) AI expertise may mean that you're asked to be involved in similar projects in the future. You'd better read this book properly!

Glossary

Adaptive processes
Business processes that are adaptable to changes in the operating environment.

Algorithm
A process or set of rules to be followed in calculations or other problem-solving operations, especially by a computer.

Artificial General Intelligence (AGI)
An Artificial Intelligence which possesses human-like capabilities of tackling cognitive problems from a wide variety of domains.

Artificial Intelligence (AI)
A computer program displaying behavior that can be called intelligent; can also refer to the R&D field of developing AI programs.

Bias
The deviation between some property of the computed result set from the correct value; bias can be systematic (due to fundamental problems with the model) or random (due to sampling errors, bad input or other issues).

Big data
The storage and management of large amounts of data that can be analyzed to discover trends and patterns. Traditional data management software had problems with handling large datasets, thus making way for big data applications. Big data handles a large *variety* of data obtained from numerous sources that is high in *volume* and is being produced at a rapid *velocity*.

Black box
A term to describe an algorithm whose reasoning for making decisions is not transparent, i.e. algorithms which are not explainable. (See also: *Explainability*).

Business process transformation (BPT)
Radically changing the business processes prevalent in your organization. The change is undertaken to reach a new goal, usually mandated by a changing business environment or digitalization of services.

Champion-challenger pattern
A pattern for developing AI models, where the current best algorithm (the 'champion') is compared to a potential replacement (the 'challenger'). If the challenger is deemed superior to the current champion, it replaces it as the new champion; this process is continuously repeated to improve the quality of AI.

Confidence ratings
A machine-generated rating that indicates the estimated likelihood that the result is correct; typically a number between 0 and 1 or a percentage.

Classification
The process of sorting objects or data into a set of categories, which can either be predefined or constructed dynamically from data.

Dark data
Data produced across the organization that is not yet used to derive any insights.

Data lake
A repository of data containing vast amounts of data in raw, unprocessed format.

Data point
A singular unit of information that can be used for analysis. This could be, for example, the amount of invoices found in the database for a particular region.

Data Science
An interdisciplinary practice that uses diverse scientific and computational tools, processes and techniques to produce insights, knowledge and decisions from structured and unstructured data.

Data scientist
A practitioner of data science.

Deep learning
A neural network consisting of a very large number of layers; computationally and financially expensive to train.

Explainability
A model's capacity to explain how and/or why it arrived at the result it provides. (See also: *Black box*).

False negative
An error where an algorithm or model indicates that a condition or property doesn't exist, when it in fact does.

False positive
An error where an algorithm or model indicates that a condition or property does exist, when it in fact does not.

Human and machine collaboration
A practice by which AI processes work together with humans – often domain experts – to achieve a goal. (See also: *Human in the loop* and *Human on the loop*).

Human in the loop
The process that takes place when the machine is unable to offer an answer to a problem, requiring human intervention.

Human on the loop
A process where the machine can carry out tasks independently from humans but remains under real-time supervision of a human operator.

Human out of the loop
A process where the machine is capable of carrying out tasks on its own without any human input or interaction.

Machine learning
Algorithms that detect patterns and use them for prediction or decision making.

Model
A computational or mathematical representation of a constructed, idealized or real process, entity or system.

Moore's Law
The observation that the average number of transistors in printed circuit boards doubles roughly every two years.

Natural language processing
Algorithms which can interpret, transform and generate human language.

Neural networks
A class of algorithms commonly used in AI that roughly mimic biological neural networks, where data is encoded and stored within artificial neurons connected to one another.

Optical character recognition (OCR)
A method of extracting text from documents. OCR uses pattern recognition to understand what is written and translates those findings into digitized texts. An example of OCR would be an application that scans business cards and automatically adds them to your smartphone contacts.

Procurement
The strategic process of sourcing, negotiating and acquiring goods from an external party. Focuses on getting the right amount of the right products for the right price at the right time.

Reinforcement machine learning
A machine learning algorithm decides how to act in certain situations, and the behavior is rewarded or punished depending on the outcome.

Strong AI
A synonym for AGI.

Supervised machine learning
A machine learning algorithm that is trained using past data and applies this training to new data.

Training data set
A data set including input data and expected output that is used to train a supervised machine learning algorithm.

Transfer learning
A class of machine learning algorithms that allow insights gained from solving one problem domain to be transferred to another problem domain.

Turing test
A test devised by Alan Turing to determine whether an AI can be considered an AGI; in the test, a human can pass messages to an entity which is either a human or a machine, and the AI is said to pass the test if it fools human testers into thinking it is human.

Ubiquitous computing
Computing that takes place across a wide variety of devices, i.e. not just desktop, laptop and server computers but also mobile phones, wearable devices and various IoT devices.

Unsupervised machine learning
A machine learning algorithm that is programmed to detect new and interesting patterns in completely new data.

Validation
A human or automated process by which the results of an AI process are checked, to make sure the quality is high enough for business use. Also used to give feedback to improve future results.

Validation data set
A data set including input data and expected output; used to validate a supervised machine learning algorithm.

Weak AI
An AI that is not an AGI; also called narrow AI.

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About the authors

Sammeli Sammalkorpi is the co-founder of Sievo. His top focus is to help Sievo's customers turn their procurement data into dollars. He holds a master's degree from the Helsinki University of Technology and has over 15 years' experience in procurement consulting, leadership and software development. Raised in Arctic Lapland, Sammeli is the father of three, a youth soccer coach and aspiring beatboxer.

Johan-Peter Teppala is the CEO of Sievo Inc. Located in Chicago, he leads the American operations of Sievo. He holds a master's degree in Industrial engineering and has helped procurement professionals reach their key targets for over 15 years. Originally from the coastline of Finland, Johan-Peter is a father, a mountain trekker and an enthusiast of fast cars.

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