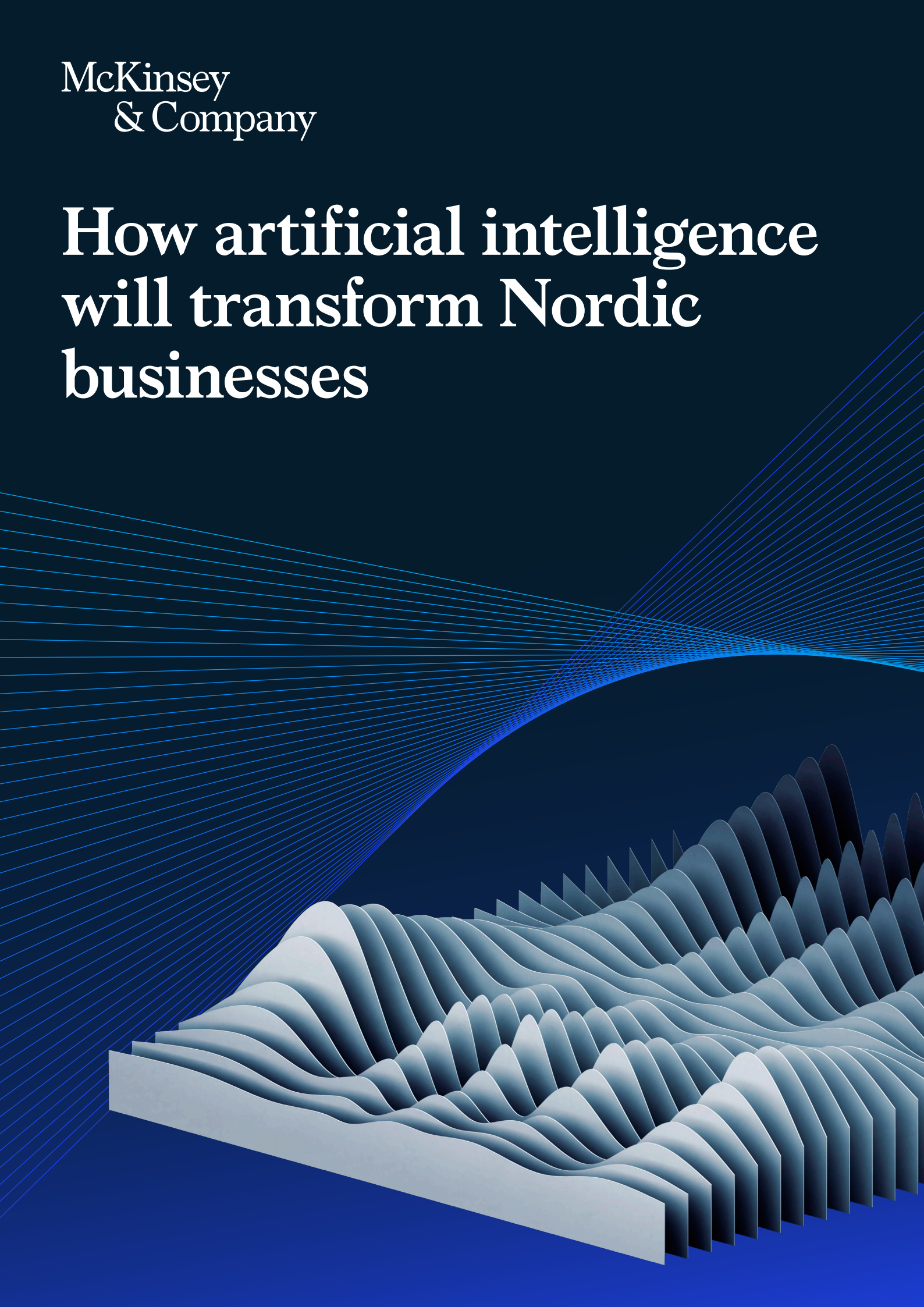
McKinsey & Company

How artificial intelligence will transform Nordic businesses



Authors

Heidi Østergaard

Engagement Manager | McKinsey & Company

Jacques Bughin

Senior Partner and Director | McKinsey Global Institute

Jens Riis Andersen

Partner | McKinsey & Company

Jørgen Rugholm

Senior Partner | McKinsey & Company

Mads Poulsen

Consultant | McKinsey & Company

Michael Chui

Partner | McKinsey Global Institute

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Executive summary

Artificial intelligence (AI) is set to radically reshape the way companies do business. From retail to healthcare and finance, machines are likely to play a growing role in making companies more efficient, responsive, and relevant to customers' lives.

Already, AI is the driver behind some of the world's most profitable businesses, helping technology firms distribute an array of products and services across digital platforms. Companies such as Amazon, Tencent, and Netflix are leading the development, creating personalized offerings that evolve in line with people's choices and preferences. In the age of AI, industry boundaries become ever fuzzier, with companies forming alliances, even with competitors, and moving into new industries by innovatively leveraging their vast amounts of data and technology.

The reason artificial intelligence is so compelling is its ability to not only process vast quantities of data, but also to extract patterns and learn from experience. By being able to accomplish cognitive tasks commonly associated with humans, it creates the building blocks from which companies can build an array of "intelligent" services. AI is an industry-agnostic, general-purpose technology, which in recent years has moved from concept to reality.

We estimate that some 40 percent of the total working hours in the Nordics could be automated by adapting existing technology alone.[1] Since AI is driving a substantial part of this automation potential, it will therefore have a major impact on the Nordic workforce in its entirety. However, AI is not only an automation play. It is also an augmentation and enhancement play. It can provide predictions at a scale and depth of detail impossible for individuals and has the power to transform human behaviors – the prospect of self-driving cars and computer-based healthcare are not far on the horizon. In the future, we are likely to see many more organizations shaping their activities and business models around AI and data, which will in many cases become a key strategic asset. As a result, the onus will be on companies to ramp up their systems and capabilities.

In the Nordics, AI represents a significant commercial opportunity. Kone, for instance, is creating a competitive advantage by monitoring the performance of more than one million elevators and escalators. The company uses AI for predictive maintenance, leading to reduced customer reports of problems by 60 percent. Similar success stories can be found around the world. US-based John Deere is using AI is to disrupt the entire agricultural value chain: robots for harvesting, monitoring crop and soil health, and tracking/predicting the impact on crop yield. Amazon has opened cashierless stores and is experimenting with autonomous drones for warehouse logistics and last-mile delivery. Finally, JD.com runs a fully automated warehouse where robots carry out all functions, including product entry,

[1] The Tuborg Research Centre for Globalisation and Firms and McKinsey & Company, *A future that works: the impact of automation in Denmark,* April 2017

storage, packaging, and sorting, handling up to 16,000 order packages per hour with an accuracy of 99.99 percent.

McKinsey research for this report suggests that exclusively applying AI techniques we know today can unlock USD 80 billion in value in the Nordics, equivalent to approximately 2 to 3 percentage points in profit margin uplift. These numbers are based on 400 use cases across 19 industries, yet only constitutes the direct impact from currently proven deep-learning techniques and applications. AI should not only be assessed on the basis its current potential – it also represents a trajectory that creates winners and losers. For instance, a recent McKinsey study[2] simulated that front-runners[3] could potentially double their cash flow compared to nonadopters[4] by 2030. This is due to the fact that establishing endowments of data, computing power, and organizational capabilities is needed for harvesting AI's full potential in the future.

Companies are often investing not only because they can see a definite impact on the bottom line, but rather because they do not want to miss out on a potential advantage against their peers. Across sectors, companies' prioritization of business domains indicates that they invest in AI with an aim to capture productivity gains but equally so to drive new business.

To unlock the potential, companies require a strategic step change. Most are currently in the early stages of AI adoption. By investing more, they can capture more first-mover/fast-follower advantage. Indeed, our findings show that first-movers/fast-followers in AI are already more profitable than the industry average.

Commercialization of AI remains indeed in its infancy. However, laggards should be cautious. Usually, once an industry reaches a tipping point, slow adopters will see significant pressure on margins.

In aiming to become AI leaders, Nordic businesses have structural disadvantages relative to companies in the US and China. This is largely due to the two countries' scale and tech clusters, e.g., the investment inflow, superstar talent base, and world-leading hubs. What the Nordics do have is a good starting point for establishing globally-leading capabilities to apply AI throughout the businesses. This is manifested in a number of key enablers, such as digital transformation maturity, an open/agile workplace culture with a flat hierarchy, and an AI-positive, innovative and adaptable workforce.

The objective of this report is to:

- Provide a fact base for discussion of AI in Nordic C-suites, including how AI is changing businesses, the value at stake, and Nordic businesses' starting point.

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[2] McKinsey Global Institute, *Notes from the AI frontier: Modeling the impact of AI on the world economy,* September 2018

[3] Companies that fully absorb AI tools across their enterprises over the next five to seven years

[4] Companies that do not adopt AI technologies or have not fully absorbed them in their enterprises by 2030

- Inspire Nordic companies to succeed, with reference to the characteristics of leading adopters, and put forward concrete actions to take.

Our research on the implications of AI on Nordic businesses leads to a number of key insights:

AI can unlock significant value potential, and early adopters excel

- Existing AI domains can unlock USD 80 billion of value for Nordic businesses, corresponding to a 2 to 3 percentage point uplift in profit margins.
- On average, early adopters have a profit margin 7 percentage points higher than the industry average.

AI has not yet reached a tipping point

- Front-runners in AI, including telecom, financial services, advanced industries, and automotive, are also generally front-runners in digital.
- However, AI diffusion has not reached a tipping point, suggesting that first-mover/fast-follower advantages can still be achieved in most industries.
- The main trigger for AI investment is competition; rivals' progress increases propensity to invest three times more than the perceived value of AI.

Nordic businesses are well-positioned to scale AI and drive innovation within business domains, especially in their stronghold niches

- Nordic businesses already have key enablers in place for scaling, including an agile, low-hierarchy workplace culture and flexible employees.
- Still, Nordic AI investment remains relatively meager and talent is scarce. In addition, the region comprises much smaller "home" markets and does not have vibrating tech hubs like the US and China.

Our exclusive survey of Nordic CXOs' views on AI in 2019 suggests that Nordic C-suites may underestimate AI's impact and overestimate the talent challenge

- AI is not a priority on Nordic C-suites' agendas. While more than three quarters of businesses are piloting or embedding AI into at least one function/business unit, only approximately 30 percent have rolled it out at scale and few discuss it on their boards.
- Nordic C-suites do not expect AI to dramatically reshape the competitive landscape over the next three to five years.
- The most significant barriers to adoption are a lack of talent, strategy, and technological infrastructure.

Nordic companies are at a critical juncture in their uptake of AI. Few have realized its full potential, but the building blocks are in place. We see ten key action areas where leaders can make a difference.

Ensure executives establish a thorough understanding of AI opportunities in their areas of responsibility and develop a vision for AI scaling.

Analyze the value chain to identify high-value business domains and let these drive the AI strategy.

Let prioritization of domain capabilities be both impact and feasibility led; there is much potential to be captured with what you can do here and now.

Agile is here to stay. Organize agile, stable cross-functional teams around specific business domains to land domain capabilities quickly and at scale.

Define needs, carefully craft role descriptions, and spend recruiting efforts on finding experienced hires.

Exploit AI being an increasingly mature technology – data science PhDs are no longer required for applying AI.

Data scientists are not the whole story – hire or train business translators and software developers.

Adopt an agile mindset, also for building the data platform, supported by principles that allow incremental development.

Use a plethora of modern technology to incrementally design a tech stack fit for purpose – cloud provider A vs. B is not a strategic choice.

Be proactive in AI trend scouting, partner across boundaries, and share knowledge to avoid AI models that are obsolete.

Companies have the digital experience, workforce expertise, and technology resources to turn AI into a key driver of value. The missing ingredients are strategic urgency and clarity on how best to realize value. Those willing to invest early in acquiring those capabilities are most likely to emerge ahead of the pack.

Scope and methodology

In this report, we are focusing on the strategic, competitive, and business implications of AI. Hence, we refrain from analyzing other important questions such as the policy implications, ethical challenges, and legal/data privacy concerns of AI. Technically, we only consider Artificial Narrow Intelligence (ANI), also known as "weak" AI, in this report. ANI is designed and trained to perform a single task and operates within a predetermined, predefined range.

When assessing the value opportunity of AI, we consider the incremental value of current (known) AI technologies over traditional analytics, recognizing that there will be future waves of developments and domains for AI. To clearly distinguish from analytics, we generally estimate the value impact from use cases utilizing currently deployable deep-learning techniques, specifically "feedforward neural networks," "recurrent neural networks," and "convolutional neural networks."

Our results build on extensive McKinsey experience as well as groundbreaking research and models developed by McKinsey Global Institute (MGI). Furthermore, we have conducted an exclusive survey of over 75 executives in the Nordics for this report. Finally, we have benefited greatly from discussions with over 40 experts, executives, AI start-ups, and public institutions. The results of this report are to be presented at Axcel Company Day 2019.

1. AI is a general-purpose technology that has moved from concept to reality, turning into a game changer across industries

Rapid development of AI, while computers have become faster, smarter, and more powerful, means that the technology is increasingly useful for "cognitive" tasks previously considered restricted to humans. In some of its abilities, AI has now exceeded human performance, for example in game playing, or arguably, analysis for the detection of cancer or other medical conditions. In addition, developers are also rolling out an array of business domain capabilities for industries, enabling more relevant and efficient services.

AI promises to reshape industries, jobs, economies, and our daily lives

AI is a branch of analytics, albeit to the extreme end in terms of sophistication. AI can perform tasks that are characteristic of human intelligence (e.g., planning, recognizing language, recognizing objects and sounds, learning and responding through a self-selected "decision"). Commercially, AI is the latest step in the digital lifecycle (beyond core and advanced digital technologies) and can be a key driver of competitive advantage, as shown by large tech companies that have put AI at the center of their businesses.

AI is universally important because it is a general-purpose technology. It will enrich the value chain across industries and functions. Its impact will be reflected not only in its direct contribution but also in its ability to enable complementary innovations. Already, numerous industries are leveraging its potential:

In agriculture, the entire value chain faces disruption: led by John Deere, companies are deploying AI solutions for activities ranging from monitoring of crop and soil health, to predicting the impact of weather changes, all the way to harvesting. Within healthcare, AI is used to identify high-risk groups, predict diseases, increase speed and accuracy of treatment, automate diagnostic tests, and inform pharma R&D. In most B2C industries, AI is deployed to predict and recommend the next purchase. Amazon, for example, is so confident in the accuracy of its algorithms that it has patented "anticipatory shipping": shipping products to distribution centers close to customers before they have been ordered.

AI includes five technological capabilities as well as activities unified by techniques and approaches

In the general discussion revolving around AI, several terms are reappearing – not always as viewed by the same lens. In the following section, subsets of AI are elaborated by different lenses; a "capability" lens, an "approach" lens and finally a "technique" lens.

AI technologies include five technological *capabilities*:

a. **Machine learning.** Systems that are trained (and retrained) using data to recognize patterns and respond based on classifying input.
b. **Natural language processing.** Algorithms that process human language input and convert it into understandable representations.
c. **Computer vision.** Technology that processes and analyzes images to derive information and recognize objects.
d. **Virtual assistants.** Software agents that perform everyday tasks and services for an individual based on feedback and commands.
e. **AI robotics.** High-tech robots that can assist humans or act autonomously based on their environment (e.g., autonomous vehicles, AI-infused, collaborative robots).

Measured by external investment in AI-focused companies, machine learning is the most popular, attracting about 55 percent of funding in 2016. Computer vision received roughly 30 percent, AI robotics (including autonomous vehicles) attracted about 7 percent, natural language attracted about 6 percent, and virtual assistants attracted about 2 percent.[5]

Machine learning as a class of activity is unified not by any particular task but by common techniques and approaches. It is both used to obtain a **direct capability** and is an **enabler** of other technological capabilities. Machine learning is applied using three key *approaches*:

a. **Supervised learning.** This is the most commonly deployed machine-learning method, which provides analysis based on data (e.g., the picture shows a dog, the e-mail is spam).

b. **Unsupervised learning.** This is "learning without a teacher." The models are not fed a correct answer to learn from, but instead cluster input data. Applications include market segmentation and recommender systems (e.g., personalized content, personalized shopping experiences).

c. **Reinforcement learning.** This takes the environment into account and is primarily used in sequential decision making. Reinforcement learning is widely used in AI robotics.

Deep learning is a term often mentioned in an AI context and is arguably currently the most sophisticated subset of machine learning. The *technique* can process a wider range of data resources, requires less data preprocessing by humans, and can produce more accurate results than traditional machine-learning approaches. It can be applied in supervised learning, unsupervised learning, and reinforcement-learning environments, and is the driver behind numerous recent AI advancements.

Many natural language processing tasks (although not all) are based on machine learning and deep-learning algorithms. For instance, natural language architectures

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[5] McKinsey Global Institute, *Artificial Intelligence: The next digital frontier?*, June 2017

utilize deep learning to train a model that can accurately predict the next word in a given sequence or sentence. Modern computer vision techniques also heavily rely on deep-learning algorithms.

What is different now? Convergence in algorithm advances, computer power and storage, and data availability has made AI ready to scale

The idea of AI is more than 50 years old. The source of the term is considered by many to be from a Dartmouth College summer workshop in 1956, which focused on "thinking machines."[6] The first self-learning algorithm was developed by American computer scientist Frank Rosenblatt in 1958, and the first deep-learning algorithms were published by Soviet mathematician Alexey Grigorevich Ivakhnenko in 1965.

Still, over the past decade, interest in and uses for AI have exploded. This renaissance can be explained by 1) algorithm advances, 2) increased computing power and storage, and 3) data availability.[7]

Algorithm advances. Improved methods developed for estimating parameters are making AI more accurate in less time. AI now outperforms humans on speech recognition (error rates of about 27 percent by leading models in 1997 versus less than 5 percent error today, surpassing human performance).

Computer power and storage. Specialized hardware is cheaper, better, and more suited for today's massively parallelized operations. Specialized cloud-based infrastructure and model-building environments enhance capabilities.

Data availability. Data creation and availability have seen exponential growth, which contributes to higher accuracy.

As a result, applications that just a few years ago were considered futuristic are now being rolled out at scale. Turning to the example of image recognition, in 2010, state-of-the-art AI produced image recognition error rates of 28 percent, much higher than humans' 5 percent. Today, AI recognition error rates are less than 5 percent, with some applications (e.g., facial recognition) below 2 percent. In November 2018, the training speed was 16 times the speed of that in June 2017.[8]

Being able to perform on a par with humans (or outperform) has significant commercial implications. For example, Apple has replaced fingerprint login with facial recognition on its iPhone X model. The same technology is embedded in automated diagnostic tests in healthcare.

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6 Moor, James. "The Dartmouth College Artificial Intelligence Conference: The Next Fifty years," *AI Magazine, Vol 27, No. 4*, 2006

7 McKinsey Analytics, *An executive's guide to AI,* 2018

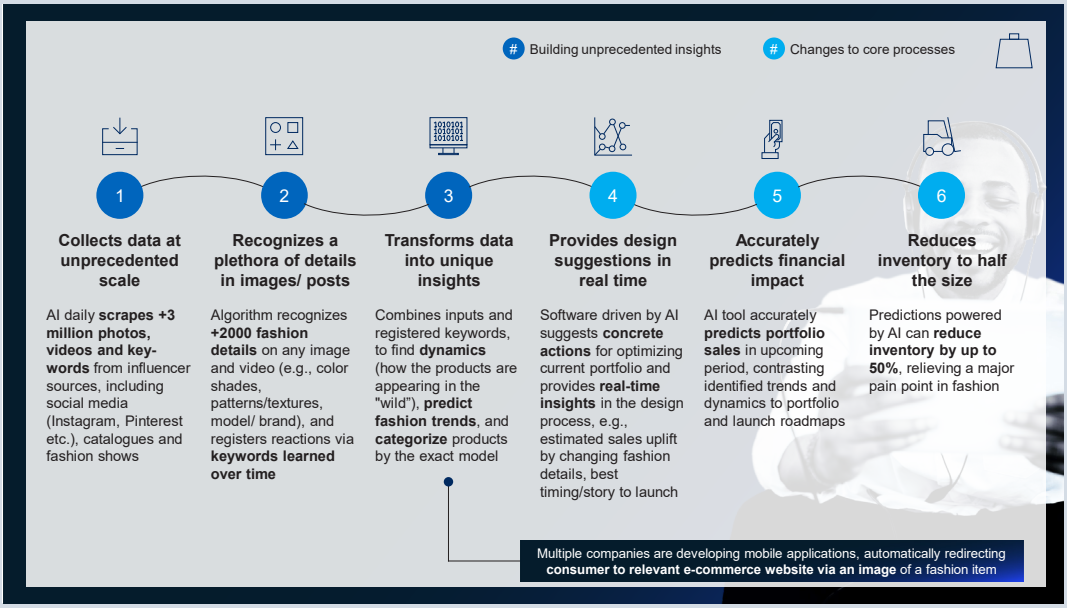
8 Shoman et al., *"*The AI Index 2018 Annual Report,*" AI Index Steering Committee, Human-Centered AI Initiative, Stanford University, Stanford, CA,* December 2018

AI stands to change fashion within its core value generating activities

The fashion world has always been competitive. Designers are required to be steps ahead of the fashion curve to secure a hit collection. While influencers used to be few and powerful, culminating in select fashion shows and the renowned “September Issue”, social media have decentralized influencers. Millions of users are daily creating fashion posts, from which an even greater number draws inspiration. Yet myriad sources of insight allow AI to shine in design processes and now stands to fundamentally change parts of fashion’s core business (Exhibit 1).

EXHIBIT 1

AI CHANGES FASHION WITHIN ITS CORE BUSINESS PROCESSES



Source: McKinsey; expert interviews

Collects data at unprecedented scale. Designers were previously bound to read countless magazine, attend fashion shows and trawl through the social media to shape their intuition. AI algorithms, on the other hand, covers much more ground and have every detail fresh in mind. For instance, one start-up’s solution daily scrapes more than 3 million photos, videos and key-words from various influencer sources, including social media, catalogues and fashion shows.

Recognizes a plethora of details in images, videos and posts. Deep learning algorithms, notably variants of large convolutional-based neural networks, are used to understand unstructured data such as images, videos and multilingual blogs posts. The neural networks are trained with millions of images and are currently recognizing over 2000 fashion details in any image and video (e.g., color shades, patterns/textures, model/brand). For the given post, consumer reactions are identified using keywords that the algorithms learn over time. In this way, unstructured data is transformed into structured data. For instance, a blog post may be identified to highlight product category “shoes” of type “sneakers”, specifically “Dad sneakers”, colored “leopard” and “white” in the style of “street wear”, made in “leather” materials. Furthermore, a neural network may find that the influencer is using the sneakers for a “date” and “going-out” looking for a “hipster” look. The

reactions may be registered as “next buy”, understood from a sentence such as “*Where can I buy these?”* or “liked”, from e.g., a given emoji or from “*I love these”*.

Transforms data into unique insights. The AI engine processes the structured data (e.g., fashion details, uses and feedback), obtained from each picture, to find patterns for different combinations of fashion details. From this multiple insights can arise, such as dynamics, i.e., how the products are appearing in the "wild”, including how customers are using the products, and whether, where, and by whom they are desired. These insights can further be condensed to identify and predict fashion trends (e.g., ¾ sleeves, leopard print, loose fit). Additionally, by comparing insights to the current collection, company tailored insights are produced to find what should be changed to ensure a best-selling collection (e.g., missing certain colors in portfolio, need different shirt lengths and shapes). Finally, products can be categorized down to the exact model. This is tremendously valuable for fashion companies, as it allows to exploit insights already known by about the fashion item (e.g., prices, competitive situation). It can also change current go-to-market processes. In fact, multiple companies progressing in the development of mobile applications that allows a consumer to take an image of fashion item automatically be redirected relevant e-commerce website.

Provides design suggestions in real time. Software driven by AI uses the company tailored insights to suggest concrete actions for optimizing current fashion portfolio, both on a portfolio-wide level and in real-time. Currently available solutions in fact provide real-time insights to the design process for creating a best-selling assortment. During the design process, the designer can draw inspiration from a dynamic “Moodboard”, i.e., similar items that the AI engine has registered to perform well, and gets feedback on the design on a fashion detail granularity (e.g., adding longer sleeves generate USD X million in additional sales, consider adding stripes as they are missing in the dress-collection and expected to be next on the fashion curve). Such real-time insights dramatically reduce time to market. Once a product is designed, the software can help create relevant product stories that connects with customers and provide insights about rightly timed product launch.

Accurately predicts financial impact. Utilizing the unparalleled amount of structured data, the AI engine can accurately predict upcoming period’s sales. This can happen by using the structured data from upcoming period’s portfolio and the quantified insights about future trends. A recent McKinsey study estimated that AI can reduce forecast errors by 50 percent.

Reduces inventory to half the size. Fuelled increased accuracy in demand forecasting, AI has the power to reduce inventory by 20-50 percent, relieving a major pain point in fashion.

2. AI can unlock USD 80 billion in value across the Nordics, equivalent to a 2 to 3 percentage point profit margin uplift

A fundamental aspect of deciding whether to adopt AI is the associated value opportunity. An important question arises: should a given company be a fast follower (a strategy that has worked well with most information technologies) or should it be more aggressive in adopting AI?

Corporates mostly choose to adopt AI because of competitive pressure from new entrants and forward-leaning incumbents, and to a lesser extent, due to the value creation potential

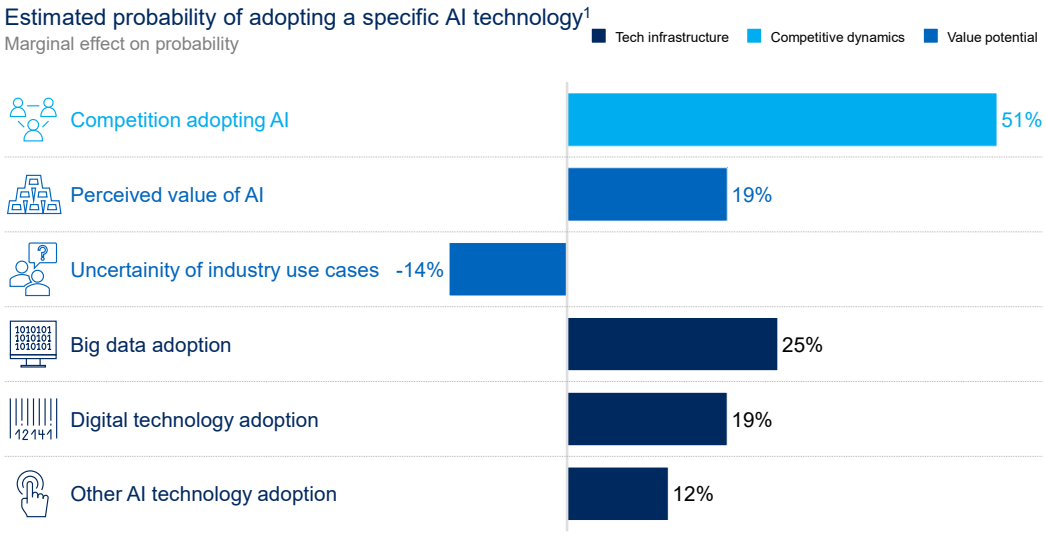
Competitive pressure is the main driver for AI adoption: companies fear they may be at a competitive disadvantage if they do not match rivals' investments. However, this perception may miss the fact that being proactive can unlock significant value. Early adopters have shown to be more profitable than peers.

An expert working with various Nordic clients noted that the companies he has dealt with primarily look towards what other companies are doing when investing in AI. Following the investment, one or two enthusiasts in the business lead the efforts, largely without any success. Empirically, McKinsey Global Institute estimates that the perceived value of AI boosts the probability to invest by approximately 19 percent, while competition adopting AI increases probability by about 51 percent for European companies (see Exhibit 2).

One implication is that decision makers are often not fully aware of AI's potential impact on value. Rather, they mirror rivals' investments to make sure they don't overlook something that might put them at a competitive disadvantage.

EXHIBIT 2

DRIVERS OF AI INVESTMENTS AND ADOPTION



1 Includes piloting AI technology. The coefficient is an average of the 5 AI technologies analysed (computer vision, machine learning, language processing, smart robotics, and virtual assistants) weighted by the current adoption rate by technology. All drivers are measured relative to competition

Source: McKinsey digital survey, 2017; McKinsey Global Institute

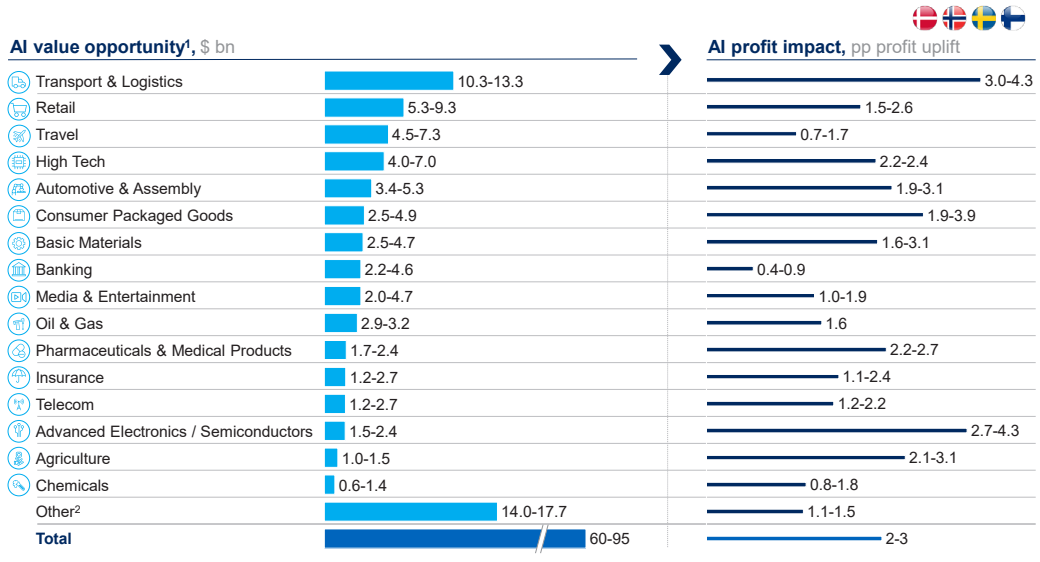
While value potential is a secondary driver of AI investment, it can in fact offer significant financial potential across industries. Within all industries, AI enables business domain capabilities that can unlock both revenue growth and efficiency improvements.

MGI research and McKinsey Analytics have analyzed more than 400 specific business domain capabilities utilizing mature deep-learning techniques to quantify the value opportunity. These span the value chain across several industries, and include, e.g., the optimization of price points, yield enhancement in manufacturing, recommending next product to buy, predictive maintenance, AI-driven hiring and retention, inventory and parts optimization, and customer service management.

Across these capabilities, AI can unlock USD 60-95 billion in value for Nordic businesses, equivalent to a 2 to 3 percentage point profit margin uplift. Importantly, this value potential only constitutes the direct impact from currently proven deep-learning techniques and applications, hence future AI applications are not taken into account. Among specific industries, transport and logistics offers the highest potential (USD 11-14 billion), followed by retail (USD 6-10 billion), see Exhibit 3.

EXHIBIT 3

NORDIC VALUE POTENTIAL BY INDUSTRY



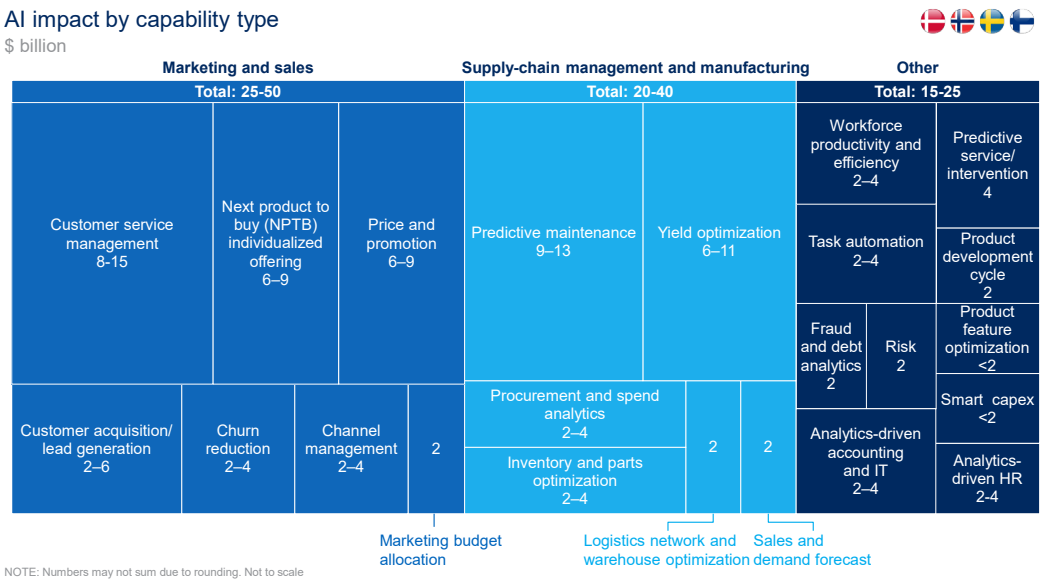
1 AI is defined as 'feedforward neural networks', 'recurrent neural networks', and 'convolutional neural networks'
2 Other included public and social sector, health care systems and service, and aerospace and defense

Source: McKinsey Global Institute; McKinsey analysis; IHS Markit

From a functional perspective, the highest total value potential is in marketing and sales (USD 25 to 50 billion) and supply chain management (USD 20 to 40 billion). In the former, customer service management represents the largest value opportunity (USD 8 to 15 billion). For the latter, predictive maintenance currently represents the largest value opportunity (USD 9 to 13 billion), see Exhibit 4.

EXHIBIT 4

NORDIC VALUE POTENTIAL BY DOMAIN AND FUNCTIONAL AREA



NOTE: Numbers may not sum due to rounding. Not to scale

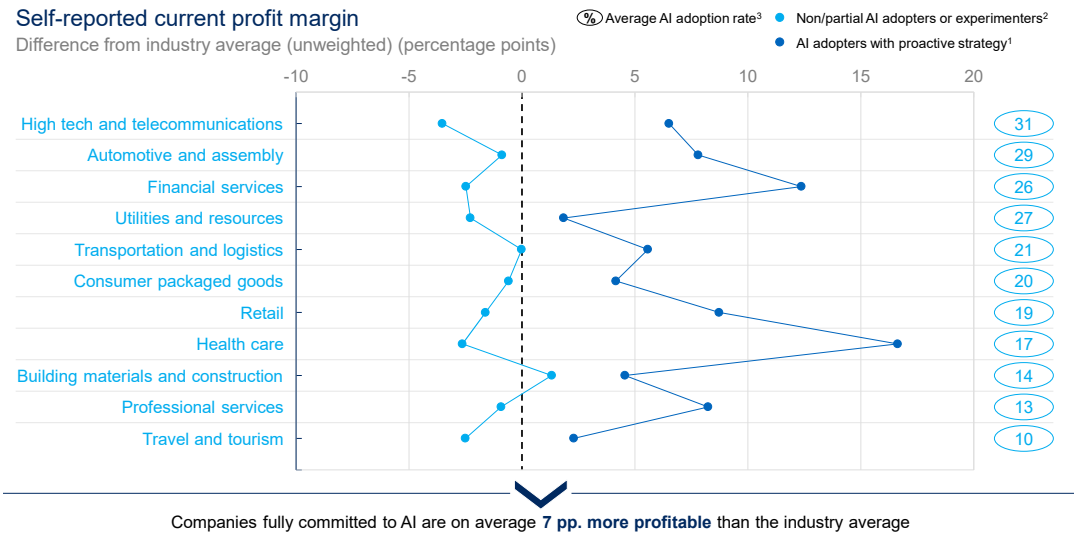
Source: McKinsey Global Institute; McKinsey analysis

First-movers capture most value. Companies with a proactive AI strategy achieve an operating profit margin about 7 percentage points above the industry average, McKinsey research shows.[9] On the other hand, adopters/experimenters and nonadopters are on average about 1.5 percentage points and about 2 percentage points below the industry average, respectively. While the gap may also be caused by the correlation between cash generation and new technology investments, it does suggest that AI can deliver significant competitive advantages, but only for firms that are fully committed to it (see Exhibit 5).

By industry, the largest differences are found in financial services (about 14 percentage point difference) and healthcare (about 19 percentage point difference). By contrast, the difference is only approximately 3 percentage points in building materials and construction. This can partly be ascribed to relative AI adoption rates, and that some industries have more developed AI domains, creating greater competitive differentiation.

EXHIBIT 5

PROFITABILITY MARGIN AS A FUNCTION OF AI STRATEGY



1 Firms that are big data and cloud services users and report their strategic posture toward AI to be: "Disrupting our industry using AI technology is at the core of our strategy". 2 Firm that respond "We have changed our longer-term corporate strategy to address the AI threat or opportunity disruption," or " we have developed a coordinated plan to respond to the AI threat or opportunity but have not changed our long-term corporate strategy." 3 Percent of companies adopting 1 or more AI technologies at scale or in business core; weighted by company size

Source: McKinsey Global Institute AI adoption and use survey; McKinsey Global Institute analysis

Significant variability in AI adoption with digital leaders being ahead on their AI journey

AI builds on existing digital technologies, so it is no surprise that the most digitally enabled companies also tend to be the most AI enabled. In fact, the probability that a company will adopt an AI tool increases in line with its progress on its digital

9 It is, however, not straightforward to statistically establish a causal relationship

journey. Specifically, if a European company has implemented big data analytics, it increases the probability of adopting a given AI tool by 25 percent. If a company has core digital technologies in place, meanwhile, it has an estimated 19 percent probability increase.

Across the Nordics, telecom and financial services are among the industries leading in AI adoption, which can largely be explained by their heavy investment in digital transformation.

Adoption of AI is not only subject to the upsides, e.g., unlocking value and securing license to compete. Industries are also subject to distinct structural challenges:

Model design (human capital). Competition for talent is intense. Given that new capability types have not historically been present within some companies, it requires quite different HR competencies to attract the AI talent. As a result, most are found at leading tech companies.

Model deployment (AI capital). Several factors are at play: 1) Lack of availability of data and data labeling, 2) Poor generalization of algorithms (slight modifications may require a completely new data set) and biases in models (data not representative), and 3) Interpretation issues in black-box algorithms, which in some industries create regulatory compliance issues and hinder upper management communication.

A lack of AI capital is linked to both digital maturity and established ways of working. For instance, the insurance industry has always employed mathematical models and descriptive statistics. Data generation and availability are part and parcel of the way it does business. The construction industry, meanwhile, has less access to these types of inputs.

First-mover/fast-follower advantages in AI can still be achieved in most industries

Can less-proactive AI adopters still enjoy first-mover advantages, and are these advantages likely to persist? The short answers: yes and (likely) yes.

A recent McKinsey[10] study shows that on average, during the early stages of digital transformation (digitization rates, defined as industry revenues flowing from digital below 30 percent), less than one in ten incumbents across industries adopt proactive strategies that change their portfolios and business models. However, once about 15 percent of revenues shift to digital attackers and very fast followers (in most cases, with corresponding digital rates of about 40 percent), there is a tipping point. When advanced incumbents and established start-ups constitute the new normal, laggards fall away (Blockbuster, RadioShack, etc.).

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[10] Bughin, Jacques, Laura LaBerge, and Nicolas van Zeebroeck, "When to shift your digital strategy into a higher gear," *McKinsey Quarterly*, August 2017

The study finds that for industries well past the 40 percent digitization mark (high-tech, media, and telecom), attackers still account for more than 15 percent of the market, and more than one in five of incumbents move boldly. Disruption hits late-adopters the hardest. Attackers squeeze their revenues, and heavy investment is required to keep pace. Our research shows that the bottom quartile struggles to remain competitive.

As AI is the latest wave within digital technologies, we also expect to see a shift in the industry dynamics with persistent first-mover advantages. In fact, only about 10 percent of companies have engaged in effective AI scaling across the enterprise,[11] with less than half of those leveraging the majority of AI capabilities. Therefore, there is still time for incumbents to become fast-followers by investing in AI and the infrastructure that enables it.

[11] Bughin, Jacques, and Nicolas van Zeebroeck, “Artificial intelligence: Why a digital base is critical,” *McKinsey Quarterly*, January 2018


SHOPPING
CONNECTED
Tomatoes
Garlic
Potatoes
Milk
Cheese
Vegetable Curry
In a large saucepan over
medium-high heat oil and
sauté onion, and garlic until
golden. Stir in curry powder
and tomato paste, cook 2 to
3 minutes. Stir in tomatoes,
vegetable bouillon cube,
mixed vegetables, water,
salt and pepper to taste.
Cook approximately 30
minutes until vegetables
are well done (not crunchy).
Sprinkle with fresh cilantro
prior to serving.
LOW STOCK!!

3. Applications of AI in the industrial and retail sectors

AI has the potential to solve difficult issues in various industries and can provide predications at a scale and depth of detail impossible for individuals. To offer some concrete examples of applications that can serve as inspiration for Nordic businesses, we are focusing on the industrial and retail sectors.

The industrial sector: AI has the potential to become a critical value creation tool

AI is set to radically reshape the industrial sector over the coming years, with applications from advanced robots to intelligent manufacturing and virtual factories taking center stage. Advances in AI technologies will enable companies to leverage the fast growth in data resources to optimize processes in real time. That will mean shorter development cycles, improved engineering efficiency, and a much lower error rate. AI will also inform system management, enabling leaders to make smarter decisions on supply chains, production schedules, and scenario planning.

In the Nordic region, advances in AI represent a significant opportunity. The sector already accounts for more than 50 percent of Nordic exports and works at a high level of productivity relative to global peers.[12] The ability of AI to optimize processes throughout the value chain could be the key driver of the next stage in its growth.

McKinsey research shows that AI can be a significant driver of value, both internally and through new partnerships and ecosystems. It has the potential to create value in the Nordics of about USD 11-17 billion annually (roughly USD 750-1,200 billion globally).[13]

AI can create the most value in supply chain management, manufacturing, operations, and aftersales/support, our research shows. These account for about 70 percent of the industry's total AI potential. Example domain capabilities include AI-assisted supply chain planning, collaborative robotics, computer-vision-enabled defect detection, and predictive maintenance (see Exhibit 6).

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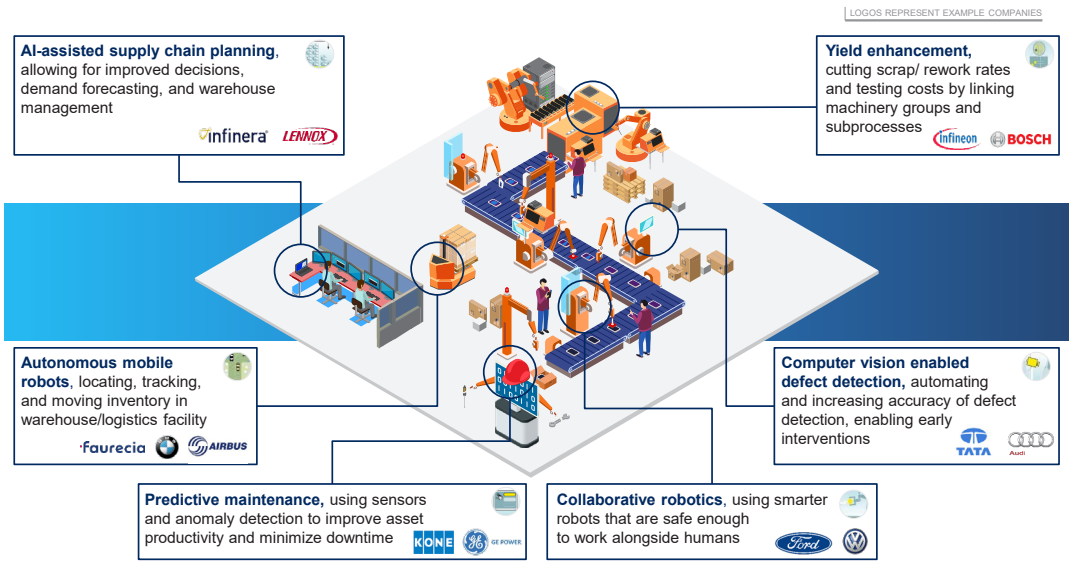
[12] Nordic co-operation, "Digitalisation and automation in the Nordic manufacturing sector – Status, potentials and barriers," *TemaNord 2015:578,* December 2015

[13] Data from McKinsey Global Institute, The Word Bank, and Nordic Statistics used for calculations

EXHIBIT 6

AI CAPABILITIES IN INDUSTRIAL CORE OPERATIONS



Source: McKinsey; Press search

Case example: Danfoss uses AI in 100,000 apartments and has reduced building energy costs by 10 to 20 percent

Buildings are responsible for approximately 40 percent of energy consumption and 36 percent of CO_2 emissions in the EU. Around three quarters of energy is used for heating and cooling, which represents a significant cost and environmental challenge. Around 70 percent of the average household's energy bill is spent on heating and cooling, corresponding to roughly USD 270 billion annually in the EU.[14]

Danfoss partnered with and invested in Leanheat to optimize heating systems using AI. Their solution leverages temperature and humidity data to control heating. Specifically, control room data is combined with data collected from wireless IoT sensors located in individual apartments. The machine-learning software produces a unique, thermodynamic model and automatically maintains a desired temperature (see Exhibit 7).

The solution has been installed in 100,000 apartments worldwide, leading to an average 10 to 20 percent reduction in energy costs and 30 percent reduction in maintenance costs. The latter is possible due to AI predicting/flagging changes in the building, e.g., behavior, humidity levels. The climate impact is considerable. In a family home, it enables an annual reduction in CO_2 emissions of 2.5 tons. The average Nordic citizen is responsible for about seven tons of CO_2 emissions annually.[15]

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[14] Danfoss, *Rethinking energy efficiency – optimizing technical building systems,* 2018

[15] The World Bank – Table: CO_2 emissions (metric tons per capita)

EXHIBIT 7

DANFOSS' AI SOLUTION FOR OPTIMIZING BUILDING HEATING

Source: Danfoss; Leanheat

Retail sector: AI-enabled retail companies can win the battle for digital footfall and respond to changing sentiments among highly informed customers

The retail sector is in a prime position to leverage AI applications in transforming its business. From smarter supply chains, to tailored and dynamic customer experiences, the technology enables game-changing plays that can catalyze a significant impact on the bottom line.

Retailers can use AI to analyze vast quantities of data to inform forecasting and market analysis, helping companies make decisions that reflect the business environment in real time. With business domain capabilities spanning from automated picking and loading and self-driving trucks, to anticipatory shipping in e-commerce, self-scanning checkouts in stores, and targeted offers, AI stands to alter retailers' value chains in their entirety.

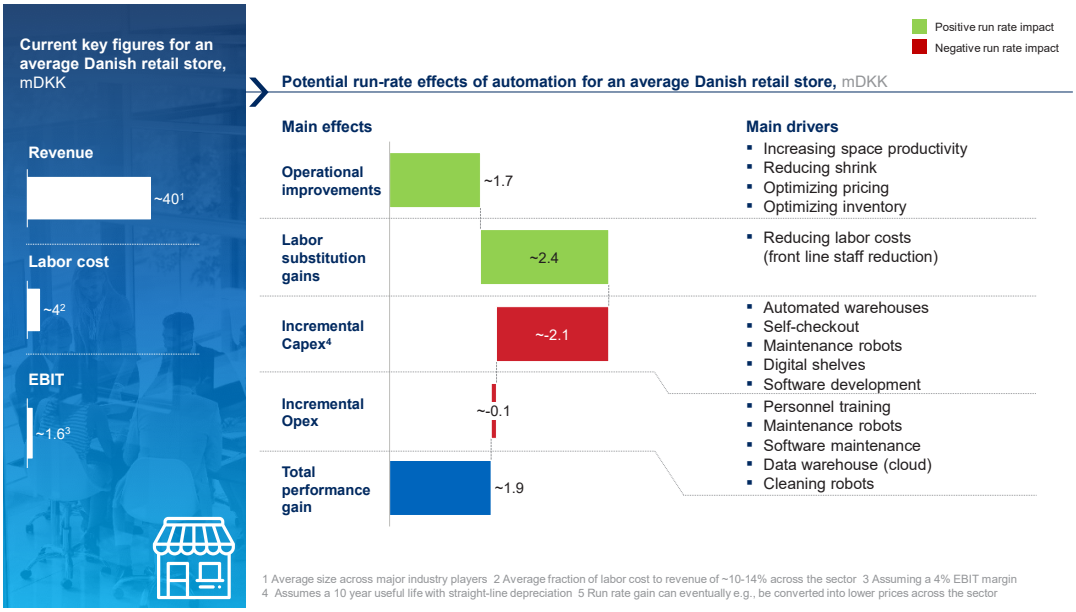
Through the application of AI, the retail sector thus has the chance to move away from lower-than-average productivity, a relatively low-skilled workforce, and a high number of routine activities.

We estimate the annual value creation potential of AI in retail to be about USD 5.3-9.3 billion in the Nordics (about USD 450-780 billion globally). It will likely have the most impact in pricing and promotion, and other sales and marketing areas (USD 3.5 to 6 billion), and automation of routine activities (USD 1.2 to 2.4 billion). Below, we direct our attention to AI's impact on one specific part of the value chain: store operations. It is estimated that a Danish retail store can achieve performance

improvements of about DKK 2 million, corresponding to a doubling of its profits (Exhibit 8).

EXHIBIT 8

AI'S IMPACT ON AN AVERAGE DANISH RETAIL STORE



Source: McKinsey Case Studies Economics model

Case example: AI enables retailers to achieve unprecedented scale and levels of efficiency. Amazon Go is among the most progressive customer-facing automation initiatives.

Customers of grocery businesses increasingly value speed and convenience over endless options. Among companies to respond to this dynamic is Amazon, which has leveraged AI to offer cashierless checkout in its Amazon Go chain of convenience stores (see Exhibit 9).

Amazon Go works as follows: upon entry to the store, the customer's phone is scanned, and the customer is identified by video analytics. Video analytics then identify the products taken by the customer, which enables automatic checkout as the customer leaves the store (i.e., cashierless). Several AI applications are deployed, most notably computer vision, which is fed with data from cameras, depth-sensing cameras, and infrared sensors. Behavioral clues, such as dwelling and movement patterns, are also analyzed.

This helps Amazon charge for purchases and enables the optimization of store layouts and personalized offers. Following the visit, the details of the visit and transactions are available via an app.

Amazon Go stores generate about 50 percent more revenue per square meter than a typical convenience store, according to a Royal Bank of Canada analysis.[16] And of course, Amazon Go does not require extensive human supervision on-site. Amazon plans to open as many as 3,000 Go stores by 2021, according to Bloomberg.

EXHIBIT 9

AMAZON GO INNOVATION FOR CASHIERLESS CHECKOUT

Source: Expert interviews; press search; company websites; RBC

[16] Molla, Rani, "Amazon's cashierless Go stores could be a $4 billion business by 2021, new research suggests," *Recode*, January 2019

4. Messages from Nordic C-suites – an exclusive McKinsey survey

This chapter discusses how Nordic C-suites view AI in 2019. McKinsey has conducted a survey of around 80 Nordic CXOs, covering the business implications of AI. While AI is expected to play in increasing role, few see it as a game changer anytime soon.

AI is not (yet) being implemented at scale and is often not on a CXO's radar

AI is not a key priority on Nordic C-suites' agendas. While more than three quarters of businesses are piloting or embedding AI into at least one function/business unit, only 30 percent have rolled it out at scale (across multiple functions/business units). While this number exceeds the global counterpart[17] (21 percent), dating one year back, it does reflect the fact that many Nordic CXOs attach relatively little strategic importance to AI; only 21 percent consider it to be a core element of the corporate strategy and just one in four discuss it to more than a "medium" extent at board meetings.

This ambivalence is also reflected in investment levels. Nordic companies allocate a modest share of their investments to AI technologies. Almost two thirds of companies allocate less than 3 percent of their total investments to AI. Around nine out of ten allocate less than 10 percent of their total investments.

Nordic CXOs see AI as increasingly important, but overall, C-suites may still underestimate its potential

Nine in ten C-suite members expect to increase AI investments over the next three to five years, and almost half of these expect to invest significantly more than today. Approximately half of C-suite members expect AI investments will secure the enablement of other initiatives, with only a small direct financial impact.

Still, a growing number see AI playing a more important strategic role. Almost 40 percent expect AI to be a core part of initiatives or among the two to three key areas of their corporate strategy over the next three to five years.

Given that executives expect to ramp up their AI activities, it is reasonable to expect increasing competition. The latest McKinsey global AI survey revealed that 71 percent of the respondents expect to increase investments in AI. This indicates that a global competitive race indeed is in the making.

Almost two thirds of C-suite members expect either no impact from AI on their industry, or some impact but not affecting overall strategy. Very few (4 percent)

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[17] McKinsey & Company's Global AI Survey of February 2018 with 2,135 participants

believe AI will dramatically disrupt current business models, shaping future strategy.

These views, however, are not held with a lot of confidence; just 17 percent of C-suite members believe they have very good understanding of how AI will impact the current business model of their company.

Talent, strategy, and technology infrastructure are the main barriers to adoption

Around half of Nordic executives regard AI talent as their primary challenge. To this end, it is interesting to see how exactly C-suites plan to close the capability gap. The answer: with a bit of everything. Specifically, more than 40 percent of the CXOs expect to acquire AI capabilities through the following paths: building AI capabilities in-house, partnering with businesses and academic institutions, buying/licensing capabilities from large tech companies, and finally, buying capabilities from professional services or system integrators. The distribution is in fact surprisingly uniform, with the three latter all at approximately 40 percent, and the five out of six options comprising the use of internal and external capabilities are chosen by between 31 and 55 percent of the CXOs. It thus appears that there is no consensus on the best way to attract talent, which may also be due to different company prerequisites. The one option that seems less popular, however, is acquiring other companies for capabilities (12 percent), which may again be linked back to the relatively low investment levels.

The second and third most significant barriers to adopting AI are strategy and technological infrastructure, both mentioned by around a quarter. The Heads of AI also find the latter to be problematic, specifically data access and management. However, one of the biggest barriers according to the senior professionals is their middle management. They have not yet internalized the implications of AI and may occasionally oppose AI roll-out.

Finally, to overcome the barriers, it should be noted that virtually all C-suites draw inspiration primarily from global leading tech companies and digital natives (e.g., Google, Amazon, Netflix, Tencent). As discussed in the next chapter, these companies do indeed serve as a great source of inspiration; however, there are other companies with more similar business environments to draw best practices from.

AI IS NOT YET A PRIORITY ON THE NORDIC C-SUITE AGENDA

Many Nordic businesses are experimenting with AI but few have applied it at scale

78%
are piloting or embedding AI into at least one function/BU

30%
have embedded at least one technology, across their business

vs **21%**
for global peers

AI is not fully on the radar of Nordic CXOs

Only **21%**
have included AI in a core part of initiatives across their corporate strategy

Only **1 in 4**
discuss AI to more than a "medium" extent in their Board meetings

Few Nordic CXOs are investing heavily in AI

~2/3
of Nordic businesses dedicate less than **3%** of total investments to AI

Top barriers for AI adoption are lack of talent, a clear AI strategy and technological infrastructure

51%
lack talent with appropriate skillsets while around a quarter lack a technological infrastructure to support AI or an AI strategy

Top 3
Talent and strategy are also among the top 3 barriers for global peers

Most companies do no expect AI to change their industry

~2/3
of Nordic businesses expect no impact from AI on their industry, or some impact but not affecting overall strategy

Nordic CXOs perceive AI as an increasingly important topic

90%
expect to invest more in AI in 3-5 years

vs **71%**
for global peers

Almost **40%**
consider making AI a core part of initiatives across their future, core strategy

5. Global leaders and what we can learn from them – three broad approaches

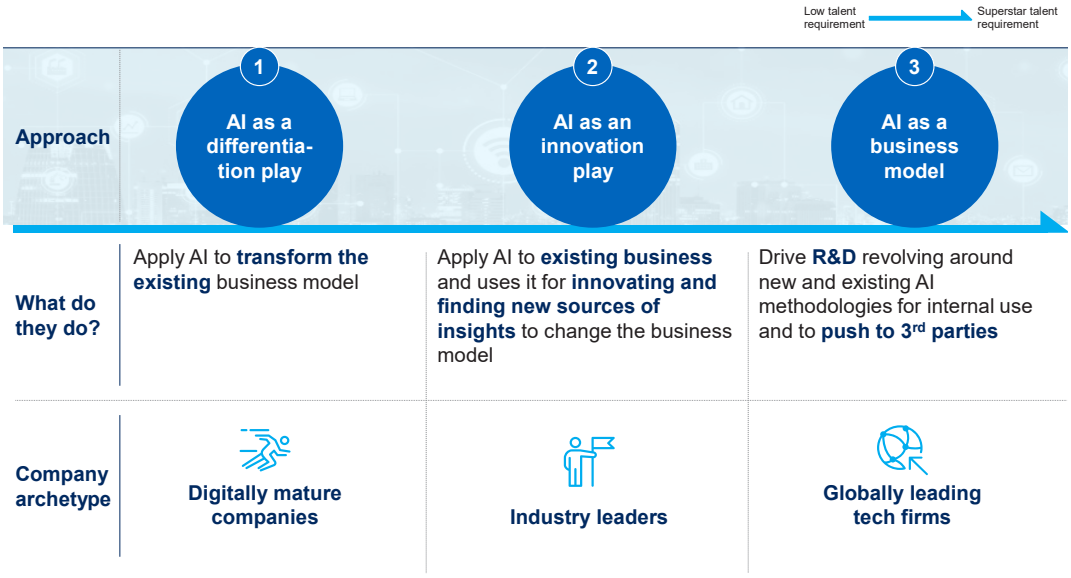
Global tech companies such as Google, Amazon, Tencent, and Alibaba are investing heavily in AI R&D, launching moon-shot projects (aimed at solving important problems in unique ways), and helping build vast ecosystems of companies that help them expand and accumulate data. They also have significant structural advantages, primarily based on their large home markets and developed infrastructure resources. As a result, they operate on a different scale than most Nordic firms. However, they are an excellent source of inspiration on how to set the strategic direction and use AI effectively. Industrial players are also starting to separate themselves from the pack. Given the industry mix in the Nordics, skewed towards industrial players with comparable legacy systems, competitive positions, and product offerings, vast learnings from such AI leaders can be attained.

Leading AI adopters can be characterized by three approaches to AI, with distinct best practices to learn from

Among the biggest global users of AI, we see three broad approaches reflecting the ambition level (see Exhibit 10).

EXHIBIT 10

APPROACHES TO AI BASED ON AMBITION LEVEL



Source: McKinsey

Companies with an "AI as differentiation play" approach are typically agile developers and digital front-runners

These companies are often front-runners in digital transformations and have built up a strong analytics base which, as addressed in chapter 2, serves as a

prerequisite for utilizing AI as a differentiation play. Companies approaching AI as a differentiation play have assessed AI to serve as an impactful addition on top of existing initiatives and position themselves as quick followers in their respective industries. Given that it is not in scope to push the boundaries for applying AI, the AI organization can be grown from within, coupled with partnerships within the industry for knowledge sharing. It often suffices to keep the investment levels in the range of 1 to 2 percent of revenues, *not* to be confused with share of investments previously mentioned, over the period of the transformation (typically 4 to 5 years).

Companies with an "AI as innovation play" approach tend to be industry leaders, and often work with AI partners

These companies are generally in a globally leading position, have significant data resources at their disposal, and, in turn, have discovered how to use data early. Prominent examples include Siemens using AI to control gas turbines, Novartis using AI for drug research development and optimizing its sales force, and EE (the largest UK mobile operator) using AI to create personalized marketing. Companies approaching AI as an innovation play are leveraging various channels to grow the AI organization. It is grown by hiring and training, leveraging partnerships outside the same industry, and using M&A.

The extent to which each channel is leveraged varies. Some primarily develop their own AI domains internally (e.g., EE), some form close partnerships with universities (e.g., Novartis and University of Oxford), some partner with tech giants for more disruptive AI projects (e.g., NVIDIA and Mercedes on autonomous vehicles), and some use M&A to enable AI domain innovations (e.g., Siemens acquiring Mendix).[18] Still, many are linked to a Nordic business or have a Nordic counterpart, e.g., Vestas, Novo Nordisk, and Ericsson. It thus seems natural for the biggest Nordic companies to adopt a such approaches and selectively replicate success stories created by companies in similarly competitive positions.

Companies with an "AI as a business model" approach are mainly US and China-based tech companies with structural advantages

These companies are characterized by being digital natives and running a data-driven, scalable business model with network effects. Heavy investments in R&D (e.g., Facebook invests 18 percent of revenue in R&D) and an innovative culture bring these companies at the forefront of AI technology development.

With the highest ambition level, the tech giants using "AI as a business model" have been responsible for recent groundbreaking research and are have vast in scope: in terms of patents, the WIPO flagship study in 2019 found that IBM had by far the biggest AI patent portfolio, with 8,920 patent applications, and Microsoft following

[18] Ismail, Nick, "Siemens acquires Mendix for $730M to accelerate R&D innovation," *Information Age,* August 2018

with 5,930 patent applications.[19] Also, in the open source community, the tech giants are leading contributors. On Github, the largest host of source code in the world, a 2018 statistic analyzing contributions places Google first and Microsoft second.[20] Other major AI technology developers include Facebook (FAIR), Amazon, and NVIDIA in the US, and Baidu, Alibaba, and Tencent in China.

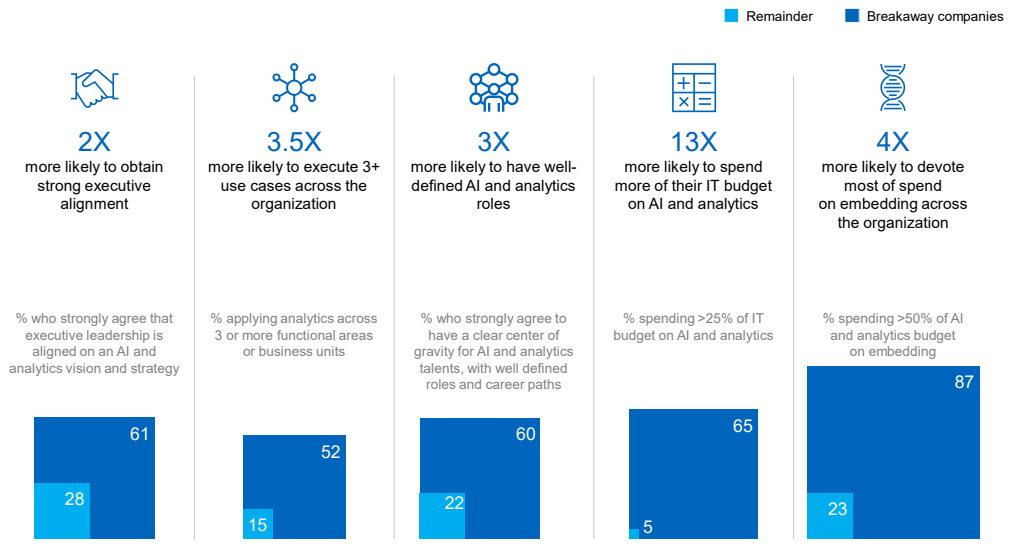
This picture will likely remain unchanged in the future. China and the US enjoy structural advantages, including extensive home markets, developed hubs (unlike the Nordics), strong investment frameworks, and large pools of talent.

The biggest users of AI are breaking away

Across ambition levels, leading AI users are starting to break away from the remainder. While companies piloting are struggling to capture value, the breakaway group is achieving the elusive goal of AI at scale. At a closer sight, the select group separates themselves in relative terms by having a sound strategy for scaling AI and strong foundational capabilities in data, AI practices and people, all enabling scaling (see Exhibit 11)

EXHIBIT 11

STRONG FOUNDATIONAL CAPABILITIES ENABLE SCALING



Source: McKinsey

Importantly, the breakaway companies within AI and analytics are also notably ahead on one of the biggest challenges in an organization's AI journey: turning insights into outcomes. Without completing the "last mile", investments can go to

[19] WIPO, "WIPO Technology Trends 2019: Artificial Intelligence." Geneva: World Intellectual Property Organization, 2019

[20] Google's and Microsoft's employees providing code to more than 1,500 and 1,200 of the top repositories respectively, cf., Hoffa, Felipe, "Who contributed the most to open source in 2017 and 2018? Let's analyze GitHub's data and find out," *freeCodeCamp.org*, 2018

waste. For instance, a global financial-services company made a significant commitment to analytics and AI for fraud detection. It had made sizable investments and deployed some 1,500 analytics professionals in a center of excellence. Though it had world-class fraud-detection algorithms, it had not created the processes to integrate these insights into the day-to-day work and decisions of its employees and as a result did not see any significant changes in outcomes, despite major investments. A big part of completing the "last mile" is making clear who in the organization is empowered to make particular AI-based decisions on a day-to-day basis. Breakaway companies are found to be 2.5 times more likely to establish decision making rights and accountability. Finally, the leading AI users ensure team members have the tools they need to do so, and continually refine decision making through AI. In fact, they are 1.5 times more likely to achieve quick, continually refined decision making.

Nordic businesses are well-placed to approach AI as differentiation and innovation

Nordic businesses are not as structurally advantaged as US and Chinese companies and therefore may struggle to mimic the AI business models of tech giants and to use AI as a business model.

Still, many Nordic businesses are positioned to approach applied AI as a differentiation play and to draw inspiration from leading companies in this category. These tend to be agile and digitally advanced. The Nordic environment is similar, characterized by an open/agile culture with a flat hierarchy, and an AI-friendly and flexible workforce.

For the former, the fact people relate to one another as equals, regardless of job titles and formal positions, is critical for collaboration across functions.[21] For the latter, this entails that the Nordic is globally among the most willing to embrace AI and the transformational changes it brings.[22]

Nordic businesses are also competitive regarding their digital transformation journey. The digital share of ICT value corresponds to 3.3 percent and 2.2 percent of GDP for the US and China respectively; by comparison, Finland's digital ICT equals 3 percent of GDP, Sweden's digital ICT equals 2.8 percent of GDP, with the number being 2.2 percent for Denmark – these positions correspond to rank 1, 2, and 4 in the EU. The European Commission's latest Digital Transformation Scoreboard, as well as the DESI index puts the Nordic member countries in the top positions with a significant lead over other member countries.

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[21] World Economic Forum's Global Competitiveness Report 2018 ranks Denmark and Sweden as top two globally

[22] EU Commission survey of about 28,000 EU citizens, Denmark ranked number one in EU 28, and with Sweden and Finland ranked number three and five respectively

With competitive digital infrastructure in place, the Nordics are also engaging in initiatives to increase its output of AI-capable candidates. The most ambitious of its kind is Finland, teaching 1 percent of its population the basic concepts within AI.[23]

Finally, Nordic businesses operating in global niches are also well-placed to approach AI as innovation. These companies have historically excelled in innovation (Sweden, Finland, and Denmark rank third, seventh, and eighth respectively on the Global Innovation Index), which is a key capability in ensuring AI projects lead to productive and scalable changes.[24]

AI creates ever fuzzier industry boundaries and shifts the competitive landscape

To meet consumers' rising expectations, companies are forming alliances with other companies, even competitors, to create complementary networks of offerings and services. In the world of digital networks, AI is enabling actionable opportunities regarding the individual consumer's broader needs from different pieces of information about a consumer's immediate desires and behaviors.

We expect this trend to continue, given the vast amount of data required to fuel the AI engine. Thus, ecosystems will effectively be competing on the aggregate data sets that each participant can translate into actionable business insights. To this end, it will become even more important for companies to adapt a wider lens when assessing would-be competitors – and would-be partners. Tech giants are becoming competitors and partners in new industries by being innovative in utilizing their vast amounts of data and technology.

For instance, Amazon is now a significant player not only in e-commerce, but also in cloud computing, logistics, consumer electronics, and retail. Furthermore, with its DRIVE technology, NVIDIA has partnered with 370 of the world's automakers, tier-1 suppliers, developers, and researchers, creating a data-generating ecosystem. As a result, the chipmaker has used AI to become a key player in the future automotive industry.

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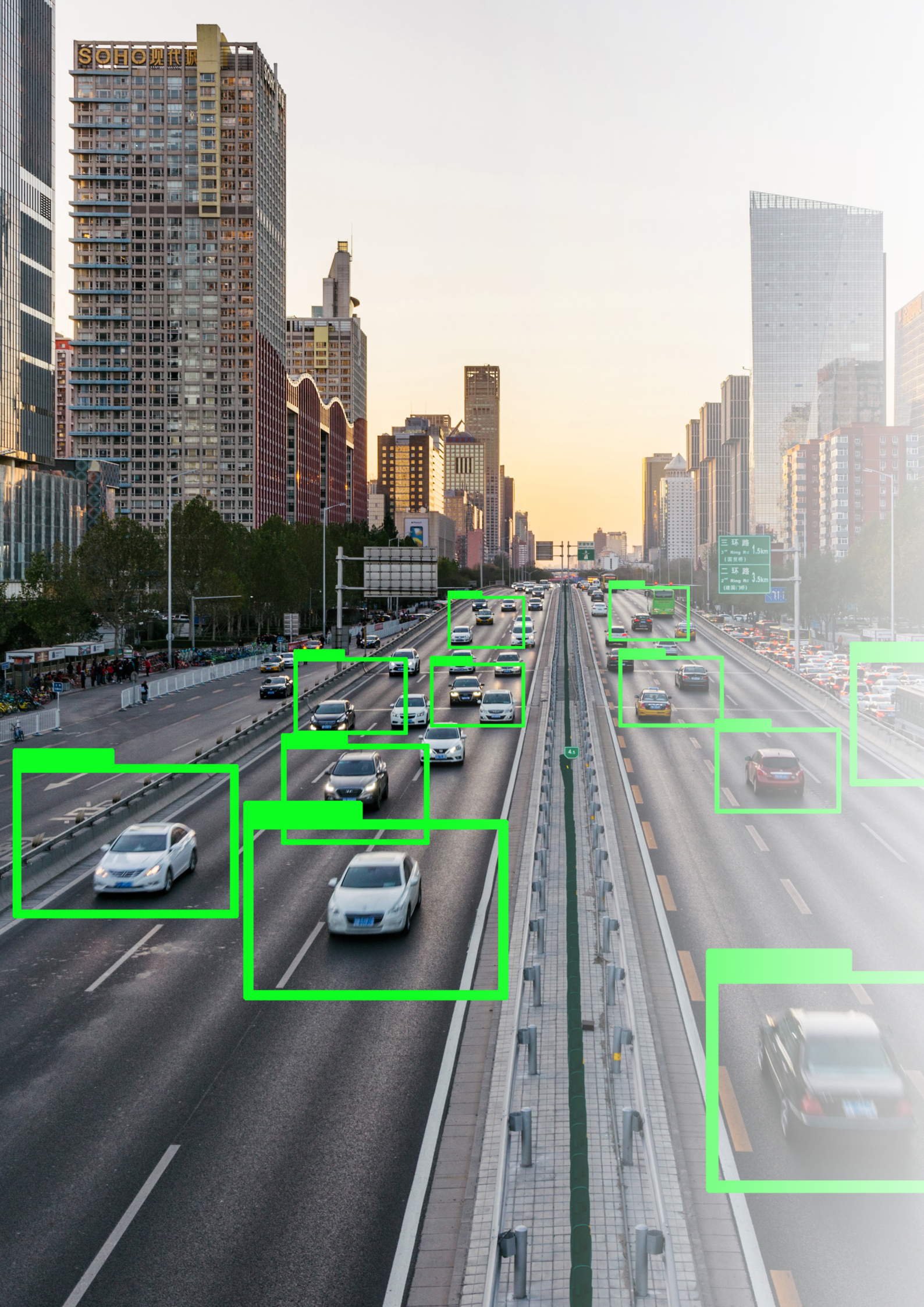
23 University of Helsinki, *Finland is challenging the entire world to understand AI by offering a completely free online course - initiative got 1% of the Finnish population to study the basics*, September 2018

24 Cornell University, INSEAD, and WIPO, "The Global Innovation Index 2018: Energizing the World with Innovation." *Ithaca, Fontainebleau, and Geneva.* 2018


SOHO现代城
三环路 1.5km
3rd Ring Rd
二环路 3.5km
2nd Ring Rd

6. Seven building blocks to scale AI – and Why scaling AI is a challenge

This chapter draws on best practices from our work with AI leaders globally and lays out the most important dimensions for successfully scaling AI throughout the organization. First, the key dimensions, and one layer deeper, the building blocks, are introduced. Then, the major pitfalls that we observe in the context of the framework are discussed. Finally, disclosable examples of AI leaders excelling within the building blocks are provided.

How to win in the age of AI

AI proofs of concept are relatively simple to execute. The much harder task is scaling. In response, we see seven building blocks that can encourage and enable AI productivity. These are loosely grouped in three key pillars of action: strategize the scale-up process, obtain and utilize capabilities to drive the AI transformation, and be experimental in fueling the AI engine (see Exhibit 12).

Strategize the scale-up process. The path to scale is most easily navigated when the C-suite maintains a vision of the destination (in terms of AI's potential) and a coherent strategy for getting there, based on stringent *prioritization of business domains.* Business domains can only be prioritized and underlying use cases can only be formulated to maximize business value if the *executives have a holistic understanding of AI.*

Obtain and utilize capabilities to drive the AI transformation. AI implementation at scale is complex. Companies need to answer tough questions about how to upskill, reskill, and attract new talent. A critical pillar of this approach is the organization/governance to enable scaling. The means clearly defining the roles required and then focusing on *training and/or acquiring the capability.* It is then central to govern the acceptance and *integration of AI capabilities throughout the organization*.

Our executive survey emphasizes the challenge, revealing that only around 30 percent of companies have embedded at least one AI technology across multiple business units.

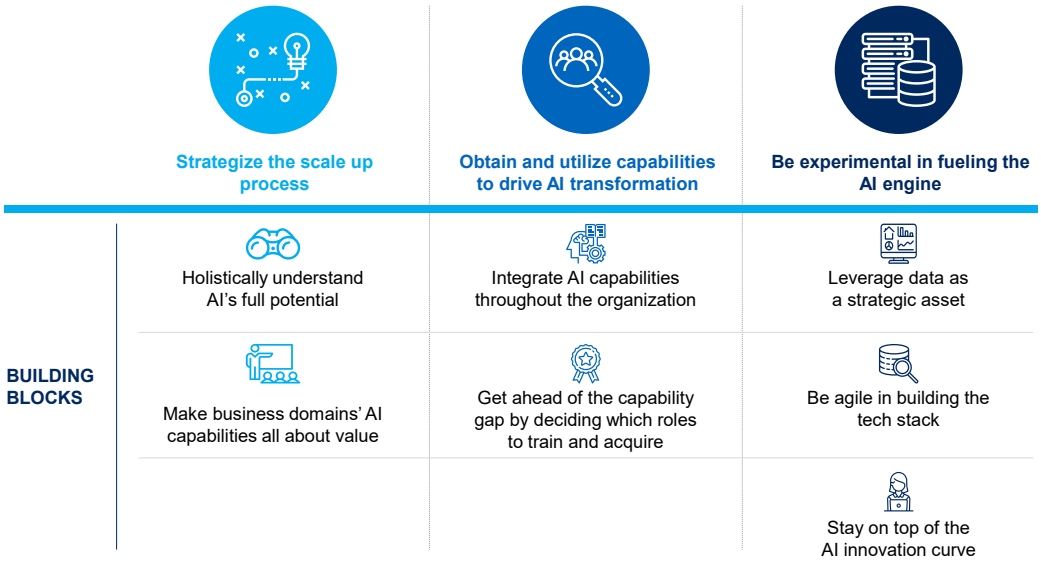
Be experimental in fueling the AI engine. An important pillar is the right data model (standardized and accessible), infrastructure, and technology. Without data – and lots of it – AI cannot be implemented. Equally, *leveraging data as a strategic asset* is a critical lever in creating a competitive advantage in the age of AI. Finally, to ensure feasible AI deployment, a technology stack should be formulated up front in coherence with business domain focus areas. It is important to orchestrate a plethora of technologies and be *agile in building the tech stack*.

AI is an extremely rapidly evolving field, and algorithms can, as outlined in chapter 1, quickly become obsolete, which makes *staying on top of the AI innovation curve* critical. The vital lesson is that access to the latest technological infrastructure and

knowledge-sharing across companies and practitioners is important for maximizing business value.

EXHIBIT 12

BUILDING BLOCKS FOR SCALING AI



Source: McKinsey

Companies are challenged in scaling – 10 barriers to adoption

AI is at the same developmental stage as digital was five years ago. Every CXO wants to "own the AI box," but our survey shows few have a clear idea of what it can do. Perhaps for that reason, across the three key areas of strategy, capabilities and experimentation, companies are struggling to implement AI to its potential.

We have identified 10 barriers of AI adoption. Among these, four stand out as being particularly difficult:

C-suites do not see AI as an integral part of the business (*barrier 1*)

Some two thirds of Nordic businesses allocate less than 3 percent of their total investment to AI, according to our survey. In addition, executives expect no or very little strategic impact. Half of companies discuss AI infrequently or not at all in board meetings, and only one in five C-suites see AI as a core part of initiatives across the corporate strategy.

AI piloting is outside the core (*barrier 3*)

Nordic businesses generally pilot AI outside core activities. As an expert from Sweden noted, "Too many companies do generic stuff with AI but do not fix an actual business problem." Perhaps not surprisingly, therefore, just 40 percent of executives expect AI to have a significant financial impact. However, a change of approach may bring a different result. Our analysis shows value capture is most

likely in everyday core activities, such as production volume forecasting and pricing/promotion.

AI capabilities are isolated from the business, limiting organizational buy-in and transformation potential (*barrier 4*)

AI capabilities tend to sit in isolation, either centralized and far removed from the business or in pockets of poorly coordinated silos. Both models are suboptimal. Over-centralization creates bottlenecks and leads to a lack of business buy-in, while decentralization carries the risk of maintaining disconnected data models.

A CEO from a leading Nordic AI start-up noted “The capabilities end up sitting isolated in most businesses I’ve worked with. What happens is that they can show proof of concept but can simply not put it into production, as they are not integrated with the rest of the organization and the associated tech infrastructure.”

Translator and software developer roles are often underestimated (*barrier 7*)

Business translators and software developers tend to get less attention than data scientists. However, translators are vital in helping data scientists build actionable solutions that maximize commercial value. Similarly, software developers are critical in turning AI models into value-creating applications.

■ Building block X Barriers to AI scaling

	**Holistically understand AI's full potential**	**1** **Lack of visibility in AI** benefits results in AI not being a core part of the strategy
	**Make business domains' AI capabilities all about value**	**2** Focus on standalone use cases without a roadmap for value capture, resulting in **strategy non-coherent with high-value AI domains** **3** AI pilots are happening **outside of the core,** limiting value potential and organizational buy-in
	**Integrate AI capabilities throughout the organization**	**4** **AI capabilities are isolated** in a peripheral business division without a clear purpose, limiting ability to transform the business
	**Get ahead of the capability gap by training or acquiring AI talent**	**5** AI **roles are poorly defined** and talent is underutilized, resulting in little or no impact **6** Misconception that only top PhDs can be effective data scientists, making **capability acquisition ineffective** **7** Translator and software developer **roles are underestimated,** making AI solutions generic and nondeployable
	**Leverage data as a strategic asset**	**8** Decision makers are captivated by the idea of a **"magic" data lake containing all data,** with successful implementation very rarely occurring
	**Be agile in building the tech stack**	**9** A **"big bang" target-state tech stack** is built from the outset that addresses all legacy systems, hindering quick AI scaling
	**Stay on top of the AI innovation curve**	**10** **Knowledge sharing is not pursued,** making AI solutions go from state of the art to obsolete

Best practices around the globe

Some companies are pulling ahead with respect to the seven key building blocks.

Royal Dutch Shell has an AI-first strategy and has built a center of excellence with the purpose of identifying high-value business domains. Microsoft CEO Satya Nadella commented, “What’s happening at Shell is pretty amazing. They have a very deliberate strategy of using AI, right across their operation…from the drilling operations to safety in…Shell retail stations.”

Some of the leading tech giants take this ambition one step further. As an example, Tencent has shifted to an “AI in all” strategy, aiming to integrate its AI-related technologies within various industries.

Novartis has deliberately focused its AI efforts on its main business areas, such as drug discovery and optimizing its sales force; the commercial success of which has snowballed organizational buy-in. Following this, Novartis has been able to find a recipe for rapidly moving from s ideation to embedding in real-world applications and as a result, has successfully adopted AI at scale.

For building capabilities, Google has educated a third (18,000) of its engineers over two years through its fast-paced “Learn with Google AI” training program.

Pfizer has established an AI center of excellence and offers AI training across the company. It held five AI boot camps in 2018 with more than 1,000 employees taking part. Facebook, meanwhile, uses a “co-employment model,” where top academic profiles are hired for part-time positions and continue to work at their respective universities.

Leading companies are also actively pursuing the latest trends. JD.com has successfully leveraged the start-up landscape. Its “AI Accelerator” program facilitates partnerships with tech start-ups. More than 80 percent of its first-year participants have succeeded in introducing their new AI technologies through JD.com’s businesses. It’s common among AI leaders to partner with universities for long-term innovation collaborations like, e.g., Novartis/Oxford and IBM/MIT.

Finally, some companies are leveraging innovative data management techniques to help fuel the AI engine, and are achieving competitive advantages as a result. Telefonica, for instance, has launched a platform that processes and unifies data generated by three platforms (network, IT, and products and services), and guarantees data consistency, powering numerous business domain capabilities. Similarly, Tesla uses sensors to gather data from its fleet. An AI engine (even in nonautonomous cars) then predicts what the driver will do and compares it to actual actions, generating even more data.

Building block	Examples of companies with best practice
Holistically understand AI's full potential	Tencent 腾讯: Follows an "AI in all" strategy Shell: Deploys AI applications at scale, from retail to drilling operations
Make business domains' AI capabilities all about value	Novartis: Focuses its AI efforts on its core business: drug discovery and sales
Integrate AI capabilities throughout the organization	Google: Has opened research centers around the world and launched a fast-paced "Learn with Google AI" training program
Get ahead of the capability gap by training or acquiring AI talent	facebook: Uses a "co-employment model" to recruit top academic profiles Pfizer: Offers AI training throughout the company
Leverage data as a strategic asset	Tesla: Pursues innovative methods of gathering data from its assets Telefónica: Has created a platform that governs and manages data, resulting in numerous domain capabilities landed
Be agile in building the tech stack	Uber: Utilizes a tech stack that enables "democratization" of machine learning
Stay on top of the AI innovation curve	JD.COM: Has launched an AI accelerator program IBM: Partners with universities on joint AI research

7. Ten actions to accelerate AI adoption

AI is likely to be a game changer for businesses over the coming decade. To reap the benefits in terms of performance, efficiency, and customer service, corporate leaders in the Nordics must develop an approach to driving AI that reflects their business needs and is based on best practice. Our analysis boils down to ten recommended actions, which can be pursued in parallel.

1. Ensure executives establish a thorough understanding of AI opportunities in their areas of responsibility and develop a vision for AI scaling

The C-suite must set out an ambitious AI vision and a clear path to scale based on prioritized business domains. Importantly, the prioritization must feed into a roadmap for conquering the "last mile" by embedding AI into decision making processes.

First, it is critical that the executive team has a full understanding of what AI can do for the business. To that end, companies such as Tata Steel have created an internal Analytics Academy. The Academy is aimed at building a number of critical roles such as Data Scientists, Data Engineers and Data Translators, and at building an understanding of the AI opportunities to the executive team. This is particularly relevant for Nordic CXOs; in our executive survey, only 16 percent believe they have a very good understanding of how AI will impact their business model.

2. Analyze the value chain to identify high-value business domains and let these drive the AI strategy

For each step in the value chain, companies should map business activities and identify pain points and opportunities. They should then identify business domains, e.g., manufacturing execution, where they believe AI can create business value. In practice, collaboration with managers in each activity area can be a helpful way of generating use cases necessary for landing the domain capabilities. For instance, a leading pharmaceutical company mapped the critical activities for each of its key processes and identified the relevant stakeholders to interview. For one of its key R&D processes, 23 pain points were identified based on stakeholder interviews. As a result, 11 use cases for landing domain capabilities were generated.

Ultimately, such an approach will create a "long list" of use cases, which should be grouped by domain (e.g., customer insights, R&D, plant management & quality, manufacturing executing). Companies should quantify the potential impact of each domain before deciding how to move forward. In our survey of Nordic CXOs, only 5 percent expect AI to be among two to three key topics in the next full corporate strategy.

3. Let prioritization of domain capabilities be both impact and feasibility led; there is much potential to be captured with what you can do here and now

The first step is to run a diagnostic of the company's AI maturity. This involves assessing the state of data, models and tools, culture, organization, and talent. The results of the diagnostic should guide the prioritization.

For the purposes of manageable efficiency, companies should initially focus on the top three to five business domain capabilities in terms of potential value over a one-year timeline. It is worth picking a few "quick wins" to generate momentum and encourage buy-in. The first few domain capabilities also serve as search space for a replicable recipe for effectively landing capabilities in agile sprints.

A Nordic example within prioritization based on value and feasibility is Axel Johnson, one of the largest trade and service companies in the Nordic region. In 2017, the group launched Axinsight, a groupwide collaboration for data-driven business development. The stated goal is to "utilize data to create more customer and business value." The collaboration works within set limits, ensuring feasibility prior to initiation and enables quick deployment. In one of the "experiments," 600 million data points from one of its companies were used to benchmark a data-driven recommendation against their "normal" option for 30,000 customers. The result of its large-scale "experiment" was that the data-driven alternative increased value by about 20 percent. Thus, the company designs the limits of its dry runs in advance to ensure "quick wins," while tracking the incremental business value that is so crucial to gain momentum across the organization.

4. Agile is here to stay. Organize agile, stable cross-functional teams around specific business domains to land domain capabilities quickly and at scale

In the age of AI, team compositions fundamentally change, e.g., research teams in many businesses now also include data scientists and data engineers. As a response, a hybrid model has proven effective, with agile teams populated by people from the business and data scientists. The team should be embedded in the organization and should be accountable for delivering impact. Establishing an AI center of excellence has further been shown to be effective in driving cultural change and training people on the job. Such a hybrid structure has, for instance, been successfully adopted by a leading global apparel player. Each data scientist is embedded into different core "product" teams (e.g., product recommendation, pricing solutions), while utilizing a common platform, built for reuse, to land the business domain capabilities.

Finally, it is critical that a senior executive is designated to maintain strategic direction. An advisory board is often useful in that regard. Board members may comprise the CEO, relevant senior executives, and external partners. The board should meet periodically to challenge and assess whether sufficient value is being delivered.

5. Define needs, carefully craft role descriptions and spend recruiting efforts on finding experienced hires

Multiple skills are required. It is important for job descriptions to rigorously define necessary business, technical, and AI skills (e.g., a translator needs a mix of AI and business skills, a data engineer mainly requires tech skills, a data architect needs a mix of business and tech skills).

Capabilities do not need to be externally sourced. Employees can also be upskilled through internal or external programs. Internally, workshops can act as informal in-house "academies" that can enable knowledge sharing and learning. As

exemplified in the last chapter, virtually all AI leaders are upskilling their workforce. Capital One utilizes its existing army of financial analysts, which through its internal "Big Data Academy," is transformed into collaborative and nimble teams of data scientists, engineers, designers, and product managers.

Indeed, it's an advantage that the Nordic workforce is both enthusiastic about lifelong learning and willing to pursue new knowledge and degrees, as evidenced by Nordic countries' being top ranked within lifelong learning in the EU.[25] The bulk of companies we have interviewed assess that the capability gap to some extent can be "upskilled away," notably when combined with fresh graduates.

The critical element in this process is acquiring experienced AI capabilities. As a lead scientist at a major Nordic retailer noted. "It is surprisingly easy to find people with talent, but hard to find people with a lot of experience. What you really want is people who have five to ten years of previous experience doing advanced analytics." Thus, the bulk of the hiring or acquisition efforts should be made with the purpose of finding experienced capabilities that can provide guidance to talents and lead the execution of the companies' AI agenda.

6. Exploit AI being an increasingly mature technology – data science PhDs are no longer required for applying AI

Cloud providers such as Amazon, Google, Microsoft, and IBM are building component technologies to make it easier to develop and deploy AI algorithms. With that in mind, barriers to entry are falling. Access to massive volumes of data, an innovative mindset, and basic analytics knowledge are often sufficient for making progress. This relative simplicity should inform the talent strategy, internally and externally.

In one example of the leveling playing field, students at a UC Berkeley AI Summit in March 2019 competed against data science majors and PhDs on a real-world 56,000-patient data set to determine patient readmission rates. The winning team had no prior AI training and included two high school students and a history major. The experiment was evidence of how mature and accessible applied AI has become. In another example, part-time students at Fast.ai built an image classification algorithm that beat Google's previously top-ranked code.

Still, companies shouldn't get too relaxed about talent. Experienced data scientists remain a scarce commodity, and companies must ensure they generate a backlog of high-priority domain capabilities to motivate engagement. The evidence suggests data scientists get bored quickly and can easily find new jobs. The Financial Times reported that data scientists "spend one to two hours a week looking for a new job," based on a Kaggle Survey and Stack Overflow survey of 64,000 developers.[26]

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[25] Eurostat, *Table: Participation rate of adults in learning in the last four weeks,* 2017

[26] Waters, Richard, "How machine learning creates new professions — and problems," *Financial Times,* November 2017

7. Data scientists are not the whole story – hire or train translators and software developers

Translators and software developers should be a top priority in setting up the team. Translators should ideally be internal candidates who are well-placed for promoting engagement and understanding. New hires lack the most important quality of a successful translator: deep company knowledge. Consequently, many companies have created their own translator academies. One global steel company, for example, is training 300 managers in a one-year learning program.

A sufficient number of software developers should also be hired to ensure that the AI models can be put into production and maintained. A global pharmaceutical company has seen success in globalizing its capability capture by establishing research departments in, e.g., Beijing and Seattle. By securing presence in leading AI hubs, it has sourced a significant share of its AI capabilities overseas.

Finally, it is critical to create the glue of the trinity: ensuring data scientists, have frequent touchpoints with both translators, and software developers.

8. Adopt an agile mindset, also for building the data platform, supported by principles that allow incremental development

Given that AI methodologies and resources are becoming increasingly standardized, data will be the strategic asset that enables businesses to win. Being innovative in combining proprietary, public, and purchased data can thus be a real driver for competitive advantages. The innovative mindset should not be limited to data sourcing, but also data ingestion. An expert, for instance, noted that the leading AI companies are increasingly moving towards sourcing real-time streaming data to the cloud, which represents a major opportunity, as it allows infusing AI into real-time products and services (e.g., a call center knowing what the topic of a call is, even before picking up the phone).

Considering the increasing strategic importance of data, it is crucial to quickly get started with building a functioning data platform for AI. Rather than coherently defining a full-fledged “end state” data lake structure, one should take an agile mindset and use new tools available to allow agile adoption. There is no need for a “big bang” deployment by preemptively thinking through every data problem in the organization.

An agile approach should be supported by carefully crafted guiding technological principles, enabling incremental construction of the data platform. While domains of responsibility are precisely defined with persons in charge of quality (e.g., customer, product, content), the same definitions can easily be updated to introduce new fields, translations, or cater to changes in data availability. Technology will ensure that the overall model stays congruent and adheres to the defined principles. A data model like this allows for data experimentation, as long as the technological principles are not violated. As such, the technology is effectively used to govern itself: if the principles are violated, the data can simply not be put into the data stack.

9. Use a plethora of modern technology to incrementally design a tech stack fit for purpose – cloud provider A vs. B is not a strategic choice

Fundamental for designing the AI tech stack is to have a granular understanding of the tools and technologies available. For designing the tech stack, an agile approach coupled with technological principles is also preferred. Furthermore, the persons who implement and use the tools (e.g., software developers and data scientists) should be the ones deciding which tools to utilize depending on the tech requirements (e.g., block storage vs. object storage for storing data).

Our experience working in the field of AI shows that many companies use AI cloud solutions for flexible deployment and usage. These are extremely fast to get up and running and serve as a great environment to initially test an AI model versus, e.g., a standard analytics benchmark. By being able to experiment through minimum viable products, AI cloud solutions can help to give an indication of where the business value lies. Therefore, clouds serve as accelerators and important enablers – however, which clouds to use are less relevant.

10. Be proactive in AI trend scouting, partner across boundaries, and share knowledge to avoid AI models that are obsolete

Given the rapid development of AI, companies must keep track of developments and how domains (e.g., maintenance, manufacturing executing) are being successfully addressed across their industries and beyond. Furthermore, data scientists should network regularly to share knowledge and experiences. Both objectives can be advanced by partnering or by hosting/participating in public forums, such as conferences. For instance, at the “Samsung Global AI Forum,” Samsung invited an audience of industry experts, thought leaders, and academics to share their insights, talk about best practices, and investigate opportunities for collaboration.

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Nordic companies are at a critical juncture in the uptake of AI. Some are experimenting, but few are scaling up, and often conversations about AI are absent from the boardroom. As a result, they are falling behind global leaders in leveraging AI to innovate, work more efficiently, and serve customers better.

Still, all is not lost. Nordic firms are in a great position to generate momentum. The necessary digital competencies, technical knowledge, and workplace cultures are in place. Now it is incumbent on corporate leaders to seize the moment, based on their company’s resources, market, and ambition. AI is a general-purpose technology – it can bring benefits to all industries and across a range of functions. The task therefore is to identify where it can have the most impact and to invest, with conviction that it will create real value for the business.

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