

# Longer Term Investments

## Automation and robotics - Spotlight on artificial intelligence

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- We maintain our structurally positive view on automation and robotics as we continue to see strong demand from emerging markets.
- As the driving force behind machine intelligence, artificial intelligence (AI) complements the automation trend and is at the center of the fourth industrial revolution. Thus, we have expanded this theme's scope to include AI.
- The AI industry will offer solid growth prospects, in our view; we conservatively expect industry revenues to grow from USD 5bn in 2015 to USD 12.5bn in 2020, representing an average annual growth rate of 20%. In this update, we cover key AI topics like scope, growth drivers, inhibitors, use cases, investment opportunities and the broad economic impact.

### Our view

Have you ever come across artificial intelligence (AI)? Chances are you have already experienced AI in some basic form like the voice assistants from Apple's Siri and Amazon's Echo, product recommendations on e-commerce websites, or the robot reporters providing live coverage of US presidential elections and the Rio Olympics. But this is just the beginning: the scope of AI is vast and set to take the world by storm.

We continue to believe that smart automation will power the fourth industrial revolution, combining the innovation of industrial and IT processes to drive global manufacturing productivity gains. As a result, we expect the industry to grow in the mid-to-high single digits on average. We have expanded the scope of this theme to include AI as it is at the center of the fourth industrial revolution; like the brain, AI is driving the evolution of machine intelligence. Beyond powering the broader trends like industrial automation or autonomous driving, AI also provides significant growth opportunities as a standalone industry, in our view. From winning highly complex games like Go and powering robot advisors, AI is regularly in headlines and its rapid development cannot be ignored.

AI still has a lot of room to grow and create a lasting impact on business. We conservatively expect AI-related revenues to grow from USD 5bn in 2015 to USD 12.5bn in 2020, representing an average growth rate of 20%. Beyond 2020, the opportunities are immense as the evolution of AI will have far-reaching implications globally, which we examine in detail later in this report. We believe AI is almost ready for business applications and should provide interesting opportunities for both companies and investors. While some low-skill, predictable and routine jobs will be risk of redundancies, we do not think AI will seriously challenge global employment. As with any technological change, AI will boost labor productivity and should spur the creation of creative jobs. Overall, we see more opportunities than threats from AI's emergence.

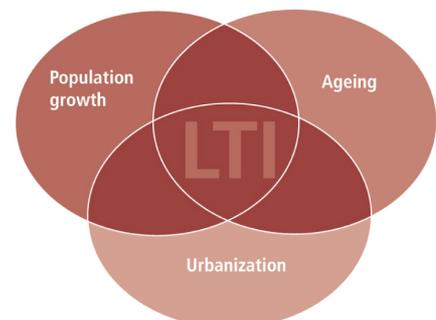
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Source: Monty Rakusen, Plain picture

### Introduction to the Longer Term Investments (LTI) series

- › **The Longer Term Investments (LTI)** series contains thematic investment ideas based on long term structural developments.
- › Secular trends such as population growth, ageing, and increased urbanization create a variety of longer term investment opportunities.
- › Investors willing to invest over multiple business cycles can benefit from potential mispricings created by the typically shorter term focus of stock markets.



## Introduction

“At some stage...we should have to expect the machines to take control.”

The above quote made by Alan Turing in 1951 has been a key guiding principle for data scientists and business leaders interested in artificial intelligence (AI). The topic of AI is once again gathering momentum with billions of dollars being invested into the space; around 2,000 start-ups globally have AI as a core part of their business model. And with headline-grabbing news like for example Google's AlphaGo defeating the Go world champion or Baidu's personal assistant Duer accepting orders at some KFC restaurants in China, people are now wondering if AI is ready for mainstream adoption. Our detailed views on AI are provided in the following frequently asked question (FAQs).

## Artificial intelligence FAQs

### 1. What is artificial intelligence?

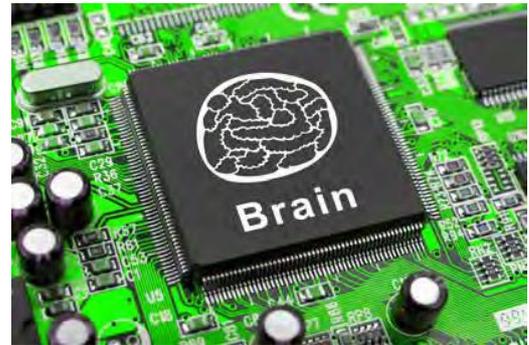
The term is derived from Latin words, *inter ligare*, which refers to the capacity of creating connections between notions. Accordingly, we view artificial intelligence as a set of tools and programs that make software 'smarter' in a way an outside observer thinks the output is generated by a human. In the most simplistic terms, AI leverages self-learning systems by using multiple tools like data mining, pattern recognition and natural language processing. It operates similar to how a normal human brain functions during regular tasks like common-sense reasoning, forming an opinion or social behavior. That being said, AI is an umbrella term to cover a confluence of multiple technologies, such as machine learning, which includes deep learning, cognitive computing, natural language processing, neural networks, etc. (see Fig. 1).

The main business advantages of AI over human intelligence is its high scalability, resulting in significant cost savings. Additionally, other benefits include AI's consistency and rule-based programs, which eventually reduces errors (both omission and commission), AI's longevity coupled with continuous improvements and its ability to document processes - some of the few reasons why AI is drawing wide interest.

### 2. Is AI a reality and ready for business?

While many sci-fi movies like *Star Wars*, *The Terminator* or *2001: A Space Odyssey* have shown the extreme potential of AI, most of that remains imagination. Despite research for more than five decades, the real progress on AI has been witnessed only in the recent past. We believe AI is divided broadly into three stages: artificial narrow intelligence (ANI), artificial general intelligence (AGI) and artificial super intelligence (ASI).

The first stage, ANI, as the name suggests, is limited in scope with intelligence restricted to only one functional area. ANI is, for example, on par with an infant. The second stage, AGI, is at an advanced level: it covers more than one field like power of reasoning, problem solving and abstract thinking, which is mostly on par with adults. ASI is the final stage of the intelligence explosion, in which AI surpasses human intelligence across all fields.



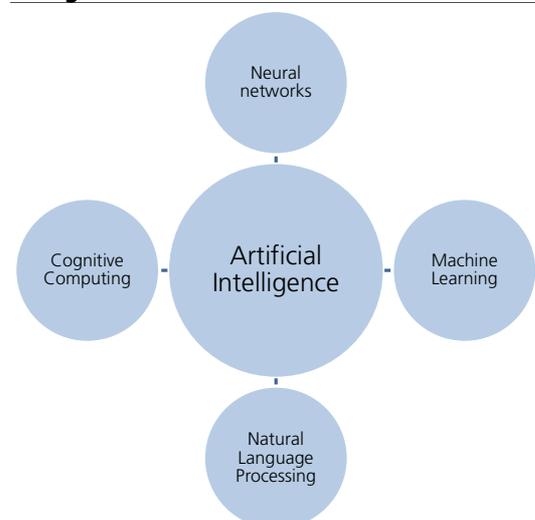
Source: Dreamstime

### Box 1: Artificial Intelligence set to take off

Key highlights from the report

1. AI is almost ready for business with growing use cases.
2. We do not see severe global unemployment challenges as we think only 50-75m jobs globally will be potentially affected.
3. AI will eventually drive innovation and provide employment opportunities in other areas.
4. We conservatively expect AI industry revenues to grow from USD 5bn in 2015 to USD 12.5bn in 2020.
5. Key beneficiaries include software companies with a first-mover advantage, robotic process automation (APA) industries and indirectly R&D leaders in healthcare and hi-tech engineering due to efficiency gains.
6. Companies that fail to adopt in industries like retail, finance, auto and transportation will be at risk of falling behind.

**Fig.1: AI is an umbrella term for many technologies**



Source: UBS, as of 15 August 2016

The transition from the first to the second stage took the longest time (see Fig. 2), but we believe we are currently at the final stages of the transition to the second stage - AGI, in which the intelligence of machines can equal humans. This is by no means a small achievement as AGI can solve many of mankind's problems. Thus, we believe AI is almost ready for business.

**3. How will AI be used?**

The use cases of AI are manifold as AI-based software will push the limits of automation. Like a brain, AI powers the traditional sources of automation and robotics and drives progress of sectors like autonomous vehicles and drones. But as a standalone industry, AI-based software can create significant business opportunities. A few examples include virtual assistants or chatbots providing expert assistance, smart or robot advisors in the fields of finance, insurance, legal, media and journalism, and expert healthcare systems that provide medical diagnosis and assistance. Other benefits include significantly improving efficiencies in R&D projects by reducing time to market, optimizing transport and supply chain networks, and improving governance by better decision-making processes.

Despite multiple use cases, we need to be realistic in our expectations on AI-based applications as some of them may take some time to materialize. Autonomous driving is an example of one of those long-term projects, but the good news is AI is already pushing ahead such projects. Virtual assistants, for example, is one such area, where a few start-ups like Clara Labs or x.ai offer email-based virtual assistants at a nominal cost that can schedule meetings. Expert systems are also low-hanging fruit; for example, in the legal field, AI can help lawyers save significant amounts of time by looking up an obscure court ruling written in everyday language from the 80s or 90s within a few seconds or by drafting contracts or even predicting outcomes in some cases. And AI is already being used with insurance and loan underwriting and reading MRI scans. In summary, we believe AI will not only reduce costs by automating processes but also maximize revenues by helping corporates introduce new product and service categories.

**4. What are the main drivers and hurdles for the AI industry?**

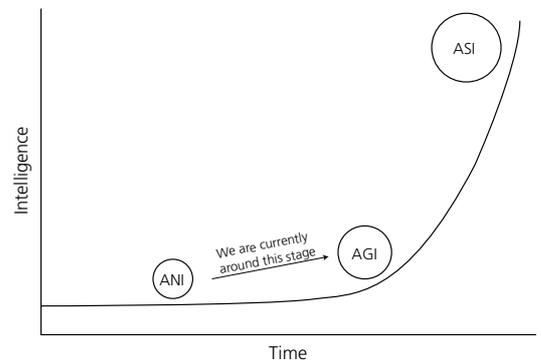
We are optimistic on the future growth prospects of the AI industry. The exponential growth in computing power and the solid cloud and smart device ecosystem in place, coupled with favorable supply factors like low computing and storage costs, advanced algorithms and the increased availability of AI-based talent, are supportive factors. On the demand side, we believe corporates and governments are realizing the benefits of AI, resulting in increased attention and spending on AI projects.

That being said, the AI industry is not without limitations; despite high expectations, the reality is AI is still in a nascent stage and needs time to fully commercialize some of its applications. The emotional aspect of AI is still a work in progress, which may raise some ethical issues. In addition to security risks, the impact on employment is a major challenge governments and corporates need to address before the AI industry can truly take off.

**5. Is AI a major threat to global employment?**

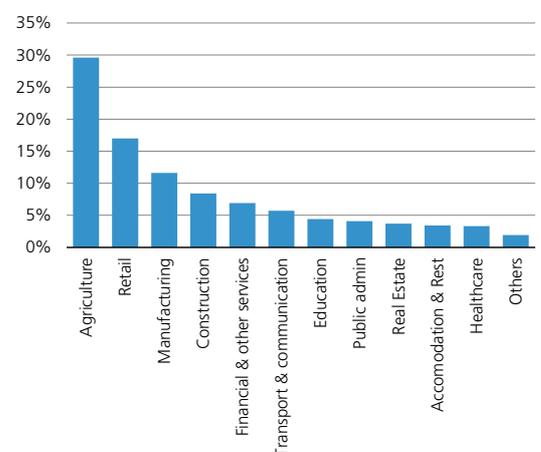
The rise of AI is not without its own controversies; AI's impact to global employment is a major concern. By automating tasks that rely on analyses, subtle judgments and problem solving, AI can be a threat to low-skill, predictable, and routine jobs in industries like retail and financial services and indirectly through the broader automation of the auto and certain manufacturing industries.

**Fig. 2: The evolution of artificial intelligence**



Source: UBS, as of 15 August 2016  
 Note: ANI: Artificial Narrow Intelligence; AGI: Artificial General Intelligence; ASI: Artificial Super Intelligence

**Fig. 3: Global employment by industry**



Note: Rest = Restaurants  
 Source: ILO, UBS, as of 15 August 2016

While it's difficult to project the exact impact at this stage, assuming 5% of the jobs in these industries are routine in nature, we expect 50-75m jobs globally will be potentially affected due to the advent of AI (representing only 2% of the total jobs worldwide). However, it will take a long time for AI to fully replace these jobs as AI technology needs to be further developed and due to the fact that corporates and governments are still warming up to AI.

Like any technological evolution, we believe overall employee productivity will significantly increase with the rise of AI, providing enough opportunities for employees to upgrade their skills and focus on other creative aspects. With the emergence of other disruptive business models like apps or sharing economies highly likely in a post-AI era, we see increased scope for jobs that require a high level of personalization, creativity or craftsmanship - tasks that will still need a person.

Overall, we think the fears of a global employment crisis are unfounded as AI will eventually drive innovation and provide employment opportunities in other areas.

**6. What are the growth opportunities for the AI industry?**

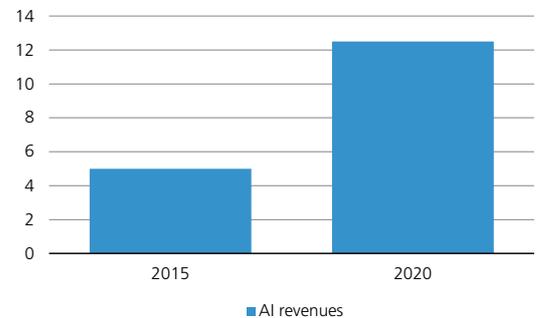
AI, in its initial stages, has been largely restricted to powering the machine intelligence of the industrial automation and robotics industry and has gradually expanded into drone and autonomous driving applications. AI has only started to emerge as a standalone industry; the combined industry revenues based on multiple sub-segments and public disclosures by industry participants was USD 5bn in 2015. While we continue to believe AI will drive the broader automation and robotics industry, the AI industry should also grow at a solid CAGR of 20%, reaching USD 12.5bn by 2020 and representing a mid-single-digit share of the overall Big Data analytics market. Our estimates may prove to be very conservative if AI adoption takes off sooner than expected, leapfrogging from specific department functions to organization-level projects. Growth rates should accelerate once use cases expand as AI fully transitions from the initial ANI to AGI stage, which will prompt a significant expansion in the addressable market.

**7. What are the investment opportunities of AI?**

Given the limited size of the AI market currently, direct beneficiaries in the public-listed space are mainly limited to select technology companies. These mainly include software companies with a first-mover advantage in AI and robotic process automation (RPA) industries. In the medium term, we expect the AI industry to consolidate given the outsized number of startups focused on AI. But as industry standards emerge, there will only be a few potential winners. Assuming enterprise value/sales multiples of 10-15x, which is on par with other emerging fast-growing industries within the tech sector, AI as a standalone industry should offer a total market cap of USD 120-180bn by 2020.

The other way of investing is to look at the indirect beneficiaries from AI's increased adoption. We believe R&D-intensive companies will benefit the most as AI significantly improves R&D efficiencies, which will result in margin expansion. These include healthcare, hi-tech engineering and select services companies. For example, with deep learning and predictive analytics tools, AI can significantly reduce the costs and time of drug development in the pharma industry by predicting the therapeutic use of new drugs, thus driving huge efficiency gains. And conversely, companies that fail to adopt in industries like retail, finance, auto and transportation will be at risk of falling behind.

**Fig. 4: We conservatively expect AI revenues to grow by 20% CAGR from 2015 to 2020 in USD bn**



Source: UBS estimates, as of 15 August 2016

## Conclusion

We think that over the next decade, the current industrial revolution will turn today's manufacturing into smart factories. In our view, the smart automation industry's total annual revenues currently stand at around USD 150bn and are expected to grow by mid-to-high single digits on average. Overall, we think that industrial software will be a growing differentiator for companies and investors. We expect the industrial software market to grow on average at around 10% with superior margins.

Software is at the center of this revolution, but there is also tremendous demand for automation hardware, such as robots, from emerging markets and several sectors, which should lead to sustainable growth. For example, the rising trend of multiple IT devices per individual (compared to one PC in the past) coupled with shorter product cycles (six months to one year) has led to a surge in increasingly complex device manufacturing. The rising trend of automation by IT manufacturers is evidence of the recent strong demand for industrial robots. Other supporting long-term drivers are demographic challenges in key countries like China and, in general, rising wages in emerging markets. Please refer to our earlier report, "Longer Term Investment: Automation and robotics," published on 27 January 2016 for our detailed views on automation across various segments.

Artificial Intelligence will further complement the overall automation trend as we see increased interest from corporates and governments to drive AI-based processes beyond industrial automation. Despite our above-average growth forecasts, we believe the addressable market should offer accelerating growth prospects beyond 2020 as the use cases expand.

## Risks

In the long term, for the broader automation and robotics trend, we see a global industrial recession as the main risk that would negatively impact automation investments. In the short term, a subdued oil price could hinder petrochemical investments in process automation, and peaking automotive investments could negatively impact factory automation spending. For artificial intelligence, risks include increased regulations due to ethical and employment-related concerns and slower-than-expected progress due to limited innovation.

### Box 2: Link to sustainable investing

We think that automation and robotics is part of the energy efficiency thematic, which is a sustainability-themed investment. Energy efficient products and services significantly help to mitigate climate change through the reduction of greenhouse gas emissions. Energy demand is rising, particularly in emerging markets. A growing population, continued urbanization and rising wealth levels contribute to this structural trend. The most important driver for energy efficiency is stricter regulation. As a result, energy efficiency is becoming a key business factor for a growing number of companies that also affects consumers. From an investment perspective, smart automation represents one of the fastest growing segments in the broader industrial and IT sectors.

## Appendix

<b>Terms and Abbreviations</b>			
Term / Abbreviation	Description / Definition	Term / Abbreviation	Description / Definition
A	actual i.e. 2010A	bn	Billion
CAGR	Compound annual growth rate	COM	Common shares
E	expected i.e. 2011E	Market cap	Number of all shares of a company (at the end of the quarter) times closing price
p.a.	Per annum (per year)	Shares o/s	Shares outstanding
UP	Underperform: The stock is expected to underperform the sector benchmark	CIO	UBS WM Chief Investment Office
x	multiple / multiplier		

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