ARTIFICIAL INTELLIGENCE & INNOVATION MANAGEMENT FOR BUSINESS LEADERS

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INNOVATI°N 360

You must not fight too often with one enemy,
or you will teach him all your art of war.

— *Napoleon Bonaparte*

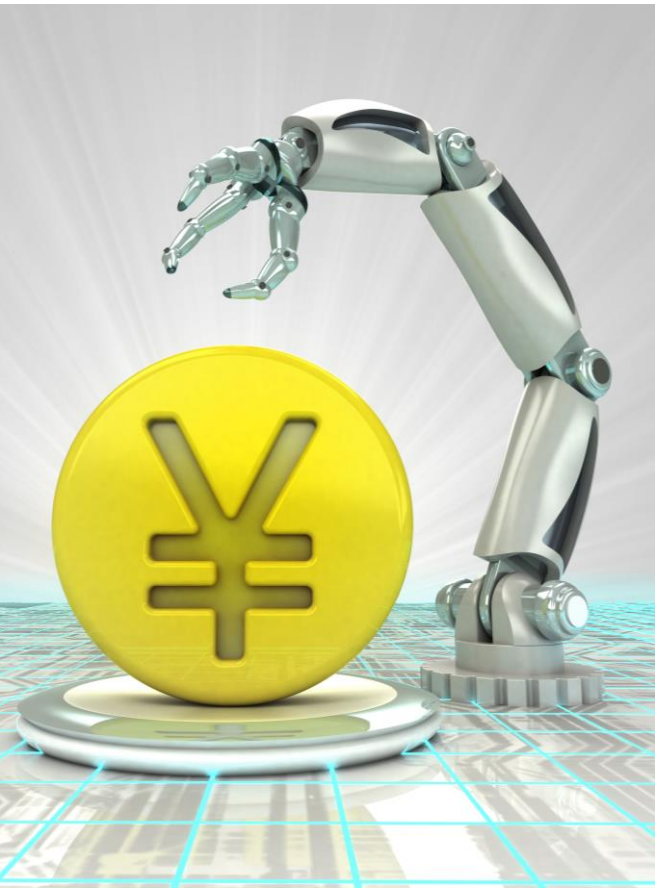
Not long ago one of my clients, a very skilled former top consultant, now a seasoned industry leader, asked for "*Artificial Intelligence for Dummies*". An interesting question for a very skilled and insightful person and somewhat reminding of the internet hype in the 90s when firms made fortunes via fund raising and spectacular non-working projects for the new economy. Is AI (Artificial Intelligence) akin to *The Emperor's New Clothes*, a tale from Hans Christian Andersen about two weavers who promise an emperor a new suit of clothes which they claim is invisible to those who are unfit for their positions – is it stupid or incompetent? Think about when the emperor parades before his subjects in his new clothes, and no one dares to say that they do not see clothes on him for fear that they will be seen as "unfit for their positions, stupid, or incompetent". But, finally, a child cries out, "But he isn't wearing anything at all!". The very valuable client made a point by asking if there is an *Artificial Intelligence for Dummies* book, because it was just like in the 90s when there was spectacular stories of technology, and a threatening sense of not understanding of it – and we might very well end up in the same way as we were then. The technology matures but many of the promises that were made have been broken. However, a few new enterprises, on a very large scale, have grown as a result of the investments and technology that emerged during the 90s – and this has been the case over and over again throughout history. Technology, investment, and brave leadership have all reshaped the future in times when promises and dreams were broken. At the same time, coincidences have often played a role in the history and outcomes.

One example how technology and coincidence most likely changed history is Enigma. The Enigma machine is a piece of spook hardware invented by a German and used by Britain's codebreakers to decipher German signals traffic during World War Two. It has been claimed that as a result of the information gained through this device, hostilities between Germany and the Allied forces were curtailed by two years. What would have happened if the British codebreakers had not cracked it? We do not know, but what we do know is that it was cracked by a number of skilled mathematicians, including Alan Turing, and that their breakthrough was reached by, for example, acquiring this stolen Enigma and the use of new technology called the 'Bombe' (BBC, 2017).

While technology, strategy, and knowledge can change things, sometimes in combination with coincidences, players can also learn from each other – advantage become equalized and balance is reached until the next tipping point is reached due to temporarily advantages. Or, as Napoleon Bonaparte put it, "You must not fight too often with one enemy, or you will teach him all your art of war".

Innovation is about gaining, sustaining, and using advantages for as long as possible while, at the same time, learning for the coming situations without exactly knowing if, when or how it will be used. Innovation is about preparation. Recall the three horizons first defined by Baghai, M., Coley, S., and White, D. (1999), these can be described as:

- The first horizon (H1) concerns itself with smaller, incremental innovations that build on existing business models, extending the existing S curve of the company. These can normally be accomplished with little structural change and lead time.
- The second horizon (H2) is more creative and proactive, expanding and building new businesses into new directions.
- The third horizon (H3) is sometimes characterized as "moon shots" or "skunk works." This is a much more explorative approach to future S curves, to be commercialized in H2, which ends up producing significant cash flows in H1.



Now to artificial intelligence: Ask yourself in which horizon is AI and how should you approach and, if possible, use it? To guide you when answering this question, we will walk through five steps to investigate, understand, and project possibilities of using artificial intelligence in business. These will be based on a combination of technology insights and practical experience. I will express the steps using straight-forward language, with pros and cons and, most importantly, it will be clean from dystopic scenarios. When reading the five steps, keep in mind that the increase of patent applications and investments in artificial intelligence in United States and China is tremendous – with 28,000 filed patents, 35,000 AI companies, and over $20bn USD in investments from only 2016, which is forecasted to boost global GDP by $16trn (The Economist, 2017). The most likely reason behind the growing interest in AI is the growing computing power and new computer architecture which can perform vector operations much better (important for AI) than traditional computer architectures. It is not a brave statement that we will see totally new computer architecture and algorithms taking AI even further than today and you will benefit from getting ready for the future.

1. What is Artificial Intelligence and Machine Learning - How Does it Work?

Over the decades, there has been a number of solutions for artificial intelligence; from rule-based systems providing advances; to conclusions being drawn from a set of predefined rules; to self-learning systems (so-called machine learning). With today's computer power and new computer architectures handling vector calculations more efficiently than ever before, self-learning systems have become of great interest. At the moment, the most well-recognized method for learning is Artificial Neuron Network (ANN), which is based on the basic principles of how a brain works.

The Brain

The core component of the nervous system in general, and the brain in particular, is the neuron (or nerve cell). A neuron is an electrically excitable cell that processes and transmits information by electro-chemical signaling. The average human brain has about 100 billion neurons and each neuron can be connected to up to 10,000 other neurons, passing signals to each other via as many as 1,000 trillion synaptic connections (see figure 1 for an illustration). An ANN is build up by neurons and the weighted connections between them (the equivalent to synapses), and react to inputs by giving an output.

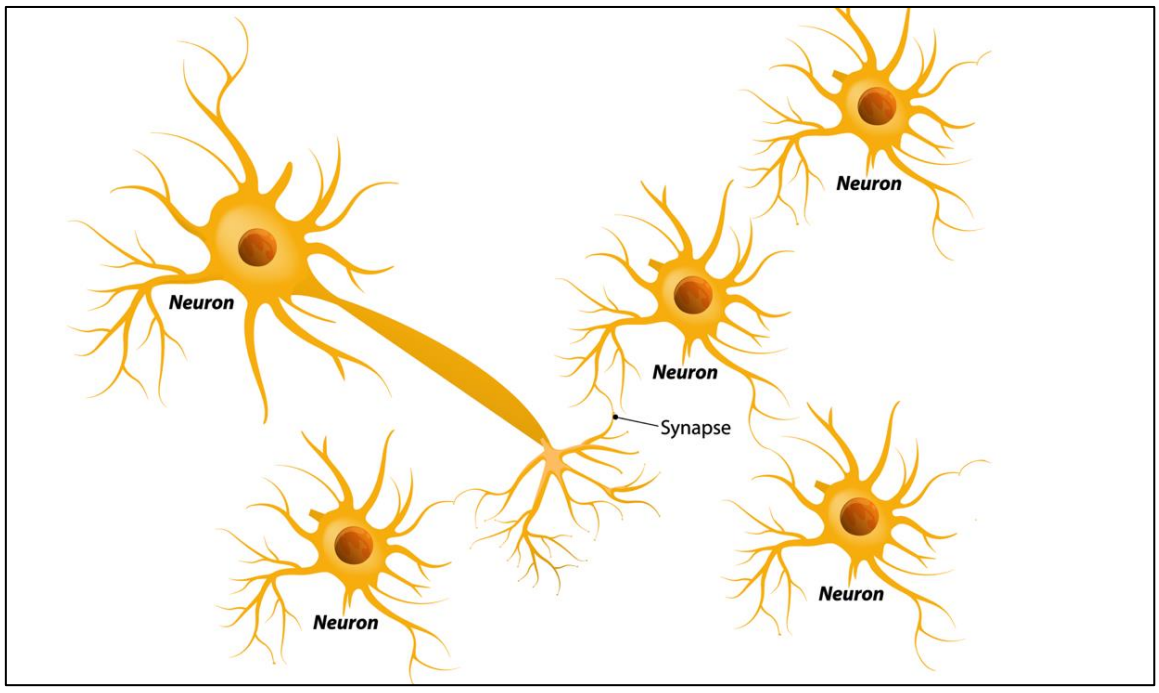


Figure 1. *A sketch on neurons and how they are connected by synapses in the brain.*

The Black box

Basically, as shown in figure 2, an ANN is a "black box" with a set of inputs (a vector or an array of inputs) and a set of outputs (a vector, or an array of outputs). The set of inputs consists of a number of values, normally between 0 and 1 (e.g. 0.3; 0,4; 0.7; 0.1) and a number of outputs, normally between 0 and 1. The ANN is not intelligent from the beginning, it needs to lean data (so-called propagation) to act in what is perceived as an intelligent way of making, for example, decisions and forecasts. You can say that, in the simplest form, an ANN is a function of an input-vector delivering an output vector.

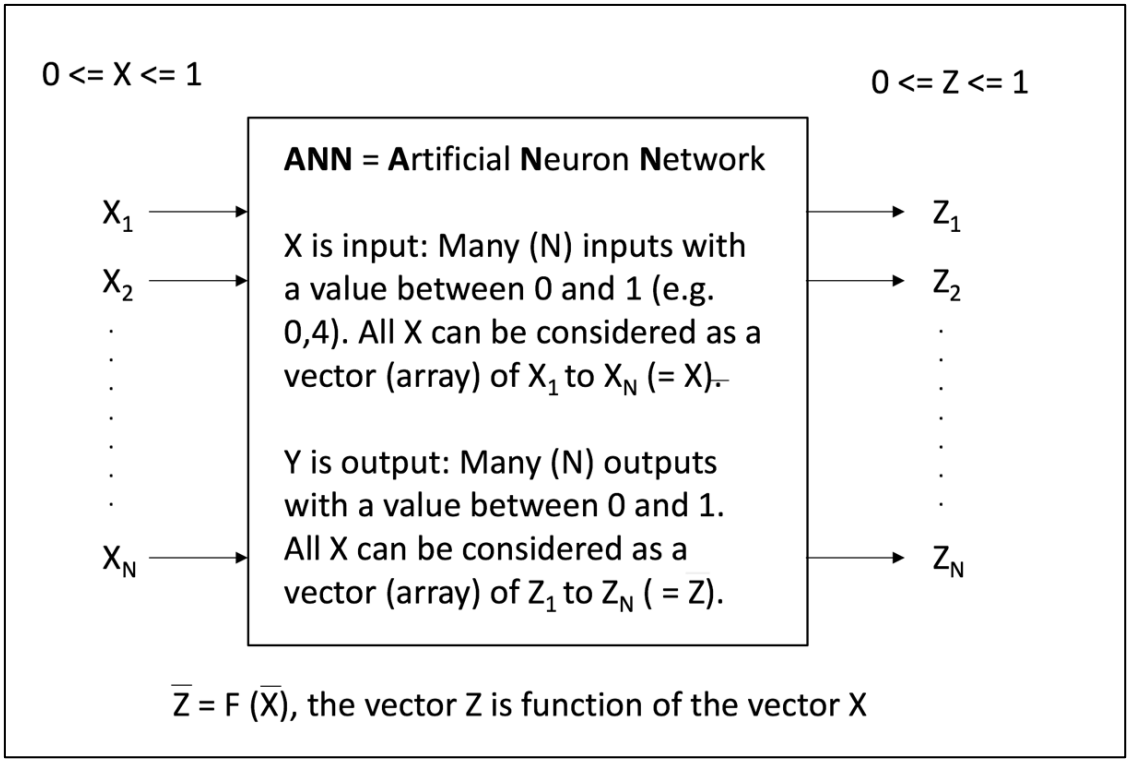


Figure 2. *Showing the basic principles of an Artificial Neuron Network.*

In ANNs, you have a number of input neurons and an output of neurons – it does not have to be the same number. An example of an application is frequently sending out marketing campaigns to drive online sales. By sending these out, you will gather past data on conversion rates (actual sales in relation to the size of the audience) and the time when the campaign was sent. If you have a lot of data on conversion rates and dates (day, time), you can actually use an ANN to predict the best time (day of the week and time of the day) to send a campaign to get the best conversion rate. The input is then time (week day plus time of day) and the conversion rate. The output is the time at which to send the campaign for the maximum conversion rate. To make this possible, you need to convert the input variable to a number (X), with a value between 0 and 1, so that you get a number for the output variable (Z), with the value between 0 and 1, that can translate to days and time of the day.

Now, it might not be especially easy or even possible to predict the conversing rate based only on the time that a campaign is sent. However, you can add more inputs, such as:

- Length of the campaign (word count);
- Click-rate;
- Weather conditions;
- Length of the headlines;
- Colors used;
- The price range;
- The price in relation to competitors (via price comparisons sites);
- If you have the products in stock;
- Delivering terms and conditions;
- Special deals and discounts, and so on.

Defining the input format, defining output format, and mining past data (input and output) is the key to machine learning. Beside the input, output, and the learned data, the ANN also needs to be designed to optimally solve the task.

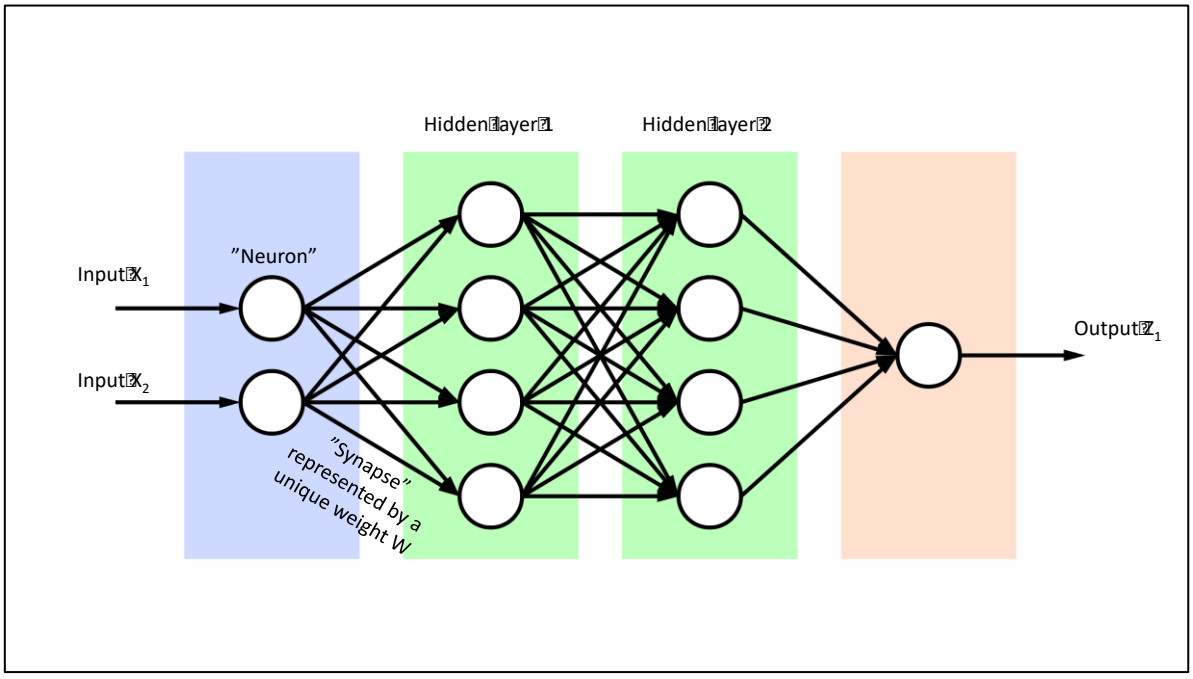


Figure 3. *Many layers of neurons, forming a deep learning system.*

Design: Hidden Layers

As figure 3 shows, there are several layers of neurons, connected via ”synapses”, between the input layer of neurons and the output layer of neurons. When looking at many layers, you call it deep learning and this allows the possibility to solve more complicated tasks. There is no rule for the number of layers or the number of neurons in each layer, it is a design question and it has to be tried out via many tests on past data. In figure 4, you can see how the neurons are connected, every neuron is connected to all other neurons in the layer before and every connection has a weight (0 is used for a “non-connection”). The job of the neuron is to summarize all inputs by firstly weighting every input and then summarizing it. The sum of all weighted inputs is then transformed into a number between 0 and 1 (sometimes -1 to 1) that is sent forward to the next layer, and to the next layer, until it is in the last output layer where the output is normally between 0 and 1. The function used for transforming an input to an output in each neuron is called activation function.

Design: The Activation Function

Until recently, Sigmoid or hyperbolic tangents were used exclusively but ReLU is now also a common activation function (it stands for Rectified Linear Unit) in the hidden layers. According to the scientists C. Zhang & P. C. Woodland (2015), it also possible to parametrize the activation functions and, thereby, gain a better result for various applications, such as speech recognition. Both have their pros and cons (which will be not discussed here). One reasonable conclusion to draw is that the activation function will be developed further, for different applications and hardware architectures, and hardware will be -made to carry out the calculations (as these are time-consuming calculations when learning the ANN).

Design: Backward propagation of errors and The gradient descent

Backpropagation, or backward propagation of errors, is when the result in the output layer (Z with a ^, see figure 4) is compared with the expected result from the learning data (Z) and the difference is used to adjust the weights in the neural network. The Gradient Descent is the algorithm used for adjusting the weights and there are several approaches to do this. As with the activation function, the selection of the algorithm depends on the application. Sometimes, stochastic methods are used to try different weights. As with the case of activation functions, backward propagation of errors and the Gradient Descent are subject to development and also depend on the application for the ANN.

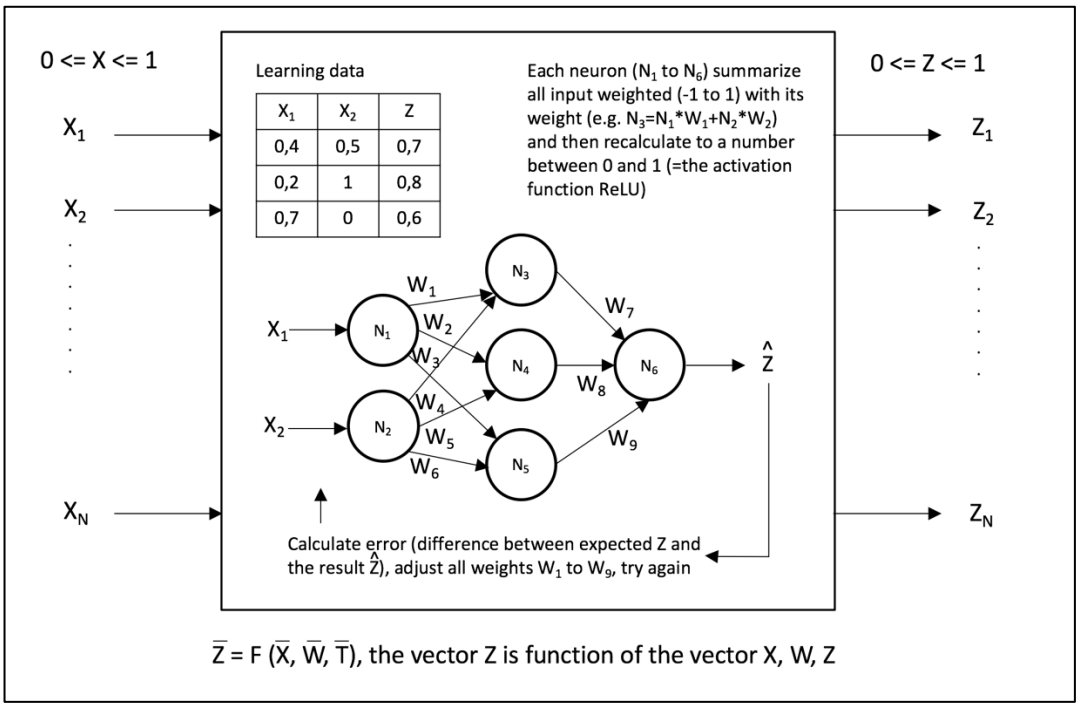


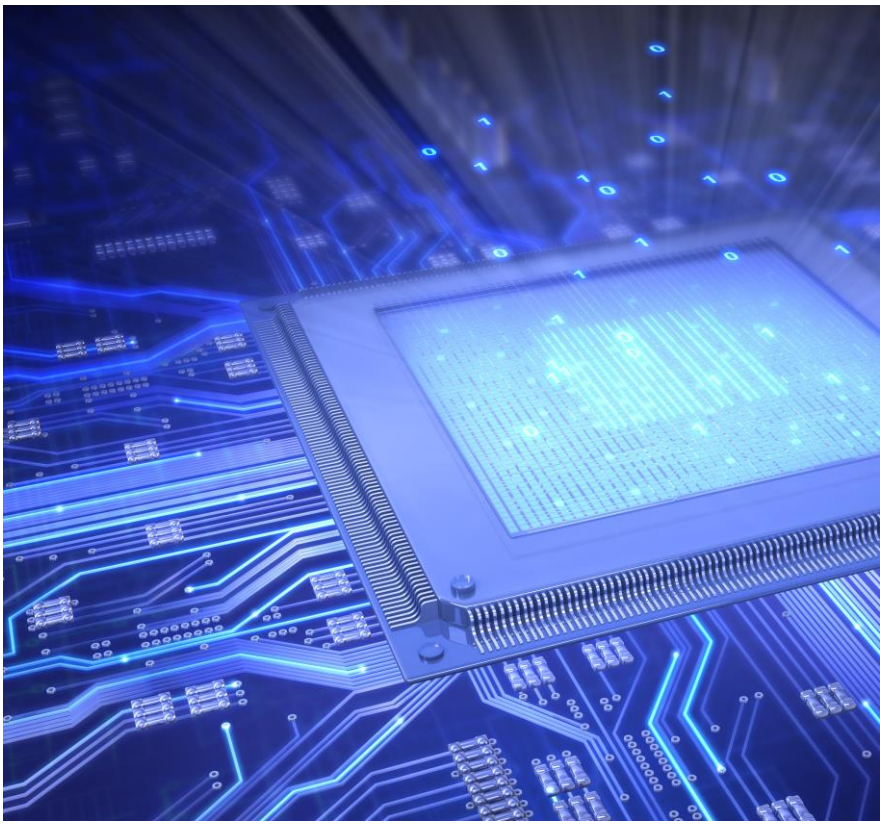
Figure 4. *An ANN with several layers, weights, and learning data. Backpropagation adjusts the weights based on error calculations.*

Design: Recurrent Neural Network

One issue with ANN is that it, in its basic construction, does not work optimally for consecutive sequences, such as text, speech, video, and audio. Therefore, Recurrent Neural Network (RNN) was developed using both predictions (the result) and earlier data as inputs. Typically, you develop several ANNs with functions for Forget, Select, and Ignore based on earlier data. This is very useful for anything embedded in time, such as text, speech, video, and audio recognition, as well as production and social interaction. It is most likely that we will see lots of ANN organized in larger nets to solve more complex tasks.

2. What can Artificial Intelligence and what Deep learning can do for you

When an ANN is trained with the execution, the actual use of the net is very efficient and does not require a lot of hardware. ANN can be deployed on hardware, such as watches, sensors, and other small circuits, with a CPU and Internet connection. This allows disruptions in many industries and business models, such as heating or cooling systems for homes and industries, smart homes, and logistics and transportation of goods. Just imagine that you might be able to reduce the amount of electricity needed to run your heating pump at home or the cooling system for a computer farm by 40-70% just by adding AI. The same goes for many other applications.



By using standardized and cheap hardware that can run ANN, and using Internet connections for the hardware's intensive deep learning, the price can be reduced to almost nothing and, at the same time, you get more learning data from several local installations. This makes it possible to compile better learnings to provide back to local, simple pieces of hardware though Internet connections. The trend of the Internet-Of-Things (IoT) and Industrial-Internet-Of-Things (IIoT), combined with centralized data collection, deep learning, and localized software propagation, is most likely something that will lead to the disruption of many business models with new revenue streams via subscriptions, significantly more efficient operations and maintenance, smarter functions, higher security, and more possibilities to be a part of large networks, which optimizes resources in new ways by sharing economy models. At the same time, new concerns about integrity and cyber security are raised and all forces have counter forces. It is most likely that we will see closed systems, or trusted communities, to a higher extent than before.

More Applications

Other areas that ANN has proven to be useful is when conducting, for example, cancer diagnoses and telemedicine, translating texts written in natural languages, recognizing objects in enormous masses of visual data and other advanced search tasks, providing automated advice in online help desks, pricing, trading, and, recently, self-driving cars that seem promising for the future. Common

for all applications, you need to be able to define important inputs that will have impact (reasonably closed loop systems) and you must have access to a lot of past data of inputs and outputs (expected outputs). This need for inputs and expected outputs for leaning in an ANN network has come of great interest, such as in the example of home heating or cooling systems where millions of users can cooperate via the Internet to gain data and make the efficacy superior compared with alternative approaches. Another emerging trend is reinforcement learning with rewards, inspired by behaviorist psychology, concerned with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward. Reinforcement learning is made without any correct input/output pairs and is used for instance in the experiments with self-driving cars.

Data collected though Internet as well as reinforcement learning could be viewed as machine innovation, most likely in the first horizon. Now, someone might ask why not in the second and third horizon? There are at least two issues that make machine innovation in horizon two and three pretty hard:

- The need for diversified input data, which is hard to gain;
- Complex learning needs stochastic models that are based on the random and random is, at the moment, not possible to simulate for computers (we are close to achieving it but even an enormous amount of random data would be needed in complex deep learning might not be enough).

Let's come back to above discussion later and bring with us that diversified and large amounts of data, as well as random numbers, are important key to drive deep learning towards self-innovation and are not just improvements in the first horizon.

Intersection Thinking

ANN combined with IoT, IIoT, Robotics, Nanotechnology, BioTech, and MedTech seems promising and, following earlier patterns, innovations are often created in the intersection between disciplines – many times by outsiders not expecting it to occur, such as when they are trying to improve something rather make something new and unconventional (for example, the discovery of penicillin). According to the Society for Interdisciplinary Studies (2017), the photo copier was invented by a lawyer, the color film by a concert violinist, and the oil refinery by a racing driver, and it is not a brave guess that new ground breaking inventions will be made by outsiders and in the intersection between all new disciplines.

Level of applications

According to A. Rao (2017), artificial intelligence business applications can be divided into three categories:

- Assisted intelligence, now widely available, improves what people and organizations are already doing;
- Augmented intelligence, emerging today, enables organizations and people to do things they couldn't otherwise do;
- Autonomous intelligence, being developed for the future, creates and deploys machines that act on their own.

The categorization is useful because it helps us to scope who will use the technology in relation to humans and businesses. Typically, assistant intelligence is used for decision making, removing unnecessary administration, and making tasks faster, which creates space and opportunity for social engagement, experience, and human judgement. Augmented intelligence is an extension and, indeed, very interesting as it is already in use by many of our clients with good results. Typically, it used for remote pro-active maintenance of factories, production cells, and other complex systems, such as lift systems, which reduces the maintenance cost substantially. Another typical area for augmentation is for the service industry where consultants, lavers, doctors, auditors, and other knowledge workers can give faster, more accurate, and more precise advice when using AI to extend their ability. The autonomous intelligence is already here with simpler applications, such as robotic lawn mowers and we can expect to see many applications in the coming years for autonomous intelligence.

Innovation and AI

Some of the real breakthroughs for AI was when AI could win world championships in Chess and GO. Typical applications when deep learning is applicable is when there is a clear input, clear output, and a lot of accessible data with variations. When we know what we want (defined output), AI works very well and drives innovation in the first horizon. This also leads to new business models in the second horizon with totally new applications (as in the example of reducing costs and introducing subscription models based on data from a community). But, can AI be used to drive innovation without human interference? The problem with AI is that it needs to be fed with defined inputs and expected outputs, as well as a lot of diversified data. There are attempts going on to use AI to train AI, other attempts at done using the Internet "scrape" data in enormous amounts, classify it and then use it. However, it seems that we keep ending the conformity due to the lack of the possibility to work with unexpected inputs, outputs, and data. In the last chapter, we will discuss this a bit deeper and, for now, we claim that AI needs humans to innovate. And, based on our experience from client assignments, humans need AI to innovate in a certain required speed.

As an example of how AI can help human innovation in the second horizon, eventually the third, let's take my own firm, Innovation360™, and the innovation analytic tool, InnoSurvey™, as an example. Many years back, I decided to investigate the linkages between growth and innovation and ended up with a rather large literature study reviewing the most important innovation management literature over the past 100 years. The work resulted in the Innovation360 Framework and I started to collect data based on the structure of the framework. After a while, we, at Innovation360 Group, developed an expert-based analyzer that could generate a 40-page analysis based on data from one company. The collection was made by sending out 92 questions. Based on the framework, we asked managers, employees, and externals about their perception of using digital surveys sent out by e-mail to make it possible to collect large amounts of data for each investigated company, for any and all kinds of organizations. At a one point, we decided to launch a free version, based on just one respondent's answer, and, from this, we gathered data from many thousands of companies in all continents and in 62 countries. At the beginning, we were afraid of bad quality data from unknown sources (the free version) but after carefully investigating it, using p-value calculus to test data from known sources (from consultancy assignment), we could draw that the quality of unknown sources was good enough. After a while, we released what we developed – an Innovation Analytic tool, not just enhancing our ability to make faster and more accurate analysis but also saving a lot of our and our clients' time. The tool was named InnoSurvey™ and we started to accredit top consultants all over the world. After just one year, we had 100 licensed practitioners using our solutions in 20 countries all over the globe and, today, it used all over the world. It could have stopped here but it did not because we saw new patterns in leadership, strategy, culture, capabilities, and competences to successfully run innovation portfolios over time. We realized that deep learning might give us new insights that the science in the past has not been able to do. After the insights, we started to develop our own gated RNN with supervised learning, controlled by accredited hand-picked consultants internally and externally. This project is now scaling up and the future will tell the result. The hypothesis is that by using the best brains to interpret deep learning results from a large amount of innovation management data, we can innovate how we consult clients not just by automation but also through a totally new kind of analysis, by business pattern recognition and advice synthesized by thousands of brains skilled in the art of innovation management. This case, illustrated by the birth of InnoSurvey™, and the journey it has taken shows the potential of combining AI and human power to enable new ways of thinking and working. The next step of this project can very well disrupt the consultancy industry, forming it into orchestrated networks of organizations helping each other out, supported by experienced and highly skilled facilitators instead of classic consultants running projects per hour and charging several clients for the same advice.

3. How Artificial Intelligence Can be Used to Reinvent Your Business Model

The business model is normally considered to consist of an internal part and an external part, where the internal part is the cost structure and the external part is revenue. For an example of how a business model can be reinvented, heating and cooling systems can be equipped with AI technology in a way that substantially reduces the cost to run these systems and allows the possibility to sell subscriptions, where you pay a subscription fee with your own data and without the subscription customers will not get the maximum effect of the system. The heating and cooling example is innovation for both cost and revenue. The same concept goes for the example of InnoSurvey™, with less time of the users' time being used up and new insights are gained that can change how consultants operate and potentially change their assignments. One way to look upon business model innovation is through the lens of what is called the "eight shadows of innovation", where internal and external innovation possibilities are broken up into eight interlinked parts.

Eight Shadows of Innovation

The Wheel of Innovation, as an illustration, is inspired by the work of Mohanbir Sawhney, Robert C. Wolcott, and Inigo Arroniz (2006). It is based on the analysis from more than 1,000 companies in 62 countries, as well as many years of extensive consulting assignments by the author (Penker 2011, 2016). The Wheel of Innovation was designed to measure the capabilities of an organization. The 66 capabilities that are defined in the Innovation360 Framework (mentioned earlier) are mapped onto 16 aspects (legends) in the Wheel of Innovation. Each of these aspects is discussed in detail in the first and second volume of the book series *The Complete Guide to Business Innovation 2017*.

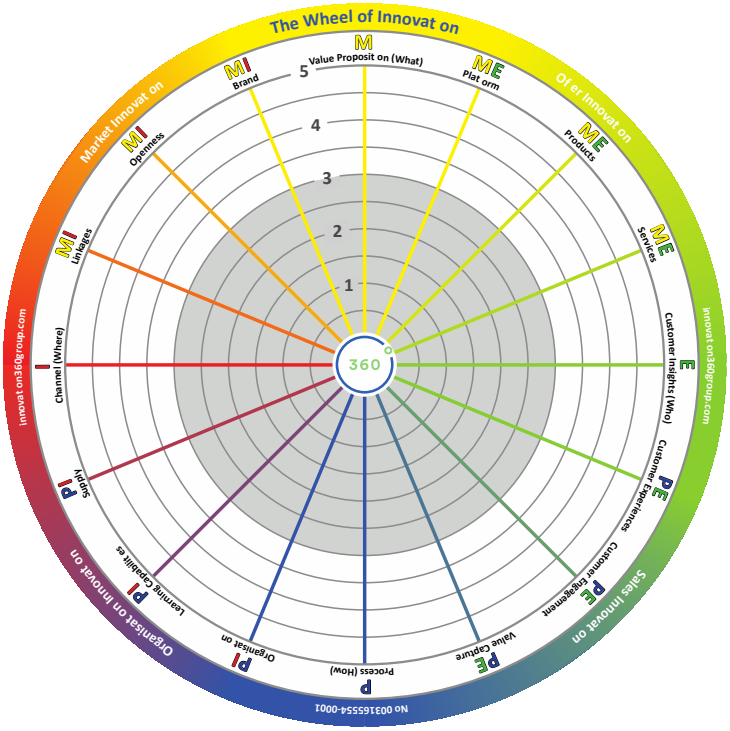


Figure 5. *The Wheel of Innovation.*

The Wheel of Innovation can be used to plot an organization's profile and compare it to other organizations or industries. In the Wheel of Innovation, each aspect is rated on a scale of 1 to 5:

5 = Changing the Industry (white area)

4 = Strong (white area)

3 = Neutral (between white and gray area)

2 = Weak (gray area)

1 = None (gray area)

The Wheel of Innovation is composed of four dimensions (see top row of figure 6):

- Driving External Transformation (E): These capabilities are linked to external transformation, which relates to the offer and to sales;
- Driving Internal Transformation (I): These capabilities are linked to internal transformation, which relates to the organization and marketing. Marketing refers to building capabilities for growing the market and not market activities, which fall under sales;
- Driving Market (M): These capabilities drive market expansion, which are supported by data from InnoSurvey™;
- Driving Profit (P): These capabilities drive profit, which are supported by data from InnoSurvey™.

Figure 6. *Eight shadows of innovation.*

Each one of the eight possibilities in figure 6 can be the hunting ground to re-innovate your business model and a lens to look through while doing that. So, let's walk through each of the eight perspectives and look at some examples of how AI can drive and have driven business model innovation.

Market Innovation by AI (a general lens): One tangible and common example of open innovation is when AI can be used to facilitate and orchestrate innovation ecosystems with customers, partners, suppliers, and the market in general. Amazon is one of the companies doing this, they use AI to co-create with their audience – everything from cloud computing services to publishing books. Another example is Airbnb and Uber, where the model is to connect people with resources – people want to use this resource and it orchestrates a whole process with AI models for the best experience.

Profit Innovation by AI (a general lens): E-commerce providers and retailers are one group that often use AI for price optimizing, producing stock level forecasts, and purchasing products (especially when there is size, color, model, and session variations). This is directly linked to profit through gross margins and by higher inventory turnover rates in the warehouses.

Internal Transformation by AI (a general lens): Learning organizations constantly challenging themselves by using AI to gain new insights and knowledge. One example is consultancy firms and research centers using big data and AI to gain new insights that can be used to reach out to the market, enabling them to keep and grow the market. Another typical area for internal transformation is to actually outsource parts of the value chain, building and orchestrating the upstream part of the ecosystem. By using AI, they can optimize manufacturing in large ecosystems.

External Transformation by AI (a general lens): This typically engages customers by using and developing offers in a way that creates a superior experience through the whole life cycle, as well as the product and service development. In the gaming industry "moding" (users/customers modifying games) is a way of engaging hardcore customers in product development. However, in the past, moding has been a very hard skill to hone within customers as it is difficult to code without any guidance. Today, the gaming industry has developed tools for moding and a lot of experiments using deep learning and AI are undertaken. This simplifies the process for the moders but also allows mods to modify exiting games and develop new games using AI and deep learning.

Offer Innovation (a specific external lens for market growth): Typically, AI is used here to gain data from user usage to offer complementary or new services and products based on earlier behavior. This especially drives growth. Examples of companies using AI here is Spotify and Apple Music. Another example is how Netflix uses data on how we watch movies to actually adopt manuscripts and movie effects, using AI to gain more market growth.

Sales Innovation (a specific external lens for profit): Typically used to interact with a large number of customers. AI has revolutionized customer services in many organizations that, today, use "bots" (automate online customer clerks) for customer care. Bots for customer care and customer service have been proven to be very reliable, efficient, fast, and accessible 24/7.

Organizational Innovation (a specific internal lens for profit): Here, augmentation of a human's capacity to provide services is a good example of AI application. Typically used in the consulting, construction, reparation, and translating industry.

Marketing Innovation (a specific internal lens for market growth): Here, we typically innovate how channels and brands are used, which is an internal process of what message and positon we want to be in the market. AI has been around for some time in this area with widely used solutions, such as Google Analytics (for understanding digital footprints), Google Trends (for market insights), and a number of specific solutions for analyzing brand awareness and a brand's position.

4. Limitations and Business Risk of using Artificial Intelligence and Machine Learning in Business Development

As me mentioned, in-data needs to be formatted between 0 and 1, which is not ideal for data that describes, for instance, country codes, product IDs, and other data that is not just a number. However, it is easily adjusted by adding more input nods, which requires more computing power when learning the ANN.

Another potential weakness is how to treat the out-data when you are not working with probability, as the output is in the range 0 and 1. This can be handled by working with a threshold value (such as 0.5), letting each neuron have a bias – a constant term that is added to the sum before it goes through the activation function. This also requires more learning, which in turn requires more computer power.

Moreover, many applications require causality (time dependency), such as human interaction, manufacturing, maintenance, and natural languages. An ANN vanilla solution will not do and you need to implement several neural networks (as earlier mentioned, a RNN), which in turn calls for more computer power.

There are no rules for the number of neurons in the hidden layers that must tested and, most likely, this is dependent on the application. Again, adding more of them may increase the capabilities of the model but requires more compute power.

It is obvious that computer power is the key to ANN's success. This is something that, together with new architectures and new algorithms, is on its way to being solved – after this, it is no longer an obstacle.

From a business perspective, in-data is more of a relevant issue. It is not enough to just have a lot of data, popularly called big data, rather it must be the right data. If we do not have diversified data, ANN will conform and end up giving conformed outputs, which will not work very well. This is a real issue and the data quality must be assessed and complimented with real data, and not just with approximations. Here, stochastic methods and random numbers might play a role, but it is premature at this stage.

Moreover, machine learning in the business world is also highly dependent on what parameters

are used as input data and sometimes it is not possible to judge this as you simply do not know. Let's say, for instance, that you want support with writing a shareholder purchase agreement (SPA). The process of the merge or acquisition will impact the wording and paragraphs, based on psychology and not only fact or prejudice. Writing a SPA is a pretty simple and straight-forward process in learning from best practice and prejudice, however the psychology is trickier. Maybe, in the future, it will be possible to make this type of judgement but, for now, it does not really seem to be there. However, there are methods for supervised learning where you can, step-by-step, complement new inputs – these are provided by experts.

If you have enough experts, it might very well work (this is also how Google Translate and Innosurvey™ are built, together with experts in innovation management around the world). Human supervision is one possible way to extend the learning process.

Another issue, which is actually a risk, with AI and business application is de-learning and sabotage. It is possible to feed AI data that will intentionally sabotage the learning and eventually change the behavior, this can become a huge risk. ANN and more critical applications need to have an "emergency button" and must be supervised, not just because of dystopic scenarios with self-learning war machines in the future but simply because you can sabotage the learning and the whole ANN is a black box that cannot be proven or fully validated.

5. When Will "The Terminator" be a Reality?

There are a lot of dystopic prophecies out there. Without trying to support or reject them, some background thinking will be provided in this chapter to allow you to make your own judgement.

The computer power, architecture, and algorithms are the most likely candidates to make any kind of judgement that is needed to for any kind of rational task. But, there are several issues that are not solved yet and that has, as stated earlier, to do with not always knowing what input data is needed and, even when we do, that input data might not be accessible. Now, it has been said that social media and the Internet provide us with all we need to know about humanity and behavior and it is just a matter of computer power. However, I am rather certain that not all information is accessible via the Internet – let me mention classified information or business secrets. Even if they are leaked from time to time, new information and knowledge is always being created. Now, you could argue that AI can create such new information and now we come to the core problem for AI to truly challenge humanity. How come that creativity and innovation, regardless if it is to do with trade secrets, design, art, national secrets, or disruptive technology, is hard for AI to simulate? Or, is it? Let's say that it is not hard and it has most likely already been on the market. Perhaps it is not commercially functional but is in laboratories, but it is not publicly known in the market at this moment. If, or when, it happens then the question is about how we will we react. A guess is that some humans will find a new way to satisfy our needs and eventually AI will be able to simulate that as well. One thing that seems to differ us, as humans, from ANN is random numbers. Random numbers cannot be generated by any known machine in the world's history, and many have tried. There are chip sets on the market with enormous amounts of so-called randomized numbers but, even if they are random, with the random numbers needed by all AI to simulate human creativity, it might still not be enough and, most importunely, it will most likely led to all AI using the same algorithms and trying to build new algorithms in the same way. However, it is likely to conform or heavily diverge, with the result that humans will still win when it comes to creativity.

Beside creativity, it seems, according to N. Persaud (2005) at Department of Neurology at University of Cambridge, that humans use their random-generating neural machinery to make difficult decisions. On the other hand, according to N. Persaud (2005), it is also possible that certain people, perhaps those with neurological or psychiatric impairments, are less able or unable to generate random numbers. So, it seems like an ANN cannot replay all humans, but potentially some.

Moreover, N. Persaud (2005), says that, if the random-generating neural machinery is employed in decision making, its impairment would have profound implications in matters of agency and free will. My conclusion is that they key to building a “terminator” is true random numbers and, personally, I do not believe that will happen. However, I do believe that AI can serve humanity and that we need to put up regulations and rules on how to apply it for the best use for humanity and avoid catastrophic scenarios due to sabotages or bad input data due to a lack of human supervision.

About the author Magnus Penker

Magnus Penker is an internationally renowned thought leader and author on innovation, digitization, and business transformation. He has spoken at prestigious global forums and events, including the Global Peter Drucker Forum, top-ranked international business schools, a variety of associations, and some of the world's largest companies.

He has been honored with two *Business Worldwide Magazine* awards for his achievements, the "Most Innovative CEO Sweden 2016" and "Growth Strategy CEO of the Year Sweden 2016" awards. Additionally, he has launched 10 startups and has acquired, turned around, and sold more than thirty European SMEs.

Through his best-selling American books on digitization and IT engineering, and his more than twenty years of experience as a management consultant and business leader, Mr. Penker inspires leaders to stay on top by finding a new way of thinking and organizing.

For the past eight years, he has used his practical and theoretical insights to develop InnoSurvey™, a leading methodology and global innovation database that is used for business analysis and to support companies, business leaders, and scientists around the world. Today, Mr. Penker is the CEO and founder of the Innovation360™ Group, headquartered in Stockholm, Sweden, and New York in the United States.

Mr. Penker is driven by the recognition that, in these turbulent times, we must understand our core strengths and determine how we can use those capabilities and competencies to create advantages in a globalized market with endless possibilities. The global map is being redrawn at speeds never before seen, and historically low interest rates are attracting capital to global digital-risk projects that will further strengthen this movement.

Mr. Penker has a BSc in Computer Science (CTH, Sweden) and an MBA from the Henley Business School, England.

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About Innovation 360 Group

Under the expert guidance of Magnus Penker, Innovation360 Group together with licensed practitioners, helps organisations to sharpen their innovation capability, generate and re-innovate their value propositions as well as speeding up their global go-to market projects through innovative strategy, business and organizational development. They do this by means of research based innovation assessments and measurements, based on their global innovation database and research in the innovation area, evidence based analysis and recommendations on concrete execution plans for increased innovation capability, profit and growth.

The Innovation360 Group primarily works with organizations that espouse high ambitions and strong international focus on innovation, positive change, profit & growth. Innovation360 Groups' Licensed Practitioners are established in the US, Europe, Asia and Africa with a strong presence in over 20 markets across all continents.

Mission

Our mission is to help organisations all over the world to assess and strengthen their innovation capabilities for sustainable growth and profit.

Motivation

We are convinced that by supporting and strengthening the global innovation capability needed for sustainability we will also contribute to addressing many of humanity's grand challenges, e.g: Food, Energy, Water, Security, Global Health, Education, Environment, Poverty and Space.

Aim

Our aim is therefore to help 1,000,000+ entrepreneurs, companies, executives and scientists all over the world to become world class innovators by providing our unique innovation measurement tool and database, InnoSurvey™, as a free-to-all digital on-line service complimented with an enterprise tool and consultancy services by our consultants as well as through licensed practitioners all over the globe.

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