Petteri Virtanen

Applying artificial intelligence platforms to the Financial sector

Opportunities and Threats

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Abstract

Author(s)	Petteri Virtanen
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This thesis gives insights for SME wealth management companies who consider to adopt Artificial Intelligence platforms it discusses, theories behind those, and in which way could wealth management companies benefit by applying the latest technologies. The thesis also discusses some of the regulatory standards and risk management tactics for AI applications. FinTech applications are increasing trend as profits are harder gain. Currently, companies are looking new alternatives to save costs and relieve the workload of their employees. Artificial intelligence may provide new solutions to these problems.

Wealth management business has traditionally been a more exclusive field where only the wealthier individuals have gained access to different market information and theories behind it. After the 1970s however, this aspect has slowly changed, and different wealth management options have come to exist for nearly all customer segments. As investment banks are going for traditional banking as well, the demand from historically not so interesting customers is getting better wealth management services. The rise of FinTech especially in the millennial customer segment has created unique opportunities to create self-wealth management platforms, and some millennials are even getting rid of traditional wealth managers.

Are there some aspects that traditional wealth management houses could do to retain customers to switch new AI and Robot powered applications? One way is to implement these applications for the business itself to ease the fees for customers while cutting the costs down and increase efficiency at the same time.

There is a huge amount of different applications and regulation from which to choose. These applications and platforms also differ from each other. Nevertheless as technology proceeds it is a necessity for businesses, especially SMEs, to adopt at least to some extent these applications.

One major question is also, to what extent can a wealth manager trust AI? And whether wealth managers become extinct in the future?

Keywords	Artificial Intelligence, Finance, SME, Wealth management

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List of abbreviations

AI	Artificial Intelligence
AML	Anti-money Laundering
AUM	Assets Under Management
B2B	Business to Business
B2C	Business to Consumer (Business)
DMA	Direct Market Access
EMH	Efficient Market Hypothesis
ETF	Exchange Traded Fund
GDPR	General Data Protection Act
NAV	Net Asset Value
SME	Small and medium-sized enterprises
TER	Total Expense Ratio
RSBAM	Risk-sensitive benchmarked asset management

1   Introduction

As new technologies start to emerge in every possible field of business, financial institutions are on the cutting edge for adopting these. Pressure since 2008's financial crisis has had an everlasting impact on financial institutions, especially those operating as intermediaries since it is harder to gain profit in the age of digitalised markets. As digitalisation has spread to every area of life, even the old business processes must be changed to gain investors' interest.

Since millennials are more familiar and trusting towards digital applications, there is also a customer demand to fill, and as millennials become homeowners and investors, they are more likely to adapt quickly to use wealth management options with companies that can provide them. This is putting pressure on traditional wealth management businesses which must know what technologies to adopt and what practices to remove from their product lines.

Since human capabilities are limited, these new algorithms are powered by artificial engines to get every drop of profits in the market. For this research, the writer is constructing a guide for wealth management companies who are thinking to switch from traditional platforms to new AI-powered ones or are interested in doing so.

The writer will also discuss underlying theories and limitations to these artificial intelligence platforms to gain insight regarding how they work in different market conditions. The writer will conclude by taking a more in-depth look at the organisational and operative benefits and risks associated with these new technologies.

1.1   Research background

The thesis is written to serve as a strategic guide for small and medium-sized companies, and the geographical scope is limited to Nordic countries, whose regulation standards are discussed in contrast to European standards.

The topic of Artificial Intelligence platform research is somewhat new, so up to date literature and research are published now and then. The writer is using the newest

possible material in association with older market theories to bring an understanding of how AI platforms work.

The relevance of this research derives from the fact that AI mergers and acquisitions have been on the rise from 2012. Some researchers see this as the height of the so-called hype loop but as figure 1 shows the overall interest to AI development seems to be on the rise when coming to the year 2017.

Figure 1

Global artificial intelligence merger and acquisition activity, 2012-2017
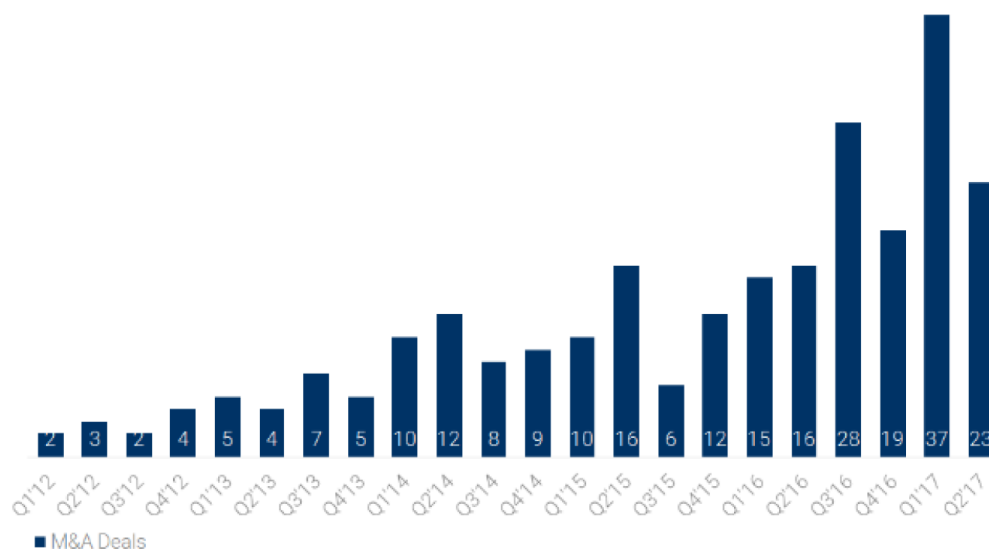
Source: CB Insights (2017), "The Race For AI: Google, Baidu, Intel, Apple In A Rush To Grab Artificial Intelligence Startups," Research Brief, July.

As seen in Figure 1 the interest in AI has been steadily increasing regarding mergers and acquisitions. The research questions for this thesis were constructed from the facts above since the overall interest for AI-powered applications has been increasing. The writer came up with two different main categories with research questions:

1. In what ways does Artificial Intelligence wealth management bring value?
2. What are the most definitive underlying opportunities and threats for using Artificial intelligence platforms?

Question one is rather apparent: companies and firms in any field want to know is it worth to adopt new business processes and exclude old systems. This is what question one is trying to answer: if the company were to adopt a new type of AI, say algorithmic trading

software for instance, what value it precisely does it bring when taking into account that software upgrading can be rather expensive even in small scale. The value aspects of this thesis are answered in chapter 2 and 3

The second question goes beyond the issue of value and answers aspects of the new AI software differently: What are the risks of AI applications in the market? What type of compliance unit should the company establish for AI? Can AI improve the existing compliance? The questions answered can be seen in chapters 4 and 5. Chapter 6 concludes the research by pointing out how AI can improve the productivity of wealth management companies, but also sees the risks associated by adopting this type of software. (Ernst & Young, 2014)

2 Background and definitions

2.1 Pre-financial crisis and the aftermath

In the early 2000s the financial world was recovering from the dot-com bubble crisis, and slowly but surely the financial institutions started to make profits of phenomenal scale. The adoption of the early algorithmic trading and new free-market entrants, as well as the increases in productivity, meant that the financial crisis had been overcome. One rather unique source of income before the 2008 financial crisis was the triple-A grade CDO instruments or Collateralised Debt Obligation's which are according to Investopedia structured cash-flow instruments. The government and financial institutions backed these and rated them to be very safe instruments. (Investopedia, 2018)

Some economists have argued after 2008 that these highly rated instruments were only a money-making machine and that even people who constructed them would not buy them. To the extent where the report by the New York Times claimed that certain large financial institutions even placed opposite bets against the market, I.e. they bet against their products. This for anyone would seem at least slightly shady. The more important question is how did they manage to do this and almost bankrupt the modern financial world? (Morgenson & Louise, 2009)

The answer is the lack of control or compliance in general. There were no compliance or risk-controller teams inside the company, or if there were their warnings they were silenced or their opinions replaced by more suitable opinions. For the company overall increases in compliance costs have in recent years made it nearly impossible for accountants or compliance managers to succeed without AI or machine learning applications as they are such powerful tools to recognise anomalies in large data sets. It has become clear that AI is here to stay.

As the financial world saw the downswing of the whole economy by their actions the executives, managers and investors needed to throw some of the risk management theories away in order to understand everything that went wrong. Even though there was foul play in the market by the big investment banks, the analyst firms and investors. More people should have seen how the investing genre was changing. Older theories of market efficiency needed and still, need revising, this can be done by changing market player minds, or by a powerful disruptor deriving from the technological process and

adopting old and new strategies to compete in the new ever more rigorous market environments. Robo-Advisors are paving the way for a new era of the portfolio and invest management and along with AI-tools in compliance the sky is limit.

2.2   What is AI and how to define it?

AI in its various forms has many definitions, but one particularly useful is the following by Financial Stability Board: "AI is the theory and development of computer systems able to perform tasks that traditionally have required human intelligence". (Financial Stability Board, 2017) The distinction from machine learning can be seen in figure 2.

Figure 2

A schematic view of AI, machine learning and big data analytics
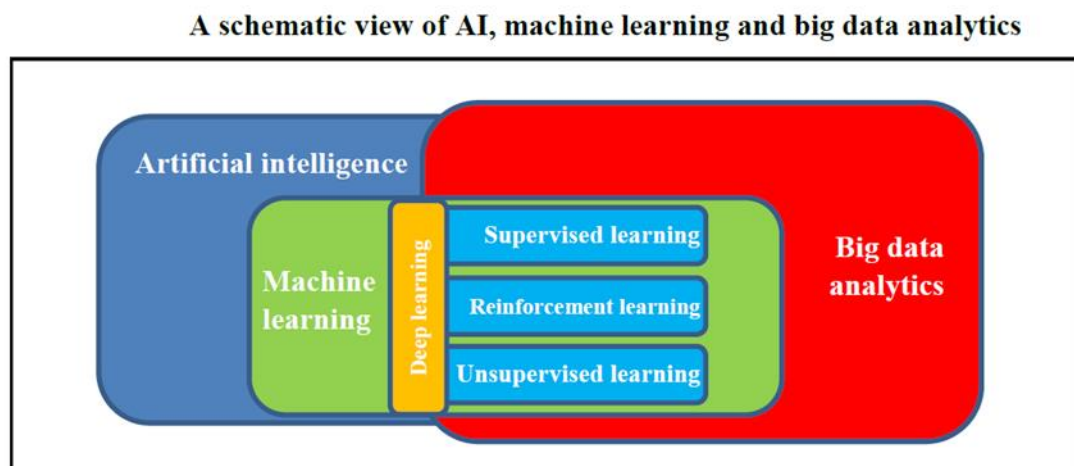
Source: The Financial Stability Board (FSB) 2017: "A schematic view of AI, machine learning and big data analytics."

As can be seen, machine learning should be classified as a sub-category of AI and other big data analytics. The difference in methods that these applications use however is not necessarily so distinctive. Four main categories can be defined to be different machine learning or AI categories, and they vary mainly in the form of human interaction:

1. Supervised learning: Is an algorithm that is fed different styles of training data which contains labels, e.g. algorithm can be used in the financial field as an AML countering method where it identifies known characteristics in money laundering.

2. Unsupervised learning: Is where the algorithm data is not labelled distinctively, and the algorithm is used to detect patterns, e.g. investors who are seeking to price illiquid assets.

3. Reinforced learning: Can include both labelled data and non-labelled data, e.g. Self-driving cars use reinforcement learning as they require to have both labelled data (traffic laws) and they also need to know how to react to changing circumstances (traffic accidents, etc.) quickly

4. Deep learning: Is a modern form of machine learning, it uses different layers of data to construct "artificial neural network". This means that the algorithm can use different "decision making" styles to construct an understanding from data sets, e.g. deep learning algorithm allows programs and computers to "read" and distinctly different things from a set of images, say, a car.

These frameworks are rather broad and mainly give insight into what different algorithms are used in general. The differences come up more precisely when we look at what type of problems AI and machine learning can solve. (Kolanovic & Krishnamachari, 2017)

One of the discoveries which should be considered when anyone starts to make decisions on whether to adopt Robo-Advisory and Artificial Intelligence platforms is to take account of the term called Mathwashing.

According to Frida Polli, a neuroscientist and independent author for Forbes magazine Mathwashing is "our tendency to attribute objectivity to technology." (Polli, 2017) This means that humans who are working in and around Artificial Intelligence platforms should pay close attention and seek consultants if needed to battle biased data. For the applications this affects in many ways: these can be discriminative because of an accident in the data sets run for AI platforms, or on purpose to affect public opinion.

According to Mathwashing website, this is one the most significant threats and challenges to create a non-biased platform. In other words, the algorithms are only as intelligent as the testing data used to train them - if the data are biased so will the algorithm be, since sometimes we humans forget that humans still train these applications gathered data sets.

Machine learning is used widely in different types of problems but mostly in the classification of data and statistical analysis. When it comes to separating these two, the classification analysis is rather often probability based and is used to classify for example execution of trading by asset managers, as machine learning can with correct data and human interaction mine profits from the marketplace and therefore bid on prices in contrast with the historical prices. It is a potent tool when comparing the Net Present Value of financial instrument and can suggest different outcomes.

However, as we are talking about a trained algorithm, itself, it cannot determine why precisely the price of an asset is what it is in the future, thereby creating the need for human interaction.

The Financial Stability Board stated that: "machine learning algorithms used by asset managers merely look at different correlations that are hard to recognise by human eye". So, it seems that even when AI applications are being adopted and used more, they are used as another helping hand for humans and not to replace talented professionals even though there have been warnings by various sources.
(Financial Stability Board, 2017)

Writer agrees with the Financial Stability Boards statement that machine learning is used to look different correlations, but dos not agree that they are hard to recognise by the human eye, they are rather impossible. Reasons for that these anomalies are rather impossible to see is that if asset managers only look what the software has initially constructed of plain hard data and does not consider any possible flaws that behavioural biases might do, machine learning is not going to be anything more than a data crunching machine.

Now the writer has defined the technical differences within the field of AI, in the chapter 3 writer will discuss the financial point of Artificial intelligence, the platforms that are used and different financial theories that are put into action with the different algorithms described in this chapter.

The writer will also discuss the behavioural science side of AI and the applications that could yield interesting results when Neural networks and AI are combined to make an investment machine of the computer age.

3   The new waves of wealth management

Private banking and wealth management have evolved over the years from exclusive services for the market niche to an offering of almost every single commercial and state bank. This change however considered mostly only wealthy individuals and their assets mainly in the Private banking side until the mid-2000s. After new technologies have emerged competition in the whole sector has increased since companies look for more and more customers even from the market groups which have not been so lucrative before. This has been one of the drivers why investment professionals have had to adopt new more powerful technologies in the growing markets.

The traditional view with the 21st-century investment and wealth managers has been to use specific analytics tools and a wide range of Excel applications with everyone's knowledge of the market, to guide their customer's portfolio. Tasks vary from rebalancing client portfolios to gathering knowledge for possible future outlooks by actively scrutinising gathered data from different sources. As it turned out in 2008, it has not always been easy for investment professionals to see if there are massive shifts in the market.

Trained professionals have mainly used traditional wealth management platforms within their companies, and often their clients have had no idea what software packages are used, or they have had no specific interest in them.

In the future, however, we can see that the firms have to establish different types of digital advisors not only because of the shrinking profits but also from the customer's demand, which is an important fact when evaluating the value creation of traditional and AI-Advisory. The cost structure of AI-Advisory is generally cheaper, but this is not always the case (when calculating overall investments in Software-as-a-service (SaaS), Platform-as-a-service (PaaS) or Infrastructure-as-a-service (IaaS). (Kolanovic & Krishnamachari, 2017)

Since AI-Advisors are robots, one point must be clear: In the event of a flash crash or Bear, a market customer needs to have the necessary knowledge on how to act in such a situation. This is because even though AI-Advisors have proven to be cost beneficial, they have not yet experienced Bear market conditions. If applicable an investment

advisor should be contacted in such an event or at least consideration of using AI-Advisory with an investment advisor.

All in all, AI-Advisory opens investing to a broader audience and gives more people direct access to the market; this is the investor point of view thus also customer point is beneficial as more capital is invested in the market hence creating more value to assets in place.

One critical step for researching wealth management and investing in detail reader should understand the basics of portfolio management. The easy and feasible approach is to determine what is an individual's investment policy or portfolio allocation, this is a step where investor decides what asset classes and with which weights are chosen for the target portfolio. Every asset class and security have a risk and return so the basics fundamental of investors risk appetite and the time of the investment is crucial. (Cochrane, 1999)

The portfolio management principles are the same for Robo-advisory, but the inputs are gathered online and run through an algorithm that determines the appropriate asset classes and weight for an individual portfolio. Robo-advisors tend to invest in ETF: s, and often use mean-variance analysis, which will be discussed in this chapter.
After the portfolio plan is set individual investor can choose them if they want to actively manage portfolio or remain passive and let the algorithm sort it out.

3.1   Re-defining wealth management

Generally, Robo-Advisors are a term created to illustrate different digital platforms used by wealth and private banking companies or created individually. The name Robo-Advisor, which is commonly used, is misleading since these platforms are either humanly created algorithms or AI created (In which case they are initially coded by human). (Investopedia, 2016)

Most commonly Robotic advisors are used in financial planning, but recent developments in AI technologies such as IBM's Watson are giving more ground to them to be used even as complete solutions from insurance to personal banking. (Kiulian, 2017)

Currently, these algorithms-based applications are used in mainly two different categories. First one is a fully automated digital advisor, and the other one is advisor assisted. As can be seen from the naming of these the first one is threatening to financial wealth manager jobs around the world, whereas the latter one assists wealth manager to meet and designing customer solutions. (Ernst & Young, 2014)

These developments also create availability of investment services for a much larger audience who are willing to trust algorithms to make investment decisions. It is yet to be seen how Robo-Advisors survive next bear market since technologies of Robo-Advisors are only less than decade old. This will keep customers still at some level dependent on investment advisors. (Archer, 2017)

According to Techfluence, there are 98 B2C, and B2B Robo-Advisors in Europe and Germany alone has 41. This means that the competition and different choices for Customers in both B2C and B2B side have many different choices. This development has only been in the last few years, and it remains to be seen how natural competition will affect the market. (Mellinghoff, 2017)

As the stated field of Wealth management is becoming more competitive even inside Europe, because of this, customers might start to demand even more value as diversification into alternative DIY bots gives customers more options to start investing.

The underlying concepts of Robo-Advisory are rather old next writer will discuss the different financial concepts that are being used in different Robo-Advisory platforms. After this writer will show the risks and building blocks that need to be associated when thinking of adopting a Robo-Advisory platform.

3.2   Efficient market hypothesis

When talking about AI-advisory and especially value creation is EMH should be considered. EMH is a theory which states according to Eugene Fama:
 "Investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time fully reflect all available information." (Fama, 1970)

Furthermore, Fama states that market in which prices always fully reflect are called efficient. In other words, this means that it is impossible to beat the market because all share prices already incorporate all information relative to them

There are three different believed forms of market efficiency, these three models (which vary from the investor's mindset) are essential to know when talking AI-Advisory. The different efficiencies are:

1. Weak-Form efficiency
"assumes that current security prices fully reflect current security market information."
This means that historical data does not reflect the future price of securities. Also, weak form assumes that any technical analysis does not guarantee more returns.

2. Semi-strong-form efficiency
"assumes that current security prices adjust rapidly to release of new public information."
This means that public and non-public data factor the individual security price. Also, a fundamental analysis does not guarantee more returns

3. Strong-form efficiency
"assumes that fully reflect all public and non-public data; that all market, non-market and inside information reflect security price."

This theory means the so-called "perfect market" where no one can get guaranteed excess returns.

Along the years, however, EMH has received criticism for not being accurate enough to in modern information age.

When discussing whether there is value creation for a customer some points need to be clarified:

Since AI-Advisors cannot give the experiences of human wealth manager in the panic situations or other types of abnormal behavioural situations, it can be stated that AI-advisors are more relying on the Weak form of EMH, but where they still give some credit to active management. (Morningstar, 2017)

As discussed earlier EMH is old portfolio theory. However, since AI-Advisory uses mainly historical data to find market anomalies and the fact that most pure AI-Advisors invest in ETF products EMH's weak form is mainly used or coded inside the algorithm used. This should also be taken in account when calculating end value; henceforth if the customer does not believe in the weak form, they should study alternative options rather than AI-Advisory. (Fama, 1970)

3.3   Other Financial theories associated with Robo-advisory

As discussed, earlier Robo-advisory in most cases rely on old theories of the finance, so it should not be surprising to learn that these coded algorithms also use, in many ways mean-variance analysis and optimisation as well as Capital Asset Pricing Model theories proposed by (Markowitz, 1952) (Tobin, 1958) and (Sharpe, 1964). The writer briefly discusses these theories.

The main umbrella term in financial diversification can be kept the "Modern Portfolio Theory" that is a framework for most of the later decade's financial mathematics framework. Diversification was first modelled when Markowitz determined that the risk of a portfolio should be divided into Firm-specific risk (idiosyncratic, asset-specific) and systematic risk (economic cycles, interest rates changes).

Markowitz model demonstrated that combining stocks into a portfolio, the risk is reduced by the factor of which the stocks face systematic risks and how great is the individual stocks correlation with the remaining portfolio i.e. the lower portfolio volatility the lower firm-specific risk inside the portfolio. The key is that a diversified portfolio yields higher returns and have less volatility than the least volatile of its individual stocks. (Markowitz, 1952)

The importance of time horizon in the portfolio management was researched by Paul Samuelson "myth of time diversification" in which was stated that the investors risk tolerance itself should be unaffected by the time of the investment cycle. However, later studies, especially in the field of behavioural finance, have stated that the risk aversion through time might only be a myth. (Samuelson, 1963)

Markowitz' framework of mean-variance was extended by Tobin who constructed the model where risky assets compiled by risk-free investments. Tobin's unique portfolio represents the highest Sharpe ratio of any portfolio in the economy. The Sharpe ratio measures the portfolio's risk-adjusted return and suggests that all investors should old the portfolio with the highest Sharpe ratio as it is weighted to be the ideal exposure to risk.
(Tobin, 1958)

In the 1960s Sharpe draws the CAPM model based on Tobin's work which was relatively close to what Fama had assumed in the development of EMH theory. CAPM assumes that rational investors invest with the same expectations, identify and demand efficient portfolio and thus since supply and demand equal this efficient portfolio must be the market portfolio. (Sharpe, 1964)

Some empirical studies have found out that certain investment strategies have not followed the traditional pricing models like CAPM, there have been three major strategies in which have interpreted in two different way:

1. Size, historically smaller market capitalisations have generated more return than a larger one. (Banz, 1981)
2. Value, stocks that have had a high book value in contrast for their market value (Stattman, 1980)
3. Momentum, short-term trends in stocks tend to persist over some period of time. (Jegadeesh & Titman, 1993)

As mentioned there has not been a clear rational way why the asset prices have behaved as in these three ways. Behavioural finance theorists De Bondt and Thaler assume that they are rational deviations from the efficient frontier caused by investors over or underreaction. Neoclassical thinkers Fama and French have argued that these trends

represent the anomalies of compensation of risk that is not captured by the model that was used to price the assets. Either way, these are noteworthy standpoints to consider how AI-advisory should be configured in the first place. (De Bondt & Thaler, 1985) (Fama & French, 1996)

It should be noted that even though AI-advisory as a whole is highly relying on technical analysis, it uses certain aspects different from its human counterpart. Gathering and monitoring data in a matter of seconds, and compiling this gathered technical analysis as an input to another end of the algorithm, which in turn can execute according to say target allocation levels in a matter of seconds. These actions are then monitored by an investment professional who can draw conclusions and adjust the algorithm in place.

Other quantitative factors that are even more in line with AI are the so-called Risk-sensitive benchmarked asset management. These strategies while in some line with the technicalities and assumptions with Fama's weak form efficiency take even more into account the volatility aspect of the market.

For AI advisors the risk-sensitive asset management can be found rather crucial. This comes from two different cases. Investors or customers who are risk-averse and seek to match specific benchmark allocation with AI may have slightly more chance of succeeding. This comes from the fact that we assumed that the markets are of Fama's weak form efficiency, so the historical prices do not necessarily reflect the security prices in the market when using the RSBAM model.

The AI advisors can with the help of the available market information and quick data crunching from all the available sources create price parity situations where AI's quick execution may prove more useful than the traditional in-depth analysis of long-term investment objectives.

However, the RSBAM model can be used the other way around by risk insensitive managers to maximise long-term yields with technical analysis. Whichever is the right way for an investor to execute is dependent upon fundamental principles, such as the risk medium the investor is willing to take.

This model should be used carefully as it has been more employed in the early 2000s. In the coming years, we might see this type of hedge fund strategy allocated more into

ETF's and AI advisory as we are closing the end of what is called Equity cycle. Equity cycle a refers to "Wyckoff Stock Cycle" which states that there are four phases in between bull and bear market. (Davis & Lleo, 2008)

3.4   Behavioural finance

The theory of behavioural finance came in to play in the 1980s. In the very essence, behavioural finance is understanding the psychology of financial decisions let them be made by anyone from institutional investors to households, humans have always been the ones making financial plans. In the field of behavioural finance researcher tries to answer very fundamental psychological questions, how do people think? How do people act?

Assuming that in the past financial field has been vastly dominated by thinking that people in the markets and the markets themselves act rationally, uniformly and take account of all the available data when making investment decisions. But as we have seen in the past few decades with many financial crises, that humans tend to act with intuition rather than with rigours data crushing attitude in the marketplace.

So, the question lies is either side of the spectrum from believing that markets and people are perfect to the intuitive markets, right? The answer is both since the 1980's scholars and professionals have been debating around the subject whether the markets work in the best way and are the investors really making the most rational choices based on in-depth analyses of companies and macroeconomics.

The answer is not universally accepted but studies have found that investors tend to make rather un-rational decisions not only during the crisis points of the economy but even in the daily fluctuation level when no new "important" information has been published. (Information is, for example, United-States labour statistics, annual reports etc.)

Such a behaviour raises questions whether the markets are much more ruled by the intuition of fund managers and other investors than it is for the Maurice Kendall's so-called "random walk", which was later an inspiration for Eugene Fama's EMH theory. Older theories also talk about "naïve investors" or "noise-investors" who are seen as

disruptors in the marketplace and who are the main reason to blame that markets are not operating rationally. (Fama, 1965)

Golden standards of the markets have been for decades the de-facto facts that security prices are priced accordingly in the market and that the sophisticated investors always take advantage of all mispricing by using arbitrage strategies so that the security prices follow the future cash-flows precisely.

Behavioural finance has challenged these theories by finding many situations where there are no rational reason for security prices be what they are and how they behave, one theory is the so-called "Price momentum" where the past winners of the stock market tend to stay winners even when there is no justifiable evidence supporting that they should or that the positive trading give volume for trading and increases a security price even though there is no evidence of why.

Prime example of this is a Finnish company Talvivaara when the company was already in the brink of bankruptcy and heavy environmental lawsuits were put in place its stock price actually went up multiple times, writer suggests that the reason behind is that investors did not act logically but bought the stock by intuition, hoping that the government would bail out the company it partially owned. Finnish government depreciated all the value of the stock in the last quarter of 2014. (Oksanen, 2018)

So the wealth managers in the future should understand not only broadly the market phenomenon's but in more specific detail scholars have created a joint model that consider the older neoclassical finance and behavioural finance theories. These theories are to adjust the framework that is built by CAPM and Modern Portfolio theory by letting industry experts see how the behavioural aspects can have a, for example, the pricing of securities, selling point of securities and economic cycle trends that affect buy and sell behaviour.

Interesting finds from behavioural finance studies is also that by trying to affect customer's mindsets much as is done in neural marketing, customers might be willing to pay more likely if they were credit defaulted. The exact source of this behaviour is unknown but study by suggests that by promising new financial freedom in the future customer was more willing to pay back the depts. (Hamalainen, et al., 2010)

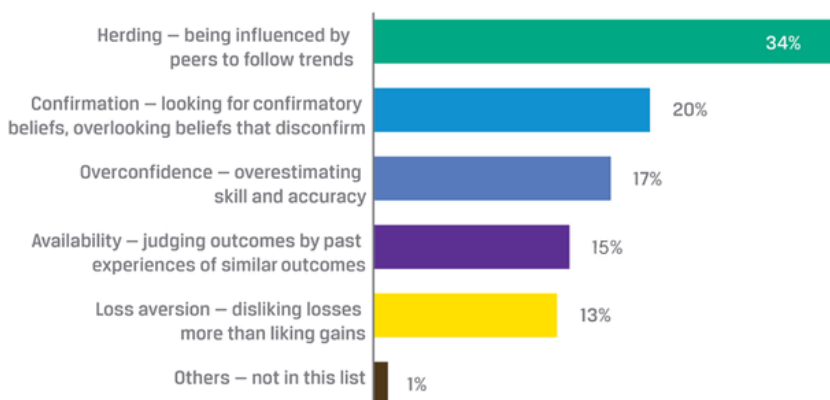The most basic biases usually associated within the field of behavioural finance are demonstrated in figure 3.

Herding – being influenced by peers to follow trends — 34%
Confirmation – looking for confirmatory beliefs, overlooking beliefs that disconfirm — 20%
Overconfidence – overestimating skill and accuracy — 17%
Availability – judging outcomes by past experiences of similar outcomes — 15%
Loss aversion – disliking losses more than liking gains — 13%
Others – not in this list — 1%

Figure 3 Source: CFA (http://cfa.is/2CXgpBL)

As we can see from figure 3 there are multiple biases that affect an investor's decision. Some of the biases are categorised to be either Cognitive or emotional. Cognitive bias is defined: "a systematic pattern of deviation from rationality in judgement." whereas Emotional Bias is: "When you make decisions driven by emotions, rather than by logic and facts. It has also been defined as a distortion in cognition and decision making due to emotional factors." (Jubi.ai Innovations, 2018)

These biases if not addressed or noticed might hurt the financial market as a whole, not only it is bad that investors do not make the rational decisions, but the fact that many institution and investors still purely believe that the market is indeed a homogenous and all investors are rational when making investment decisions. As mentioned, there is a middle ground where the markets operate but that must be adopted in a much larger scale if the behavioural aspects will be taken into consideration. In the chapter 3.7 writer will discuss how Robo-analysts might help investors to see market anomalies with the help of AI.

3.5   ETF: s and AI

Many sole AI-advisory platforms that are serving only the end customer are investing ETF: s only. Investment philosophy for investing ETF: s only derives mainly from the technical analysis (where AI is king) as it is easier to make an algorithm that only follows couple indexes where the ETF: s is following. These reasons are why its beneficial for

anyone considering AI advisor as a part of a business function or as an individual investor to know what are the key ratios to look at in ETF:s.

Exchange-Traded Funds are securities that follow closely to some market indices such as S&P 500 (The Standard & Poor's 500 indices) to match the market by investing the same stocks or other securities traded by that index most often this is done by contacting owners of these shares and placing them in a custodial bank from which ETF shares are then created and traded for investors. The value of ETFs is most often calculated using Total Expense Ratio and Net Asset Value, i.e. TER and NAV.

NAV for ETFs uses per share value based on trading day closing prices and is calculated as follows:

NAV = (asset value – liabilities) / Number of shares outstanding

From this, the customer needs to remember that NAV changes per each day, and to gain insight into it historical NAV prices can give some insight. The reason why NAV is important for AI-Advisory lies in the fact that most AI-Advisors use ETFs as their base portfolio.

Another term discussed is TER, which is important when discussing AI-Advisory as it states how much costs there are underlying inside single ETF product. As the basis to use AI-Advisory is to gain a competitive advantage by reducing costs, this can be seen as one of the most important factors of value creation. TER is calculated:

TER= Total Fund Costs / Total Assets

Since the size of TER affects the total returns, it is beneficial to know differences of TER in AI-Advisory and traditional fund management.

3.6   How does the Robo-advisor work?

The main question that arises now is how exactly a Robo-advisor is constructed how it invests client's money? A research of 28 different Robo-advisors found out that there are usually five main building blocks for creating a what is called a "real Robo-advisor" this derives the focus away from advisors that are only suggesting and building a portfolio to more sophisticated models that can rebalance the portfolio automatically and depending on the country of operations even use creative accounting to reap tax benefits, which to many smaller investors is the first chance of getting "premium" wealth-management services. (Beketov, et al., 2018)

The underlying financial theories are relatively simple, most use improved versions of Markowitz's Modern Portfolio theory or the more developed theories of Sharpe.

The building block or workflow generally consist of from:

1.   Selection of appropriate asset classes
2.   Identifying the investor's investment profile
3.   Asset allocation according to the investment profile
4.   Monitoring and rebalancing of the portfolio
5.   Ongoing portfolio management and reporting

These five steps do not derive much from the traditional wealth management provided by financial institutions, they are merely technical tools relying mostly on the vast amount of market data created each day. Some platforms offer more in-depth analyses but for the smaller investor, the usefulness without education for different trading strategies might be irrelevant, if their risk-profile analysis is done based on the older theories that are debated and discussed whether they are relevant or not, Robo-advisor might actually be hurting the investor with lesser knowledge of the market.

For these reasons the asset allocation methods should be clearly instructed so that the investors have the necessary knowledge when answering an online questionnaire, also investor should be familiarised with the basic principles of behavioural finance in order to be sure that the decisions they are making are in line with the Robo-advisors rational view of the marketplace.

The most interesting part when discussing Robo-advisory in the future is the adoption of Neural Networks and AI to Robo-Advisory. As stated earlier Neural Networks are self-learning algorithms that feed on the data and can create decision trees from vast data-sets. Now when taking the aspect of technical analysis capabilities of AI-Advisors and combining them with behavioural-and neo-classical finance theories many interesting things happen.

3.7   From Robo-advisory to Robo-analysts and more

New technological processes have allowed sci-fi-fi like features to consumers home, take Amazon's Alexa as an example. Fifteen years ago only the innovators could have

thought that we have our own personal computer assistant at all times in our homes. Now in the United States, it is very common to have Alexa or any other smart home appliance that makes life easier for everyone. This is why the focus in the financial markets should already shift from robo-advisory as a disruptor to robo analysts services.

According to Anastasia Akula, Chief Operating Officer of Capital.com, robo-analysts can already analyse potential behavioural biases in the marketplace. (Akula, 2017) This type of development is crucial as we are moving from the traditional neoclassical thinking to consider different investor biases. Not only can this be beneficial to investors in the market but, for the overall performance of markets and security prices the development of unbiased investing platforms that warn investors if it thinks that they are making a biased choice.

The analyst software is not for retail-customer only, in fact, it is quite the contrary. Morgan Stanley has been developing its own AI-powered analyst software for years to help employees with many customers to better adapt quickly changing market conditions.

The platform helps financial advisors to better understand the overlying technical anomalies in the market, as according to study in 2004 only 8% of the financial analysts perform in-depth accounting and financial research for the assets that them invest. Even though old study, David Trainer from Forbes states that this number is likely to be even lower today. (Morgan Stanley, 2004) (Trainer, 2017)

The Morgan Stanley AI takes the Robo-analysts even one step further, they are using algorithmic supporting methods, much like Netflix, "because you viewed" function in a context of finance. The call it the "Life events" and describe that it can help to guide their customers in difficult financial situations quickly. For example, if a customer's child has a certain illness the program can suggest hospitals and schools, with the financial analysis and investment plan to save for. Life events are the type of financial planning help that would not be possible without AI-platforms, the reason is simple there is not enough time to work with every client in such a special way that they would need. (Davenport & Bean, 2017)

So even the customer service field can be more competitive with Robo-analyst solutions. Investors are most interested in the basics, does it bring more value than a traditional investment manager? In a short yes, in a more comprehensive view, it's complicated.

Robo-analysts can shed a light for hard to reach financial filing, quickly without the manipulative accounting by management and draw more accurate predictions of asset prices in the market. One could argue that the information is there and that in their research they have taken steps to analyse all the available data, that might be true but if investors in the wider perspective are relying on the headline reports and accounting filings, the securities might be over or underpriced with wrong principles.

According to respected investors such as Adam Smith and Warren Buffet stocks and other assets should not completely be priced with accounting results, instead of using economic earnings can be more beneficial for three main reasons according to New Constructs:

1. Based on the complete set of financial information available
2. The standard for all companies
3. A more accurate representation of the true underlying cash flows of the business

The challenges for investors is to get needed data in order construct economic earning model is time-consuming and difficult, but with the help of powerful Robo-analysts algorithmic processing the process could become more easier and available for the much larger audience. (Trainer, 2017) (New Construct, 2018)

The theory behind economic earnings derives from multiple sources, let them be management intervention in accounting, salespeople boosting or the fact that accounting data was originally designed to be used by debt investors rather than equity investors.

There might be a herding and confirmation bias towards accounting data and the fact that it is educated widely in the universities and business schools does not help the ongoing standards of using such data as the principle de facto in equity investments.

As we have looked different applications used in the present-day financial marketplace let's now focus into the practical aspects and factors that are driving the demand for change and adoption of AI-applications. (New Construct, 2018)

4   The factors driving AI

4.1   Technology

The search for new strategies and profits, whether investment manager quantitative or fundamental, requires a lot of data and information. As in the new digital age, the managers should know how to use vast "alternative" datasets (social media posts, commercial transaction, credit card data), while also relying on old more traditional datasets (retail sales reports and quarterly earnings, etc.). It might become overwhelming and impossible to see what is the relevant data and appropriate software for say a fund to perform and also keep the margins low. Why is it so? What drives the AI to be relevant to solve this and why has it increased in the past years? (Pelliciari, 2017)

There are three main drivers for technological adoption, these are:
1. The increase in data available
2. Increases in the computational power used
3. Advancement of AI technologies and machine-learning algorithms

The increase in data available is not the only factor that affects in the point 1 above. One crucial fact is that the data itself has become cheaper in general. However, the factors driving this are the technological push and demand for more sophisticated machines that in turn generate vast amounts of data, financial and other. We can see clearly from Figure 3 that the global use of data has increased drastically in the year 2010 and 2017.

Figure 4

Costs of storage and global data availability, 2009-2017
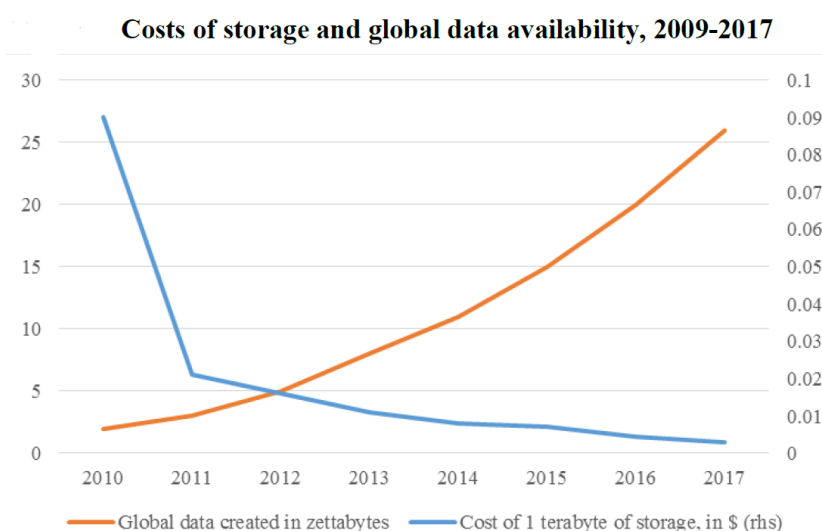
Source: Reinsel, Gantz and Rydning (2017); Klein (2017). One zettabyte is equal to one billion terabytes.

Increases in the computational power allow this gathered data to be used promptly. Also if we refer to Moore's law in computational science, the overall cost of computing generally has come down 30% a year.

As stated before AI is not a new technology but the increases regarding points 1 and 2 have made it possible to generate fast self-learning neural networks that mine alternative data sets in order to seek profits, The execution algorithms then make the trade and the wealth managers are given more time to devise long-term investment plans, and make sophisticated company and country analyses that go in line with these plans. This will, in turn, lead to increases in profits and perhaps lower margins for the customers.

The lower margins for end customers can and will vary regardless of what tools investment company uses, but if we try a little mind game, it should not be difficult to imagine that. If in the past the data crunching in the 80s, 90s or early 00s have been the job for a whole division of educated analysts who require to be paid at least €1000 week which for a team of 20 people makes up to €20000 in the salaries only.

Now let's think of a modern marketplace where data is available immediately for everyone, one program with a right algorithm can gather all needed information that required 20 people and a week in time in a matter of seconds, with the price of the licence and maximum two data-analysts who work for €2000 per week. Even If the investment firm pay dividends of etc. the old higher profit margins for end customers are not justified.

It should be noted that firms may still justify the higher margins to be the premium from their smart investments.

The positive results from an early adopter of AI are also playing rather a big role as a driver why more and more companies want to acquire AI processes. Deloitte State of Cognitive Survey study states that Executives expect the cognitive advantage to transfer their area of the industry already in 2-3 years.

The study also states that the primary benefits for companies are Enhancing features, functions and or performance of processes, products and services. This supports the facts stated earlier that the competition in the markets are increasing and the demand for more optimisation and cost-effectiveness is in order.

(Deloitte, 2017)

4.2 Regulation

As MiFID II or Markets in Financial Instruments Directive rolled out in January 2018, it was said to bring lower more transparency to the market. It has been debated what the transparency means. Transparency in MiFID II can be seen as the disclosure of the significant cost structure and data behind it but also as the way in which trade executions in the market are happening. Jamal Tarazi, director of European business development for Hudson River Trading, stated that "important aspects of transparency in MiFID II is the liquidity options for different assets". Liquidity, of course, varies between asset classes and even in the security level itself, but as noted earlier AI platforms help to crunch the vast amounts of data, this in turn especially in European markets could benefit trading and liquidity of some of the more illiquid securities as AI finds the best prices quickly in the marketplace. This does not take into an account the dark pools and HFT traders in detail as in MiFID there are limitations of how much securities of one market can be traded in Dark Pools which are private exchanges and usually used by institutional investors selling large amounts of stocks without misleading the general market. (Hanks, et al., 2018)

MiFID II also enforces market players to reveal the so far secret information of the cost structure within finance field, although according to Alan Miller, co-founder and chief investment officer of SCM Direct, the Financial Service Authorities in many European countries is not doing enough to enforce the new rules. (Hanks, et al., 2018)

MiFID II in the European scene is both an opportunity and threat for AI-advisory and the end customers. On the other hand, we can see as the enforcement starts to drive financial institutions, more transparent data that if captured accordingly by data crunchers of AI can be used in benefit of finding the best deals in the market with even lower cost than before. On the other hand, however, the regulation brings questions whether these AI-powered advisors draw margins so low that the traditional asset management firms cannot compete anymore. What this means is that the more traditional asset management can utilise AI software in their processes and perhaps use those along with their existing knowledge to find even more lucrative investment options. As noted before the pure AI advisory is merely conducting technical analysis, so the lower costs it brings is not necessarily a bad thing as we see the hidden costs more and more in the future.

4.3   Risk management and compliance

New regulatory challenges such as MiFID II and the European General Data Protection Regulation (GDPR), are increasing the overall cost of compliance and the need for more practical tools to measure how these regulations are put in place.
(English & Hammond, 2018)

Brief interview with Ms. Tarja Harju-Nurmi the Risk Compliance Officer of the Finnish Sp-fund management company revealed that the not only the overall costs of the new regulation has increased in companies but the interpretation of these rules as well, the business practices rely more on compliance and the monitoring tasks in every area of wealth-management increases. Another note was the HFT-trading, i.e. high-frequency trading is that smaller companies might have difficulties to compete with larger market players when new regulations are placed. However, the challenge is for the regulators to keep up with the technical levels where the market players are going. (Pohjanpalo & Schwartzkopf, 2018)

So, the question rises can AI help companies to follow regulation, there is no simple answer, but according to the Financial Stability Board, AI can help the companies to automate their business monitoring activities. (Financial Stability Board, 2017)

The automation of these activities might help to prevent the frauds and Anti-Money-Laundering in the financial field but as the Reuters study in the cost of compliance suggests most companies feel that the costs are increasing too rapidly and that there seems to be a relation to the regulation in the first place. (English & Hammond, 2018)

As we are most likely not going to see any relief for these regulations with news such as the Danske Bank or Nordea money laundering scandal, the powerful non-biased AI-controlling could help to solve the problem. (Pohjanpalo & Schwartzkopf, 2018)

4.4   The challenges of adopting AI

There are still certain aspects that must take into consideration before implementation of AI software. CGI report states four different factors that should be considered when implementing automated advisory platform:

1.   What features does the platform offer?

a.   The firm must decide on which level they want to implement Robo-Advisor.

2.   How scalable is the platform?

a. When a business grows, the platform should scale with an increasing number of customers.

3.   What are the integration challenges?

a. The platform needs to work with existing IT-solutions.

4.   What other challenges need to be addressed?

a. These challenges include the firm's databases, online security as well as practical things such as computing power needed for individual PCs. (CGI and PATPATIA & ASSOCIATES, INC, 2016)

One of the most significant shifts for companies is the customer base when adopting technologies from Robo-Advisory. This is because when traditionally costs of investment management have rallied around 1 % - 3 % per annum for customer plus plausible commission, Robo-Advisors both automated and advisor-assisted, are usually under 1%. This fact, associated with initial lower investments, has created a slightly more competitive sector in the investment management field.

However, the larger institutions are adopting smaller fees in the face of the new disruptors and this can be seen in figure 5.

As can be seen from Figure 4 account minimums are generally much lower or even

Figure 5

Robo-Advisor	AUM	Features	Annual Fee	Account Minimum	Perks
Betterment	$13.5 billion	Overall planning; IRAs/401(k)s; access to advisor	0.25% to 0.5% of account balance	None	One month free for each referral; one year free after three referrals
Wealthfront	$5 billion	Overall planning; tax optimization	0.25% of account balance	$500	$10,000 managed for free; $5,000 managed for free with referrals
Personal Capital	$4 billion	Every client is matched with an advisor; tiered services; tax optimization	0.49% to 0.89% of account balance	$25,000	$100,000+ accounts can buy individual securities
Bloooom	$710 million	401(k)s/403(b)s; access to advisor	$10/month	None	N/A
Acorns	$257 million	Millennial-focused; unique investment strategy via "spare change" of expenses	$1/month for accounts under $5,000; 0.25% of balance thereafter	None	Free for college students for up to four years
SigFig	$120 million	Retirement planning; access to advisor; tax optimization	Free up to $10,000; 0.25% of balance thereafter	$2,000	N/A
WiseBanyan	$80 million	Overall planning; free management	Free; extra fees for add-on services	None	N/A
Ally Invest	$60 million	Goals-based planning tools, low-cost, non-proprietary ETFs	0.003% annually	$2,500	N/A

Source: Investopedia "Standalone Robo-Advisors"

non-existent when comparing traditional and new companies. Figure 4 also states that the stand-alone Robo-advisor companies are using investment advisors in their product planning. The need for advisors even in Robo-advisory could derive from the fact that the people with more capital i.e. the older generations tend to still want an advisor to give some insights about investing plans, and their trust with completely automatized investing platforms tend to be lower than younger generations.

Figure 6

Robo-Advisor	AUM	Features	Annual Fee	Account Minimum	Perks
Vanguard Personal Advisor Services	$51 billion	Every client is matched with an advisor; tiered services; one-time financial plan	0.05% to 0.3% of account balance	$50,000	Fee waiver for retirement plans with $500,000+ or 55+ clients
Schwab Intelligent Portfolios	$10 billion	Overall planning; ETF selection; IRAs	Free	$5,000	N/A
BlackRock Future Advisor	$700 million	IRAs/401(k)s; investment management; Fidelity and TD are custodians	0.5% of balance for Premium account; free for 401(k) advice	$10,000 (for Premium account)	First three months of Premium account free
Fidelity Go	Not yet available	Millennial-focused; low-cost mutual funds/ETFs	0.35% of account balance	$5,000	N/A
TD Ameritrade Essential Portfolios	Not yet available	Millennial-focused; low-cost ETFs backed by Morningstar	0.3% of account balance	$5,000	N/A
E-Trade Adaptive Portfolio	Not yet available	Mutual funds/ETFs; tax optimization; access to advisor	0.3% of account balance	$10,000 for managed account; $5,000 for IRAs	Free for first six months; Cash reward and one month of free trades for $10,000+ deposit

Source: Investopedia "Legacy Offerings"

Figure 5 represents the "Legacy offerings" or the more traditional investment companies have larger AUM's but this can already be explained by the sheer number of customers they serve already. It is rather simple to offer more automated solution to an already existing customer than it is to sell a product for completely new companies. This creates challenges for new companies as since the financial field is extremely trust related. (Investopedia, 2016)

These facts also create availability of investment services for a much larger audience who are willing to trust algorithms to make investment decisions. It is yet to be seen how Robo-Advisors survive next bear market since technologies of Robo-Advisors are only less than decade old. This will keep customers still at some level dependent on investment advisors.

Some other difficulties of adopting an AI-systems are more traditional, there is a lack of AI-professionals in the whole field of computer sciences, the supply does not meet the demand and thus some companies thinking of aligning and adopting AI-processes go under.

The projects themselves can also be rather tricking as anyone working in almost any company might expect the legacy systems might not work with the intended new programs and these interactions might cause more sunken costs than they bring value. Special note for AI is that company should not just implement it here and there and try it

without any proper launch cycle for another business process i.e. automating accounting but not automating the underlying processes such as liquidity management for instance.

From financial perspective the temptation of adopting just some of the processes is great, but as in any strategy for every IT-software the transformation should be done, not only it will ease the compliance part (in Financial Firms especially) but the overall risk of adopting AI-platforms reduces when one complete business function at least is aligned with the same software.

However, being said that difficulties are adopting AI-software, Deloitte study suggests that being one of the early adopters of these programs has its benefits since 83% of early leaders in cognitive solutions said that their companies had achieved benefits from working with new AI-powered technologies. The matter of perceptions is changing in the field as a whole, and this gives more and more companies an incentive to adopt different solutions in order to become an early adopter of AI.
(Deloitte, 2017)

There are always challenges when adopting a new system architecture and integrating them with existing legacy systems. With artificial intelligence, the challenges are also in the minds of the employees. Mindset towards AI and automatization are mixed, in one-way AI is seen as easing the workload from employees and let them focus to different areas. On the other hand, automation can reduce or at the very least change the spectrum of professions needed by companies.

This can lead to clashes within the company, so it is up for the executive management to give employees the means to continue their job, by example education. If certain developments are not done in the company culture itself, the resulting automation might not only cut jobs and costs but poison the atmosphere for the remaining employees as they might fear that their occupation is on the line next. Strategical analyses with process planning should be started well before the automation process itself starts to avoid unnecessary harm to the workplace.

In the next chapter, writer will conclude this paper with more insights for companies who are thinking of adopting AI for their financial platform spectrum.

5 Conclusion

As have been demonstrated by examples in previous chapters, Robo-Advisory is here to stay and is growing at an enormous pace. Thus, it seems that every investor should consider using it because of the lower costs. However, as we can see with EMH's levels of efficiency, markets are far from perfect and individual investors tend to make decisions based on instinct rather than reasoning. AI advisory might help to stabilise the market as the people would trust the technical analysis done by it this might help to keep the current level of assets that the investor is holding and in a market, downswing gives recommendations of which assets should be liquidated, which bought and which keep. (Knowledgenet, 2018)

However, since not every investor is equipped with million-euro portfolio, smaller investors might achieve more results by using Robo-Advisory to avoid costs and even perhaps seek for smart alphas of the market. The cost avoiding is mostly about what types of securities smaller investors are investing since ETF:s have smaller costs associated generally that the traditional mutual funds an individual might see this as an opportunity to gain larger chunk of the profits, it should be noted that lower costs do not guarantee higher returns, but for a starting investors smaller costs are tempting. Seeking smart alpha completely with AI is hard.

Since most of the stocks are evaluated in traditional terms, i.e. price of the stock is the present value of future dividends, it should be theoretically possible to grasp alpha that is beating the index with only technical analysis. The fundamental reason to use Robo-advisory should be to gain enough information to make a sophisticated investment decision without the need to use the wealth manager.

The need for a wealth manager is a tricky question but something that should be addressed. As the writer has spoken from the perspective of behavioural finance, in the future if wealth managers want to keep their competitive edge they should learn how ammend from other sources than technical analysis and experience.

What this means is that wealth managers and fund managers should stop and think for their trading strategies and portfolios, compare them to the benchmark indexes as well as to tables that describe biased financial decision behaviour. By doing this the

managers can have an edge against robot-advisory. Financial firms, especially those working in the field of active management should take a moment and look at these traits as well.

If there are alarming findings adoption of Robo-analyst software with the experience of manager can be beneficial. Robo-analyst software should not be looked like a complete guide to portfolio analysing, but rather as a more in-depth analysing program that can detect patterns that have not been even thought before, these being to name one loss-covering or overconfidence in trading. Firms can benefit if the trading costs can be brought to a justifiable level where trading is done in harmony with economical technical analysis associated with investors experience and behavioural financial models.

Since these smaller investors tend to have different reasons for investing than large investors, e.g. pension, saving for down payment or college savings. They also should possess some knowledge on how the market works, even the very fundamentals such as sell on high and buy on low. Robo-Advisors might give them leverage to do that, but it remains to be seen how smaller investors behave in a situation where S&P 500 is down by 6%, and everyone else is selling. The next couple of years will show how Robo-Advisory survives in that.

Artificial intelligence is sometimes seen as a bad thing, and against this, the writer hopes to promote the many bright sides it brings within. One aspect is to get companies and humans altogether see that they can work with artificial intelligence and make the world a better place with it.

Compliance as a whole has increased within the last ten years and this drives the use of tagged algorithms and asset allocations by AI, not only the sheer volume of data that is created will do this but the fact that companies, if not outsourcing the compliance, do not have the capabilities of handling new regulatory standards. The size of compliance teams is going to increase or at least stay the same in following years which also drives costs up. Smart usage of AI can reduce these costs in regulatory reporting and live to monitor. As these are adopted the cyber security is also a point to watch.

The regulatory problems both in the perspective of controlling individual business processes and to control AI-itself are being developed in a fast pace; these regulatory standards will determine the overall costs of AI-adopting in the overall Financial industry,

but as stated already it is on the rise. The problems might arise if smaller companies find themselves in a position where it is not possible for them to adopt new expensive platforms and they are in a sense forced out of the market. With the cost of these, we will hopefully see a more transparent and fair marketplace in the future.

Some tricky parts with implementing Artificial Intelligence is the fact that it requires much knowledge in many areas. In the financial field, it requires the basic knowledge of the financial industry but in the other, it requires a vast amount of knowledge in computer science and to gain vast knowledge in both is trick.

Because of this, the writer wants to see more evolving consulting companies working with AI or probably as middlemen between AI and Financial service companies. This means mainly for consulting companies to adopt highly trained professionals with knowledge in both fields.

Education of the existing workforce is a must and should not even be mentioned as work in the present day means, constantly evolving, not everyone does that on their selves so little nudging from the company's side is not bad. These employees still might have valuable experience that is needed in the work force even after automating processes and investment planning.

Moreover, as stated by Nelson Mandela "Education is the most powerful weapon you can use to change the world." So is the Artificial Intelligence with the help of that the world will inevitably change in both good and the bad. And I vow for the good.

6   References

Akula, A., 2017. *Capital.com's innovation: can artificial intelligence combat behavioural biases?* [Haastattelu] (4 October 2017).

Archer, S., 2017. A fund betting on robots and AI is crushing it and it's targeting millennial investors. *Business Insider*, 16 08.

Banz, R. W., 1981. The relationship between return and market value of common stocks. *Journal of financial economics,* 9(1), pp. 3-18.

Beketov, M., Lehmann, K. & Wittke, M., 2018. *Robo-Advisors: Quantitative methods inside the robots,* s.l.: CrossMark.

CGI and PATPATIA & ASSOCIATES, INC, 2016. *Beyond Robo-Advisors: Using Technology to Power New Methods of Client Advice and Interaction,* s.l.: CGI GROUP INC..

Cochrane, J. H., 1999. *Portfolio advice for a multifactor world.,* s.l.: The Center for Research in Security.

Davenport, T. & Bean, R., 2017. How Machine Learning Is Helping Morgan Stanley Better Understand Client Needs. *Harvard Business Review*, 3 August.

Davis, M. & Lleo, S., 2008. *Risk-sensitive benchmarked asset management,* s.l.: Quantitative Finance.

De Bondt, W. F. & Thaler, R., 1985. Does the stock market overreact?. *The Journal of finance,* 40(3), pp. 793-805.

Deloitte, 2017. *The 2017 Deloitte State of Cognitive Survey,* s.l.: Deloitte.
English, S. & Hammond, S., 2018. *Cost of Compliance,* London: Thomson Reuters.

Ernst & Young, 2014. *Advice goes virtual, How new digital investment services are changing the wealth management,* s.l.: Ernst & Young.

Fama, E., 1965. The Behaviour of Stock Market Prices. *The Journal of Business,* 38(1), pp. 34-106.

Fama, E., 1970. *Efficient Capital Markets: A Review of Theory and Empirical work,* New York: Journal of Finance.

Fama, E. F. & French, K. R., 1996. Multifactor explanations of asset pricing anomalies.. *The journal of finance,* 51(1), pp. 55-84.

Financial Stability Board, 2017. *Artificial intelligence and machine learning in financial services,* Basel: Financial Stability Board.

Hamalainen, P., DeBondt, W., Forbes, W. & Muradoglu, Y., 2010. *What can behavioural finance teach us about finance?,* London: Emerald.

Hanks, S., Miller, A. & Tarazi, J., 2018. *MiFID II: Life After Implementation* [Haastattelu] (10 10 2018).
Hartshorn, S., 2016. *Machine Learning, With Random Forests and Decision trees.* s.l.:Amazon Digital Services LLC.

Investopedia, 2016. *Robo-Advisor (Robo-Adviser).* [Online] Available at: https://www.investopedia.com/terms/r/roboadvisor-roboadviser.asp [Haettu 10 10 2018].

Investopedia, 2018. *Investopedia Collateralized Debt Obligation - CDO.* [Online] Available at: https://www.investopedia.com/terms/c/cdo.asp [Haettu 27 10 2018].

Jegadeesh, C. M. & Titman, S., 1993. Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of finance,* 48(1), pp. 65-91.

Jubi.ai Innovations, 2018. *Behavioral Biases, and How to Overcome Them, courtesy Artificial Intelligence,* s.l.: Chatbotslife.

Kiulian, A., 2017. *Robot is the Boss: How to do Business with Artificial Intelligence.* s.l.:Amazon Digital Services LLC.

Knowledgenet, 2018. *Problem Analysis And Decision Making Best Practices,* s.l.: Knowledgenet.

Kolanovic, M. & Krishnamachari, R., 2017. *Big Data and AI Strategies: Machine Learning and Alternative Data Approach to Investing,* s.l.: J.P.Morgan .

Markowitz, H., 1952. Portfolio selection.. *The journal of finance,* 7(1), pp. 77-91.

Mellinghoff, M., 2017. *Techfluence.* [Online]
Available at: http://www.techfluence.eu/investtech.html
[Haettu 14 12 2017].

Morgan Stanley, 2004. *Journal of Applied Corporate Finance,* New York: Morgan Stanley.

Morgenson, G. & Louise, S., 2009. Banks Bundled Bad Debt, Bet Against It and Won. *The New York Times*, 23 12, p. A1.

Morningstar, 2017. *Morningstar.* [Online]
Available at:
http://www.morningstar.com/InvGlossary/efficient_market_hypothesis_definition_what_is.aspx
[Haettu 12 12 2017].

New Construct, 2018. *Economic Vs. Accounting Earnings,* s.l.: s.n.

Oksanen, J., 2018. Katso, miten Talvivaaran osakkeiden arvo suli – tappioita pääsee vihdoin vähentämään verotuksessa. *Ilta-Sanomat.*

Pelliciari, V., 2017. *Machine Learning: Fundamental Algorithms for Supervised and Unsupervised Learning With Real-World Applications (Advanced Data Analytics Book 1).* First toim. s.l.:Amazon Digital Services LLC.

Pohjanpalo, K. & Schwartzkopf, F., 2018. Browder Laundering Complaint Shows $97 Million Nokia Payment. *Bloomberg*, 29 10.

Polli, F., 2017. *The Dark Side Of Artificial Intelligence,* s.l.: Forbes.

Samuelson, P. A., 1963. *Risk and uncertainty: A fallacy of large numbers.,* s.l.: s.n.

Sharpe, W. F., 1964. Capital asset prices: A theory of market equilibrium under conditions of risk.. *The journal of finance,* 19(3), pp. 425-442.

Stattman, D., 1980. Book values and stock returns. *The Chicago MBA: A journal of selected papers,* 4(1), pp. 25-45.

Tobin, J., 1958. Liquidity preference as behavior towards risk. *The review of economic studies,* 25(2), pp. 65-86.

Trainer, D., 2017. Why Robo-Analysts, Not Robo-Advisors, Will Transform Investing. *Forbes*, 19 July.

7 Appendix

Four last month's of trading with Talvivaara Stock

History: Talvivaara Mining Company PLC					Change period : 06/11/2014		Update
Date	**Open Price**	**High**	**Low**	**Close Price**	**Volume**	**VWAP**	**Trades**
06/11/2014		0.030	0.030	0.030	0		0
05/11/2014	0.031	0.031	0.030	0.030	3,039,235	0.030	203
04/11/2014	0.031	0.031	0.030	0.031	1,994,173	0.031	205
03/11/2014	0.031	0.031	0.030	0.030	5,834,552	0.030	477
31/10/2014	0.032	0.032	0.030	0.031	6,404,471	0.031	468
30/10/2014	0.034	0.034	0.030	0.032	5,434,606	0.032	480
29/10/2014	0.034	0.035	0.034	0.034	1,806,662	0.034	139
28/10/2014	0.034	0.034	0.033	0.034	1,842,879	0.034	151
24/10/2014	0.034	0.035	0.033	0.034	3,788,970	0.034	237
23/10/2014	0.034	0.036	0.034	0.035	2,878,953	0.035	240
22/10/2014	0.036	0.036	0.035	0.035	4,173,589	0.035	255
21/10/2014	0.038	0.038	0.036	0.036	5,140,216	0.037	318
20/10/2014	0.039	0.039	0.036	0.038	6,845,789	0.038	360
17/10/2014	0.036	0.039	0.033	0.037	5,275,013	0.036	365
16/10/2014	0.036	0.036	0.030	0.035	8,247,392	0.033	379
15/10/2014	0.037	0.038	0.035	0.036	2,825,958	0.037	224
14/10/2014	0.037	0.038	0.036	0.037	2,887,059	0.037	208
13/10/2014	0.038	0.038	0.036	0.037	1,637,998	0.037	184
10/10/2014	0.039	0.039	0.036	0.038	4,243,196	0.037	300
09/10/2014	0.040	0.040	0.039	0.039	3,981,774	0.039	258
08/10/2014	0.040	0.041	0.039	0.040	4,869,624	0.040	295
07/10/2014	0.041	0.041	0.038	0.040	6,446,611	0.040	430
06/10/2014	0.041	0.043	0.040	0.040	8,587,021	0.041	648
03/10/2014	0.041	0.045	0.040	0.040	22,103,886	0.042	1,306
02/10/2014	0.034	0.040	0.032	0.040	29,623,948	0.038	1,652
01/10/2014	0.046	0.046	0.035	0.036	55,866,215	0.039	3,329
30/09/2014	0.072	0.075	0.036	0.046	138,190,215	0.051	7,666
29/09/2014	0.062	0.065	0.058	0.060	22,706,518	0.061	1,317
26/09/2014	0.055	0.057	0.054	0.056	9,946,697	0.056	649
25/09/2014	0.057	0.057	0.053	0.053	13,443,481	0.055	384
24/09/2014	0.070	0.072	0.056	0.058	29,568,825	0.064	1,552
23/09/2014	0.053	0.069	0.050	0.067	31,065,708	0.061	1,605
22/09/2014	0.056	0.056	0.051	0.053	8,450,301	0.053	513
19/09/2014	0.055	0.056	0.054	0.054	2,707,018	0.055	250
18/09/2014	0.055	0.055	0.053	0.055	4,041,565	0.054	283
17/09/2014	0.055	0.057	0.053	0.054	5,910,491	0.055	382
16/09/2014	0.052	0.057	0.050	0.055	8,119,508	0.054	562
15/09/2014	0.060	0.060	0.053	0.053	15,303,364	0.055	824
12/09/2014	0.061	0.063	0.058	0.059	7,380,398	0.059	494
11/09/2014	0.063	0.066	0.060	0.060	8,505,104	0.063	492
10/09/2014	0.069	0.070	0.062	0.063	12,765,815	0.065	736
09/09/2014	0.071	0.076	0.067	0.069	26,619,302	0.072	1,506
08/09/2014	0.058	0.070	0.058	0.070	34,425,463	0.066	2,054
05/09/2014	0.059	0.060	0.056	0.057	5,505,848	0.058	401
04/09/2014	0.058	0.060	0.057	0.059	2,937,612	0.059	255
03/09/2014	0.059	0.060	0.058	0.059	3,981,306	0.059	322
02/09/2014	0.057	0.059	0.055	0.059	3,005,238	0.057	292
01/09/2014	0.060	0.060	0.055	0.056	7,058,712	0.057	479
29/08/2014	0.061	0.061	0.059	0.060	2,964,229	0.060	407
28/08/2014	0.063	0.063	0.059	0.059	6,612,997	0.060	614
27/08/2014	0.060	0.063	0.060	0.062	6,318,709	0.061	439
26/08/2014	0.061	0.063	0.058	0.060	13,735,395	0.060	729
25/08/2014	0.070	0.071	0.060	0.063	7,689,027	0.066	549
22/08/2014	0.071	0.072	0.069	0.069	2,572,439	0.070	244
21/08/2014	0.070	0.071	0.069	0.070	3,829,529	0.070	379
20/08/2014	0.071	0.071	0.069	0.070	2,280,501	0.070	355
19/08/2014	0.070	0.071	0.068	0.069	5,256,585	0.070	478
18/08/2014	0.070	0.071	0.069	0.070	3,592,456	0.070	559
15/08/2014	0.067	0.069	0.066	0.068	4,667,715	0.067	433
14/08/2014	0.074	0.074	0.065	0.065	8,179,847	0.068	504
13/08/2014	0.073	0.080	0.070	0.073	18,949,226	0.076	1,150

Email discussion with SP-fundmanagement compliance officer:

FW: Opinnäytetyö kysymyksiä

Virtanen Petteri (Sp-Rahasto) <petteri.virtanen@saastopankki.fi>

ti 30.10.2018 9:21

Vastaanottaja:Petteri Virtanen <Petteri.Virtanen@metropolia.fi>;

From: Harju-Nurmi Tarja (Sp-Liitto)
Sent: tiistaina 30. lokakuuta 2018 9:18
To: Virtanen Petteri (Sp-Rahasto) <petteri.virtanen@saastopankki.fi>
Subject: RE: Opinnäytetyö kysymyksiä

Hei,
anteeksi myöhäinen vastaus. Laitoin vastaukseni alle punaisella.

Terveisin,
Tarja

From: Virtanen Petteri (Sp-Rahasto)
Sent: tiistaina 16. lokakuuta 2018 14:25
To: Harju-Nurmi Tarja (Sp-Liitto) <tarja.harju-nurmi@saastopankki.fi>
Subject: Opinnäytetyö kysymyksiä

Hei,
Semmoisella asialla tässä liikkeellä että minulla olisi opinnäytetyö loppusuoralla, mutta tarvitsisin asiantuntija kommenttia muutamaan asiaan. Eli kyseessä olisi seuraavanlaisia kysymyksiä mikäli aikaa löytyisi näihin vastata (kysymykset siis englanniksi voin nämä kääntää jos tarvetta):

How would you see that the financial regulation implemented in the past few years such as MiFID are going to affect financial sector players to adopt new regulatory and compliance practices and platforms? Sääntelyn määrä on ollut valtava ja se on vaatinut toimijoilta paljon resursseja (työtä+rahaa), mutta myös tulkintaa sääntelyn sisällöistä ja varmaankin myös oman riskinottohalukkuuden arviointia. Compliance rooli kasvaa, sääntelyn kasvaessa. Liiketoiminta tarvitsee Compliancea tulkitsemaan ja avustamaan uuden sääntelyn implementoinnissa. Compliancen valvontatehtävät myös kasvavat.

What challenges do you see in such laws as Germany's HFT act that financial sector companies should take into consideration when adopting Artificial Intelligence into their processes (trading, customer service compliance etc.)? Oletan, että HFT = High Frequency Trading. En tunne Saksan sääntelyä, joten en osaa ottaa kantaa siihen erityisesti. Yleisesti näen HFT-kaupankäynnin jossain määrin eriarvoistavan sijoittajia, pienet sijoittajat eivät kykene "kilpailemaan" suurten sijoittajien kanssa. Jos Saksassa on asiaa lain tasolla säännelty, vaikuttaa se minusta hyvältä asialta, mutta onko asian sääntely lailla oikea ratkaisu vai voisiko asian hoitaa esim. kauppapaikkojen itsesääntelyllä, en osaa tähän ottaa kantaa. HFT:n ohjaaminen sääntelyllä on varmasti haasteellista, koska alla oleva tekniikka kehittyy kokoajan, eikä sääntely ole yhtä ketterä kuin tekninen kehitys. Haasteita tähän liittyen on kauppapaikoilla, arvopaperinvälittäjillä ja suurilla sijoittajilla, eivätkä nämä haasteet varmaankaan ole samoja näillä eri toimijoilla.

Jos näihin vastaaminen onnistuu niin kysyn luonnollisesti mahdollisuutta siteerata varsinaisessa lopputyössä mikäli se on mahdollista muussa tapauksessa voin ehkä myös anonyymisti tämän tehdä mutta se minun tulee varmistaa koulun puolesta.

10/30/2018 Sähköposti – Petteri.Virtanen@metropolia.fi

Ystävällisin terveisin

Petteri Virtanen
Hallinnon Asiantuntija

Säästöpankki

Säästöpankkikeskus
Sp-Rahastoyhtiö Oy
Teollisuuskatu 33
00510 Helsinki
Puhelin: +358 50 571 6068
Fax: 010 436 6449
petteri.virtanen@saastopankki.fi