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Automated Trading Systems VS Manual Trading in Forex Exchange Market

Marli Damião Abade Nunes

Dissertation presented as partial requirement for obtaining the Master's degree in Statistics and Information Management

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ABSTRACT

In the recent decades, automated trading has been widely used in Forex and Money Markets, as well as in financial markets. This auto trading provided substantial benefits to transaction efficiency. Many trading robots have been created to substitute humans, capable of simulating trading strategies and continuously making profits. Nevertheless, programs cannot reproduce all human behaviour and most robots are over-sensitive, therefore, it is difficult to have the same results as human traders. The study focuses on evaluating the trading machines sensitivity and effectiveness. The economic markets can benefit from the machine in several ways, through continuous operation, increasing diversification, short/term trading opportunities and by forecasting opportunities e. g. currency price changes.

The further investigation indicates that the majority of forex trading robots are profitable, in fact, there is a great tendency for curve-fitting or data-mining. There are some impressive robots out there; of course, these systems maintain an advantage and successfully manage risk. The best ones are more about position sizing and cutting losses quickly and less about high win rates. The greater the sensitivity the greater the trading opportunities, but this decreases the performance.

This research will contain interviews with experts that will validate the study.

KEYWORDS

Forex Exchange Markets, Technological Edge, Manual Trading, Human Behaviour, Effectiveness and Sensitivity

INDEX

FIGURES INDEX

TABLE INDEX

1. INTRODUCTION

First, the ECN (Electronic Communication Network) was created, which allowed brokers to publish offers and sell stocks even after business hours. In 1971, the association that would change the financial market was created - National Association of Securities Dealers created the National Association of Securities Dealers Automated Quotations, or NASDAQ that practically just put bids and offers on an electronic bulletin board. Subsequently, the New York Stock Exchange (NYSE) formed a Designated Order Turnaround (DOT) system that allowed brokers to direct stock orders directly to the trading specialist, ignoring trading brokers. The 90s were the great revolution on the trading markets with more powerful computers and upgraded internet.

In the early 2000s, computers started to choose the timing, pricing and quality of trades - High-Frequency Trading, due to faster hardware and the creation of high-level algorithms.

"Forex market is the largest market in the world with an average trading value over $5 trillion per day." (Lfcmarkets, 2011).

It does not have a centralized market where dealings are directed; instead, it is carried out electronically over the counter (OTC), by computers, traders and other market participants around the world.

Currently, forex trading is performed mainly by trading robots that are coded as programs and can place transactions, following the signals. This way we get a fast reaction to the oscillations of the market, since human traders tend to waste time evaluating the markets and then making the decisions. The robots can take advantage of many opportunities by saving time and by avoiding the psychological factors of human traders, such as greed and fear.

1.1 BACKGROUND AND PROBLEM IDENTIFICATION

"Technological change has revolutionized the way financial assets are traded. Every step of the trading process, from order entry to trading venue to back office, is now highly automated, dramatically reducing the costs incurred by intermediaries." *(The Journal of Finance, 2011)*

Algorithmic trading (AT) lowers companies cost of capital due to improving risk sharing, hedging, liquidity and provide prices more competitive. AT is now used to send orders, make decisions and monitor the same orders. Institutional investors use algorithms to trade large quantities of stocks, and usually control the price, timing, quantity and routing of orders.

However, the growth of this type of trading has direct impacts on the markets, such as the massive activity produced by the algorithms, overloading exchanges, and market data providers. This impact imposed the quick improvement of the infrastructures. The question is, is it worth investing more in automated trading? Is it more efficient and profitable?

Manual trading requires constant reading, updating and monitoring of the market, in addition to a clinical look and emotional control, and also, it requires that the trader be in person operating on the platform. In Automated trading the software automate the tasks of operating the buy and sell, in place of the human trader. However, it is necessary to configure the robots so that they execute the commands within a strategy defined by the trader.

In the further research, the above questions will be analysed, seeking the advantages and disadvantages of manual trading versus automated trading. With the AT/ robot trading growth, the liquidity in equity markets highly improved. But we can't conclude immediately that it was directly due to the same. Nevertheless, the effects can be reversed if the algorithms are used mainly to demand liquidity. In fact, AT can lead to underperformance, as both suppliers and liquidity seekers invest in better algorithms to try to take advantage.

So far, we can highlight the main pros and cons in this early stage of the research:

PROS	CONS
Reduce emotional trading;	Mechanical failures;
Permits back testing;	Requires the monitoring of functionality;
Preserves the trader's discipline;	Can perform inadequately.
Allows multiple accounts.	

Table 1 – Automated trading Pros and Cons

In sum, as the electronic trading increased, new trading strategies effectively implemented by computers emerged which include trend following, arbitrage and regression by control several markets and studying the past records.

1.2 MOTIVATIONS AND JUSTIFICATION

"Forex algorithmic trading strategies have also brought to life several other trading opportunities that an astute trader can take advantage of." *(TradingStrategyGuides, 2019)*

The world of financial trading changed significantly, as technology has been growing and also as the internet era has been taking place. The transaction efficiency benefited from the application of robots. The FX traders want to develop trading robots because they do not want to waste their personal time or do anything manually. Unlike humans, some computers are able to scan numerous charts, and this way they regulate when to trade or not to trade. The best robots are those that suggest solutions for profitable opportunities even in uncertain markets, and when the actual trending is to go down, in this case, computers will define the best strategy to enlarge profits and avoid possible losses. Nevertheless, the same could lead to loss after loss, although they trade within a certain range, make a particular number of pips (incremental price movement) inside the fitted range, throughout the slowest time on the Forex market, and they recurrently set a limited pip targets, and might not even use a stop-loss. The objective is to try to make profits in each trade, even if it is only a few.

We can highlight two main difficulties of this analysis - applying the fundamental analysis to robot programming and the simulation problem. This is because markets are defined by economic events, therefore, this data is difficult to code as MQL4 to reproduce human behaviour. Also, it is difficult to code human complex behaviours into trading machines.

The above challenges will change the results and decrease the effectiveness and the gains of robots. This research will be concentrated on testing trading robots and scrutinize and explain the pros and cons of robotic trading and in which way we can improve it.

The rationale of this study includes the algorithm of trading robots, data analysis and searching for improvements. The other factor that can highly influence the trading robots is noise. Market noise represents all price data that misrepresents the picture of the underlying trend due to small corrections and intraday volatility. There are strategies to combat the robots and predatory algorithms. One option for retail investors is to identify an acceptable level of discretion outside the posted bid/offer spread and avoid the noise in the quote. This could mean placing limit orders outside the bid/offer, and paying up an extra when buying to secure execution without being adversely affected by the speed of High-Frequency Traders.

The general tendency during the past decades has been towards markets more and more technology driven, this because it helps reducing transaction costs and risk, decreases bid/ask spread expands entry speed and rises trade control. It can be easily perceived that trading has a very important role in the financial market and that is why it is a subject that deserves to be studied.

This study can be useful and add value to the trading market, and the interested parties such as big institutions and smart money that are the most proficient algorithmic traders. Algorithms for market making are used by investment banks, Hedge funds, prop traders, pension funds and broker-dealers.

1.3 OBJECTIVES

This investigation aims at outlining the effectiveness and significance of automated trading, comparing it with human trading, and analysing the several impacts in the financial markets, especially in Forex and Money Markets. To perform this research will be evaluated the different factors that affect trading performance and investment returns, whether IT limitations or trader´s psychology.

- How can the effectiveness of the trading robots be evaluated?
- How can robots adapt to the constantly changing markets?
- What is more profitable, human trading or robot trading?

The answers to these questions are as follows:

Effectiveness and sensitivity of trading robots: As aforementioned, robots through programming are capable to start and trade positions. Its effectiveness, on the other hand, is rated based on the market prices and the specific setup installed on the computer which limits trading opportunities. This is because of two main reasons:

a) Computer programs cannot replicate all the human behaviours or all the mathematical algorithms. ***"Custom indicator is a technical indicator written independently in addition to those already integrated into the client terminal. Like built-in indicators,***

they cannot trade automatically and are intended for implementing of analytical functions only." *(MQL4 Book, 2011);*

b) Decrease of the percentage of profitable orders and the trading performance due to trading robots noise.

Capacity to adapt to market changes: The major handicap is that despite being able to perform several tasks they cannot give judgments within an economic or financial change nether be creative as the robots based on historical data. So, the robot can make more money but also close one position. Its incapability to respond to changes means that it can respond to incorrect information. The benefits from the Forex trade robot are limited.

Human and robot trading financial results: based on the specifications of the trading strategy installed in it, the computer can manage the markets to find buy or sell opportunities. Protective stop losses orders, trailing stops and profit targets will be generated automatically. In rapidly changing markets, this can be very important because it prevents giant losses, considering that the oscillations move against the trader.

2. LITERATURE REVIEW

In this chapter, Forex and Money and Markets as well as Software Automation will be deepened and will serve as a support for the rest of the case study.

2.1 FOREX AND MONEY MARKETS

2.1.1 Overview & concepts

Forex and money markets, FXMM, foreign exchange, FX, or currency trading is a decentralized global market where all currencies in the world are exchanged. This market is largest and most liquid financial market worldwide. Comparing with the stock market is a lot higher. Differences in exchange rates are determined by demand and supply, which in turn determine traders' gains. (Brown, 2015)

"Forex transaction: It's all in the exchange." (Fxcm, 2020)

David Bradfield indicates that we can trade currency like stocks/futures/options, based on predictions of the future but the exchange rate fluctuates continuously. In Forex we can trade up or down just as easily. The rationale is to buy it if currency is expected to increase in value and to sell it if currency is expected to decrease.

Additionally, Bradfield stated that, with such a large market, finding a buyer when is to sell and a seller when is to buy is much easier than in other markets. This gives very good liquidity, which means if the trader wants to buy or sell any top currency pairs, there are many opportunities. Also, with this volume on the daily basis, one average trader has absolutely no chance of inducing market direction.

Forex trading is a 24-hour market that only closes from Friday night to Sunday night. (Bradfield, 2019)

In the next table, we have the most important concepts regarding FXMM:

CONCEPTS	DESCRIPTION
Spot market	In contrast of the futures market, in which delivery is due at a later date, on the Spot market the delivery of financial instruments or commodities is immediate. It is a public financial market that can be through an exchange or OTC – over-the-counter. (Brown, 2015)
Forward market	The delivery of financial instruments in this market is in the future but the price is established in advance. This market also known as the foreign exchange market, trades securities, commodities and interest rates. (Brown, 2015)
Hedgers	Exporters and importers, firms, governments and some private investors. Someone using the traded item. (Hull, 2015)
Speculators	Group of people (traders or investors/ banks, corporations, funds and individuals) that take advantage in order to profit from the price volatility. They usually purchase assets for short periods of time and are important to markets because they provide liquidity and take market risk. (Hull, 2015)
Currency Pairs	Currencies are always traded in pairs and are recognized by a three-letter code. (Brown, 2015)
Bid and Ask or Buy or Sell	The Bid (sell) represents the price that a buyer is willing to pay for a currency/ financial instrument. For instance, the price that an individual can sell the USD and buy the EUR. The Ask (buy) is the amount a seller is willing to sell a currency / financial instrument. (Hull, 2015)
PIP	Is the last decimal point exposed on a rate. (Brown, 2015)
Orders - Stops and Limits	Market order is defined by the capacity of anyone being able to enter the foreign exchange markets at the market rate / price. When someone enter the market at a future rate is called as Stop Loss or Limit Order. (Brown, 2015)
Trailling stops	It is an active stop loss that does not let approach the market price and thus ensures less risk. (Brown, 2015)
Hedging trades	It is a reverse trade that is a trade with the opposite direction of a specific transaction. This does not close the position, however, has the same result. (Hull, 2015)
Rollovers	When a position is automatically rolled or swapped to the next business day. By rolling over the position the settlement date will be extended. (Hull, 2015)

Table 2 - Forex and Money Markets concepts

2.1.2 Financial Instruments

- **SPOT**

According to John C. Hull, Spot trading being one of the most usual types of forex trading is a two-day delivery contract, except in several currencies, unlike futures contracts that are normally three months long. This trading characterises a “direct exchange” between two currencies, where a Forex broker will often take a small fee - identified as a "swap fee" - from the client to transfer the oldest transaction to a new and identical one for further trading. (Hull, 2015)

- **FORWARD**

Is a non-standardized tailored contract between two counterparties to buy or sell an asset at a specified price on a future date and can be used for hedging speculation. Forward transactions are traded over-the-counter (OTC), the counterparty that agreed to buy the underlying asset in the future takes a long position and the one that agreed to sell takes a short position. (Hull, 2015)

- **NON-DELIVERABLE FORWARD (NDF)**

NDF used in foreign exchange and commodities is a futures contract in which parties settle the difference between the rate/ contracted NDF price and the principal rate/ spot price on an agreed principal amount. The periods can be from one month to one year. (Steiner, 2002)

- **SWAP**

SWAP is a type of forward trade in which two counterparties exchange cash-flows for a specified period of time and agree to reverse the transaction at a future date. An FX swap is traded over the counter, and can be used to hedge risk (interest rate risk and currency risk), which allows companies that have funds in different currencies to control them more efficiently. (Hull, 2015)

- **FUTURES**

Is a contract that obligate the counterparties to exchange one currency for another at a fixed future date and price agreed on the trade date. This contracts are standardized to facilitate the exchange and are daily settled eliminating credit risk from Forwards. (Hull, 2015)

- **OPTION**

Is a derivative financial instrument that provides the right but not the obligation to exchange one currency into another currency at a pre-agreed strike price, prior to the expiration date. The options market is the largest and most liquid in the world. (Hull, 2015)

2.1.3 Challenges & opportunities

According to Petr Tucnik, Robotic trading can be both positive and negative for traders. There are some risks associated with this type of trading but there are, also, many benefits that can make this activity, lucrative and attractive. Forex trading is a flexible, accessible and potentially profitable activity. However, this type of trading faces some major challenges which are volatility**,** Lighter Regulatory Protection, and Fewer Residual Returns. This market being open 24 hours a day/5 days per week, is one of the most accessible markets for individual traders. The access to this market can provide leverage that can lead to considerable gains. The Forex market is rapidly evolving and has great liquidity which offers potential for Fast Returns. Forex trading adapts very well to automated trading approaches. Traders can program entry, stop-loss, setup automated trades and limit prices to train the platform to trade on certain price oscillations or other market circumstances.

In addition, we can enumerate some advantages of this type of trading such as technical strategy, less tendency for insider price manipulation, fewer tax rules, and simple tax rules. Also, another advantage is objectivity because it is difficult to remain objective with massive amounts of capital, particularly in forex market that is very volatile, as so automation takes emotions out and uses data/ trades more objectively. Back testing is another important advantage that refers to the procedure of analysing a specific trading strategy using past data. This process allows traders to improve their strategies based on the historical events.

On the other hand, traders can handle with some adverse factors that may make successful trading more challenging than it appears at first. Tech dependence, because automation and automated software are not infallible. For instance, a slow internet connection can be catastrophic, as so it is crucial that trading occurs in a fast environment and a reliable software/ hardware. Overfitting can be enumerated as a big disadvantage because it means generating statical model with more data than is required. Trading algorithms tend to be fed with too much former information. Traders can be exposed to unexpected volatility at times, due to their hope of making short-term profits, which can be unprofitable. The forex market is an OTC market, thus, as Lighter Regulatory Protection and Fewer Residual Returns. Overnight forex positions can yield interests. (Tucnik, 2010)

2.1.4 The trader role

Foreign Exchange Trader is in charge of the timely buying and selling of foreign currencies. (Corgnet, 2019)

Traders main responsibilities are:

- Finding and executing potentially profitable trades;
- Adhering and developing to responsible trading strategies that minimize loss;
- Building optimistic relationships with brokers and other industry players;
- Researching market settings and keeping well-informed of any external factors that might affect currency rates, whichever negatively or positively;
- Meeting profitability goals.

2.2 SOFTWARE AUTOMATION

2.2.1 – Concepts

Two forms of trading can be highlighted: Manual and Automatic. Manual trading is when a user manually opens and closes trades in the trading platform, whereas, Automatic trading, is when a software program executes repetitive tasks at speed orders on pre-set rules for entering

and exiting trades. Automated trading systems (ATS) determine when an order should be placed based on historical events, for example, the current market price. (Tucnik, 2010)

Artificial intelligence is becoming a main component in emerging trading strategies for hard-to-predict markets. It trades according to a inscribed algorithm and continually gathers and processes massive amounts of data, analyses events and trends, and makes choices itself. To place a trade, algorithmic trading uses a computer program which follows an algorithm that is a well-defined set of orders. Trading can generate returns at an unbearable speed and frequency for a human trader. (Tucnik, 2010)

The most important algorithm concepts are:

CONCEPT	DESCRIPTION
Percent of Volume (POV)	It is a strategy created to control transactions execution by levelling a percentage of market volume. The key is to stay as close as possible to the stated POV rate. (Leave, 2015)
Pegged	Set of a certain fixed rate for a currency of a certain country paired with a foreign currency. This is defined by a national government for a currency or a group of them. (Ganti, 2019)
Volume-weighted average price (VWAP)	It is a trading target used by traders that provides the average price a financial instrument has traded usually during one day, based on volume and price. The ratio between the value traded and the total volume usually in one day. (Gronowski, 2019)
Time-weighted average price (TWAP)	In a specified time, VWAP is the average rate of a financial instrument (i.e. security). (Gronowski, 2019)
Implementation shortfall	Including commissions, taxes, etc, it is the difference between the final execution rate and the decision rate. (Waelbroeck, 2020)
Target Close	It is a strategy that defines the ideal start time on the closing price for a trade based on prior volumes and real-time conditions. This controls the market impact. (Waelbroeck, 2020)

Table 3 - Software automation concepts

2.2.2 - Types

An algorithm is defined by a set of orders for solving a problem or finishing a task. All electronic device uses algorithms to perform its roles. All electronic device uses algorithms to perform its purposes.

Nowadays, the most used algorithm is high-frequency trading (HFT), which, according to Irene Aldridge, tries to capitalize on placing a large number of orders, on pre-programmed instructions, at various decision parameters based and fast speeds in various markets. (Aldridge, 2009)

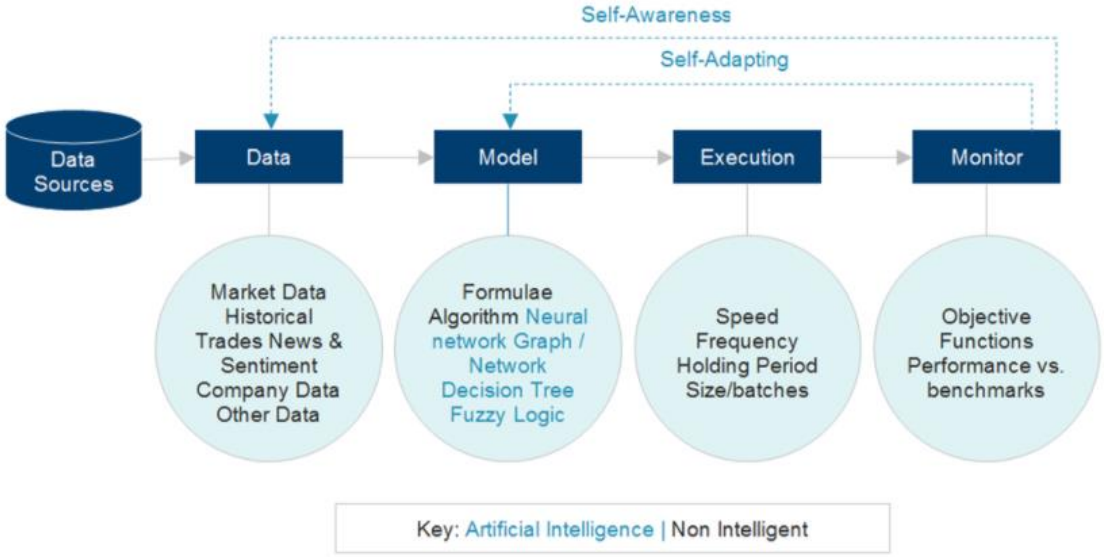

Figure 1 - Conceptual model of algorithmic trading. Source: (Seekingalpha, 2019)

Types of algorithm trading:

- **Trade execution algorithms**

Also known as TEA, alleviate slippage by 'shredding' orders into smaller portions and slowly releasing these into the market, and so, minimising the price impact of performing high volume trades. (Johnson, 2019)

- **Strategy implementation algorithms**

Trade execution algorithms frame trading signals and read real-time market data. When some pre-specified tolerance levels are exceeded, the strategy is to automatic quoting, searching for arbitrage opportunities, hedging in a market maker-type role, and producing trading signals from technical analysis. This can cause portfolios to have to be automatically rebalancing. (Johnson, 2019)

- **Stealth/gaming algorithms**

Large trades filled cause price movement that provides advantage. This is, also, used to detect and perform other algorithmic approaches. (Johnson, 2019)

- **Electronic market making**

Strategy that copies the outdated role market makers previous played. These approaches, also known as Passive Rebate Arbitrage, earn the bid-ask spread by making a two-sided market aiming at profiting. (Johnson, 2019)

- **Statistical arbitrage**

When traders trade-off of the imbalances in the correlations, that is, associate prices between securities. (Johnson, 2019)

- **Liquidity detection**

Involves the use of algorithms to identify large orders existing in a matching platform. Traders could repeatedly submit small-sized orders to detect large institutional investors orders. When a small order is filled quickly is likely to be a large order behind it. (Johnson, 2019)

2.2.3 – Software agents (AI)

Marvin Lee Minsky, that is one of the inventors of Artificial intelligence, describes it as “the construction of computer programs that engage in tasks that are, for now, more satisfactorily accomplished by humans because they require high-level mental processes”.

As stated by Djohan Wahyudi, a software agent is a computer program that acts for an operator or other computer program in a relationship of agency. The "action on behalf of" implies the authority to choose which, if any, action is suitable. In detail, it is a computer program that works on behalf of another entity, without continuous management or direct control, towards goals in a dynamic environment, probably for a long period of time. It exhibits a substantial degree of flexibility and even creativity in how it seeks to transform objectives into actions. Agents are robots that may be independent or work together with other people or agents. They should produce Ask and Bid orders, take the decision based on the algorithm being used. On the other hand, Algorithm will have access to all the necessary data (Time, Price, Order), to give results to agents and produce the decisions (Buy, Sell or Do nothing).

An agent can be defined as a software and/or hardware which is able to act independently in order to complete tasks on behalf of its user. (Wahyudi, 2011)

The agents may be classified in many dimensions (Wahyudi, 2011):

1. mobile or static agents;
2. reactive or deliberative;
3. agents could be classified along with some ideal and primary qualities which agents should display, such as, cooperation, autonomy and learning;
4. agents may sometimes be classified by their roles - information agents, e.g. world wide web (WWW);
5. hybrid agents associate two or more agent ideas in a single agent.

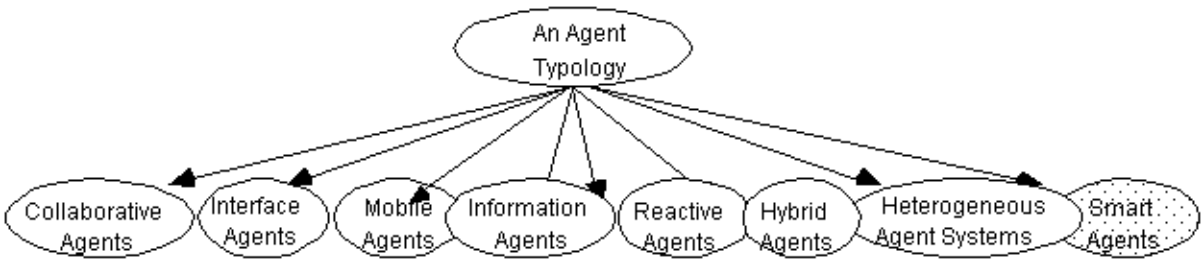

Figure 4 - Types of Artificial Agents. Source: (Knijff, 2010).

The use of AI is rising in the retail market but most traders still use the older methods of the mid-twentieth century, which are easier to learn and more practical to use, for example, traditional technical research.

A disadvantage of AI-based trading strategies is that they can generate models that are inferior to random ones. Traditional technical research is an unsuccessful method of trading because strategies based on the charts outlines and indicators derive their revenues from a distribution with a zero mean before any transaction charges. (Wahyudi, 2011)

2.2.4 – Robotic Process Automation (RPA) & Hyper

As claimed by Richard Murdoch, Robotic process automation (RPA) is the use of software robots to mechanise extremely repetitive, monotonous tasks usually performed by a user. This type of tasks saves time and money. By implementing tasks quicker, allowing employees to accomplish higher-value work, robotic process enlarges the value of an automation platform. (Murdoch, 2018)

In addition, just like humans do, RPA robots use the user interface to identity data and manage applications. To perform a diversity of repetitive tasks, they take, activate responses, and connect with other systems. Only significantly improved: an RPA software robot makes zero mistakes and works 24 hours/ 7 days a week.

RPA permits organizations to automate their systems that in turn reduce cost and time. Robotic Process Automation leverages the current infrastructure without causing break to underlying programs, and is also characterized as non-intrusive, that would be problematic and expensive to substitute. With RPA, the operating cost stop existing because of cost efficiency and compliance become a by-product of automation. (Murdoch, 2018)

On the other hand, according to Matt Calkins, Hyper automation is the use of advanced technologies to mechanise tasks that were once done by humans, such as artificial intelligence (AI), machine learning (ML), and robotic process automation (RPA). Hyper automation is not designed to completely substitute humans. Somewhat, through automation, humans can focus on tasks that are of a higher value to the organization because they are freed from repetitive and low-value tasks. Composed, automation and human involvement while reducing operational costs and growing profitability, helps organizations to offer superior client experiences.

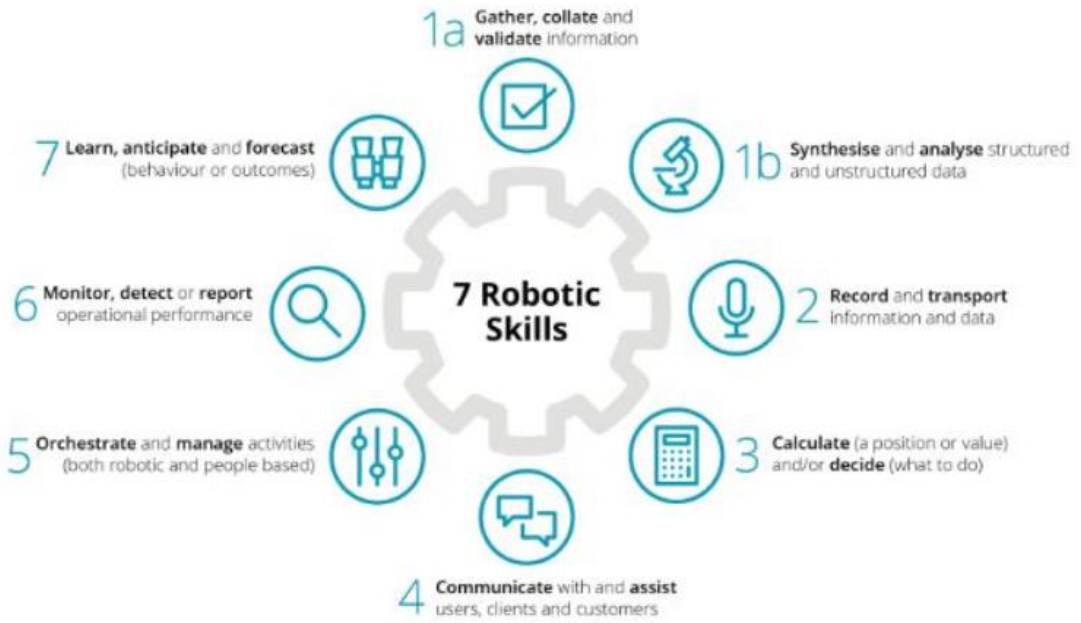

Figure 7 - Robotic Skills. Source: (Deloitte, 2016)

➔ HOW DOES ROBOTIC PROCESS AUTOMATION WORK?

- Log into any application;
- Connect to system APIs;
- Copy and paste data;
- Move files and folders;
- Process and extract structured and semi-structured content from papers, PDFs, emails and forms;
- Read and write to databases;
- Open emails and attachments;
- Scrape data from the web;
- Make calculations.

The key for hyper-automation is, actually, the capability to embrace humans in the digitization process. (Calkins, 2020)

In sum, the benefits of RPA solutions go far beyond cost savings and include:

- Reduced cycle times and improved performance;
- Flexibility and scalability;
- Increased accuracy;
- Better customer / employee experience / satisfaction;
- 24/7 availability.

2.2.5 - Software automation in Forex and Money Markets

In the opinion of Jasuli Suliadi, Automated Forex trading software in order to make trading decisions based on currency price charts, economic news and events, spread fluctuations, and other market activity - scrutinises market information. The software categorises trading signs and creates a buying or selling alert based on those values, by studying the previous data and using standards that have been set by the trader. (Suliadi, 2019)

In sum, the purposes of Forex auto trading software include:

- Analysis of the Market, as technical and fundamental analysis;
- Risk management - limit the size of open positions and manage them;
- Execute trades automatically, when the conditions are met;
- According to the specified conditions - close and open positions (reversal, take profit, stop loss...).

In recent years, the application of high-frequency trading (HFT) has increased considerably and drives a significant part of the activity in the U.S markets. While many HFT strategies are authentic, some may be used for trading fraud. If a strategy creates deliberate disturbance in the market or tries to manipulate the same, it would be illegal. Such strategies consist of "momentum ignition strategies": a market member places a non-genuine order on one side of the market (for instance, above the offer or below the bid) in an attempt to attract other members of the market to react to the non-genuine order and then negotiate with additional orders from the other side of the market. These is also defined as abusive/predatory strategies. Given the

scale of the potential effect that these practices may have, the investigation of abusive algorithms is a high priority for regulators. The Financial Industry Regulatory Authority (FINRA) has urged companies that use HFT strategies and other trading algorithms of their responsibility to ensure that the strategies do not result in predatory trades.

While the forex market is moving towards a new electronic age, institutions and traders are increasingly turning to software products that help them better manage the market and act without human intervention. This way, they have more time to create really important profitable trading strategies. This automation process still has a long way to go before the software can replace the flexibility of experienced traders. Traders accustomed to the manual system treat automated trading systems with great contempt, who are sceptical about how automated systems work. They protest that the forces of supply and demand in the market are no longer being used in determining prices. Other sections of traders, especially in the derivatives market, suggested that a regulatory framework should be implemented to reduce the risks associated with the malfunction of automated trading systems. (Suliadi, 2019)

Figure 10 - Rise of High-Frequency Trading. Source: (Hall, 2014)

3. METHODOLOGY

This research aims to analyse the advantages and disadvantages of Algorithm trading and see if there is any form of improvement. For this, we will study the data provided by BNP Paribas and scrutinize possible problems or added value. After that, we will be able to determine the improvement points. As so, for this purpose, a qualitative approach will be directed to this research, the case study method. This project ends with the case discussion that have still been validated through interviews to experts in the area (chapter 5).

3.1 CASE STUDY METHODOLOGY

"The case study is but one of several ways of doing social science research (…) The case study is used in many situations to contribute to our knowledge of individual, group, organizational, social, political, and related phenomena. (…) Allows investigators to retain the holistic and meaningful characteristics of real-life events." - (Yin, 2014)

When to use each strategy? The most important aspects to take into account are (a) the level of control an investigator has over real behavioural procedures (b) the type of research question placed, and (c) the level of focus on present whereas to historical events.

In sum, the most important condition for discriminating between the several research strategies is to identify the type of research question that is being asked. Defining the research questions is probably the most important step to be taken in a research study. For the case study, that is when the question "how" or "why" is asked about a set of present events in which the researcher has little or no control.

Types of research questions:

Strategy	Form of Research Question	Requires Control of Behavioral Events	Focuses on Contemporary Events?
Experiment	how, why?	Yes	Yes
Survey	how, what, where, how many, how much?	No	Yes
Archival analysis	how, what, where, how many, how much?	No	Yes/ No
History	how, why?	No	No
Case study	how, why?	No	Yes

Table 5 - Different Research Strategies. Source: COSMOS Corporation.

The main objective among the types of case study is to clarify a decision or a set of conclusions: how they were applied, why they were taken, and with what result. (Schramm, 1971).

It is intended to analyse BNP Paribas through a case study - an empirical investigation that deals with the technically distinct situation in which there will be many more variables of interest than data points. Data gathering is a fundamental stage of the study. By interviewing the traders from BNP Paribas, we can gather information to study/ analyse and take some conclusions whether automated trading is best for the bank or even for themselves.

3.2 CASE STUDY APPROACH DESIGN

A case study based on an already optimized trading algorithm from BNP Paribas, will be used to reveal how important the risk level optimization is, in order to improve the efficiency of the trading software. The profit maximization and the minimization of the allocated risk are as usual the main optimal criteria, but these two requirements are not enough in this case. Since the Banks have nearly the same structure, by studying one, we can adapt to all.

The methodology will follow in the diagram below:

Figure 13 – Methodology design. Prepared by the author

For the purpose of the case study method, the steps that are intended to be accomplished can be stated as follows: Determine Forex and Money Markets and Software automation concepts; Investigate types of products /areas/ Software automation; Define Software agents (AI). These

steps are detailed in the Literature Review and will be the cornerstone for this study. The research questions proposed will be validated through individual interviews with experts.

It is intended to analyse the results and conclusions and evaluate the possible factors to improve the robots to increase profit and effectiveness. Furthermore, through the case study inquiry three types of data will be collected, such as internal parameters, performance data, and transaction data. These indicators allow us to measure the performance by filtering the most important indicators: income, triggering events, trading times, order amounts, frequencies and order size. Analysing charts will also be, a very important phase of the study.

The literature review will be used to support the case study, which will be conducted with the following factors that involve trading automation:

- Forex and Money Markets:
    - Financial Instruments;
    - Challenges and opportunities;
    - Trader role.
- Software Automation:
    - Software Agents (AI);
    - Software automation in Forex and Money Markets.

3.3 INTERVIEWS AS METHOD FOR QUALITATIVE VALIDATION

One-on-one interviews will be conducted with specialized traders from BNP Paribas. This type of interview, called qualitative interview, is a more individual from a research related to questionnaires. The interviewer can enquiry follow-up research questions of the interviewee. Quantitative interview is also named as in-depth interviews, where questions are open, are considered semi-structured because the researcher has a specific topic for the interviewee. The main importance is to hear what interviewees think is important about the topic at hand and to hear it in their own words.

The interviewer typically develops a guide in advance that they can mention during the interview. Respondents are requested to provide answers in their own words and to raise their points of view, so each interview is likely to be unique.

There are many types of interviews such as: Topical interview; Life histories; Evaluation interviews; focus group interviews; cultural interview and qualitative interview. In this particular case, the qualitative interview is best suited to my study.

4. CASE ANALYSIS

In this chapter, the topics studied in the literature review will be analysed and then discussed in the next chapter, as well as, validate them through interviews with experts.

4.1 BNP PARIBAS – BRIEF PRESENTATION

The Bank that will be studied is the world's 8th largest bank, currently operating in 72 countries by total assets. Also, it has a great presence in the forex market sector. Through its corporate and institutional banking division, BNP Paribas is one of the leading global Foreign Exchange (FX) liquidity providers. The bank is registered on Euronext Paris and a component of the Euro Stoxx 50 stock market index, while it is also included in the French CAC 40 index. The bank is present on five continents with retail and investment banking operations. BNP Paribas, following in the path of many other leading financial institutions, has launched its latest attempt to capture a significant share of the online forex market. As so, it’s a great model to study the advantages and disadvantages of automated trading.

This Bank uses several automated platforms on the daily basis to trade forex, such as, Cortex. The Bank takes a flexible approach by leveraging internal resources, the Fintech sector and academic institutions. They also, create a platform very customisable and user-friendly format, dedicated to offering clients a venue to trade all FX-related.

The bank provides liquidity that can support large transactions in foreign exchange and treasury management also as hedging of currency risks. BNP Paribas provides FX solutions that support clients that manage their forex deals or clients who outsource/automate components of their currency trade flows.

Through the global forex dealing desks in Paris, London, Dublin, Luxembourg, New York, and Sydney, BNP Paribas provides global coverage for FX clients in the various major forex trading hubs. Using multiple FX platforms, clients can obtain forex rates electronically or through telephone (voice brokers). BNP Paribas presents several forex tools such as:

-FXLink - exclusive trading tool;

-Tools in association with other external platforms, for instance, FX Connect, FXAll360T, Bloomberg FXGO.

4.1.1 Automated Platforms

BNP Paribas has developed what it terms the fourth-generation algorithmic software that are capable of providing access to all the data used by the strategy during trade executions. This is intended to put maximum control of the whole process in the hands of the trader.

The algos also perform the following purposes:

-Trade system of measurement such as market depth, liquidity and trade conditions, present in a graphical manner,

-Offers a cost breakdown of the several methods of trade performance for each exact trade.

This permits users to perform their trades in the greatest conditions at the most cost-effective rates.

The most significant trades are dealt with CORTEX FX which is an electronic multi-product FX trading system. BNP Paribas offers access to a range of products, tools, and services due to their cutting-edge trading technology. CORTEX FX employs a fully-integrated trading atmosphere that gives the autonomy to focus on taking advantage of every trading opportunity and is simple to use. This platform offers access to real-time pricing for FX forward, spot, NDF and swap pricing, and as well, permits to perform and manage a variety of order types, and also, Stop Loss, Take Profit, If Done and Repeat and OCO. This platform, also, has the ability to amend, pause or cancel all orders by using a trade blotter.

Other significant platforms can, also, be listed:

- **CORTEX**- It's a FX spot algorithm execution service from BNP Paribas which arranges real-time analytics and interactive algorithms delivered via an artificial intelligence-based digital trading assistant, known as 'ALiX', that provides a range of "adaptive" strategies.
- **SMART DERIVATIVES** - Web-based system to trade equity and commodity derivatives. It lead investors from market forecasts to prices and trading in a personalized environment.
- **EBS PRIME** - Through a prime brokerage connection, this platform extends the capability to trade in the principal spot FX market to other bank and non-bank professional traders, including hedge funds.

- **ORCA-DIRECT** – This platform provides an ideal routing control algorithm by computing a variety of liquidity sources, such as, ECNs, futures and the bank's principal price. It analysis in real-time, using historical trading data to sort he best liquidity for the bank's client, when volatility increases.
- **NDF ALGO TRADING –** NDF ALGO trading platform has used simple TWAP, but the BNP Paribas algos standout because of its ability to self-adapt and react to the market in real-time. This platform is perfect for NDF market because of liquidity is very volatile and unexpected, but BNP's platform can adapt to varying market conditions.
- **FXALL –** it is a trading platform very flexible which gives users access to valuable data and smart tools. It deals forwards, spot, NDFs, swaps, and options. Also, offers the choice, agility, efficiency and confidence to users providing them with liquidity access to straight-through processing.
- **FXCONECT-** is a trading platform that enables traders to place orders via a simple user interface. It helps companies to manage their portfolios efficiently, relate to brokers and streamline operations around the world.

4.2 CHALLENGES AND OPPORTUNITIES

BNP Paribas has many tradable assets including Forex trading, Social trading and Share Dealing. The bank trading systems provide traders the flexibility to place orders, manage their portfolios, track the markets news and find trade ideas. As supported in Literature Review, several challenges and opportunities can be highlighted. The BNP Paribas platform permits traders to track the financial market for trade opportunities that match standards, but also, permits to analyse opportunities with stock evaluations and actionable research; get streaming real-time news, quotes and robust charting tools. As quantifiable finance models all work off the idea that market prices and returns will grow over time, risk diversification is a benefit of algorithmic trading in BNP Paribas. Several quantitative models claim that the randomized risk factors can affect the returns of given security. The returns of stocks, exchange rates and short-term interest rates are included in a diversified portfolio, on the assumption that the portfolio has a greater chance of return and is less sensitive to market movements. No emotion and fast order entry can be as well denoted as big advantages for BNP Paribas.

Nevertheless, as well as for all banks, automatic trading can be challenging, because it can be overfitting - trading algorithms have the tendency to be fed with too much historical information, which can lead to inflexibility of trading strategies in the present and future conditions. This is why back testing, while useful, is not completely reliable. It produces a bias for positive outcomes and gives the impression that a specific strategy will perform precisely as estimated. A platform can be programmed on prior data and perform excellent results in responding to the movements from that data, but then be programmed to the modern market and struggle to perform the same results because of the difference between the old data and the modern one. There is a risk that a program can be over-trained to fit specific trends - over-optimization – that is, the back testing of algorithmic trading platforms. Due to the risk of anomalies, errors and power losses automatic trading robots requires regulation and monitoring. Traders can be led to create what they believe to be a infallible trading strategy, that create profits under very specific market criteria. One of the main issues of an automated trading platform is the maintenance since it needs operational hardware during the execution of trades. Nasdaq advice that are required control and investigation teams, qualified to use auditory and visual warnings; as well as, a team to review the activity and to make levels of control with regularity. Finally, risk amplification is, also, an issue due to the speed of transactions performed automatically, market shocks are felt much more quickly among the global markets.

4.3 TRADER ROLE

As expected, the traders from BNP Paribas have their concerns regarding automatic trading, as their positions can be at risk. On the other hand, they argue that automatic trading can be useful as a form of support, in order to give them more time to prepare their next steps and prevent possible losses.

According to BNP Paribas traders, the main algorithmic trading strategies are usually as follows: Arbitrage, Trend-following; Quantitative; Rebalancing exploitation; Breakout/breakdown and Mean reversion. Detailed in literature review, several execution strategies can be enumerated to reach the best possible order rate: Time-weighted average price (TWAP), Volume-weighted average price (VWAP), Benefits of Algorithmic Execution, Percentage of volume (POV).

Also, the biggest advantage they have realized in applying algorithmic trading is that they plan more and worry less, which helps them expand new strategies, and it is more difficult to make mistakes with all the volatility of the market. There are other benefits, but for BNP traders, the most important are:

- To avoid substantial rate changes, trades are performed quickly;
- Several market condition controls can be achieved before placing orders;
- Trades can be tracked from several brokerage accounts;
- Abolition of manual mistakes.

The main disadvantage of algorithmic trading is that one error in the code can be disastrous, the trader can lose his complete account because in a short period, an algorithm can trade a great amount of transactions.

4.4 SOFTWARE AGENTS (AI)

The two types of Artificial intelligence are weak and strong. Weak is a form of AI that focus on a narrow tasks and seem very intelligent at it and it is designed to accelerate and automate tie-consuming and repetitive tasks. On the other hand, strong AI is the one equal to human intelligence, capable of replacing humans. BNP Paribas is interested in "weak" AI that is used universally nowadays, among all businesses.

Text, image, and speech recognition are the principal functions of BNP's artificial intelligence.

All the teams in the group can use the solutions developed by the bank, as web platforms and API. BNP is investing in a more modular IT, open architecture, performing micro-services in the form of applications, leaving behind the monolithic IT.

Being a global bank, they frequently need to execute some tasks, such as, translate confidential documents (e.g., contracts for our clients or emails), extract tables from annual reports etc.. To help teams perform this time-consuming tasks, BNP developed a application able to extract data and then yield related comments.

Finally, BNP Paribas developed a third project known as SEARCH, that is an internal search engine like Google, capable of making all information accessible in one place. Also, they created a global index, available to all, which in the long run, will become the main control for

the transformation of the bank, which is able to operate dominions and accesses. The process and principles of a business can be totally transformed by Artificial intelligence.

4.5 SOFTWARE AUTOMATION IN FOREX AND MONEY MARKETS

BNP Paribas Automated trading software identifies the signals – such as price tendencies, spread discrepancies and news that could influence the market – and analyses currency price charts at different time periods, to detect possibly lucrative currency pair trades. For instance, the software will shows a buy or sell alert and automatically place the order, if it finds a currency pair trade that satisfies the criteria set by the user to fulfil the parameters for profitability. The method one-size-fits-all does not apply to forex trading nor for forex robotic software, which has a limited number of trade-offs.

This type off trading platforms differ in speed, programmability, performance and ease of use. Consequently, what works for one trader may not work for another. In spite of the profits and benefits seen with the use of the automated forex trading platforms, these programs are not infallible, that is, the user must be aware that the software does not guarantee an infinite amount of profitable trades. Fortunately, there are methods, already discussed previously (i.e., stop losses), that help traders to bridge the risks of trading in any market and so avoid major losses.

BNP Paribas new algorithm gives clients a fully automated way to manage their gamma profile and has been uniquely built to support options trading. The Bank, developed Gamma, newest FX algorithm. Presented on CORTEX iX, the bank's FX spot algorithmic execution platform, Gamma offers clients with automated gamma hedging. Users can obtain liquidity in the market and get better spread thanks to the accessibility present by Gamma.

The Bank automated self FX platform helps FX execution related to all the securities trading and development events (corporate actions, settlement transactions, income events, subscriptions and redemptions, listed derivatives and cash flows). This also provides users access to Electronic FX Trading Skills, such as, transaction cost analysis (TCA) and market leading intelligent algorithmic FX Execution strategies.

The new strategy from BNP Paribas also benefits from two intelligent automation trademark. The first is instinctive momentum safety, that continuously tracks in what way the market is moving. A second unique trademark of the algorithm is Smart Mode, which lets the algo to

compare the historical market volatility realized in the former week and run reproductions internally to limit what the optimal spacing for placing orders should be. Once clients have input their gamma outline into the algorithm, they are also able to broadcast how the algorithm is predictable to perform. Clients can accept what the algorithm has offered or can further fine-tune variations if needed before submitting the trade. The weakness of gamma approaches is that they only actually support a linear gamma profile.

In conclusion, the range of currencies that is supported by the algorithm is vast and it is also available to trade NDF pairs. The algorithm basically automates the whole process as it intended to be left running in the background for days.

5. CASE DISCUSSION

In this section, it is intended to discuss the outputs obtained in the case analysis. Based on the findings in the previous chapter, the conclusion is that BNP has developed a lot in the area of automated trading systems (ATS), but there is still a lot of room for upgrading and implementation of new systems.

The traders from BNP agreed that the main benefit they have realized in executing algorithmic trading is that they worry less and think more. However, as well as for all banks, automatic trading can be challenging, because can be overfitting. There are many changes that need to be made to welcome the ATS.

The first benefit that stands out about automated trading software is that it is perfectly disciplined, and don't make mistakes. One of the most important disadvantages that a trader suffers from is his ability to stay focused on a plan. Nonetheless, a trader can take into account everything that is going on and process it, whereas a robot can only perform results based on the situations that have been programmed into it. Automated trading systems can be used to cheaply increase the volume of business.

The ATS can rise profit and business efficiency, however, some precautions have to be taken. Has to be set a max drawdown edge that will kill the robot if it’s triggered and use stop losses on every trade. There is a lot of work required when developing a system, but the time saved in the long run is priceless.

To validate the previous discussion, some interviews were done with BNP traders. The answers and the conclusion will be debated later.

The four questions made were:

Q1: Manual Trading or Automated Trading? Which do you believe is more profitable?

Q2: Do you believe that fully automatic trading is sustainable/feasible? If not, please,

explain your point of view?

Q3: Do you have any suggestions to improve trading?

Q4: Would you support the implementation of automatic trading?

These interviews included a French trader from BNP that do not use automatic trading and two American traders from BNP that operates manual and automatic trading. It also included a British and BNP middle officer that operates both systems.

These experts were chosen due to their high expertise in trading. These interviews were done separately and by the author through an online platform. Each interview started with a brief self-presentation and an explanation of the main objective of the dissertation.

The synthesis of the answers will be presented below.

Regarding Q1, the answers were:

Interviewee 1 (I1): I think automated trading would be more profitable for the Bank in the long run. On the back of operative costs reduction. It is true that when analysed on a trade-by-trade basis, some manual can be way more profitable as spreads, that can adapt to the context capturing more value.

Interviewee 2 (I2): This question for my it's like prisoner's dilemma in game theory. Manual trading is more profitable, but if market moves to automated trading and you are the last one, you lose your competitive edge.

Interviewee 3 (I3): I believe that automated trading can be more profitable since it reduces transaction costs. On the other hand, failures in the internet connection can occur, or even, a discrepancy between the hypothetical trade and the platform that turns the same into a real one.

Interviewee 4 (I4): In my opinion, algorithmic trading is profitable, providing that you get many things right. I mean, we can correct risk management techniques.

Regarding Q2, the answers were:

Interviewee 1 (I1): Yes, it is sustainable, but demands a high frequency maintenance on margins and details by Sales.

Interviewee 2 (I2): I believe it is in developed markets. In emerging markets, where prices tend to gap and the information is asymmetrical, this is more difficult.

Interviewee 3 (I3): I think it is feasible, however, algo trading software is excessively expensive.

Interviewee 4 (I4): Yes, it is. But, first, it is necessary to do a lot of tests and improve the software.

Regarding Q3, the answers were:

Interviewee 1 (I1): I consider important to have traders making the market spread, and not sticking to any rule.

Interviewee 2 (I2): Algos have done an incredible job in improving automatic trading.

Interviewee 3 (I3): Yes, I have. I believe that traders should review their trades weekly and monthly in order to careful review their common mistakes and improve them, and what they are very good at which they could potentially capitalize.

Interviewee 4 (I4): My suggestion is to strive to keep monthly trading strategy changes minor. It's better to focus on one matter at a time—and really make progress on it—before attempting the following issue.

Concerning the last question, Q4, the answers were:

Interviewee 1 (I1): Yes.

Interviewee 2 (I2): Yes of course! Markets are going in this direction, so no use in fighting against it. We should embrace the new technologies.

Interviewee 3 (I3): Yes! I agree.

Interviewee 4 (I4): Sure!

The four interviewees approved automated trading, instead of, manual trading. The automated trading is more profitable in the long-run. Nevertheless, they have some questions because algo trading software is excessively expensive and demands a high frequency maintenance on margins. They, also, argue that auto trading is more profitable in developed markets, instead of, in emerging markets, where prices tend to gap and the information is asymmetrical.

The BNP traders and the middle officer all agreed, by their experience, that automated trading is profitable and feasible, however, their concerns is that they can lose competitive edge and, also, the internet connection which in case of failure can make then lose money. On the other

hand, automated trading can reduce transaction and operative costs and it can correct risk management techniques.

They provided several suggestions to improve automated trading, such as, the implementation of algorithmic trading; the traders should review their trades more often to sort any mistakes and correct them and keep monthly strategy changes small.

To conclude, when asked if traders would support the implementation of automatic trading, the four agreed affirmatively. They agreed to implement automated trading, confirming the relevance of this study.

6. CONCLUSION

In this study, was performed an analysis of the advantages and disadvantages of the automated/algorithmic trading.

This work started with research in major subjects – Forex and money markets and software automation – getting support from the analysis of pros and cons of automated trading and the development of the four questions placed to four experts. These interviews, later analysed, had the purpose of validating the previous study.

This dissertation was developed with the purpose of scrutinize the possibility of the implementation of algorithmic trading, especially in banks.

The three research questions were answered through an investigation in the pitch supplemented with the available literature.

RQ1: How can the effectiveness of the trading robots be evaluated?

RQ2: How can robots adapt to the constantly changing markets?

RQ3: What is more profitable, human trading or robot trading?

The answer to these questions also resulted from the meetings previously mentioned but, to properly answer them, a deep investigation in what happens if implemented a full automated trading process in banks, was required. The main constraints identified are the costs of this implementation whether human or economic and the asymmetrical information inside the market. Also, the time the process takes and its efficiency are additional limitations.

Through this study, and the performance of the interviews, it was possible to detect some points that could be changed to reduce the time of the process, the effectiveness of it, or even to improve the trading operation. In the discussion chapter, the interviewees provided several pertinent suggestions that can improve trading in general.

This research was important to clearly understand the mainly advantages and disadvantages, but also, to review the process in order to correctly identify the breaking points and struggles. Thus, the improvements that are needed and the path to be taken is easier to define.

In summary, the conclusion that was drawn is that the automatic trading is worth investing because it brings more profit to the bank, although some precautions are necessary. Even so, the advantages prevail over the disadvantages.

6.1 LIMITATIONS

There are two main limitations of this research that should be considered. First, the validation group for the interviews was composed by a small number of experts, this was due to compliance, many of the traders did not want to give their opinions. Nevertheless, in a way to reduce this constraint it was performed individual interviews which offers more insights into an interviewee's personal thoughts, beliefs and point of views and the people interviewed were selected due to their expertise and relation to the theme, impacting in different areas of the process. This gives us a complete overview of their opinions.

The second limitation identified is that as best as the proposals may seem, only after its implementation and an experience period, it would be possible to completely understand its feasibility and impact in the process itself, and as ultimately if it is profitable.

Nevertheless, this could not be done in the scope of this master's thesis due to the short period available and may be addressed by future empirical research.

6.2 RECOMMENDATIONS FOR FUTURE WORKS

As future work the suggestion is that the interviews should be evaluated by a bigger group, and possibly through a focus group or through anonymous inquiries. This is because traders do not want to compromise the compliance policy of the bank and, also, do not want to risk their jobs, thus, do not want to respond on their behalf. It took a lot of persistence to get their answers. A focus group would encourage discussion about the proposal improvements, it's strengthens and weaknesses, but it would also stimulate the suggestion of new ideas and the discover of other hidden problems.

Secondly, as previously mentioned, and due to the lack of time associated with this master's thesis, it was not possible to develop prototype and test in real time a full automated trading. In this way, as future work the suggestion is to try to implement a test case and evaluate its impact in the process.

There is one idea stated by Njoki (2019), which was not applied in this study, also due to time restrictions and complexity, nevertheless it could be a way to take a step towards automation. It consists in the post-mechanization instability/ liquidity and effectiveness dimension of the automated trading by implementation of individual estimation strategies just as increase the example size and extension in order to determine the effect of the robotization on one deal.

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