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Conceptual Model of Automated Trading Systems Implementation

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Abstract
Automated trading systems have been present in the world of finance for a number of years and as a result, these systems have been the subject of academic research. However, integrating the automated systems within a particular trading environment has not been investigated in any depth previously. Therefore, following on from the work around assessing the impact of automated systems integration, this article focuses on developing a conceptual model which enables individual and institutional traders to identify the best operating conditions for using automated trading systems within a particular trading environment. The model considers a wide range of variables including technological factors, market conditions, cultural plus ethical characteristics, and experiential considerations. Each of these categories has a distinguishing multilayered effect on the process of deploying automated trading systems. The developed conceptual model acknowledges that the various aspects of each category are not independent as they are joined together into a singular network of factors showing the cause-and-effect interrelationships between them.

Keywords: automated trading, trader, financial market, technology

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1. Introduction

Automated trading systems (ATS) have been present in the world of finance for a number of years and as a result, these systems have been the subject of significant academic research (Domowitz & Lee, 1996; Goldin & Reinert, 2007; Zubulake & Lee, 2011; Nuti et al., 2011; Izraylevich & Tsudikman, 2012; Hanif & Smith, 2012; Durenard, 2013; Cartea et al., 2015; Varshney, 2016). The topics of these studies include, but are not limited to, the ability of these trading robots to generate positive financial results over the long-term as well as their ability to accommodate changes in the market environment. However, the existing studies have not focused on the optimal operating conditions of these systems within different trading environments (Steil, 2002; Kaufman, 2005; Maxfield, 2009). Therefore, integrating the automated systems within a particular trading environment has not been investigated to any depth previously.

ATS changed the way that modern trading is perceived and implemented for all market participants – from the largest institutional brokers that "make the market" to the individual trader fulfilling his or her personal investment goals (Treleaven et al., 2013). Automated trading was never meant to replace traditional trading but instead to offer a different approach for executing financial transactions to both individual and institutional investors who needed an alternative that enabled the robotic execution of trades based on preset market signals. The algorithmic financial settlements have increased in popularity over the years and as a result, more and more people became interested in these activities and consequently, started to create and operate trading bots. Nowadays, 70% to 80% of all market transactions are executed from automated trading software (Folger, 2019). Furthermore, the algorithmic trading market is expected to grow at a compound annual growth rate of 11.23% over the period of 2021-2026 (Research and Markets, 2021). This shows that ATS are going to continue to be a significant part of the financial markets in the foreseeable future and that is why understanding their function and mechanics is vital for the successful market participation of traders.

The use of ATS is not a panacea, these systems are capable of working effectively in clearly defined areas of financial trading and their applicability for implementation across the full spectrum of the financial sector is not possible due to the complexities of trading. As a result, the identification of where it is possible to employ automated systems is critical to financial traders as the incorrect application could lead to ineffective trading. Therefore, following on from the work around assessing the impact of automated systems integration, this article focuses on developing a conceptual model which enables individual and institutional traders to identify the best operating conditions for using ATS within a particular trading environment. The model considers a wide range of variables including: technological factors, market conditions, cultural plus ethical characteristics, and experiential considerations.

2. Automated Trading Systems Background

The concept of ATS is anything but new as its roots can be traced as far back as 1949 when Richard Donchian created Futures, Inc., one of the first trading companies, which utilized predetermined buy and sell rules to execute commodity transactions (Covel, 2020; Cruz, 2020). The idea pioneered by Richard Donchian was to identify and set trading rules that had to be "automatically" applied by market analysts whenever the preset conditions are met. The lack of proper technology meant that this process was done entirely by hand as company employees had to manually chart the market developments and determine if the pre-arranged requirements are met (Zaremba & Shemer, 2018). As a result, the process was time consuming and not at all flawless but it set the tone for the evolution of trading with financial assets (Coleman, 2019). The modern interpretation of algorithmic trading is described by Kissell (2014) as follows:

> *"Algorithmic trading represents the computerized executions of financial instruments. Algorithms trade stocks, bonds, currencies, and a plethora of financial derivatives. … Algorithmic trading has been referred to as "automated," "black box" and "robo" trading. … Trading via algorithms requires investors to first specify*

their investing and/or trading goals in terms of mathematical instructions. … After instructions are specified, computers implement those trades following the prescribed instructions." (p. 1)

Kissell (2014) argues that different terms, such as black box trading or trading robots, were coined by institutional traders and exchange brokers to try and emphasize the superiority of their systems. The idea was predominantly promotional as all of these systems, regardless of the name, represent the same concept – computer software that acts upon predefined rules set by an investor (Iba & Aranha, 2012; Leshik & Cralle, 2011; Strumeyer, 2017). In other words, the basic mechanics of ATS are comparatively simple as these systems perform one main function – they facilitate the automatic execution of a transaction on the financial markets based on a predetermined set of trading parameters. The fundamental mechanism of an ATS can be explained with three major sections – start by choosing an ATS platform or selecting a programming language for creating an ATS, then create a set of rules and conditions, and finally allow the system to place trades on its own (IG International Limited, 2021).

3. Theoretical Framework of Technology Adoption

The successful development of organizations depends on various factors ranging from the capabilities of their management teams to the way that the market perceives their brands. Researchers agree that one of the most influential factors over the last few decades is the ability of organizations to adopt and implement technological advancements (Baker-Brunnbauer, 2021; Baker, 2011; Venkatesh, 2000;). As a result, scholars have investigated and formulated a number of theoretical frameworks that explore the integration of diverse technological developments in organizations (Ivanov, 2021). These theoretical frameworks evaluate the elements and procedures that affect the process of understanding scientific innovations and their subsequent embracing by organizations with a view to achieve continued market evolution and growth (Venkatesh, 2000). The most prominent technology adoption models include the Technology-Organization-Environment (TOE) framework, the Technology Acceptance Model (TAM) plus its upgrades TAM2, TAM3, the Unified Theory of Acceptance and Use of Technology (UTAUT) plus its upgrades UTAUT2, UTAUT3, and the Technology Readiness Index (TRI) and is upgrade TRI 2.0. The following sections summarize the principal scientific argumentation of these models.

3.1 Technology-Organization-Environment Framework

The TOE framework represents a portion of a wider research concerning the fundamental process of innovation starting from its development and ending with its adoption (Tornatzky & Fleischer, 1990). The TOE framework stipulates that the decision-making related to the adoption of technology in a firm is determined by three main parts of a firm's context – the technological context, the organizational context, and the environmental context (Baker, 2011). The technological context includes all technologies that are applicable to a firm including the ones that are already embraced by the firm as well as all the accessible ones that are not yet embraced by it. The organizational context represents the internal specifics of a firm that influence its implementation of technology such as size and scope of activities, financial and nonfinancial resources, internal communications, and employee inter-connections. The environmental context includes the external factors that are relevant to the process of innovation employment within an organization with the main factors being the characteristics of the firm's industry, the accessibility to technology suppliers, and the established governmental regulations. The components of the three contexts are interrelated and ultimately explain the attitude of organizations towards technology adoption (Tornatzky & Fleischer, 1990). The TOE framework is not specific to any industry or type of company and thus, it has been used to explain the actions related to innovations of varied actual organizations.

3.2 Technology Acceptance Model

The principal idea of the TAM is to investigate the acceptance of information technology based on the perceptions of its users. The model stipulates that the perceptions of users towards new information technology can be unified into two main elements – perceived usefulness and perceived ease of use (Davis, 1989). The perceived usefulness of technology refers to whether or not its users believe that it will enhance their work performance. The perceived ease of use of technology refers to whether or not its users believe that its application is uncomplicated and unexacting. The combined effect of these two factors determines the intention to use technology (Davis, 1989). Still, the TAM does not consider any social factors that might affect the utilization of technology which is one of its main criticisms along with its assumption that the users of technology are rational people (Venkatesh & Davis, 2000). Furthermore, the model does not provide any suggestions on how to improve the design and/or functionality of technology in order to enhance its acceptance and eventual implementation (Venkatesh, 2000). As a result of these criticisms, the model was refined and upgraded to TAM2 and TAM3. TAM2 is an extension of the original model that further develops the perceived usefulness section by evaluating additional determinants (subjective norm, image, job relevance, output quality, and result demonstrability) that influence the acceptance of new technology (Venkatesh & Davis, 2000). TAM3 is a further extension of the model that further develops the perceived ease of use section by evaluating additional determinants (computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment, and objective usability) that influence the acceptance of new technology (Venkatesh & Bala, 2008).

3.3 Unified Theory of Acceptance and Use of Technology

The UTAUT is a comprehensive technology acceptance model that consolidates eight prior models including TAM and TAM2. The unified model stipulates that the behavioral intention and use behavior towards information technology are influenced by four constructs – performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). The performance expectancy is defined as the perception of users about the usefulness of technology. The effort expectancy is defined as the perception of users about the ease of use of technology. The social influence is defined as the level of appreciation of technology usage in the inner social circle of an individual. The facilitating conditions are defined as the perception of an individual about the availability of resources that are needed to promote the adoption of technology. These four constructs are complemented by four moderating variables (experience, voluntariness, gender, and age) to form the basis of the UTAUT (Venkatesh et al., 2003). The theory was further developed with the introduction of the upgrades UTAUT2 and UTAUT3. The UTAUT2 introduces three additional constructs to the theory – hedonic motivation, price value, and habit (Venkatesh et al., 2012). Hedonic motivation is defined as the enjoyment received from using technology. Price value is associated with the relationship between the monetary cost of technology and its perceived benefits. Habit is reflected by the time that has passed since a given primary technology was adopted. UTAUT3 is a further extension to the theory that explores the effects of personal innovativeness (personality traits) on information technology adoption (Farooq et al., 2017).

3.4 Technology Readiness Index

The TRI is an index that estimates the impact of a person's beliefs about technology in general (Parasuraman, 2000). This is a significant deviation from other acceptance models which concentrate on a specific technology. The TRI identifies 36 attributes that influence the readiness of individuals to embrace technological advances. These attributes are grouped into four dimensions – optimism, innovativeness, discomfort, and insecurity (Parasuraman, 2000). Optimism is the belief that technology is positive and that it brings various benefits to its users. Innovativeness is the inclination to be a technology initiator and thought architect. Discomfort is the perception that technology cannot be controlled combined with the feeling of being overpowered by it. Insecurity is the lack of trust towards technology and the doubt related to its workability. Optimism and innovativeness aid the technology readiness of an individual. Conversely, discomfort and insecurity hinder the technology readiness of an individual. The index posits that an individual can hold beliefs from each of the four dimensions which simultaneously encourage and discourage the willingness of the individual to adopt and use technological innovations (Parasuraman, 2000). This paradox is central to the TRI as it aims to evaluate the degree of influence of different perceptions on the propensity of individuals to embrace new cutting-edge technology. The theory was updated and streamlined into TRI 2.0. The new index includes only 16 attributes within the same four dimensions compared to the original 36 attributes (Parasuraman & Colby, 2015). This refinement addresses some key issues with the initial TRI – re-evaluate the innovativeness of the established scale statements, assess and add new attributes resulting from technological advancements, and simplify the research instrument.

3.5 Technology Adoption and Automated Trading Systems

The theoretical frameworks described in this section examine and try to predict the process of technology adoption on both individual and organizational level. Each of the theories has its own model that employs various determinants that are considered to influence the intention to use and the eventual implementation of new technologies. These models have been empirically tested within the characteristics of diverse specific technologies by adjusting their constructs (Baker, 2011; Venkatesh, 2000; Venkatesh et al., 2012). ATS are a type of technology that can be potentially tested with the presented theories but such a test has not been conducted. One the main explanations for the lack of such an investigation is the unique attributes of these systems that are difficult to incorporate into the presented models. Thus, a new theoretical framework has to be developed with its own model specifically designed for the distinctive features of ATS. The next section of the article introduces and dissects these features and it connects them into a uniform conceptual model.

4. Theoretical Framework of Automated Trading Systems Adoption

The successful implementation of ATS is determined by a mixture of several components which form their theoretical background. These components can be grouped into four main categories: technological factors, market conditions, cultural plus ethical characteristics, and experiential considerations (Gomber & Zimmerman, 2018). Each of these categories needs to be carefully evaluated in terms of their interconnection with users of trading robots. The purpose of this evaluation is to investigate the best operating conditions for the implementation of ATS within various trading environments. Each category and its components will be assessed separately and then joined together into a singular correlation network of factors.

4.1 Technological Factors

Technology is one of the driving forces of modern financial market commerce. Internet connectivity and computer systems have changed the complexion of trading from writing order notes on paper and submitting them on the trading floors of stock exchanges to the fully digitalized execution of deals on an electronic device from any point in the world with access to the Internet (Kissell, 2014). Scholars agree that the efficient application of automated platforms in terms of technology is determined by three main ingredients – hardware, software, and Internet (Aldridge, 2013; Coeckelbergh, 2016). Each of these elements influences the functioning of ATS in a different way but each of them is an essential part of their structure.

The most straightforward technological factor to identify is hardware as it represents the computer systems that are used to operate the trading robots. The running requirements of ATS are determined by the type and complexity of the system (Harris, 2003). Specifying exact hardware specifications for automated exchanges is challenging because of the remarkably dynamic development of technology augmented by the ever-increasing intricacy of trading software (Baldauf & Mollner, 2020). Still, one particular example is the popular platform MetaTrader 4 which is a rather unsophisticated system as it can run on “Windows 2000 or later, with a 2.0 GHz or faster CPU, and at least 512 MB RAM (although 1 GB is recommended). You should have a screen resolution of 1024 x 768 or higher, and an internet connection speed of 56 kbps or faster“ (Intertrader, 2017). These specifications show that the platform can be deployed on any regular laptop or smart device but this is not always the case as some complex applications require a sizable investment in high-end equipment.

The key area of interest for efficient application of ATS, when it comes to hardware, is accessibility in terms of both availability and price as the necessary computer systems should be readily available on the particular market at non-restrictive prices (Goldstein et al., 2014). The accessibility of any good in the scope of a market economy is determined by the supply and demand forces within the specific country. Strong demand matched by adequate supply is the best-case scenario for the prospective user of trading robots (Kissell, 2014). Such a scenario can be classified as part of the best operating conditions for ATS and some developed countries across the world can provide such a setting. However, this is not the situation in all countries. According to Aldridge (2013) the lack of the required hardware at reasonable prices can be a potential inhibitor for prospective users of automated platforms.

Hardware and software are interdependent as one cannot function properly without the other. This is true for all types of hardware and software including computer systems that run ATS. Financial market software has evolved tremendously over the years from facilitating transactions without the need to be physically present on the trading floor of a stock exchange to enabling fully automated selling and buying of various financial assets (Nolte et al., 2016). In the case of trading robots, it is possible to identify two distinct software aspects – access to software and ability to develop software (Goldstein et al., 2014). A financial market participant has two options when it comes to mechanized settlements, use an already developed automated platform and install his or her trading rules and parameters in the platform or design an entirely new system based on the specifications and needs of the participant (Schmidt, 2021). The former option is uncomplicated as the only requirements for its implementation are adequate equipment that is able to support the selected trading application and reliable Internet access. When these requirements are satisfied, the investor employs the interface of the system to construct his or her exchange program.

Developing customized software, financial or any other type, is a challenging process that demands particular knowledge and experience. The architects of trading applications should be proficient with the programming languages that are commonly used for creating ATS such as Java, Python, and C++ (Varshney, 2016). In addition, they should be able to understand the basic anatomy of dealing with financial instruments in order to build functional systems (Aldridge, 2013; Harris, 2003). The ability to recruit competent software engineers on full-time employment (usually done by institutional investors, such as hedge funds and insurance companies) or commission the services of proficient freelance programmers (usually done by individual traders) is a prerequisite for the establishment of efficient automated platforms (Chen, 2020). The unexacting process of obtaining the services of such essential personnel is needed for the successful development of trading robots (Nolte et al., 2016). Still, the availability of skilled programmers is unbalanced because of their mobility as it is possible to map out applications for a company based in Western Europe and at the same time to reside in Southern Asia (Vaughan, 2019).

Internet has become an indispensable part of the way of life for most people. This is true for the financial world as well where stock exchanges, investors, and governmental regulators are connected into a complex network of constant interaction empowered by the Internet (Baldauf & Mollner, 2020). Automated trading is no expectation as even the most ingenious trading robot operated on the most advanced mainframe computer will not function at all unless it is connected to the Internet. Thus, Internet access can be defined as part of the absolute minimum provisions for the administration of ATS (Harris, 2003). As a consequence, this particular factor is not part of the best operating conditions for such systems as Internet access nowadays can be obtained readily in most parts of the world. However, reliable access to the World Wide Web is a completely different element as there are numerous locations where Internet connectivity is possible but not reliable. Gomber and Zimmerman (2018) argue that the lack of a reliable connection can render the activities of exchange systems useless as they cannot acquire the live market data needed for the execution of transactions. Another factor of note is the speed of the Internet connection which greatly varies across different territories (Henderson, 2021). Sophisticated systems have to be linked to reliable high-speed Internet in order to function properly.

4.2 Market Conditions

The prevailing market conditions, both financial and general, can have a profound effect on the fortunes of trading robots (Asparouhova et al., 2020; Nolte et al., 2016). This is a direct result from the constant symbiosis between a financial market and an economy. This applies on both global and local levels even if there is little difference between the two because of globalization. Market conditions have a twofold influence of ATS. On the one hand, the dynamics of an economy and the corresponding impact on the stock exchange price movements provide expanded opportunities for remunerative transactions (Johnson, 2010). On the other hand, the stable economic and financial environment in a country can stimulate the interest and intensity of trading including automated exchanges (Manahov, 2015).

The success of dealing with financial instruments is based on the ability of market participants to spot a particular moment for buying or selling a designated financial asset. These trading moments are highly dependent on the dynamics of the financial markets which in turn are affected by the general market conditions. According to Baldauf and Mollner (2020) during stale economic situations the number of opportunities for executing trades shrinks considerably. This is also observed during unstable political periods or any other environment that generates civil unrest and apprehension. Academic research shows that during recessions the volume of transactions with financial instruments decreases but at the same time the profit margin of deals that go through increases (Asparouhova et al., 2020; Goldstein et al., 2014). In contrast, during favorable market conditions the economy participants are more active and this provokes more energetic financial asset price changes which results in more possibilities for opening and closing market positions (Manahov, 2015). These possibilities are the fuel that powers ATS and that is why a prospering financial system is often listed among the contributing factors for their successful employment (Kissell, 2014). Thus, it can be inferred that market conditions affect the implementation of trading robots in terms of the quantity of potential signals that can trigger their mechanized reactions.

The state of the economy also impacts the attractiveness of financial markets. Scientific analysis shows that during times of improving or stable market conditions there is higher probability for people to be drawn towards the profit potential of investment on stock exchanges (Gomber & Zimmerman, 2018; Johnson, 2010). This is a direct result from the conscious desire of these people to take advantage of the favorable economic situation. Thus, investors will be evaluating different options for engaging on the financial markets and one of these options is ATS which means that the utilization of such systems will surge. However, the volatility of returns from transactions with financial instruments generally lowers the interest and inclination of prospective traders for financial market activities during periods of negative economic development (Dover, 2019). During such periods the general disposition of most investors is conservative as they seek strategies aimed at wealth preservation which traditionally does not include automated stock exchange participation (Asparouhova et al., 2020). So, the general state of the economy affects the application of trading robots in terms of their desirability. The overall influence of market conditions on ATS can be multidirectional as it can stimulate as well as discourage their usage.

4.3 Cultural and Ethical Characteristics

The implementation of trading robots is greatly affected by the cultural background of their users as well as the ethical principles that they conform to (Tan et al., 2019; Lange et al., 2016). The impact of culture towards financial market settlements originates from the way investing is culturally treated and embraced. A number of countries in Western Europe as well as North America have an established understanding and acceptance of making investments as a course of action for wealth advancement (Wansleben, 2013). In such countries stock exchange transactions are integrated into the culture of people and the corresponding adoption of automated platforms is generally straightforward. However, some countries do not possess such a cultural background supporting investment in general as well as financial market participation (Wansleben, 2013). There is a lack of proper comprehension related to the function and potential of stock exchange transactions in such countries which creates a cultural inhibitor for individuals seeking to take part in financial market activities (Lange et al., 2016). Thus, it is more challenging to initiate and deploy automated platforms in such an environment. One of the key factors that influences the cultural predisposition towards investing is the presence of a developed market economy in the particular county (Tan et al., 2019). There are other contributing factors but the fabrics of a mature market economy absorb into the consciousness of people and contribute to their acceptance of investing as some standard business modus operandi.

The ethical principles that people adhere to are also influencing their prospective utilization of trading robots (Cooper et al., 2020; Wellman & Rajan, 2017). The exploitation of financial markets for personal well-being clashes with the moral values of some people which creates an impediment to their eventual market participation. The key moral stand of some individuals is that in order to profit from stock exchange transactions someone else has to suffer an economic damage (Cooper et al., 2020). In addition, some people hold the viewpoint that trading floors do not contribute anything material for the economy as they are dealing with intangible assets and therefore, no new products or services are introduced on the market (Davis et al., 2012). This two ethos are a stumbling block for entering and operating on the financial markets including the incorporation of ATS. The ethical perceptions of people do not adjust overnight and if the prevailing ethical principles in a country are similar to the above-mentioned ones, this could cause a considerable disruption for the investors who want to develop or promote automated platforms (Cooper et al., 2020; Davis et al., 2012). However, the lack of such moral barriers can be categorized as a requirement for the smooth employment of trading robots within a particular state (Wellman & Rajan, 2017).

4.4 Experiential Considerations

The knowledge and experience of market participants are two significant contributing factors for the successful utilization of ATS. These two factors influence a number of aspects that help prospective traders with the process of understanding and ultimately entering the financial markets (Clark, 2018; Lee, 1998; Stiglitz, 1989). The knowledge base related to stock exchange involvement is determined by the availability of university programs, educational courses, and training classes which in turn is influenced by the popularity of the subject matter within a given location (Riles, 2010). The uncomplicated access to various learning opportunities enables interested individuals to obtain the necessary skills for the productive execution of financial transactions. The thorough comprehension of trading rules, technical patterns, and market forces is essential for the transition from regular trading to automated trading (Clark, 2018). The lack of such competencies, or particularly ways to acquire them, could be a significant disadvantage for novice investors who are seeking to enter the world of ATS. Nowadays, educational options are quite diverse and not always limited to location as there are a number of online courses that can be completed from any place with Internet connection (Gajura, 2021). Still, the more chances that adopters of ATS have to gain knowledge, the better equipped they are for the implementation of such systems.

The experiential background of the trading community in a given country also plays a part in the process of developing effective algorithmic trading systems (Feng & Seasholes, 2005; Stiglitz, 1989). The number of traders and their performance history influences the general popularity of financial market participation as well as the availability of already developed automated platforms (Nicolosi et al., 2009; Feng & Seasholes, 2005). The reputation of trading is important for stimulating the interest of people in the industry and for making the above-mentioned various learning opportunities more desirable which in turn positively affects their dissemination. Another benefit of having a sizable investing body is that it becomes easier to recruit experienced trading course instructors or financial program directors (Lo et al., 2005). Furthermore, the number of existing mechanized exchange systems is greater when there are more investors seeking to employ their services. Thus, novice traders will benefit from having more options for engaging in automated settlements without having to develop their own system (Nicolosi et al., 2009). So, the lack of proper experiential background of market participants could have a negative impact on their ability to develop functional ATS.

5. Conceptual Model

The theoretical frameworks of technology adoption, such as TAM and TRI, employ various determinants that are considered to influence the intention to use and the eventual implementation of new technologies. ATS are a type of technology that can be potentially tested within the models embraced by these theories but such a test has not been conducted because of the unique attributes of these systems that are difficult to incorporate into these models. Thus, a new theoretical framework is developed with its own model specifically designed for the distinctive features of algorithmic trading. The theoretical framework of successful implementation of ATS is divided into four main categories: technological factors, market conditions, cultural plus ethical characteristics, and experiential considerations. Each of these categories has a distinguishing multilayered effect on the process of deploying trading robots that was introduced in the preceding sections. Furthermore, the various aspects of each category are not independent as they can be joined together into a singular correlation network of factors showing the cause-and-effect interrelationships between them (Gomber & Zimmerman, 2018; Strumeyer, 2017; Leshik & Cralle, 2011). These connections visualize the theoretical substructure of automated financial market transactions. Figure 1 shows this conceptual model.

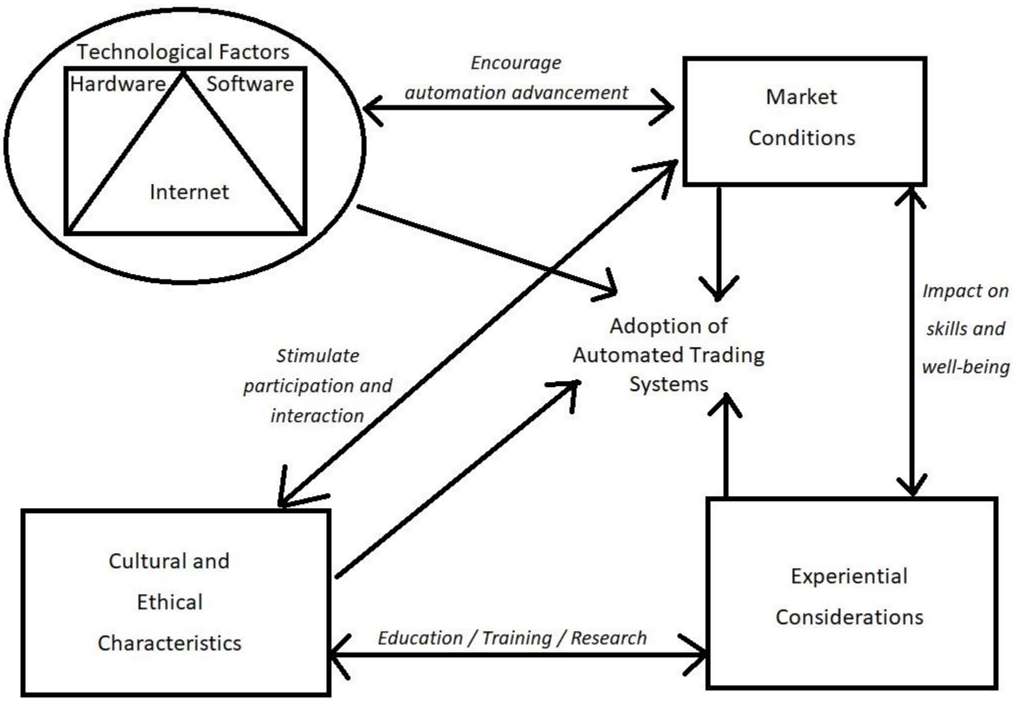

Figure 1. *Conceptual Model of ATS Implementation*

The main components in the conceptual model are the four main categories of factors that influence the adoption of ATS: technological factors, market conditions, cultural plus ethical characteristics, and experiential considerations. Each of these categories of factors has its distinctive effect on the process of ATS implementation. The cause-and-effect interrelationships between the different categories of factors are the glue that brings them together into a single uniform theoretical paradigm. There are four main interrelationships in the model with each of them connecting two sets of factors. The first interrelationship between the technological factors and the market conditions stipulates that technological progress encourages automation advancement in financial markets (Gomber & Zimmerman, 2018). The second interrelationship between the market conditions and the experiential considerations stipulates that dynamic financial markets positively impact the trading skills and the well-being of individuals (Manahov, 2015). The third interrelationship between the experiential considerations and the cultural plus ethical characteristics stipulates that financial education, training, and research creates cultural and ethical predisposition towards investing (Tan et al., 2019). The fourth interrelationship between the cultural plus ethical characteristics and the market conditions stipulates that cultural and ethical predisposition towards investing stimulates participation and interaction on financial markets (Cooper et al., 2020).

The conceptual model is informed by the evaluation of the available academic research related to ATS implementation. The separate scientific studies are joined together through the presented model with their various aspects unified into its structure in conjunction with the underlying principles of technology acceptance. However, the theoretical frameworks of technology adoption, such as TOE and UTAUT, were not formative for the model because of the unique attributes of trading robots that are difficult to incorporate into these models. Still, the postulates of models such as the TAM about new technology utilization impact the presented conceptual model by imbuing it with the fundamental inferences about the predisposition, willingness, and preparation for the application of new technology such as ATS.

6. Conclusion

The conceptual model unifies the various theoretical characteristics of automated trading and creates a platform for their better understanding in terms of their optimal operating conditions. The unifying aspect of the model creates its main theoretical contribution as the factors affecting the implementation of ATS have not been combined into a single framework previously. The various unique features of ATS are incorporated into a configuration that maps the anatomy of algorithmic trading. The inspection of this anatomy enables financial market participants to comprehend the relationships between the different factors that affect the operating conditions of trading robots.

The practical implications for both individual and institutional traders are significant as the study aids them in the process of adopting ATS by evaluating the various factors that affect their usage. The research is also significant for the academia as it provides a new perspective towards a technology driver (the use of ATS) that is changing the face of a particular industry (the finance industry). Furthermore, the evaluation of the phenomenon of algorithmic trading provokes a new outlook towards financial market participation and how this can be further developed or expanded. In addition, the analysis of ATS adoption provides relevant implications for the theoretical frameworks that evaluate the elements and procedures that affect the process of understanding scientific innovations and their subsequent embracing by organizations with a view to achieve continued market evolution and growth.

The evaluation of the components that form the conceptual model did not produce a conclusive result for the most appropriate environment for ATS initiation. Several of the analyzed factors showed that they might have diverse influences on such systems based on the specific circumstances. Such an outcome warrants further investigation into the domain of automated platforms. The presented theoretical framework can be tested within various trading environments to check if the different interrelationships in the model hold or if some of the included factors influencing the implementation of ATS should be removed or augmented by new ones. Such tests will increase the practicality of the conceptual model by helping individual and institutional traders, or managers of firms operating on the financial markets, to better understand the intricacies of ATS adoption and operation. This understanding is critical to financial traders as the incorrect application could lead to ineffective trading which can have significant negative monetary implications for them.

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