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### Decision to Invest using Algorithmic Trading Channel in Thailand

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### ABSTRACT

Recently, algorithm trading has introduced as an alternative investment channel in Thailand. This study intends to construct conceptual model in explaining investor decision process in deciding whether to invest using algorithmic trading computer platform. Theory of reasoned action (TRA), theory of planned behavior (TPB), and technology acceptance model (TAM), as well as perceived risk are employed in explaining investment decision process of Thai investor. The proposed modified technology acceptance model claims that investor attitude toward algorithmic trading determined by perceived ease of use and perceived usefulness play an important role in determine investor's intention to adopt algorithmic trading while subjective norm, social influences, affected by descriptive norm and injunctive norm is also another influencing factor. Additionally, perceived risk represents obstructive factor in preventing investor from using algorithmic trading.

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**Keywords:** Algorithmic Trading, Modified Technology Acceptance Model (MTAM)

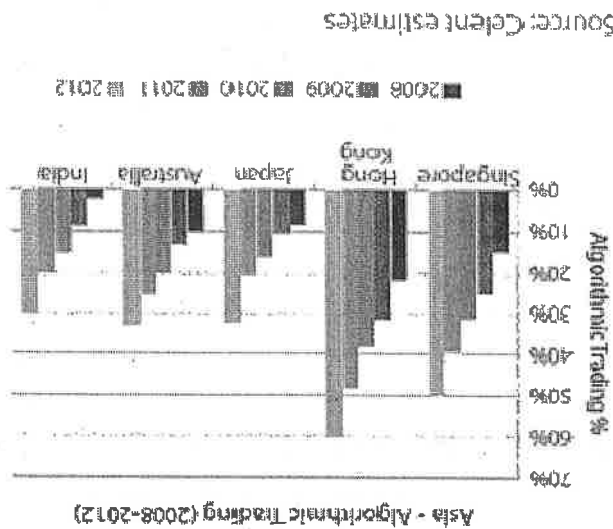
### I. INTRODUCTION

SFT trading was started with an open auction on the trading floor in 1975. In April 1991, the electronic trading, named "Automated System for the Stock Exchange of Thailand" (ASSET) was introduced. Since that time the electronic trading system is continuously improved, the current system which has just implemented is "SFT Connect". Algorithmic Trading (AT) is the evolution of the market trading mechanism. Every step of the trading is fully automated. The orders

are set in system and executed conditional on strategies which are described as algorithms. The purpose of algorithm is that it is expected to reduce the transaction cost incurred by the market participants. Currently, AT is responsible for a significant portion in developed market for example, 73 percent of trading volume in the U.S. in 2009 (Hendershott et.al, 2011), 52 percent of market order volume and 64 percent of nonmarketable volume of DAX 30 in German in 2008

the Algorithmic Trading has been adopted by several countries in Asia with a high rate of growth (Fig.1): Asia-Algorithmic Trading % (2008-2012). In Thailand, it has been accepted in these recent years. From the 2008 statistics, the transaction values via the Algorithmic Trading account for 15% of Singapore Stock Market, 13.5 of Korea Stock Market, and 9.3 in Tokyo Stock Market. In Thailand, it accounts for 0.7% of all transaction values with a gradual growth. Within the half of 2010, the values via Algorithmic Trading are 2.36% of all transactions, increasing from 2009 (at 0.9%), and contributing to more than 100% growth (Wiset Tantivanich, Assistant Manager - Stock Registration and Listed Companies (Marketing) SET, in the seminar "Algorithmic Trading Semina Market Trends and Insights for Asia")

Fig.1: Asia-Algorithmic Trading % (2008-2012)



Source: Celerent estimates

Electronic Engineering and Computers, Faculty of Engineer, Thammasat University, in [www.stock2tomorrow.com](http://www.stock2tomorrow.com)). However, in the retail investors, this is not yet popular. This is, in part, because of the automatic functioning of AT itself.

(Hendershott and Riordan, 2012). The Stock Exchange of Thailand (SET), one of Asia's rising emerging markets is in an early stage of AT. Asian markets are laggards compared with the advanced markets in adopting algorithmic trading in table 1. The reasons are many challenges related to the functionality and the technology itself. Algorithmic trading, also called Program Trading and Automated Trading (also known as Quantitative Trading, System Trading, and Robot Trading), is a computer-assisted system that provides automatic functions to enter trading orders, execute pre-programmed trading instruction, determine trading strategies, and manage investment decisions. Algorithmic Trading (AT) was widely used during 1970s-1980s by U.S. Stock Markets and gained a rapid growth in 1990s. Now,

TABLE I  
Algo trading Adoption in Asia

| Region        | Year  | HFT | Algorithm | Direct market access | Smart order routing | Off-exchange (alternative trading system, crossing network, dark pool) |
|---------------|-------|-----|-----------|----------------------|---------------------|--|
| United States | 2005  | 8   | 25        | 18                   | 9                   | 4  |
|               | 2010  | 50  | 35        | 35                   | 19                  | 10   |
|               | 2015P | 55  | 55        | 55                   | 25                  | 16   |
| Europe        | 2005  | 4   | 15        | 12                   | 6                   | 2  |
|               | 2010  | 25  | 24        | 21                   | 14                  | 7  |
|               | 2015P | 55  | 35        | 36                   | 20                  | 14   |
| Asia          | 2010  | 10  | 15        | 7                    | 3                   | 1  |
|               | 2015P | 2   | 8         | 16                   | 9                   | 5  |
|               | 2015P | 18  | 31        | 28                   | 16                  | 12   |

Source: Industry Sources, Tower group estimates

Although the Algorithmic Trading has been recognized for a long period of time in Thailand, most of the perceptions are maintained in individual investors, funds, and institutional investors (Asst. Prof. Dr. Suppawat Suppakawong, Department of

The Algorithmic Trading relies on formalized functions based on contracts, sales volumes, and automated and governed by a certain set of formulas, making profits on every market conditions. Emotions, greed, and fears cannot influence this kind of system and its decision. However, the Algorithmic Trading has some drawbacks. In some cases, the system is not flexible. It cannot analyze the emotion of the market like humans can do. For example, the system may stop sending orders when it reaches the profit target, while it still looks profitable with more orders. Or, it may cut off when it experiences a fluctuation in the market, while it is possible that the price gets high back at the end of the day. Algorithmic Trading is the cause of market fluctuation in general. This can be seen from a case on October 19, 1987 (28 years ago) which is called "Black Monday" and "Panic Sell". Dow Jones reached to -22.6% within one day, which is the worst in the history. In addition, in May 6, 2010, or the "Flash Crash", investors in the market are nervous about Greece situation or the Subprime which had happened 2 years earlier than that. The stock market opened in the negative territory. After half of the day, it moved from 100 points to 300 points in the Dow Jones. Within 10 minutes afterwards, the Dow Jones went over than 1,000 points and reached the lowest point at 9,880 points. It closed at 10,517.83 points, jumping for more than 600 points within 20 minutes.

To explain the transaction values of Algorithmic Trading, a theory will be drawn from two types of literatures. One is the Theory of Reasoned Action - TRA [2], [12] and [33] which is the Technology Acceptance Model (TAM) [8] and [9] and Theory of Planned Behavior (TPB) [1]. The other type is the literature on the benefits, risks, and trust

The Algorithmic Trading in general, investors are likely to trade via the validate the model in practice.

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Algorithmic Trading if they realize that it would give more benefits than other methods. According to the theory of risk acceptance among consumer behaviors [4], Bauer identifies that benefits usually come with risks. The distances between the customers and the broker companies and the unpredictable nature of the internet infrastructure lead to uncertainties in online transactions. The first risk is the uncertainty to lose money from mistakes in the transactions or fraudulent use of the stock account. The second risk is the possibility to lose online privacy compromised by professional hackers. The openness of online transaction platforms makes people uncomfortable with the decision to interact with e-commerce websites [16]. Youssafzai and Pallister argue that confidence may be the key factor in doing online trading business [38]. Therefore, the perception toward the confidence and risks is the major factor in predicting the adoption of online trading via Algorithmic Trading technology.

Trust has been regarded as a stimulant on the transactions between the buyers and sellers, leading

**II. BASIC CONCEPTS AND RESEARCH BACKGROUND**

*2.1. Trust*

Trust is an expectation that others one chooses to trust will not behave opportunistically [14]. It is one's belief that the other party will behave in a dependable, ethical, and socially appropriate manner [17]. Trust deals with the belief that the trusted party will fulfill commitments despite the trusting party's dependency and vulnerability [14]. Accordingly, trust is vital in many business relationships and actually determines the nature of many businesses as well as the social order.

Trust is also a central aspect in many economic transactions because of a deep-seated human need to understand one's social surroundings, that is, to identify what, when, why and how others behave. When a social environment cannot be regulated through rules and customs, people adopt trust as a central social complexity reduction strategy [25]. In particular, in the case of online businesses, which are lacking in effective regulations, consumers have to trust the e-vendors from whom they purchase, assuming, in reality, that the e-vendors will be ethical and behave in a socially suitable manner, or else the overwhelming social complexity will cause them to avoid purchasing all together [14]. Gefen [15] also indicated that without a reduction in the social complexity and risks resulting from the undesirable opportunistic behavior of e-vendors, only short-term transactions would be possible. As online trading lacks the physical presence of brokerage branch and a physical interaction between the broker personnel and the customer, it renders a unique virtual environment, in which trust is of paramount importance.

to a high expectation on the relationship over satisfied trading. Many researchers believe that Trust is a critical factor to understand the behaviors between individuals and the economic exchange [10] and [28]. The importance of confidence gains more attention among e-commerce industries because the high level of uncertainties become more and more prevalent in recent years. Jarvenpaa et al explicitly reflects that trust has a positive influence on the intention of the customers [19] and [20]. Therefore, trust has a critical role in controlling the behaviors of the customers in online trading business. In addition, the perception of risks is also another factor that can influence the customer behaviors [20] because the trust and the perception of risks lead to a situation when uncertainties occur [30]. Thus, we integrate these concepts into the stock trading acceptance model via Algorithmic Trading technology.

This study enlarges the scope of the adoption decision to explicitly include both a negative factor (perceived risk) and positive factors (trust and perceived benefits) simultaneously. The research may benefit practitioners by offering an increased understanding of customers' risk and trust perceptions which can be used in turn to devise risk-reducing strategies and trust-building mechanisms to encourage algorithmic trading adoption. The purpose of this study is as follows:

1. To investigate whether trust, perceived risk, and perceived benefit significantly impact investors' behavioral intention to adopt algorithmic trading adoption.
2. To clarify which factors are more influential and relevant with regard to affecting investors' decision whether or not to use algorithmic trading.
3. To evaluate whether the integration of TAM with TPB provide a solid theoretical basis for examining the adoption of online trading.

2.2. Perceived benefit

There are two types of perceptions of benefits. The first one is the direct benefits and the second one is the indirect benefits. The direct benefits mean tangible and immediate values. Investors will get benefits from Algorithmic Trading. For example, the orders will be fast delivered when the price meets the conditions. This saves more times and increases transparency of data. The indirect benefits mean less tangible benefits and they are difficult to quantify. For example, online trading can be made virtually from anywhere in the world with extensive investment opportunities. More value-added services, such as stock value information, and stock news, are bundled with free.

The direct benefits of Algorithm Trading

include the followings:

1. Track able. This is also called Back Testing.

This process can track back the returns from trading strategies in use. It relies on previous trading statistics years over years. This helps investors realize the risks and the returns from the selected strategies.

2. Effective. Because this kind of trading is

virtually done by a robot or computing machine who decides on the trading orders and the orders are processed automatically, the effectiveness of the trading is explicitly seen as fast and responsive. Investors do not have to monitor the trend on the screen and hit the order button by themselves. This means more time in exploring new strategies to choose in the future. Moreover, this helps them control the risks on a real-time basis, which is better than a decision made by humans.

3. Rational and Emotionless. Online trading

via Algorithmic Trading helps eliminate problems caused by human emotions. This is because the trading strategy is systematically planned ahead.

During the ordering process, the robot will perform

the checking and analyze data before placing an order. This robot is absolutely emotionless and purely rational.

4. Comparing Stocks. The robot can

systematically compare the risks and returns in real-time. It can analyze each stock and adjust the portfolios as well as automatically allocate resources based on the market trends.

5. More Frequent. This is also called High

Frequency Trading which can trade with more frequency based on the market trends. Basically, this system can trade with 24/7 in some markets such as FOREX.

Those evidences support the Perceived Utility from the basic.

2.3. Perceived risk

The theory of perceived risk has been used to explain consumers' behavior. Considerable research has examined the impact of risk on traditional consumer decision making [24]. Peter and Ryan [32] defined perceived risk as a kind of subjective expected loss, and Featherman and Pavlou [11] also defined perceived risk as the possible loss when pursuing a longed for result. Cunningham [7] noted that perceived risk consisted of the amount that would be lost (i.e. that which is at stake) if the consequences of the act were not favorable and the individual's subjective feeling of certainty that the consequences will be adverse. Most of scholars claimed that consumers' perceived risk consists of different types, which vary according to the product (or service) class [21]. The distant and impersonal nature of the online environment and the implicit uncertainty of using a global open infrastructure for transactions can bring about two specific types of risk, namely, security/ privacy risk and financial

easily used without any effort [8].

*2.5. Theory of planned behavior*

Previously, the Theory of Planned Behavior (TPB) is based on the Theory of Reasoned Action (TRA) [12], which can be used to explain most of human behaviors. It is also proven that this theory is successful to predict and explain human behaviors in any circumstances [9]. This theory hypothesizes that behavioral intention is the determinant of people. The behavioral intention in TPB is a set of three functions: attitudes, compliance to the community, and the perceived ability to control behaviors. Attitudes mean a positive / negative of an individual on the target behavior. The compliance to the community means a perception of a person that is aligned with the perception of most of people in the society. The perceived ability to control behaviors means the perception of internal limitation and external limitation on behaviors [36].

**III. RESEARCH MODEL AND HYPOTHESES**

**DEVELOPMENT**

For as far back as decade, specialists have connected TAM to inspect IT utilization and have verified that client view of both value and usability are key determinants of individual innovation selection. While TAM has numerous qualities, incorporating its premise in social brain science, the legitimacy and dependability of its instruments and its stringency, it is frequently reprimanded for overlooking the influence of social and control components on innovation acknowledgment. Such components have been found to have a significant influence on IT usage behavior [35]. These

risk. Security/privacy risk refers to a potential loss due to Internet fraud or hacker intrusion. Phishing is a new crime skill by which phishers attempt to fraudulently acquire sensitive information, such as usernames, passwords and credit card details, by masquerading as a trustworthy entity in an electronic communication [27]. A phishing attack takes places when a user receives a fraudulent email (often referred to as a spoof email) representing a trusted source that leads them to an equally fraudulent website that is used to collect personal information [11]. Both fraud and hacker intrusion not only lead to users' monetary loss, but also violate user privacy, a major concern of many Internet users. Financial risk refers to the potential for monetary loss due to transaction error or stock account misuse. According to Kuisima [22], many customers are afraid of losing money while performing transactions or transfering money over the Internet. Accordingly, this study adopts perceived risk as a negative factor to explain the intention toward online trading.

*2.4. Technology acceptance model*

The Technology Acceptance Model (TAM) is an adjustment of the Theory of Reasoned Action (TRA) which is done by Fishbein and Ajzen [2]. Davis [8] designed this model to explain the behaviors of computer use. In this model, the Perceived Utility and the perception of simplicity are prioritized factors on attitudes over technology, which then affect behavioral intention to choose any technology (eventually leading to the actual use of technology). The Perceived Utility (PU) means the level that an individual believes in one single system in terms of productivity on the user. The Perceived ease-of-use (PEOU) means the level that an individual believes that one single system can be

variables are also key determinants of behavior in the theory of planned behavior (TPB), where social influences (subjective norms) are modeled as determinants of behavioral intention, and perceived behavioral control is modeled as a determinant of both intention and behavior. As the center of this is the adoption of Algorithmic trading, which is considered as an instance of the acceptance of innovative technology intertwined with social systems and personal characteristics, the integration of TAM and TPB for our research framework should provide a more comprehensive model to examine the acceptance of Algorithmic trading. Fig.2 represents the exploration model. It asserts that the intention to use online trading is a function of: perceived benefit, PU, attitude, perceived behavior control and subjective norm. The model further demonstrates that state of mind intercedes the effect of trust, perceived benefit, PU, and PEOU on goal to conduct algorithmic trading. The proposed builds and theories are upheld by earlier studies in data frameworks writing.

### 3.1. TAM and TPB

Hypotheses 1–5 are proposed based on TAM, while Hypotheses 6 and 7 are initiated with the underlying TPB.

- H1: Perceived usefulness has a positive effect on intention to Algorithmic Trading.
- H2: Perceived usefulness has a positive effect on attitude to Algorithmic Trading.
- H3: Perceived ease of use has a positive effect on perceived usefulness to trade online.
- H4: Perceived ease of use has a positive effect on attitude to use Algorithmic Trading.
- H5: Attitude has a positive effect on intention to Algorithmic Trading.
- H6: Perceived behavioral control has a positive effect on intention to Algorithmic Trading.

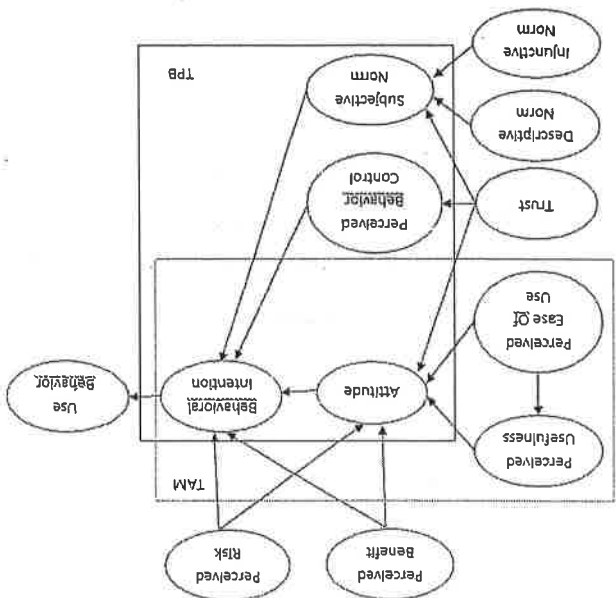


Fig.2. The proposed research model and research hypotheses

For stock investors, trust is viewed as a relevant belief that directly affects investors' attitudes toward algorithmic trading behavior. Just as cost benefit paradigm greatly influences people's attitudinal beliefs and outcome judgments, trust can be a direct influencer that determines people's attitudes toward behavior [3]. Additionally, research has shown that trust definitely increases the confidentiality of business relationships and determines the quality of transaction between buyers and sellers, as well as people's outcome expectations for many commerce activities [17], [23], [25]. Hence, the proposed hypothesized is:

**H10:** Trust has a positive effect on attitudes leading to Algorithmic Trading.

### 3.3. Trust and TPB

The relationship between trust and TPB can be examined from two aspects in which trust is hypothesized as the common antecedent of perceived behavioral control and subjective norm. With regard to the perceived behavioral control construct, trust can increase perceived behavioral control over online transactions since the virtual interactions between customers and e-vendor become more expectable [31]. According to Shi [34], perceived behavioral control encompasses two components. The first component is "facilitating conditions" [56], which reflect the availability of resources needed to perform a particular behavior. The second component is self-efficacy [1], that is, being confident of the ability to behave successfully in the situation. Explicitly, trust influences perceived behavioral control through the controlling factors of self-efficacy and the facilitation of favorable conditions [37]. According to psychological reports, self-efficacy in personal

**H7:** Subjective norm has a positive effect on intention to Algorithmic Trading.

### 3.2. Trust and TAM

The associations amongst trust and TAM have been generally examined in writing where the connections among PU, PEOU, and trust are guessed in numerous online-based business settings [14], [30]. Specifically, a model of Trust and the TAM model were all around defined in online tax settings [37]. This model explicitly indicates that trust is an antecedent of perceived usefulness, PEOU is an antecedent of trust, and trust has a direct influence on behavioral intention to adopt online tax services. Trust is one of the determinants of PU, especially in an online environment, because part of the guarantee is that consumers will sense that the expected usefulness from the web site is based on the sellers behind the web site. Hence, we hypothesize that:

**H8:** Trust has a positive effect on perceived usefulness regarding Algorithmic Trading.

Gefen et al. [14] studied the effect of PEOU on trust in a field study of online shopping. They found that the PEOU has a positive influence on trust because the PEOU can help promote customers' favorable impressions of e-vendors in the initial adoption of on-line services and further, causes customers to be willing to make investments and commit to the buyer-seller relationship. Therefore, the hypothesize that:

**H9:** Perceived ease of use has a positive effect on trust in Algorithmic Trading.



3.4. Perceived benefit

As specified previously, a stock investor will choose to adopt Algorithmic trading in the event that he/she sees that doing as such will give more noteworthy benefits than existing techniques. The perceived benefit construct has been empirically shown to significantly affect e-business adoption [39], and algorithm trading helps improve the welfare of participants by increasing the liquidity and lower the monitoring cost in the high volatility stock [5]. Therefore, it is reasonable to infer that perceived benefit positively influence customers attitude and intention to adopt algorithmic trading. Hence, the proposed hypothesized is:

H13: Perceived benefit has a positive effect on attitude regarding use of Algorithmic Trading.

H14: Perceived benefit has a positive effect on intention to Algorithmic Trading.

3.5. Perceived risk

Consumers' perceptions of risk are considered to be central to different steps in the buying process including their evaluations, choices, and behaviors since consumers are often more motivated to avoid mistakes than to maximize utility in purchasing [6]. An increase in the risk perceived by consumers could reduce their intention to buy through a particular web site. The perceived risk associated with online transactions may reduce perceptions of behavioral and environmental control, affecting transaction intentions negatively [13]. Perceived has been found to have a negative influence on buyers' dispositions or goals to use technology. Similar logic should hold true for perceived risk toward algorithmic trading. These statements lead

relationships is constructed from self-confidence and mutual trust in friendships [26]. Hence, mutual trust in the relationship between customers and e-vendors should increase customer self-efficacy and in turn, increase perceived behavioral control. On the other hand, trust can be a perceptual resource that facilitates customers' ability to gain control over online transactions [37]. While customers trust an e-vendor that behaves in accordance with their expectations, the trust beliefs are likely to increase customer's perceived behavioral control over online transactions [31]. Accordingly, the following hypothesis is proposed.

H11: Trust has a positive effect on perceived behavioral control of Algorithmic Trading activities.

With regard to the subjective norm construct, researchers have found that mutual trust and mutual influence between users and information system (IS) units are highly correlated to each other based on a study concerning the performance of information system groups

[29]. Furthermore, Taylor and Todd [36] in his proposed decomposed TPB model revealed that there are both peer and superior influences on users when determining subjective norms toward IS usage. Evidence provided by an online tax adoption study shows that trust positively influences subjective norm to adopt online tax [37]. It is reasonable to infer that trust in peers and superiors about their beliefs in the context of Algorithmic Trading should play a role in determining subjective norms. Therefore, the hypothesized that:

H12: Trust has a positive effect on subjective norms affecting use of Algorithmic Trading.

REFERENCES

us to formulate the following hypotheses:

**H15:** Perceived risk has a negative effect on attitudes regarding Algorithmic Trading.

**H16:** Perceived risk has a negative effect on intention to Algorithmic Trading.

3.6. Social factors

With regard to subjective norm, due to canceling out effect between the referent groups, a monolithic normative structure may show no relation between subjective norm toward intention [36]. Due to divergence of opinions within the referent group, the decomposition of subjective norm is very essential [36]. Researchers have decomposed subjective norm mainly into peers and superiors [36], spouse, family other than spouse and family and friends [40]. Based on the definition and the measures of Fishbein and Ajzen [2], subjective norm seems to be analogous to injunctive social norm [41]. Injunctive norm refers to normative influences in which a behavior is approved by others whereas descriptive norm refers to normative influences in which a behavior is typically performed by others [42]. Researchers have classified both injunctive and descriptive norm as components of subjective norm; and both are subject to pressure and control from the social group [43], [44]. Therefore, the hypothesized that:

**H17:** Social factor (injunctive norm) is positively related to subjective norm.

**H18:** Social factor (descriptive norm) is positively related to subjective norm.

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