DEVELOPING A DECISION SUPPORT SYSTEM MODEL BASED ON ARTIFICIAL INTELLIGENCE STRATEGY IN STOCK INVESTMENT FOR ORGANISATIONS

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Abstract. Within this fourth industrial revolution, countries have focused on capital markets. Capital markets play a critical role in a country's economic growth and development. In some states, capital markets have been a trigger for the country's progress, thus meaning that with the development of capital markets there is progress in the economy. Indonesia Stock Exchange (IDX) recorded a surge in investor growth amongst millennials. Currently, millennial stock investors make up 60 percent of the total stock investors on Indonesia Stock Exchange. Some companies in Indonesia are recording the number of individual investors or single investor identification (SID) dominated by young investors. Though this is true, in a study of documents it has been established that 69 percent of Indonesian millennials do not have a stock investment strategy. Upon this, the present study aims to discover a Financial Technology (Fintech)-Based Decision Support System Model for implementation in investing stocks that are effective, efficient and attractive to stock investors. The research applied software found on windows 10 Operating System, specifically using telegram bot account, XAMPP-Apache working as a local server, Software Ami broker, Yahoo Plugins daily Stock, while PHP the stock database used in this research was taken in real-time from yahoo finance. This research concludes that a Decision Support System (DSS) Model for Stock Investment is capable of providing information needed by investors to make wise investment decisions and helps them to create a portfolio in stock investment. This research therefore, proposes that with current Model, comprising an integrated server, Amibroker, and telegram bot assures the investor convenience to access the stock analysis and use both technical analysis and fundamental analysis as major considerations for them to make appropriate and decisive investment decisions. In other words, by using this application, investors can obtain investment strategies that have been planned with minimized risks.

KEYWORDS: Decision Support System, Fintech, Investment Decision, Technical and Fundamental Analysis

1. Introduction

During this era of the fourth industrial revolution, most countries are focused on capital markets by moving from economic deficiency to economic abundance as a new form of growth and social improvement (Sima, Gheorghe, Subi´c, and Nancu, 2020). They have adopted and integrated in their economies artificial intelligence (AI), as a new form of doing things, creating pressure and exerting force on market organisations, including investment markets (Ravina-Ripoll, Domínguez, Del Rio, and Ángel, 2019), hence affecting decision making of the would-be investors. This is happening due to the fact that the fourth Industrial revolution has evolved at a very fast pace, disrupting most sectors of the economy of each nation, affecting national systems, including administration, productivity and also the way of governance (Schwab, 2016). In some states, though capital markets have been a source of trigger for most country's progress, their maintenance is still poor due to less innovation required to much the current trend of global development within an increasingly transforming society.

In a survey on conducted by Luno, one of the cryptocurrency companies that collaborate with Dalia Research. The survey involved 7,000 millennial respondents (23-28 years). Respondents came from three continents, namely, Europe, Africa, and Southeast Asia. About 15 percent or 1,050 respondents came from Indonesia. Based on survey results from respondents in Indonesia, Luno found that around 69 percent of Indonesian millennials do not have a stock investment strategy.

In general, there are two approaches in conducting stock analysis, namely fundamental analysis, and technical analysis. Fundamental analysis is an analysis of past company performance that has occurred and is based on financial reports. Meanwhile, the Issuer Prospect is an analysis to predict future company performance based on economic conditions, government regulations/policies, performance & work plans, corporate actions, management, and certain conditions. Technical analysis or technical analysis is an analytical technique that analyzes price fluctuations in a certain time frame. From these price movements, investors observe certain patterns that can be used as a basis for buying or selling. Technical analysis can help an investor to identify patterns or direction of stock movements that may occur in the future. Predicting the direction and movement of stock prices is very difficult, often causing investors to buy excessive amounts of shares, as well as transaction costs, which should not have been incurred, and opportunities to make a profit cannot be realized. Stock investors need a systematic method to not only spot trading opportunities but also provide a consistent approach, thereby minimizing trading errors and costs. While existing trading systems, designed for a specific stock, stock index, or other financial assets, often depend heavily on pre-selected inputs and model parameters that are expected to continue to provide trading information well after initial training or a period of tested model development.

In real-world problems, alternatives in a stock investment option take place dynamically and change because of the uncertain environment. This condition is a challenge today. Investors must consider the uncertainty in the decision process and the choice of alternatives in investing; the development of a model that uses a Decision Support System (DSS) is expected to have the ability to help investors adapt to complex situations under environmental uncertainty and risk. Decision Support System plays an important role in helping investors who do not have deep knowledge of investing in stocks and have behavioral challenges (Bhandari, Hassanein and Deaves 2008). DSS is becoming more sophisticated because it uses artificial intelligence to improve investment performance predictions. In fact, much artificial intelligence and machine learning algorithms try to solve the problem of stock price prediction (Atsalakis and Valavanis 2009, Bahrammirzaee 2010, Khaidem et al., 2016, Hu et al. 2017). DSS simplifies all the theory, modeling, and algorithms behind a friendly user interface. Research has been carried out to define a DSS framework for stock prediction (Kuo, et al., 2001; Klein and Methlie, 1995; Martinez, et al., 2010). However, this study only focuses on stocks in the financial industry. There is a lot of research on the benefits of a Decision Support System (DSS), enabling investors to make better decisions. However, it is also possible that the DSS will trigger investors to become less focused on their initial goals. Decision-making made by investors is full of inconsistencies, illusions, irrational, and easily biased when making decisions in investing in stocks (Jahanzeb, 2012). DSS can influence investors by helping them to make rational or optimal decisions (Arnott, 2006; Bhandari et al., 2008; Lu et al., 2009). For example, investors can be involved in overcoming strategies that can result in unbiased decisions (Beaudry & Pinsonneault, 2005; Tarafdar et al., 2007).

There are several examples of DSS models in research, which can be described as illustrated in the table 1 below:

Table 1. Research Regarding the Decision Support System Model in Stock Investment

No	Title	Researcher	Year	Technology	Limitation

1	Decision Support System for Stock Market Prediction	RaduIacomin.	2016	Support Vector Machine	Only Focusing on One Technical or Fundamental Analysis Technique
2	Decision Support System for Investing in the Stock Market by using OAA-Neural Network	Sabaithip Boonpeng and Piyasak Jeatrakul.	2016	OAA-Neural Network	Requires a long learning time, requires large data storage space, and is not suitable for large time frame data
3	Multi-class DSS pattern classification using neural networks	Guobin Ou, Yi Lu	2006	Artificial Intelligence Neural Network	Less accurate for capital markets in some countries. Only for certain capital markets

Source: Secondary Data, Processed

Based on the description above, to be able to predict stock prices, a DSS model is needed which has a number of financial methods with different strengths and weaknesses to identify investment opportunities, which then need to integrate systematically in technical and fundamental stock analysis with the aim of utilizing their respective strengths. -In each analysis, the literature shows that only a few information technology systems are successful in doing so. Therefore, in this study, a DSS will be designed to integrate the strengths of each analysis to identify investment opportunities and risk factor analysis. This research will lead to a detailed DSS model that provides a more effective and smarter way to recognize trading signals and assist investors with trading decisions by utilizing a system that adjusts input and prediction models based on the desired output. The DSS in this research will provide an overview of the adaptive approach, some of the input and modeling techniques used, including the use of small data memory, database optimization, and can be applied to all capital markets around the world. The implementation simulation in this study will be tested on stock investors in the Indonesia Stock Exchange to illustrate how traders can generate higher returns using the developed adaptive DSS model. In this DSS Dissertation Research, it is expected to provide benefits for stock investors in making adaptive and smart decisions in investing in stocks. The aspect of novelty in this research is that the DSS model produced in this study complements the previous research DSS model, namely real-time data, using a combination of technical, fundamental, any news or information that affects stock prices, can be applied. In all exchanges in the world, and the DSS application is easy to use because it does not need installation but is attached to the Telegram Bot applications, which are integrated with Amibroker's Software, Plugin Yahoo Finance as the DSS, which is the first time developed in this study. Based on the background problems that have been described, the problems in this research are How to build a Financial Technology-Based Decision Support System Model in effective and efficient stock investing for stock investors.

2. Literature Review

Information is a set of confidential and interpreted data that is used in decision making and has also been defined as "some tangible or intangible entity that serves to reduce uncertainty about future circumstances or events" (Lucas H.C J, 1978; Buckland, 1991; Poster, 2006). Management information is important as input at every level in the organization for decision making, planning, organizing, implementing, and monitoring, and controlling. In the context of various levels of decision making, information can be described as sources, data, conclusions, and predictions drawn from data, values, and choices (evaluation of conclusions with regard to objectives and then selecting actions), and actions that involve a series of other actions.

The management information system is one of the main computer-based information systems. Its purpose is to meet the general information needs of all managers in the company or in several subunits of the company's organization. Subunits can be based on functional areas at the management level. There are many definitions for MIS, but one that best describes a management information system (MIS) as "an organization's method of providing past,

present and projected information regarding internal operations and external intelligence, to support the planning, control and operations functions of an organization. Organizations by providing uniform information in an appropriate time frame to assist decision-makers (Alvani and Khosravi, 2005; Waston, Carroll and Mann, 1987). The information in the MIS describes the company or one of the main systems in terms of what has happened in the past, what is happening now, and what is likely to happen in the future. Information is regularly available in a report, a special report, and a mathematical simulation output. All managers use information outcomes because they make decisions to solve company problems (McLeod et al., 1997).

MIS is useful in the area of decision making because it can monitor disturbances in the system, determine actions, and take action in controlling the system. It is also relevant in nonprogrammers' decision making in providing support by providing information for search, analysis, evaluation, choice, and implementation of decision-making processes (Fadekemi, 2007). MIS is very important in decision making because it provides the information needed for better decision-making regarding issues affecting the organization regarding human and material resources (Adebayo and Adesope, 2007; Asemi, Safari, and Zavareh, 2011). A decision support system is an information-producing system that is aimed at a particular problem that must be solved by managers and can help managers in making decisions (McLeod et al., 1997). Decision Supporting System Consist of user interactive, database interactive, Model, an analytical tool, DSS architect network/internet connection (Power, 2002). There are three levels involve for DSS, technology levels, people involved, and developmental approach (Watson, 1993).

3. Methodology

This study uses a qualitative research method with a case study approach. According to Creswell (2016), qualitative research is a type of research that explores and understands the meaning in a number of individuals or groups of people originating from social problems. Qualitative research, in general, can be used for research on people's life, history, behavior, concepts or phenomena, social problems, and so on. One of the reasons why using a qualitative approach is the experience of researchers where this method can find and understand what is hidden behind a phenomenon that is sometimes difficult to understand. This type of qualitative research used by researchers in this study is a case study.

A case study is a study that explores a case in-depth, collects complete information using various data collection procedures based on a predetermined time. This case can be in the form of an event, activity, process, and program (Creswell, 2016). This type of case study research is suitable as a method to answer problems faced by investors in determining their stock investment. A research location is a place or a place for conducting research in order to obtain research data, while the research site is the object to be carried out by a study. In this study, the development of the Decision Support System Model, using the Rapid Application Development Technique, in which the formation of the Model was obtained through interviews with professional workers at PT. Avedeo Mandiri Sukses based in Sidoarjo, Indonesia. The sampling technique used in this study was purposive sampling and snowball sampling. Purposive sampling is a method of sampling by selecting samples from among the population according to what the researcher wants (objectives/problems in the study) so that the sample can represent previously known population characteristics.

The sample or informant planned in this study adjusts the needs. If the information obtained is already saturated, data collection is stopped. On the other hand, if it is not saturated, the collection of information will continue until saturation of meaning can be analyzed. Rapid Application Development (RAD) or rapid prototyping is a software development process model that is classified as an incremental (multilevel) technique. Rapid Application Development (RAD) emphasizes short, short, and fast development cycles. The short time is an important limitation for this Model. Rapid Application Development (RAD) uses an iterative method (iterative) in developing a system where a system working model is constructed at the beginning of the development stage, with the aim of

determining user requirements. Rapid Application Development (RAD) is a life cycle strategy aimed at providing much faster development and better-quality results than those achieved through traditional cycles (Martin, 1990). The steps in model development can be seen as illustrated in Figure 1 below:
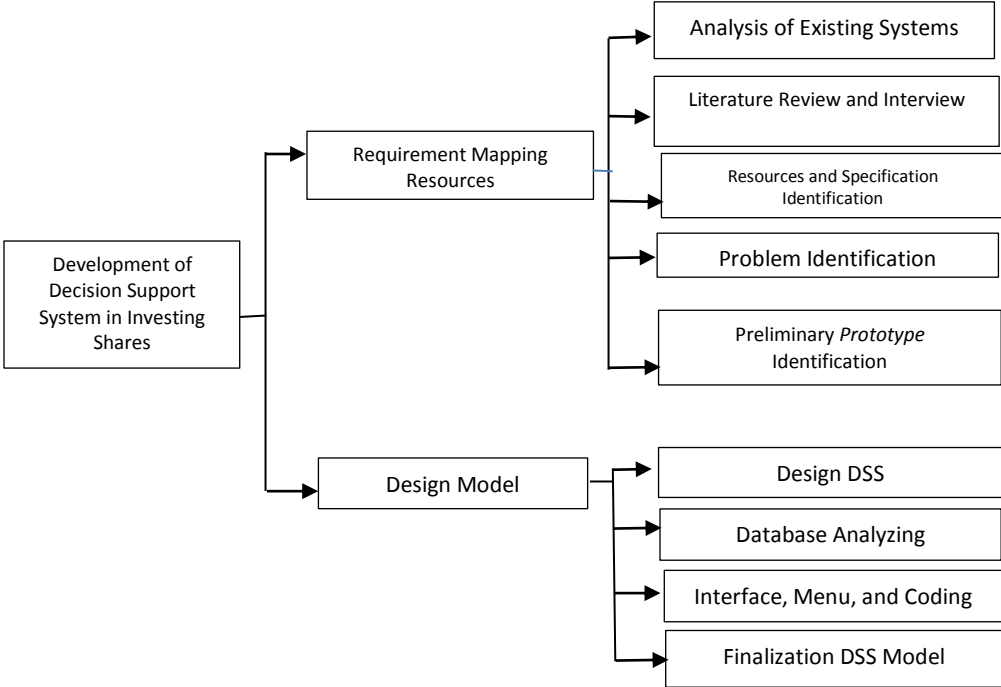
Figure 1 Methods for Development Model DSS In Investing Stocks

4. Findings and Analysis

Data Requirement and Supporting Application for Development of Decision Support System Model

   The stock database used in this study is taken in real-time from Yahoo Finance. Yahoo! Inc. (hereinafter we will call it Yahoo) is an American multinational Internet company headquartered in Sunnyvale, California. The company is listed on the NASDAQ American Stock Exchange under the symbol YHOO. Yahoo has various websites and services, such as a web portal (www.yahoo.com). In this study, stock data that will be used as the basis for the formation of the DSS model is the share data of companies listed on the Indonesia Stock Exchange. In this study, the yahoo finance stock database is used because there are several advantages, including Yahoo Finance as part of the www.yahoo.com portal and is one of the complete free stock data providers for the whole world, not only for stocks in the United States. -Financial data and shares provided are complete and up to date. Complete in the sense that it almost includes all data on stocks in Indonesia, especially those that are quite active. Meanwhile, up to date means that the stock data is intraday semi-real-time data, for the Indonesian Stock Exchange about 10 minutes late from real-time data, and is free of charge, 3. Because the data is provided by Yahoo, we do not need to change the data if it occurs. Corporate actions such as Stock Split, Right Issue, and Reverse Stock, and historical stock data for further processing can be downloaded in real-time using plugins that are directly connected to yahoo finance. Amibroker is a full-featured technical analysis & trading system development platform with advanced real-time charting, portfolio retest/optimization, and scanning capabilities. Amibroker's robust systems development environment makes it possible to find market inefficiencies, code the system, and validate it using powerful statistical methods such as walk-forward tests and Monte Carlo simulations. AmiBroker allows you to trade directly from the chart or programmatically, using an automated trading interface. In the Amibriker application, there is an AFL Code Wizard facility that automatically converts English sentences into code, so you don't need to know how to program. If you have ever wanted to create your own trading system but have trouble coding, the AFL Code Wizard is the solution. Instead of typing cryptic code, grab words from the easy-to-use interface to create sentences in plain English describing how the system should work, and the wizard will automatically generate a valid system code. The database of yahoo finance in the form of plugins will be integrated into the Amibroker software. Another tool used in this research is the Telegram Bot. A telegram bot is a bot or robot that is programmed with various commands to carry out a series of instructions given by the user. This bot is just a Telegram account that is operated by software that has an Artificial Intelligence (AI) feature. Telegram bot can do anything according to the command (which is already available). Telegram bots can be used to perform searches as a connector, reminder, instructor, integrator, and others. Telegram bot runs without the need to be installed and without the need for a phone number. They are already running on all platforms that support Telegram. They run invisibly, so they don't bother the user. Users can interact with the Telegram bot by sending a message or a specific command line. Telegram provides freedom and openness to third parties to be able to develop new Telegram bots. The Telegram bot is considered capable of providing a series of conveniences in automating user activities and can be used as a suitable container for programmers who want to hone their creativity here. Developers create many new bots that always end in "bot" to make it easy for users to find or call a particular bot, examples such as @TriviaBot, @GitHub_Bot, and others. Reporting from the core.telegram.org site, the Telegram bot can act as a smart newspaper. Every time you can be sent the latest content if you want. Telegram bot can also provide a service in the form of warnings or notifications about weather forecasts, price increases or decreases, translating, formatting, and more. So that the database of these shares can be accessed 24 hours, it must be stored in a server that can be accessed using XAMPP as a database server that

connects the Telegram Bot with Amibroker, using the PHP programming language.

Rapid Application for Development Decision Support System

Based on the model development method used in this study, namely, Rapid Application Development, it can be explained as follows:

Analysis of Existing Systems- based on the empirical search regarding the current DSS, the researcher took the existing DSS in several android applications found on the Google Play Store. From the application, the researchers tried to analyze the DSS users based on the reviews given on the Goole Play Store. Most of the users complain about updating the stock database and applications that sometimes stop working due to an unstable connection because it requires a stable connection with large bandwidth.

Literature Review and Interview- based on the literature review that has been presented in the previous chapter, it can be seen that the DSS built is only limited to a few stocks, does not provide recommendations for investors, and is constrained by database updates. In addition to literature reviews, researchers also conducted in-depth interviews with several professionals who have been experienced in making DSS models, especially in stock investment, where the use of this application according to the DSS developers is relatively lighter than the DSS, which requires installation in an operating system that takes up more program memory.

Resources And Specification Identification- based on the needs of the DSS, the researchers conducted a mapping of data requirements and supporting applications in making the DSS Model. The result of the process is that the required applications and databases include XAMMP Server, Yahoo Finance Plugins, Amibroker Software, telegram bot API token obtained from Bot Father telegram.

Problem Identification- the problem in establishing this DSS is the need for a server to run for 24 hours so that DSS users can access the server. Another problem is that an AFL programming language is needed, which is very flexible and dynamic, to create graphic analysis and stock screening that provides direction for stock investors in investing.

Preliminary Prototype Identification- the initial Model will be presented first to be analyzed in use by investors who will try the DSS that has been formed.

Design DSS- Based on the DSS Design that has been tested in the prototype stage, the DSS model will be built.

Database Analyzing- the DSS model that is already running will be conducted in-depth analysis again regarding the accuracy, accuracy, and timeliness of the database used.

Interface, Menu, and Coding- in order to interact with the established DSS, an interface is needed, namely a display or menu that makes it easy for users to access the DSS.

Finalization of the DSS Model- the DSS model that has been formed will be finalized in order to become a stable DSS model and will be integrated into a system that is stable and up to date.

Result of Decision Support System for Investing Share- the results obtained in this study regarding the DSS model can be illustrated as in the following figure 2:
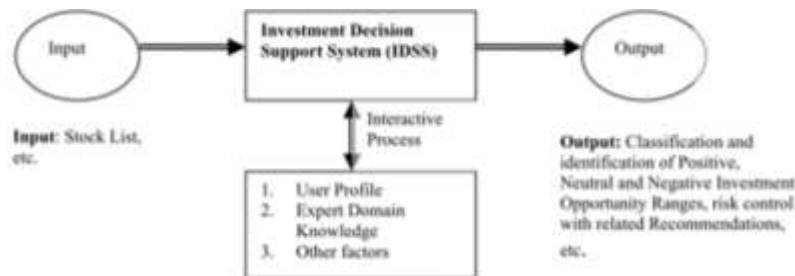

Figure 2. Decision Support System Model in Stock Investment

Source: An Investment Decision Support System (IDSS) for Identifying Positive, Neutral and Negative Investment Opportunity Ranges with

Risk Control in Stock Markets (Chen et al, 2004).

Some of the studies conducted only provide signals and indicators regarding stock recommendations, which is only information, waiting for execution from investors. Yet, with obsolescence, such information can become irrelevant in the future. In this regard the model in this study uses artificial intelligence in the automation process for stock investment recommendations that has been achieved depending on purchases and monitoring stock price predictions in regard making profits upon the investment in stocks.

The first step to try the DSS model above is to first activate the XAMPP server as shown in figure 3 below:

Figure 3. XAMPP server activation

Then to try to retrieve chart data with the stock code AALI (Astra Agro Lestari), the telegram bot command that can be typed is / AALI-7. It displays as illustrated in figure 4 below:

To try the stock recommendations provided by the DSS Model, you can do with command / analysis1, and it will be displayed as in the following figure 5:

Figure 4. DSS Model stock recommendations

The DSS model analysis result file is a stock recommendation that investors can choose to determine the buying and selling price based on the DSS model. As an illustration, see the Appendix, which presents some of the results of share recommendations by the DSS Model. To get a fundamental analysis of the DSS model, you can type AALI, and it will be displayed as shown in the following figure 6:

Figure 6. Analysis of the DSS model

The Decision support system model that has been developed can be used by investors who aim to invest in stocks by considering the recommendations for each selected stocks that will be provided by this model system. The novelty of the model in this study is the existence of artificial intelligence which directly helps and guides in purchasing shares in accordance with stock recommendations which are analyzed beforehand by the system, showing how investors can set and attain the desired profits. The decision support system models that exist so far are only providing stock recommendations or signals to investors, without executing them directly, even though the issue of buying and selling stocks is very important to get a profit in investing within stocks. This artificial intelligence technology that executes stock recommendations is what is new in this research.

4. Conclusion

Several recent studies seem to observe the DSS model in investing in stocks only based on one stock exchange in a country, for some types of stocks only, as well as the non-automated data updates with the stock database, but through a non-real-time batch update system and does not provide recommendations for options. Stocks for beginner investors who do not understand the expertise in investing in stocks.

We have several important findings. First, we found a model that can be used widely for all exchanges in the world. Both DSS models can be used for data information on company stocks around the world. Third, it is relatively easy to use and provides scientific stock recommendations from the DSS model. The fourth analysis used is a combination of technical analysis and fundamental analysis, and the five DSS models do not require special installation, and everyone can use them.

The limitations of our research are that our sample is the investors who are members of the telegram group, and the resulting decision-support information facilities are still too simple and incomplete. Recommendations for further research are that it can be developed regarding the types of charts in technical analysis that can be reproduced in combination with fundamental analysis to provide a better picture to stock investors. In terms of technology, the platform can be developed with other platforms such as WhatsApp Robotic, and for further research, other researchers can conduct tests using the Technology Acceptance Model (TAM) method to determine the importance of the DSS model in this study.

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