JCSTS

AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| **RESEARCH ARTICLE**

Candlestick Pattern Research Analysis, Future and Beyond: A Systematic Literature Review Using PRISMA

Soetam Rizky Wicaksono[1] ✉ **Purnomo[2] and Rudy Setiawan[3]**
[123]Faculty of Science and Technology, Universitas Ma Chung, Malang, East Java Indonesia
Corresponding Author: Soetam Rizky Wicaksono, **E-mail**: soetam.rizky@machung.ac.id

| **ABSTRACT**

Online stock market circumstances allow traders to examine in real time or periodically with free or paid criteria and indicators. Candlestick charts and historical data help traders predict stock values. These forecasting methods rely on traders' experience. Such unscientific judgements lack empirical facts and mathematically established theories, which are rarely published in recognized scientific journals. Initial research revealed a gap between candlestick research and practice, creating a novel idea without scientific backing. Given the different study possibilities, the literature review must address the following questions: what's the trend in candlestick indicator research over the past five years, and what's ahead for candlestick stock price predictions? This study used PRISMA to conduct its literature review. Ten articles were duplicated in three indexes. Last, the article content is compared to the research questions. Only 20 Scopus (S) papers have more than 10 citations, and 2 don't have full paper access, so only 11 match the conditions. 100 publications were obtained from Google Scholar (GS), then re-filtered to obtain 19 with more than 10 citations and 6 without full paper access, for a total of 11 articles. 100 articles from Semantic Scholar (SS) met the first requirements. Duplicate articles in each database were rechecked to produce 24 valid articles for future research. Economic and IT publications employ candlestick patterns in the study. SLR screening and literature research yielded expert systems, historical research, ichimoku, local studies, and technological analysis. Expert system group dominates research, but no technique dominates implementation. Future research can be new. Candlestick patterns have only been tested on local stock markets in one country; therefore, economic crises, commercial acts, or conflicts may lead the method to fail.

| **KEYWORDS**

Candlestick, Stock trading, Chart Pattern, Systematic Literature Review, PRISMA.

1. Introduction

The stock market is one of the main activities of the economy in the country, and this is the case in many countries in the world. STATISTA noted that there were at least more than 100 trillion USD in stock market transactions worldwide in 2015 and although it declined since the pandemic in 2020 and competition with the cryptocurrency market, it still earned at least more than 60 trillion USD worldwide (STATISTA, 2020). This shows that large transactions automatically involve a large number of traders, so it becomes a potential market to be educated in it.

The current stock market conditions, which have all become online trading, certainly make it easier for traders to analyze in real-time or periodically with a variety of parameters and indicators that are available for free or paid. There are thousands of books in various languages that discuss analytical techniques and trading strategies using these various indicators, which generally use candlestick charts and historical data to make stock price predictions. But on the other hand, these prediction techniques and forecasting strategies seem unscientific and only based on the experience of other, more experienced traders. Such unscientific assessments are based on the lack of empirical evidence and algorithms or methods that are based on theories that have been mathematically proven through the research process and are apparently rarely published in scientific journals, even more so in

reputable scientific journals.

An initial search in the SCOPUS database showing the keyword stock candlestick prediction forecasting only resulted in 27 articles in the time span of 2017 to 2022. Meanwhile, in a broader database, namely Google Scholar, of the first 500 search results with the same time span, and then searched with citation results of more than 10, only 43 articles. This means that research with these keywords, especially on the theme of stock trading, does not do as much as other themes. In other literature reviews that have been carried out with similar themes, with the keyword decision support system, stock trading also gets the same thing (Wicaksono et al., 2022). So in this study, a search was carried out with wider keywords and a better range of literature. This shows that research on this theme is not as aggressive as the trading turnover and the number of traders around the world. So there is a gap between research on stock trading, especially those involving candlesticks, and practice which later becomes a new theory without any scientific proof.

On the other hand, the increasingly popular use of candlestick indicators in trading, both stocks and forex, even in cryptocurrencies, makes this indicator even more popular for traders in making subsequent price predictions. Some service providers for displaying charts with candlesticks, such as trading view, yahoo finance, investing, and the like, became popular and benefited a lot from their paid services. Nevertheless, empirical research on this indicator does not look comparable to its popularity. In fact, there are many types of indicators that are routinely used by traders, such as MACD, Stochastic, RSI (Chootong & Sornil, 2012), and even candlestick indicators originating from Japan, namely ichimoku which is also a guide for everyday traders (Deng & Sakurai, 2014).

So that the results of the initial search compared to the popularity of candlesticks caused the need for further literature searches on this topic in order to become a guide for researchers in the field of management and computer science to be able to apply various theories and methods or algorithms in utilizing candlesticks for price predictions. Given that there are still very many opportunities open in research on this topic, the literature review carried out must be able to answer the following research questions, which are: (1) what is the trend that has occurred in research regarding stock price predictions using candlestick indicators over the past five years? (2) What method or algorithm has been dominant in research regarding stock price predictions using candlestick indicators for the past five years? and (3) what opportunities can be done in research regarding stock price predictions using candlestick indicators in the future?

The answer to the research questions is expected to be the basis for researchers to choose the methods and algorithms that will be applied in stock price predictions using the indicators in the candlestick. Especially for researchers in the field of computer science, in addition to the application of methods or algorithms that are considered appropriate can shorten the design time, it can also eventually be applied to prototype software products that eventually become commercial products. On the other hand, the use of indicators in candlesticks will no longer be a myth for novice traders since it has been supported by a variety of empirical studies if later more researchers jump into this topic.

To achieve this goal, the literature review in this study was carried out using the PRISMA method (Page et al., 2021). The PRISMA method was originally used in the field of health-related research (Shamseer et al., 2015), but along with the development of research, PRISMA can also be used in other fields (Page et al., 2021). By using this method, it is hoped that the research questions asked can be answered more accurately structured so that, in the end, it can be understood that stock price predictions using candlesticks can indeed be further researched.

2. Literature Review

In the stock exchange, there are two types of behaviour of market participants, namely investment and trading, both medium and short term. Especially for medium and short-term trading, traders often involve charts in which there are various indicators to determine and predict the price of stocks in the next period, both in units of minutes, hours, and days (Fong, 2014; Volman, 2014). The indicator is basically a statistic and probability from price history, which ultimately becomes the basis for traders' decisions in both selling and buying.

There are various indicators in stock trading that are often summarized as technical analysis in the scope of trading (Ong, 2016; Schlotmann & Czubatinski, 2019; Yuen, 2013). These indicators are generally represented in the form of charts, both in the form of line charts and other forms, such as the most popularly used candlestick charts (Bulkowski, 2008; Ong, 2016; Romero et al., 2018; Yuen, 2013). Candlestick itself is a chart that displays the open, close, low, and high positions of price movements in a certain period, both units of minutes, hours, and days (Martinsson & Liljeqvist, 2017). In the candlestick itself can be given a variety of indicators obtained from the price history with certain methods or algorithms, and can also be combined with various existing technical analysis methods.

In the scope of the literature review, the methods used can use various variants, but methods must always be prioritized that can

produce structured reviews. So that a review is produced that not only draws conclusions in a hurry and is not reliable (Rf et al., 2007). This makes the selection of methods for literature review must be based on systematic methods and has stages that have been well standardized (Van Klaveren & De Wolf, 2019). In addition, the method used has also been commonly used in various other literature review studies. One of the methods that meet these requirements is the PRISMA method which has been proven to have systemic stages and is generally and scientifically accountable (Shamseer et al., 2015).

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses, or the PRISMA technique, is a way to prioritize properly articulated research questions when doing systematic literature reviews (Page et al., 2021). so that replies generated based on the review give trustworthy outcomes and high confidence. In order to narrow down the articles that will be chosen and subjected to further analysis, PRISMA employs at least 27 clearly recognizable checklists.

3. Methodology
Filtering from three index databases, Scopus, Google Scholar, and Semantic Scholar, was used in this study to select journals with the keyword "candlestick pattern." Furthermore, selective filtering is performed by prioritizing articles with at least ten citations in order to account for the impact factor. Then, additional filtering is performed by ignoring search results in the form of book chapters and types of articles from other literature reviews in order to obtain articles that actually contain applied research in response to the research questions posed at the outset.

Next, we examined each filtered article to see if it is available in full-text format and has a valid link to be reviewed and analyzed. Furthermore, grouping is performed based on the algorithm or method employed in order to obtain heterogeneity and homogeneity from the selected articles. The results of each check of this article serve as the foundation for the analysis in the following discussion. In summary, the results of completing the PRISMA checklist are shown in table 1, which is an adapted version of the PRISMA framework.

Table 1. Checklist for PRISMA

Method for PRISMA	
Eligibility criteria	From 2017 to 2022, with citations of more than 10 and from journal article
Information sources	S = Scopus GS = Google Scholar SS = Semantic Scholar
Search strategy	From a single keyword: "candlestick pattern."
Selection process	After filtering by eligible criteria, then filter them by title. Afterward, it excludes any literature review articles, including any theoretical review.
Data collection process	Using Publish and Perish v 8 to guarantee search results, repeat at least three times. After further filtering, export the results to Excel and separate them by the information source.
Data items	Except for a real case study and the direct application of any candlestick pattern or chart, there is no particular filter for data elements. For simpler processing, all chosen items were imported into Mendeley in full-text PDF format and downloaded for additional review.
Synthesis methods	- Grouping the database results and examining each article's abstract shows a literature review or theoretical comparison, then omits it - The most commonalities are used to group objects. - The final grouping's outcomes are further examined and then harmonized across databases. - In order to address research questions and describe any methods used to tabulate or visually present the results of individual studies and syntheses, the results of the grouping reviewed were based on an abstract and full-text study.

4. Results and Discussion
4.1. Initial Selection
With the help of the keywords described in the previous section, the first choice was made using the Publish and Perish application version 8. For the Google Scholar (GS) and Semantic Scholar (SS) databases, which each have a maximum of 500 articles since the same year, the initial search for the Scopus (S) database returned a total of 98 articles since 2017. After that, the results are filtered

such that each article's impact factor is correctly ensured, providing there are more than 10 citations. To confirm the originality of the ensuing analysis study, identical articles were then searched for throughout the three databases.

The article's content is then subjected to a preliminary screening process based on titles and abstracts to see if it doesn't fall under the headings of a literature review or comparison theory, as well as to see if it actually applies a candlestick pattern or chart with its application in an algorithm or specific method. Further filtering involved removing publications that discussed using other indicators in stock trading. This is done because the type, in essence, is a new development and has nothing to do with the initial study issues. More than 80% of the articles that were decreased from the original number of articles were found in the results of this second filtering.

Additionally, the three distinct index databases were filtered for redundant data; however, it turned out that only ten articles were redundant. The appropriateness between the journal content and the setting of the research questions is then evaluated as the last stage of filtering. Based on the filtering results, out of the 98 articles taken from the Scopus (S) database, there are only 20 that meet the initial requirements with citations of more than 10, and 2 of them do not have full paper access, so there are only 11 articles left that meet the requirements. Meanwhile, from the Google Scholar (GS) database, 100 articles were obtained, which were then only re-filtered and obtained 19 articles with citations of more than 10, and 6 others did not have full paper access, so a total of 11 articles were obtained. The latter from the Semantic Scholar (SS) database obtained 100 articles which then, from the initial screening, only produced 16 articles that met the initial requirements. The overall filter results it was then rechecked for redundancy of the articles generated in each database, and ultimately resulted in 24 articles that were considered valid for further analysis. The framework of the systematic literature review utilizing PRISMA, which provides an overview of this initial selection, is shown in figure 1.
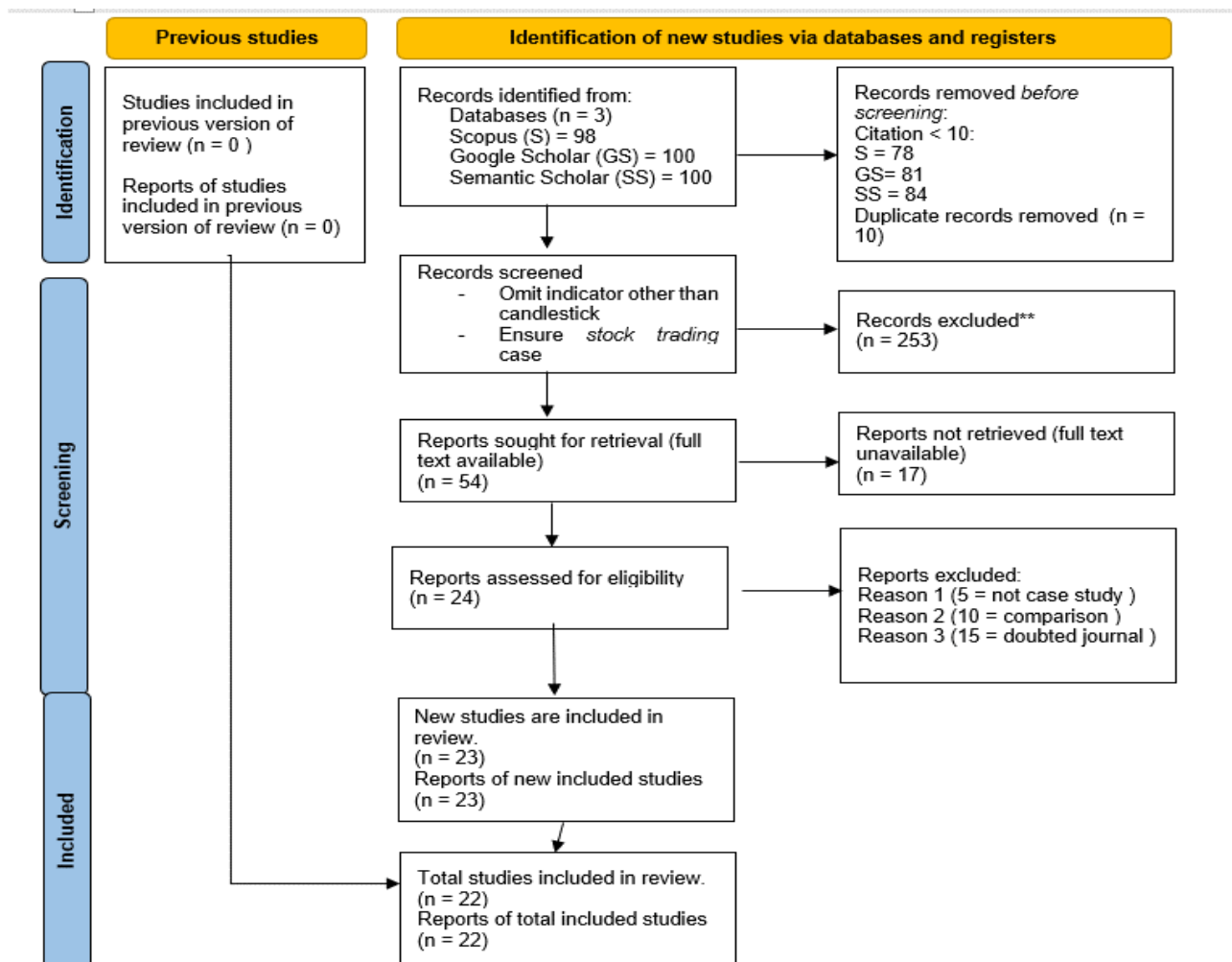

Figure 1. PRISMA flow framework

4.2. Analytical Process

Based on the initial screening results, 22 articles were obtained that were assumed to be qualified for further analysis. Furthermore, a preliminary analysis was carried out by categorizing each article into groups according to their respective content. The results of this initial analysis eventually narrowed down to five groups, namely the theme *of Expert System, Historical, Ichimoku, Local Study,* and *Technical Analysis*. This categorization is based on the results of an abstract study and the conclusions of each article that has been analyzed in the first stage. In full, the grouping of articles can be seen in table 2.

The first group shows that there are at least seven articles that discuss candlesticks and include them in the realm of the Expert System. There are two articles that use Neural Networks in making stock price predictions by making candlesticks as their main parameter (J. H. Chen & Tsai, 2020; Ng et al., 2011), While the rest use fuzzy and learning techniques to look for similarities in candlestick patterns so that they can be predicted for movement in the next period (Carpentier & White, 2013; Goswami et al., 2009) However, apart from the SLR screening results, there are dozens of articles that have the same theme but have citations that are not very significant.

The second group is an article in which historical data and statistical analysis are used in making price predictions using candlesticks. In the first article, the candlestick pattern was used extensively, which was then applied to experiments that used comparisons with other patterns (Hu et al., 2019), even though this was done in more than 25 different patterns. While the second article uses historical data, which is then entered into calculations using machine learning (Ananthi & Vijayakumar, 2020), so it is hoped that the data can be a more accurate reference in making predictions. However, the use of historical data can be wrong if there is a data anomaly in price movements, for example, during the pandemic in early 2020 or during a recession issue that could make the data not move according to the expected pattern.

The third group of SLR results is the group in which Ichimoku or Japanese indicators, which are becoming increasingly popular, are discussed. Ichimoku, also known as the Japanese Candlestick, is the result of empirical studies utilizing candlesticks and has been utilized in numerous studies on various stock exchanges to strengthen its validity (Heinz et al., 2021). However, research on this topic is still categorized as moderate because, despite the fact that many researchers have used this analysis technique, the majority of the articles produced have a low citation factor. So that there are only three articles in this group that meet the screening criteria, namely those using the S&P 500 index (Heinz et al., 2021), the China index (S. Chen et al., 2016), and one other article making predictions using Ichimoku as a parameter in clustering (Chmielewski et al., 2015).

The fourth group is a collection of articles that use candlestick patterns in price predictions on the local stock exchange. In general, local stock exchange research uses a type of event study that relates changes in stock prices to news or momentum in a certain period. So, research involving local stock exchanges using candlestick patterns is not too much, and only a few have significant citation factors. In fact, this type of research is actually very much needed by local traders because each exchange has different characteristics, as is the case with predictions on the Brazilian exchange (Do Prado et al., 2013), which are confirmed to be different from those on the Thai exchange (Tharavanij et al., 2017). Especially with the events that exist on the Chinese exchange (Li et al., 2008), but not the same as what happened on the Taiwan exchange (Lu, 2014).

A last group is a group of articles that discusses the strategy of implementing candlesticks as part of technical analysis. In this theme, there are many book-type publications that mention various types of candlestick formations and the potential for bullish and bearish that can occur as price predictions. However, discussing this strategy in the form of research or scientific work is still relatively rare compared to other themes. But in the SLR conducted this time, there are at least six articles that meet the initial screening criteria. Of the six articles, four of them discuss trading strategies using candlesticks in general, along with empirical proofs on local exchanges (T.-H. Lu & Shiu, 2011; T. H. Lu et al., 2012, 2015; Zhu et al., 2016). While the rest try to make price predictions with candlestick formations which are then combined with other methods. In general, the results of article screening can be seen in table 2.

Table 2. Article Screening Result

⊟ **Expert System**
A fuzzy decision system for money investment in stock markets based on fuzzy candlesticks pattern recognition
Candlestick Analysis based Short Term Prediction of Stock Price Fluctuation using SOM-CBR
Encoding candlesticks as images for pattern classification using convolutional neural networks
Fuzzy modeling of stock trading with fuzzy candlesticks
High-frequency equity index futures trading using recurrent reinforcement learning with candlesticks
Stock investment decision support for Hong Kong market using RBFNN based candlestick models
Stock prediction by searching for similarities in candlestick charts
⊟ **Historical**
A formal approach to candlestick pattern classification in financial time series
Stock market analysis using candlestick regression and market trend prediction (CKRM)
⊟ **Ichimoku**
Bullish and Bearish Engulfing Japanese Candlestick patterns: A statistical analysis on the S&P 500 index
Pattern Recognition in the Japanese Candlesticks
The predictive power of Japanese candlestick charting in Chinese stock market
⊟ **Local study**
On the effectiveness of candlestick chart analysis for the Brazilian stock market
Profitability of Candlestick Charting Patterns in the Stock Exchange of Thailand
Quantitative study on candlestick pattern for Shenzhen Stock Market
The profitability of candlestick charting in the Taiwan stock market
⊟ **Technical Analysis**
A Study on Technical Analysis Using Candlestick Pattern of Selected Large Cap Stocks Listed in National Stock Exchange (NSE), India with Reference to Steel Sector
Are candlestick trading strategies effective in certain stocks with distinct features?
Pinpoint and Synergistic Trading Strategies of Candlesticks
Profitable candlestick trading strategies-The evidence from a new perspective
Reversal Pattern Discovery in Financial Time Series Based on Fuzzy Candlestick Lines
Trend definition or holding strategy: What determines the profitability of candlestick charting?

4.3. Answering Research Questions

Based on the SLR search results, the first research question can be answered, namely: *what is the trend that has occurred in research regarding stock price predictions using candlestick indicators over the past five years?* Including the formation or pattern of candlesticks as parameters in artificial intelligence or expert systems-related research is the answer to this question. This leaves the topic wide open, as there are so many methods and algorithms in this field that can be combined with either similar methods or other methods, such as clustering, or by considering other parameters, such as news and corporate momentum.

Regarding the second question, *which method or algorithm has dominated stock price prediction research using candlestick indicators over the past five years?* After using SLRs to conduct a search, there is no dominant method or algorithm because researchers are still experimenting with various methods and conducting limited empirical trials on various local stock exchanges. There are currently only a small number of researchers who are able and willing to conduct trials on multiple exchanges simultaneously, as doing so requires substantial resources and considerable time. In addition, the presence of macroeconomic anomalies (e.g., recessions, wars, or political crises) and the unique characteristics of each stock exchange can lead to the failure of methods that are successful on one exchange.

For the last question, *what opportunities can be made in research regarding stock price predictions using candlestick indicators in the future?* The answer to this question is to utilize algorithms or methods that exist in the field of artificial intelligence or expert systems. This is an opportunity that is still wide open for researchers because there are so many methods in this field that there are also various formations of candlestick patterns that can be used as input parameters, both in bullish formations and bearish formations. But on the other hand, the trial of the results of the implementation of the method should not be carried out only on one stock exchange but on various stock exchanges so that it can be seen objectively if there are errors or anomalies in it.

5. Conclusion

Research using candlestick patterns until this article was finished writing is widely found in various journals, both economic and information technology themes. The results of screening and literature search using SLR found that there are at least five large groups of research topics in this scope, namely expert systems, historical, ichimoku, local studies, and technical analysis. Of the five

groups, in general, the expert system group dominates the research trend, but there is no dominant method in its implementation. So, the novelty opportunity for the next research is still wide open and becomes an opportunity that can be utilized. As for the results of the candlestick pattern implementation trial, it is still limited to local stock exchanges in one country, so it is still necessary to take into account various anomalous factors such as economic crises, corporate actions, or wars that can cause the failure of the implementation of the method.

Conflicts of Interest: "The authors declare no conflict of interest.
ORCID iD: http://orcid.org/0000-0001-5185-774X
Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers.

References

[1] Ananthi, M., & Vijayakumar, K. (2020). Stock market analysis using candlestick regression and market trend prediction (CKRM). *Journal of Ambient Intelligence and Humanized Computing*, *0123456789*. https://doi.org/10.1007/s12652-020-01892-5

[2] Bulkowski, T. N. (2008). Encyclopedia of candlestick charts. *Wiley Trading Series*, 940. http://hym-2017.corpuscodea.es/pdf/Thomas N. Bulkowski - Encyclopedia of Candlestick Charts (2008).pdf%0Ahttps://www.amazon.com/Encyclopedia-Candlestick-Trading-Bulkowski-published/dp/B00EKYJEJK/ref=sr_1_3?s=books&ie=UTF8&qid=1499257147&sr=1-3&keywords=En

[3] Carpentier, N., & White, D. (2013). Perspective des parcours de vie et sociologie de l'individuation. *Sociologie et Sociétés*, *45*(1), 279–300. https://doi.org/10.7202/1016404ar

[4] Chen, J. H., & Tsai, Y. C. (2020). Encoding candlesticks as images for pattern classification using convolutional neural networks. *Financial Innovation*, *6*(1). https://doi.org/10.1186/s40854-020-00187-0

[5] Chen, S., Bao, S., & Zhou, Y. (2016). The predictive power of Japanese candlestick charting in the Chinese stock market. *Physica A: Statistical Mechanics and Its Applications*, *457*, 148–165. https://doi.org/10.1016/j.physa.2016.03.081

[6] Chmielewski, L., Janowicz, M., Kaleta, J., & Orlowski, A. (2015). Pattern recognition in the Japanese candlesticks. In A. Wiliński, I. El Fray, & J. Pejaś (Eds.), *Advances in Intelligent Systems and Computing* (Vol. 342, Issue August 2016, pp. v–vi). Springer International Publishing. https://doi.org/10.1007/978-3-319-15147-2

[7] Chootong, C., & Sornil, O. (2012). Trading Signal Generation Using A Combination of Chart Patterns and Indicators. *IJCSI*, *9*(6), 202–209. www.IJCSI.org

[8] Deng, S., & Sakurai, A. (2014). Short-term foreign exchange rate trading based on the support/resistance level of Ichimoku Kinkohyo. *Proceedings - 2014 International Conference on Information Science, Electronics and Electrical Engineering, ISEEE 2014*, *1*, 337–340. https://doi.org/10.1109/InfoSEEE.2014.6948127

[9] Do Prado, H. A., Ferneda, E., Morais, L. C. R., Luiz, A. J. B., & Matsura, E. (2013). On the effectiveness of candlestick chart analysis for the Brazilian stock market. *Procedia Computer Science*, *22*, 1136–1145. https://doi.org/10.1016/j.procs.2013.09.200

[10] Fong, W. M. (2014). *The Lottery Mindset: Investors, Gambling and the Stock Market*. Palgrave Pilot. https://doi.org/10.1057/9781137381736.0001

[11] Goswami, M. M., Bhensdadia, C. K., & Ganatra, A. P. (2009). Candlestick analysis based on short term prediction of stock price fluctuation usingSOM-CBR. *2009 IEEE International Advance Computing Conference, IACC 2009*, *March* 1448–1452. https://doi.org/10.1109/IADCC.2009.4809230

[12] Heinz, A., Jamaloodeen, M., Saxena, A., & Pollacia, L. (2021). Bullish and Bearish Engulfing Japanese Candlestick patterns: A statistical analysis on the S&P 500 index. *Quarterly Review of Economics and Finance*, *79*, 221–244. https://doi.org/10.1016/j.qref.2020.06.006

[13] Hu, W., Si, Y. W., Fong, S., & Lau, R. Y. K. (2019). A formal approach to candlestick pattern classification in financial time series. *Applied Soft Computing Journal*, *84*, 105700. https://doi.org/10.1016/j.asoc.2019.105700

[14] Li, H., Ng, W. W. Y., Lee, J. W. T., Sun, B., & Yeung, D. S. (2008). Quantitative study on candlestick pattern for shenzhen stock market. *Conference Proceedings - IEEE International Conference on Systems, Man and Cybernetics*, 54–59. https://doi.org/10.1109/ICSMC.2008.4811250

[15] Lu, T.-H., & Shiu, Y.-M. (2011). Pinpoint and synergistic trading strategies of candlesticks. *International Journal of Economics and Finance*, *3*(1), 234–244. https://doi.org/10.5539/ijef.v3n1p234

[16] Lu, T. H. (2014). The profitability of candlestick charting in the Taiwan stock market. *Pacific Basin Finance Journal*, *26*, 65–78. https://doi.org/10.1016/j.pacfin.2013.10.006

[17] Lu, T. H., Chen, Y. C., & Hsu, Y. C. (2015). Trend definition or holding strategy: What determines the profitability of candlestick charting? *Journal of Banking and Finance*, *61*, 172–183. https://doi.org/10.1016/j.jbankfin.2015.09.009

[18] Lu, T. H., Shiu, Y. M., & Liu, T. C. (2012). Profitable candlestick trading strategies-The evidence from a new perspective. *Review of Financial Economics*, *21*(2), 63–68. https://doi.org/10.1016/j.rfe.2012.02.001

[19] Martinsson, F., & Liljeqvist, I. (2017). *Short-Term Stock Market Prediction Based on Candlestick Pattern Analysis Short-Term Stock Market Prediction Based on Candlestick Pattern Analysis*. School of Computer Science and Communication Stockholm.

[20] Ng, W. W. Y., Liang, X. L., Chan, P. P. K., & Yeung, D. S. (2011). Stock investment decision support for Hong Kong market using RBFNN based candlestick models. *Proceedings - International Conference on Machine Learning and Cybernetics*, *2*, 538–543. https://doi.org/10.1109/ICMLC.2011.6016839

[21] Ong, E. (2016). *Technical Analysis for Mega Profit*. Gramedia Pustaka Utama.

[22] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E.,

Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. In *The BMJ* (Vol. 372). https://doi.org/10.1136/bmj.n71

[23] Rf, S., Mc, M., & Sampaio, R. F. (2007). Systematic Review Studies: a Guide for Careful Synthesis of Scientific Evidence. *Rev. Bras. Fisioter*, *11*(1), 77–82.

[24] Romero, G., Romero Martínez, G., Pinta, D. A., & Borda, L. Á. (2018). CIPP model to evaluate the principles applied to develop the Input Skills in the Bachelor Degree Program of EFL. *International Journal of Education and Learning Systems*, *3*(October), 117–128. http://iaras.org/iaras/journals/ijels

[25] Schlotmann, R., & Czubatinski, M. (2019). *TRADING: TECHNICAL ANALYSIS*. ?uantu? Tra?e Solutions G?bH.

[26] Shamseer, L., Moher, D., Clarke, M., Ghersi, D., Liberati, A., Petticrew, M., Shekelle, P., & Stewart, L. A. (2015). Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ*, *349*(jan02 1), g7647–g7647. https://doi.org/10.1136/bmj.g7647

[27] STATISTA. (2020). *Stocks traded, total value (current US$)*. STATISTA. https://data.worldbank.org/indicator/CM.MKT.TRAD.CD?end=2020&start=1990

[28] Tharavanij, P., Siraprapasiri, V., & Rajchamaha, K. (2017). Profitability of charting candlestick patterns in the stock exchange of Thailand. *SAGE Open*, *7*(4). https://doi.org/10.1177/2158244017736799

[29] Van Klaveren, C., & De Wolf, I. (2019). Systematic Reviews in Education Research: In *Contemporary Economic Perspectives in Education*. https://doi.org/10.2307/j.ctt14jxsqg.4

[30] Volman, B. (2014). *Practical Analysis of the 5-Minute Time Frame*. Light Tower Publishing.

[31] Wicaksono, S. R., Setiawan, R., & Purnomo. (2022). Decision Support System for Stock Trading: Systematic Literature Review using PRISMA. *Sainsteknol*, *20*(1), 28–37. https://doi.org/10.15294/sainteknol.v20i1.37744

[32] Yuen, R. W. P. (2013). High Low Candlestick Chart. *SSRN Electronic Journal*, *April*. https://doi.org/10.2139/ssrn.2247248

[33] Zhu, M., Atri, S., & Yegen, E. (2016). Are candlestick trading strategies effective in certain stocks with distinct features? *Pacific Basin Finance Journal*, *37*, 116–127. https://doi.org/10.1016/j.pacfin.2015.10.007