

# Using the Equity Trade Simulator (ETS) to enhance the Compliance Process of Equity Portfolio Management

Meshal Alhusaynan  
King Saud University  
Saudi Arabia, Riyadh

Majed Almashari  
King Saud University  
Saudi Arabia, Riyadh

## ABSTRACT

Portfolio management is a service that seeks to provide many functions to manage portfolios along with applying different compliance and regulation rules. This paper aims to highlight the issues that sophisticated investors face once they monitor their equities portfolios that multiple portfolio managers are managing. The paper also studies the impact of this process in detail and recommends some quick and long-term solutions to its related problems. One of the possible solutions is an Equity Trade simulator (ETS). The ETS is an information system that enables portfolio managers to check the compatibility of their trades with the compliance rules that sophisticated investor has set. It also allows the portfolio manager to import the trade details to the shared data mart after executing it in the market. In addition, the ETS gives the sophisticated investor the capability to analyze the behaviors of all assigned portfolio managers by applying what-if analysis on the rejected trades that do not meet the compliance rules. Furthermore, the ETS allows sophisticated investors to keep track of all the breaches caught by the system while simulating the trade by the portfolio manager. Moreover, the ETS can be enhanced to solve more equities-related issues and extend to include different financial instruments.

## General Terms

Investment Technologies, Compliance Technologies, Investment Compliance

## Keywords

Investment, Equity, Compliance, Information system, Simulator, portfolio, investors

## 1. INTRODUCTION

The financial crisis of 2008 forced many companies and investors to diversify their internal and external investments for several purposes or objectives [1]. These objectives include diversifying assets and building a solid portfolio of assets that enhance the financial strength and growth of the company. Another purpose could be diversifying the company's sources of income through investment in other activities that do not correspond with the company's core business. Sophisticated investors follow the known rule to reduce the investment risk by not concentrating all the efforts and resources in one place: "Do not put your eggs in one basket." [2].

Most financial institutions that have a high solvency ratio, which makes them market makers, are usually called sophisticated investors [3]. They tend to match their assets to their liabilities and seek to ensure that the return spreads over and exceeds their liabilities to keep their solvency rate high [4]. Being a sophisticated investor means following the best standards and techniques and the criteria based on analytical studies to diversify the income sources and reduce the risk of investing in a particular company or sector [5]. Sophisticated investors always have the

money, but they do not have the time or the ability to keep tracking the day-to-day movement in the market periodically. However, they believe in these strategies that they put in, and they adhere to them [6].

According to the abovementioned strategy that most sophisticated investors follow, they often hire portfolio managers to manage their investments after requesting them to comply with their strict compliance rules.

The biggest problem is the massive amount of money available for such investment, making it difficult to share with one portfolio manager. Therefore, most investors and fund families agree that there is a clear need to share this amount with more than one portfolio manager according to the abovementioned reasons for risk avoidance as well as the diversification of strategies and experiences, and they allocate their most skilled managers to manage their portfolios in the market [7]. However, the most significant problem we will deal with is how to follow up with these managers regularly and ensure their commitment to following all the compliance rules during the pre-trade execution and linking them to a shared system that facilitates managing such activities.

In stock markets, machine learning and artificial intelligence capabilities are utilized to enhance pre-trade and trading execution activities to help decision-making. Conversely, process automation can be used in post-trade activities due to the many repetitive tasks, such as processing the payments and reconciling the data [8].

Currently, sophisticated investors face difficulties applying the pre-trade compliance rules when dealing with many portfolio managers. One of the main reasons this paper highlights is the lack of current practices. This research contributes to this area by providing sophisticated investors with the ETS model that allows them to:

- 1) Managing their pre-trade compliance rules instantly without exposing their holdings to the different portfolio managers.
- 2) Integrating with the different trading systems to capture the trades for post-trading compliance.
- 3) Supporting advanced analytics by capturing the rejected trades due to compliance rules.
- 4) giving the possibility to apply different analytical patterns that aim to enhance the decision-making process of compliance rules selection and that eventually helps the portfolio optimization [9].

This paper defines the problem that our study seeks to solve, how vital the problem is, and the proposed solution. Following this, the research motivation and objective are to discuss such a problem, the proposed solution, and its feasibility study.

The rest of the paper is organized as follows: Section II discusses and reviews the related works. Section III defines the problem and proposed solution. Section IV describes the research design approach. Section V studies the solution visibility. Section VI provides a short discussion of the work and presents optional future work. Finally, Section VII concludes our work.

## **2. LITERATURE REVIEW**

In this literature review, we will highlight the different types of investments, starting by explaining investment in general and investment management and equity investment. After that, we will distinguish between the three definitions of investment risk, the risk associated with the hypothetical trade, and how to mitigate that risk. The primary investment terminologies will be clarified before we brief each on investment compliance and liquidation. We will finalize the part of the literature review by highlighting the current practice and the different data import mechanisms.

### **2.1 WHAT IS AN INVESTMENT?**

The investment could be linked with a different set of activities. Still, the primary common goal or target in these activities is to "employ" the money (funds) during the period by the investor or through any portfolio manager seeking to enhance the investor's wealth. Funds and cash inflow to be invested and allocated come from assets already owned, borrowed money, and savings. By preceding consumption today and spending their savings, investors expect to enhance their future consumption possibilities by increasing their wealth [10].

### **2.2 INVESTMENT MANAGEMENT**

The investment management process captures the way of managing money or funds. It shows how an investor thinks to make investment decisions. The investment management process includes the following stages [10]:

- 1) Build the investment policy.
- 2) Analyzing and evaluating the investment vehicles.
- 3) Forming the investment portfolio.
- 4) Portfolio revision
- 5) Measuring and evaluating the portfolio performance.

Creating an investment policy is one of the most critical steps in the investment management process. Investment policy contains putting off investment objectives. The investment policy must specify goals regarding the ROI requirement and risk tolerance for the investor. "For example, the investment policy may define that the target of the average investment return should be 15 % and should avoid more than 10 % losses. Identifying an investor's tolerance for risk is the most important objective because it is obvious that every investor would like to earn the highest return possible. But because there is a positive relationship between risk and return, it is not appropriate for investors to set their investment objectives as just" [11].

### **2.3 EQUITY INVESTMENT**

Stock investment is one of the most well-known types of investment, where people are buying and selling the shares of their firms. There are different types of stock investments. These two are common and preferred stock. In this section of the literature review, we will give more insights about the common stock. These days, no one is calling it common stock. It is called Equity [12].

Equity investment means buying and holding company shares from the stock market by individuals or firms in anticipation of income from dividends and capital gains. Equity has different ways of trading, either OTC, which stands for over the counter, and the second method is through the regular trading platform [13].

Among the various investment options, equities may be highly rewarding, but the risks are equally high. Investment in the capital is like owning a small part of the business.

Equity dividends are shared with investors after settling all liabilities. Moreover, it is not necessarily that dividends are cash-

based. One type of dividend is a stock dividend, in which the firm pays stocks rather than cash. The primary feature of equity is that it does not have a maturity date [14]. There are many advantages of equity as an investment:

- High income
- Receive income in cash (dividend).
- High liquidity.
- Easily movement among the different investors.
- Transaction cost is low.

On the opposite side, there are some disadvantages of equity as an investment:

- Riskier.
- Complicated selection process
- Low operating income

Equity mutual fund helps an individual to reduce the risk of investing in equity for several reasons. The main reason is that fund managers are professionals who have more knowledge of the market than the average investor does [15]. Therefore, their performance is likely to be better than the average investor. Previous studies show that investors select fund managers based on past performance as a primary criterion [16].

### **2.4 INVESTMENT COMPLIANCE MANAGEMENT**

Investment Compliance management refers to ensuring compatibility with all applicable laws, rules, and regulations set by organizations, regulators, industries, cities, countries, or, in general, any rule officially applied to a particular financial paper [17]. However, compliance is a frequent process that requires ongoing oversight and continuous improvement as businesses respond to the regular and rapid changes that highlight the need for agility to follow market movements and trends. Therefore, leaders should improve their compliance agility and adaptability [18].

### **2.5 CURRENT SYSTEM MECHANISMS OF EQUITY PORTFOLIO MANAGEMENT**

The equity market has improved dramatically in recent years. The automaton acceleration, along with the development of new trading platforms, has resulted in intense competition and enhanced trading platforms and features. These platforms allow traders to implement their advanced strategies more effectively [19].

During our practical investigation, we found out that most of the tools in the market are well-designed and have the best functionalities when the relationship between the portfolio manager and the investor is one-to-one, which means that the investor has only one portfolio manager investing the money on-behalf him [20]. There are different mechanisms for managing the portfolios currently:

- 1) The first mechanism is concentrating on the portfolio managers' levels. It focuses on managing the portfolio itself and giving the capability to generate some reports and share them with the investors. Investors then will take care of these reports and import them to their systems in case of any [21].

Many known tools in the market give and provide the following capabilities [22]:

- Trading platform
- Portfolio analysis
- Compliance management
- Notifications and messaging
- Report generation

- 2) The second type is developed for sophisticated investors. It allows them to keep track of their investment. But it doesn't necessarily communicate with the managers on the spot [23]; what we mean is that the investor needs to get the data on a daily or monthly basis based on the agreement with the portfolio managers and update his system either manually or using some ETL batches [24].

Many known tools in the market give and provide the following capabilities:

- Cash flow analysis, including income and expenses.
  - Worth net calculation
  - Check on and analyze your investments
  - Post-trade compliance management
  - Account fees management.
  - Assets allocation report
- 1) Business intelligence dashboard

Personal capital and mint are the most popular software in this field that provide the capabilities mentioned above [25]

## 2.6 Current Data Import Methodologies

Equity trading markets have evolved rapidly with the continued utilization of data acquisition and processing functionalities.[26] Most sophisticated investors are currently asking the portfolio managers to send their daily transactions as per their requirements and accordingly utilize the ETL. The Extract, Transform, Load (ETL) is an automated process that captures the raw data, then extracts the required information, then transforms it to the target format, and eventually loads it to a data warehouse. When building an ETL process, we must integrate the different data sources and apply many plan and test cycles to ensure that we transform data correctly [27]. The main advantage of following this approach is that you do not need to apply different mapping mechanisms to reflect the differences between your system and the managers' system, and this can be an advantage for both the organization and the portfolio manager depending on who will be responsible for managing the mapping part [28]. Moreover, as an organization, you will transfer the data quality check and the database compatibility against the received file to the web service side. So, you will ensure you receive the data after applying all the needed checks from your side on the web service [29].

On the other side, some traders within the portfolio managers see that this could lead to a disadvantage where the trader is required to enter the trade two times, one before executing the deal and the second time after the execution.

Another disadvantage is that the portfolio manager might ask the organization to pay a management fee because the portfolio manager will require an entire team responsible for extracting the data from the portfolio management system and applying the checks required from that sophisticated investor. This always depends on the volume of money that has been funded to the manager, which will affect this fee calculation [30].

## 3. PROBLEM AND SOLUTION DEFINITION

### 3.1 Problem Statement

Sophisticated investors cannot keep track of their investment position when they invest with different portfolio managers, and those managers always face difficulties in following their compliance rules due to frequent changes.

### 3.2 Importance of the problem

Keeping track of the money invested by different portfolio managers is one of the leading aspects of sophisticated investors. By not having such a concept, the sophisticated investor will

need to spend more money to assign auditors to review the different activities being done by other portfolio managers. A sophisticated investor will not be able to change the compliance policy frequently due to many reasons.

## The Proposed Solution

As shown in Figure 1, the solution will provide a shared investment technology containing a data mart managed by sophisticated investors and accessed by the portfolio managers. This solution will allow the sophisticated investor to configure the compliance rules and limits in the system and let the portfolio managers check the compatibility of their intended trade before executing the trade officially in the market and then submitting the validated entries to the investor. The investor will provide the portfolio manager with a web service that all the traders can access belong to that manager. All traders are requested to check the compliance compatibility before the actual execution in the market. If this hypothetical trade passes all the limits and compliance checks, the trader will receive the green light to execute this deal in the market and import all the transaction details in the data mart. If this hypothetical trade does not pass the list of checks, the system will block the deal and notify the organization of this expected breach. Accordingly, the trader will not be able to execute the trade in the system [31].

## 4. RESEARCH DESIGN

Through the research design, all the necessary and required information will be obtained to accept or reject the hypothesis. This research is non-experimental, transactional, and descriptive. Non-experimental because the variables cannot be manipulated; the collected data will be obtained from the population. It is transactional since the data collection will be carried out simultaneously [33]. Non-experimental research is research that is done without deliberately manipulating variables; what is done in this type of research is to observe phenomena as they occur in their natural context and then analyze them. In a non-experimental study, no situation is built, but already existing situations are observed, not intentionally provoked[34]. Non-experimental studies can be of two types: transactional and longitudinal. Sectional or cross-sectional research designs

Collect data at a single moment, at a minimum time. Its purpose is to describe variables and analyze their incidence and interrelationship at a given moment. Descriptive transactional designs aim to investigate the incidence and the values in which one or more variables are manifested within the quantitative approach [33]. The procedure consists of measuring or locating a group of people, objects, situations, contexts, or phenomena in a variable or concept and providing their description.

## 5. SOLUTION FEASIBILITY

To find out how this enhanced Investment compliance process and solution is touching the investor's needs, we conducted a survey. We analyzed the respondents' results to highlight the motivators and improve the process in the future to fulfill the needs and cover the gaps in the proposed solution.

The survey contains 18 survey questions (SQs) and was conducted using an online questionnaire referenced in e-mails and web links sent to the participants through different channels such as WhatsApp and Telegram. The survey has been pre-tested by a group of specialists in the same area to ensure receiving the information that brings value to our solution. The survey was sent selectively to some people who manage different equities portfolios and sent randomly to many people and groups to ensure that it reaches different types of thinking styles and

different levels of financial expertise. The total number of respondents was 23 out of 40.

In this part, we will highlight and analyze the feedback of the answers received in the survey. The first part included general questions to determine our respondents' profiles and assess their expertise in the stock market. We found out that 70% of the respondents are investors in the stock market, and we believe that this percentage is a little bit high if we consider that we did not target only a specific group of

people to measure the need for such a system. This gives us many indicators. One of them is that Saudi families consider the stock market as one of their main targets to invest their money. Investing in the stock market requires an acceptable level of knowledge, and this indicates that such a system will be marketed easily because it touches an area that the majority of society knows.

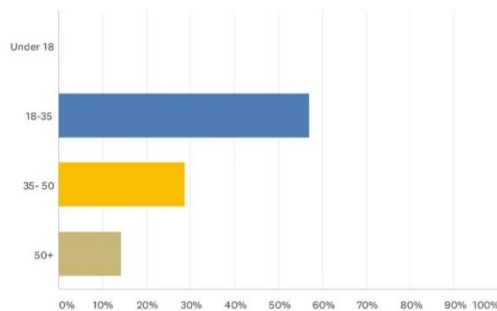


Fig 2. SQ1: How old are you?

According to Fig.2, we found that 57% of the respondents are between 18-35 years old, 25% are between 35-50 years old, and the rest are above 50 years old. Fig.3 illustrates that 95% of the respondents consider and classify themselves as the middle class, which means that they have some savings to invest but do not consider themselves as rich people. Only 5 % were classified as under the middle class. This system targets those who can support and outsource the portfolio management task to a third party. This percentage gives motivation to enhance the proposed solution.

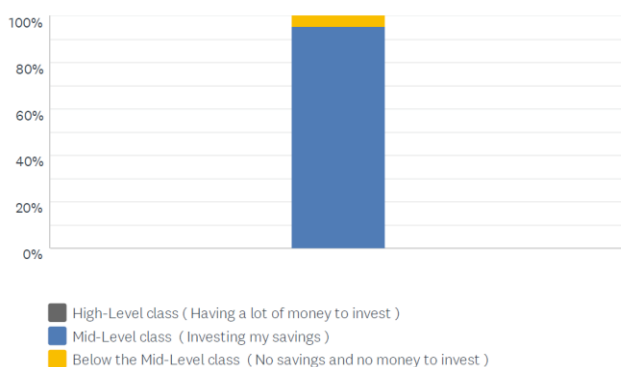


Fig 3. SQ2: From which class would you classify yourself?

As shown in Fig.4, a good indicator of this survey is that 85% of the respondents invest in equities out of the different financial instruments. This delivers an important message highlighting that most Saudi families consider equities as one of the main types of investment or, let us say, the most popular types of investment in Saudi Arabia. Moreover, this supports the importance of having such a system that meets the needs of Saudis.

The compliance system usually targets those who have more than one portfolio because of the difficulties in monitoring the different rules across many portfolios simultaneously. As illustrated in Fig.5, the survey shows that around 44% of the respondents have more than one portfolio. We think this is a good percentage for a randomly distributed population.

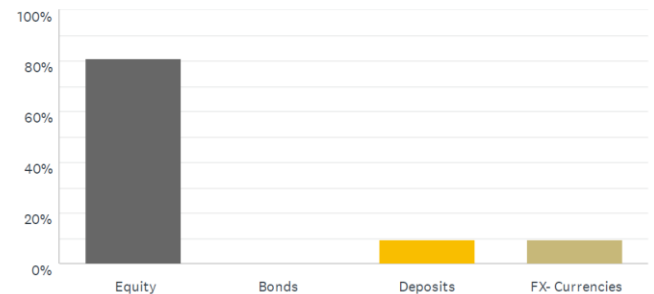


Fig 4. SQ3: In what kind of instruments do you usually invest?

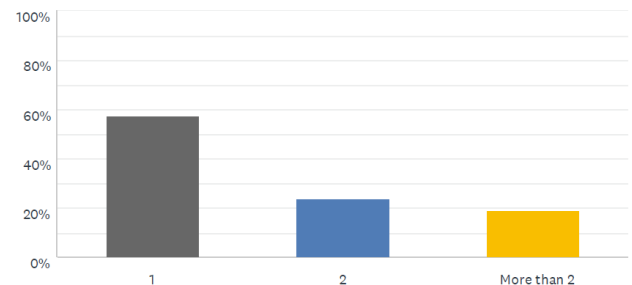


Fig 5. SQ4: How many portfolios do you have?

Such a system targets those who keep monitoring their investment, and the survey reports highlighted that 80% of the respondents are stockbrokers, which means short-time investors who sell and buy his quantities on different companies frequently. If you are a stockbroker, the percentage of breaching compliance rules will increase because of the increasing number of transactions.

One of the main issues that Saudi families are afraid of is putting their money under the custody of the portfolio managers. They usually do not trust the portfolio managers, and they do not think that those portfolio managers will bring more value to their investments.

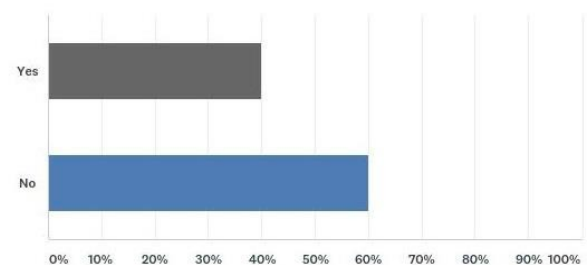


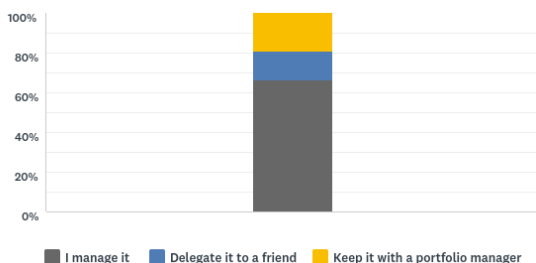
Fig 6. SQ5: Do you trust keeping your money with one or more portfolio managers?

The survey analysis shows that 60% of the respondents do not trust putting their money with portfolio managers. They have mentioned many reasons for this. One of the reasons is that those portfolio managers make ambiguous decisions, and it is challenging to know their strategy if the amount of money to be invested is not huge. Some clarified that the return on investment

is unrealistic based on their expertise. Another reason was that the investors think they can make more money once they manage their portfolios. These reasons motivated me to proceed with such an idea because they highlight the need for such practices that allow investors to trust that their money is safe. The ability to control the activities that managers do is to raise the investors' trust. As we clarified those investors are not afraid of the manager itself but from being unaware of the status and the movement of their money.

The compliance system has usually limited the trader from easy movement in the market and between the assets. In the survey, we intended to know what are the triggers of their decisions or, to be specific, how those investors are making investment decisions. The analysis shows that 25% of the investors are making personal decisions without depending on any consultation. In contrast, 40% prefer to consult financial advisors.

To know what will be the value that such a system will deliver to investors, we need to know the current situation of the portfolios being managed by them. After analyzing the survey, we found that almost 33% of the investors are delegating the process of managing their portfolios to a different entity. This percentage is a little bit small. The reasons are already mentioned in the trust paragraph. This can be a motivator and frustration at the same time. We can say that most investors are managing their investments by themselves. So why do we need to invest in such a solution if the majority do not touch the concept of portfolio management? However, suppose we see it from the other side. In that case, we see it as a motivator as well because the investors highlighted that they do not trust the portfolio manager because they do not know about their money. They are not able to monitor their investments. Therefore, we recommend this proposed solution to overcome these issues and provide the proper technology to strengthen such a field.



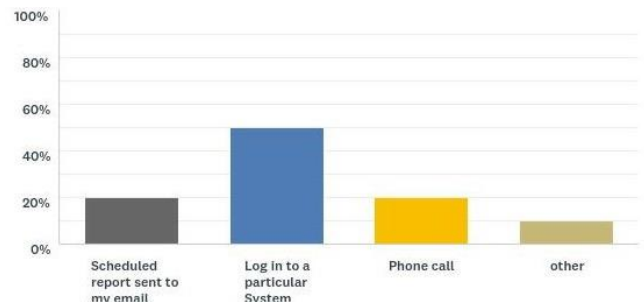
**Fig 7. SQ6: Do you manage your investment or delegate it to someone else?**

The main goal of the compliance system is the capabilities offered to the investors by letting them manage their constraints. These constraints can be cash or quantity limits. For example, the portfolio manager should not exceed 40% of the portfolio's total assets in the real estate sector. Another example is the limit on the cash in the portfolio. For example, the portfolio must keep a 3% cash of the portfolio's total assets. The survey analysis shows that 17% of the investors who invest their money with different entities have constraints. The majority do not share these constraints with the portfolio managers because they do not trust that the managers will follow their constraints, and this is another motivator for using such a system. For those who put and share the constraints with the managers, the survey shows that they are facing difficulties in monitoring the execution of these constraints. The compliance system that we propose offers the investor the capability to monitor his investment by keeping an eye on their movements and transactions. This system will restrict the portfolio managers from breaching the agreement

with the investor without his knowledge. Such restrictions provide value for both the portfolio manager and the sophisticated investor. This is another good indicator of how such a system provides value to the targeted community by solving the issues that prevent them from making the right decisions.

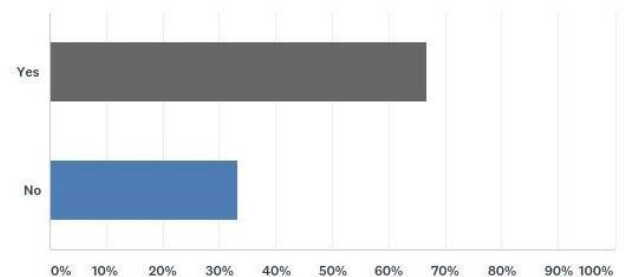
Only 10% of the respondents claimed that they face difficulties when contacting the portfolio managers, while the majority highlighted that the managers are responding immediately. We think this is normal. They want to keep competing in this area with other companies and managers providing the same services. Moreover, this can be considered as a motivator, mainly when some portfolio managers accept the system and provide such services to their investors for free. At that time, all managers will compete to provide such services to keep and increase their quota in the market.

To study the best follow-up method that investors use and need, we intended the survey to ask the investors about the way they are receiving their reports. 50% say that they keep monitoring their investment through an electronic system. This increases the possibility of using the proposed compliance system that will be web-based. 20% clarified that the portfolio managers update them through Email. The compliance system will quickly provide this service. Others are receiving their updates through SMS and mobile calls.



**Fig 8. SQ7: How do you receive your notification and reports from the portfolio manager?**

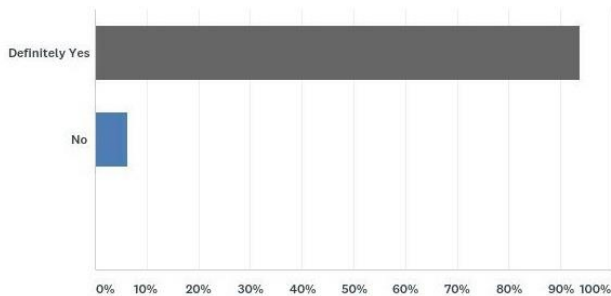
In the survey, we focused on the investors' satisfaction with the current capital company's system. 33% indicated that they are not happy and satisfied with the existing system for many reasons. One of the reasons is the bad performance of these systems during market hours. Other limitations were mentioned, such as the inferior technology basis, wrong mobility platform, and lagging connectivity. 40% of the respondent's investors highlighted that the existing system does not allow them to manage their constraints probably. We think it is because the current system was not designed to cover the compliance rules and constraints at this level. This limitation supports the idea of building such a system.



**Fig 9. SQ8: Do current capital companies' systems satisfy your compliance needs?**

After going through all these details with the investors and collecting all the needed information, we explained the idea of

the compliance system and asked them whether this system would add more value to them. 94% of the respondents show their willingness to use this system in the future once developed.



**Fig 10. SQ9: Considering the explained ETS model, do you think that it will add value to your compliance management process and you will use it?**

In this part of our report, we highlighted the outputs of our interviews with a convenient sample of (relatives, friends, banks employees, and investment experts) portfolio managers in Saudi Arabia, and we discussed with them the feasibility of using the proposed system by the portfolio managers.

Most of them clarified that the current platforms do not allow investors to control their investments. Some think that such a platform will complicate their work will restrict them, and reduce their revenue. However, this is not what we are looking for. The idea of having this proposed compliance system is to enhance the trust between the investors and managers. Therefore, it will force the manager to comply with the investors' compliance rules. The portfolio managers highlighted that if the amount of money invested by the investor is substantial, they will accept whatever the investor requested to manage his money. The majority agree that this proposed compliance system will reduce the mistakes of breaching the rules and raise the investor's trust level. They all agree that using such a system will no longer be an optional decision if the competitors start using and applying its functionalities with their investors. They will be forced to use it. Otherwise, they have to accept the fact that investors escape to other portfolio management service providers. One of the portfolio managers mentioned a good missing point that adds value to our solution, which adds functionality that allows the portfolio manager to request the investor to approve one of the breached transactions after mentioning the justification. This will add more value and flexibility to both the managers and investors and prevent losing the market's chances during trading hours.

## 6. DISCUSSION AND FUTURE WORK

Such solutions can be optimized and integrated with different systems within the organization. Shortly, we will be focusing on enhancing the solution by considering the integration with many data providers such as Bloomberg[35] and Reuters[36] and the data services collectors and providers such as RIMES[37]. In addition, we will check the possibility of utilizing the available APIs to extract the data prices from the data owners such as TASI in our case in Saudi Arabia and other indices such as S&P, DAW J, and FTSE for those who are targeting the international market. Updating the prices will allow sophisticated investors to keep track of their market value and help activate the compliance rules on the market value level. Another working area would be optimizing the search using different options and generating reports on different levels.

## 7. CONCLUSION

This paper highlighted the need for a model that allows sophisticated investors to instantly manage their pre-trade compliance rules without exposing their holdings to different portfolio managers. At the same time, we highlighted how this model could be utilized for integration with the other trading systems to capture the trades for post-trading compliance. We discussed the problem and devised the ETS (Equity trade simulator) solution. We showed the ETS design and capabilities along with an end-to-end process. After that, we analyzed the feasibility of the ETS by conducting a survey analysis in Saudi Arabia. Finally, we concluded the research with the possible future activities to improve the model and increase its maturity.

## 8. REFERENCES

- [1] L. Theron and G. Van Vuuren, "The maximum diversification investment strategy: A portfolio performance comparison," *Cogent Economics & Finance*, vol. 6, no. 1, p. 1427533, 2018.
- [2] J. C. Bogle, "Selecting equity mutual funds," *Journal of Portfolio Management*, vol. 18, no. 2, p. 94, 1992.
- [3] Y. Chen, B. Kelly, and W. Wu, "Sophisticated investors and market efficiency: Evidence from a natural experiment," *Journal of Financial Economics*, vol. 138, no. 2, pp. 316-341, 2020.
- [4] S. D. Stewart, C. D. Piros, and J. C. Heisler, *Portfolio Management: Theory and Practice*. John Wiley & Sons, 2019.
- [5] R. Spiegler, "A simple model of a money-management market with rational and extrapolative investors," *European Economic Review*, vol. 127, p. 103488, 2020.
- [6] J. Blocher and M. Molyboga, "The revealed preference of sophisticated investors," *European Financial Management*, vol. 23, no. 5, pp. 839-872, 2017.
- [7] J. Fang, A. Kempf, and M. Trapp, "Fund manager allocation," *Journal of Financial Economics*, vol. 111, no. 3, pp. 661-674, 2014.
- [8] P. Morel et al., "Fintech in Capital Markets 2018: Boosting Productivity Through Technology Innovation," *The Boston Consulting Group*. Retrieved December, vol. 1, p. 2019, 2018.
- [9] G. Hu and H. Liu, "Application of Data Mining Technology in Portfolio Optimization," in *Journal of Physics: Conference Series*, 2020, vol. 1648, no. 4, p. 042064: IOP Publishing.
- [10] K. Levišauskait, "Investment analysis and portfolio management," *Leonardo da Vinci programme project*, 2010.
- [11] C. P. Jones, *Investments: principles and concepts*. Wiley, 2010.
- [12] F. J. Fabozzi, J. L. Grant, and B. M. Collins, *Equity portfolio management*. Frank J. Fabozzi Associates, 1999.
- [13] M.-C. Hsieh, "DATA-DRIVEN PORTFOLIO OPTIMIZATION WITH DRAWDOWN CONSTRAINTS USING MACHINE LEARNING," *Contemporary Perspectives in Data Mining: Volume 4*, p. 53, 2020.

- [14] G. Heywood, J. Marsland, and G. Morrison, "Practical risk management for equity portfolio managers," *British Actuarial Journal*, pp. 1061-1140, 2003.
- [15] M. E. Björnsson, "A study in portfolio management," *brandeis* 1998.
- [16] C. C. Cox, "A Comparison of Active and Passive Portfolio Management," 2017.
- [17] M. HARGRAVE. (2020, 12 Dec). Compliance Department. Available: <https://www.investopedia.com/terms/c/compliancedepartment.asp>
- [18] K. I. Cooperative, "Realizing the value of compliance through greater effectiveness, efficiency, and sustainability,"
- [19] M. Teo, "How liquid are liquid hedge funds?," Available at SSRN 1571287, 2010.
- [20] N. Bahmani, D. Yamoah, P. Basseer, and F. Rezvani, "Using the analytic hierarchy process to select investment in a heterogenous environment," *Mathematical Modelling*, vol. 8, pp. 157-162, 1987.
- [21] G. Girardi, K. W. Hanley, S. S. Nikolova, L. Pelizzon, and M. Getmansky Sherman, "Portfolio similarity and asset liquidation in the insurance industry," 2018.
- [22] M. Khan, "Evaluation of a Real-Time Buying Power Engine for Wealth and Asset Management," 2017.
- [23] J. J. Angel, L. E. Harris, and C. S. Spatt, "Equity trading in the 21st century," *The Quarterly Journal of Finance*, vol. 1, no. 01, pp. 1-53, 2011.
- [24] V. K. Bhalla, *Investment Management (Security Analysis and Portfolio Management)*. S. Chand Publishing, 2008.
- [25] S. B. Anders, "Four Leading Money Management Apps: Mint, FutureAdvisor, Personal Capital, and Acorns," *The CPA Journal*, vol. 85, no. 9, p. 64, 2015.
- [26] J. Samuel, R. Holowczak, and A. Pelaez, "The effects of technology driven information categories on performance in electronic trading markets," Samuel, J., Holowczak, R., & Pelaez, A.(2017). The Effects Of Technology Driven Information Categories On Performance In Electronic Trading Markets. *Journal of Information Technology Management*, vol. 28, no. 1-2, p. 1, 2017.
- [27] M. Hendayun, E. Yulianto, J. F. Rusdi, A. Setiawan, and B. Ilman, "Extract transform load process in banking reporting system," *MethodsX*, vol. 8, p. 101260, 2021.
- [28] A. Mikhaylov, N. Sokolinskaya, and E. Lopatin, "Asset allocation in equity, fixed-income and cryptocurrency on the base of individual risk sentiment," *Investment Management and Financial Innovations*, vol. 16, no. 2, pp. 171-181, 2019.
- [29] W. F. Sharpe, "Adaptive asset allocation policies," *Financial Analysts Journal*, vol. 66, no. 3, pp. 45-59, 2010.
- [30] H. A. Shawky, N. Dai, and D. Cumming, "Diversification in the hedge fund industry," *Journal of Corporate Finance*, vol. 18, no. 1, pp. 166-178, 2012.
- [31] C. Beuselinck, "Financial Reporting Quality in Private Equity Backed Companies: The Impact of Ownership Concentration," *Small Business Economics*, 2007.
- [32] S. S. Smith, "Digitization and financial reporting—how technology innovation may drive the shift toward continuous accounting," *Accounting and Finance Research*, vol. 7, no. 3, pp. 240-250, 2018.
- [33] G. Radhakrishnan and Research, "Non-experimental research designs: Amenable to nursing contexts," *Asian Journal of Nursing Education*, vol. 3, no. 1, p. 25, 2013.
- [34] C. B. Thompson and E. A. Panacek, "Research study designs: Non-experimental," *Air Medical Journal*, vol. 26, no. 1, pp. 18-22, 2007.
- [35](May 3, 2021). Bloomberg. Available: <https://www.bloomberg.com/>
- [36] (May, 3, 2021). Reuters. Available: <https://www.reuters.com/>
- [37] (May, 3, 2021). RIMES. Available: <https://www.rimes.com/>