Quality Assurance for Electronic Trading Platforms

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Abstract Electronic trading has become an increasingly important part of the financial markets landscape in recent years. The applications on which electronic trading happens are called Electronic Trading applications or Electronic Trading Platforms. These Electronic Trading Platforms are complex applications due to the complex nature of financial markets, the critical importance of real-time data and execution, its integration with different other upstream and downstream applications and because of strict regulatory and compliance requirements. In this paper, we would study different features supported by electronic trading platforms, challenges faced by development and quality assurance teams in testing them and different types of testing that should be performed to ensure a robust and bug-free trading solution for trading platform applications.

Keywords Trading Platform; Trading Applications; Software Quality Assurance; Software Testing; Investment Banking; Automated Trading; High-frequency Trading; Performance Testing; Security Testing; Integration Testing; API Testing; Sanity Testing; Automation Testing.

Introduction

Before the emergence of Electronic Trading, all the Trading happened Offline through the physical exchanges. Stock exchanges for equity and other asset classes were physical locations where buyers and sellers would meet to trade stocks and other financial securities. Traders would contact their brokers by phone or in person to place orders, request market information, and receive investment advice. Brokers would then gather on the exchange floor to execute trades, negotiate prices and execute trades manually on the exchange floor or through other intermediaries. Traditional Trading was a time-consuming process.

Examples of traditional stock exchanges include the New York Stock Exchange (NYSE) and the London Stock Exchange (LSE).

Instinet was the first major electronic trading alternative to the trading floor in 1969. Instinet was founded as the first Electronic Communication Network (ECN), which was created to allow brokers to post offers to buy and sell stocks after regular market hours. Also, Instinet allowed clients (institutions only) to bypass the trading floors and deal with each other on a confidential basis.

With the advances in technology, changes in regulation, and changes in the structure and liquidity characteristics of financial markets, financial trading happening on electronic trading platforms is on the rise. The maturity and advances of Electronic Trading platform, however, may be different for different financial asset classes. But nevertheless, most of the asset classes like Equity Securities, or FX, or Fixed Income Securities or the other derivatives like Swaps are all now traded electronically.

In this paper, we will understand Electronic Trading Platforms, challenges faced by Quality Assurance Engineers in Testing electronic Trading platforms, and different types of testing that should be performed to ensure a robust and reliable platform application.

Understanding E-Trading Platforms

In electronic trading, transactions are entered, routed, executed and cleared electronically with little or no human intervention. Electronic Trading happens on trading applications, known as Electronic Trading Platform or E-trading platform. Electronic Trading Platform is a comprehensive software solution providing an ability to place trades and monitor accounts, create portfolios through financial intermediaries for investors, traders online and in real time. It is a digital system that facilitates the buying and selling of financial instruments, such as stocks, bonds, currencies, commodities, and derivatives, through electronic means.

There are different Trading Platforms for different financial asset classes. First and foremost, Traders look out for the trading platforms that offers the financial asset classes they want to trade on. Financial Instruments may include Stocks, Fixed Income Securities, Trading on FX, Derivatives, etc. Once the Trading platforms offering the financial instrument to be traded on are shortlisted, Traders look out for a good Trading platform offering a variety of features. Different features may include offering a variety of order types to execute trades like limit order, market order, stop order, etc. Some Trading platforms provide real-time market data, news feeds, research reports, charting tools, and risk management features.

Automated Trading and High-frequency Trading strategies are also the advanced key features which Traders may like to have, especially if they have big volume trading requirements. Automated trading is a trading technology in which order and trade decisions are made electronically and autonomously. High-frequency trading is a subset of Automated Trading in which orders are submitted and trades executed at high speed, usually measured in microseconds. High-frequency trading strategies seek to gain advantage from the ability to process information on market conditions quickly and react instantaneously.
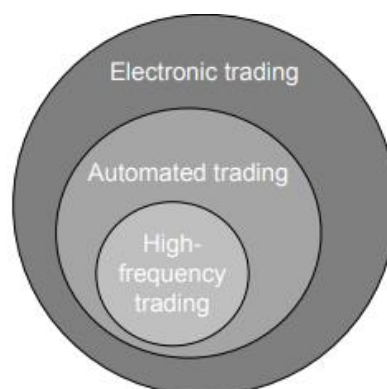
All these features coupled with an easy-to-use interface gives the trading platform an edge over other trading platforms offering trading for the same asset class.

Execution Quality is also one of the key factors in deciding a trading platform. Low latency and high-speed execution with minimal slippage and order rejections, even during peak trading hours is a great advantage for a Trader trading on any financial instrument.

Customer Support and Fees for executing trades are other criteria traders look out for before deciding on a trading platform that they want to use.

By evaluating trading platforms based on these categories, traders can identify platforms that best suit their trading objectives, preferences, and risk tolerance.

Challenges in Quality Assurance for Electronic Trading Platforms

Electronic trading is integral to the financial markets. Even minor glitches in the trading platform software, such as the "flash crash" of May 6, 2010, can make the financial institutions bankrupt and put a big question mark to the capabilities of modern trading platforms [6]. The flash crash was a trading glitch in the brokerage firm's computer system triggered by an order placed in the futures market [7]. This caused panic trading to spillover to the equity market, thereby causing the Dow Jones Industrial Average to plunge 600 points in just 5 minutes [8]. More than $1 trillion in market value disappeared, all because of a small glitch in the trading system.

Thus, Quality Assurance for trading platforms presents several challenges due to the complex nature of financial markets, regulatory requirements, huge transaction amounts involved, etc. Some of the common challenges in testing of electronic trading platforms are listed below:

A. **Complex Financial Asset Classes:** In order for Quality assurance Engineers to test Trading Platform applications, they need to understand the Financial Asset Classes supported on their Trading Platform applications. Financial markets are inherently complex, with multiple asset classes, trading venues, and global exchanges. Testing trading platforms supporting diverse asset types, trading instruments, market protocols, price variation, transaction fees and different trade flows requires a thorough understanding of the financial market and trading platform being tested.

B. **Automated Trading and High-frequency trading Risks**: Automated trading and High-frequency trading is susceptible to bugs, errors, and unintended behaviors that can lead to financial losses or regulatory violations. Quality Assurance for automated trading systems should involve rigorous testing of automated trading, risk controls, and trading sanitizer checks to mitigate the risks.

C. **Regulatory Requirements**: Compliance with financial regulations adds complexity to QA efforts for trading platforms. Regulatory requirements like Dodd-Frank Act impose stringent data protection, reporting, and transparency obligations, necessitating robust compliance monitoring and reporting mechanisms. Trading platforms operating across multiple countries face challenges in complying with varying regulatory requirements and legal frameworks. QA efforts must account for cross-border compliance considerations.

D. **Cybersecurity Risks:** Due to high trading volumes and sensitive trading data involved, trading platforms are at a high risk of Cybersecurity risks. To protect against malware, data breaches, and other cyber-attacks, Organizations need to ensure they have cybersecurity measures, regular security audits happen on regular basis. Also, Quality Assurance Engineers or Developers need to perform Security and Penetration Testing.

All these challenges require a comprehensive approach to quality assurance, collaboration across multiple teams, continuous monitoring, and proactive risk mitigation in the ever-evolving financial markets.

Software Quality Assurance for Electronic Trading Platforms

A trading platform having a good source of market data or liquidity would not benefit a trader, if the trading platform has performance issues or is prone to cyber attacks or is not efficient. So, QA testing must be one of the top priorities for financial application developers to assure Investment Banks, Hedge Fund Companies, and other Financial Institutions that they can have the best bet on their money through the Trading platforms which provide them the efficiency, reliability, security and performance.

Some of the Testing techniques that should be used while testing finance applications or the trading platform applications are:

A. **Functional Testing:** Verifying that all the features and functionalities developed on the Trading platform are working as per requirements. Some of the most common functional requirements include order placement, order execution, market data validations, transaction fee validations, validating portfolio analysis tools, and reporting capabilities.

B. **Integration Testing:** A Trading platform usually would be connected to upstream and downstream systems to collect market data, price information, and reporting. When functionality is developed, then it is

very important to do integration testing to verify integration between different connected systems. All these applications are designed by different teams and follow different sets of logic. Integration Testing ensures that the integrated unit's function properly as one unit and align with stated requirements.

C. **API Testing:** Trading Platforms commonly are connected with other Investment Banking applications through the APIs (Application Programming Interfaces) in FIX (Financial Information Exchange) Protocol. It is also easier and comprehensive if the interaction of trading platforms and Investment Banks is tested through what is known as the API Testing. For API Testing, various Testing Tools also known as Passive testing tools are used for automated log collection, data structuring, monitoring, system behavior analysis and user certification [10]. Test tools allow analyzing high volume of data promptly, reacting to deviations in the system's behavior from requirements, and troubleshooting [11].

D. **Performance Testing**: Trading platform application performance is tested under various load conditions to ensure it can handle high trading volumes without slowdowns or outages. Specialized testing tools are used to ensure quality of high load trading systems with high availability. The main requirement for such tools is that they should be capable of creating realistic, high loads [12]. Latency, response times, throughput, and scalability are tested to identify performance bottlenecks.

E. **Security Testing:** Security testing is verifying the software's compliance with security standards, evaluating the security features and mechanisms. All the sensitive information should be tested against common threats like data exposure, phishing, ransomware, and malware.

F. **Regression Testing:** Regression Testing is to make sure that the new functional changes have not impacted the other features of the trading system negatively. It is best to perform the regression tests every time the product changes. It will be much easier to detect new and unexpected bugs within the system through the Regression Testing. Regression Testing ensures robustness of the system and reduces bug creeps in the trading system.

All the above Testing techniques ensure that the new feature developed on the trading platform is bug-free, stable, robust and is reliable for trading huge volumes of financial assets.

Conclusion

Financial Trading applications or trading applications are complex involving connections with different systems upstream as well as downstream systems. Testing trading applications has its challenges due to the compound nature of the trading system, complex nature of financial markets and ever-changing regulatory requirements. It becomes very important that trading applications are thoroughly tested to mitigate risks and provide a seamless and secure trading experience for investors. By investing in QA processes and procedures, trading platform providers can enhance their competitiveness, reputation, and sustainability in the highly competitive financial markets.

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