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Quality Assurance in Investment Banking Domain

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ABSTRACT

Investment Banking applications are complex applications supporting different trading platforms, risk management systems, compliance, and regulatory requirements. Different Investment Banking applications have different software testing and QA requirements, depending on the domain function they are supporting, complexity of the flows and external applications they are integrating with. Investment Banking is a huge domain, and everything cannot be summarized in a single white paper. In this paper we will study the commonly used terminologies in Investment banking domain, especially around trade life cycle, and what quality assurance activities need to be performed in complex Investment Banking applications, covering majorly around the trade flows.

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Introduction

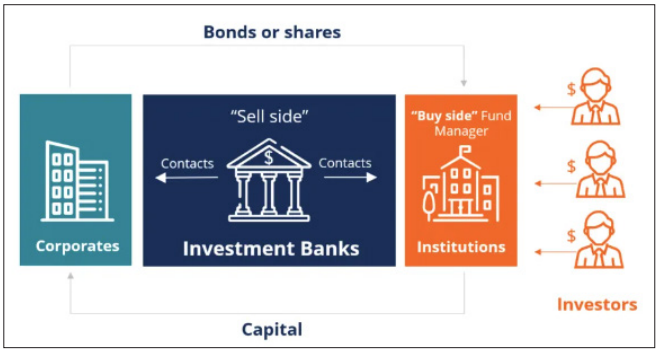
Investment Banking is a huge domain, with lot of Products, trade flows, mergers and acquisitions, compliance, and regulatory requirements. The Investment Banking Applications are even more complex supporting all the different facets of trading, investment analysis, risk management, compliance, and other key activities.

With the advancement of technologies such as artificial intelligence, machine learning, and cloud services, vulnerabilities in the system are expected to rise. A small glitch in the system can cause Investment Banks to lose millions of dollars, cause reputational loss and can be a victim of compliance and regulatory fines. So, it is important that Investment Banking Applications are thoroughly tested. The customer experience and customer data security would continue to remain the primary focus for the financial sector for which banking systems are looking for ways to improve their applications, simplify customer journey, and provide them with a seamless user experience.

In this paper, we will study how to test an Investment Banking Application. But to test an Investment Banking application, we will first need to study what an Investment Banking is, different commonly used terminologies like Primary Market, Secondary Market, and Trade Life Cycle. We will not be able to explain all the different facets of Investment banking in this Paper, but we will try to cover the most commonly used terminologies and cover how quality assurance can be covered in those areas.

What is investment banking?

Investment Banking (IB) is the division of a bank or financial institution that assists in big, complex financial public and private transactions to raise money for individual investors, large corporations, and governments [1]. These financial institutions or Investment Banks provide underwriting services to help clients raise capital and complete transactions such as mergers and acquisitions (M&As) [2].



Businesses need money to operate and grow their businesses, and the bankers help them get that money by marketing the company to investors. Underwriting is the process of raising capital through selling stocks or bonds to investors in Primary Market via Initial Public Offerings (IPOs) or through trading stocks or bonds in Secondary Market on behalf of corporations or other entities.

In Mergers and acquisitions (M&A), Investment Banks provide advisory to corporations and institutions in helping them find, evaluate, and complete acquisitions of businesses. IBs use their extensive networks and relationships to find opportunities and help negotiate on their client's behalf. IBs advise on both sides of M&A transactions, representing either the "buy-side" or the "sell-side" of the deal.

Investment banks may also provide related services such as market-making and securities trading for both equities (i.e., stocks and their derivatives, such as options) and fixed income, also known as FICC (fixed income, currencies, and commodities) [3].

Some common examples of Investment Banks include JPMorgan Chase, Goldman Sachs, Morgan Stanley, Bank of America Merrill Lynch, Credit Suisse.

Primary and Secondary Market

As stated in the above section, Investment Banks raise capital through selling stocks or bonds to investors in Primary Market or through the Secondary Market. Let us understand what it means by Primary and Secondary Market.

The primary market is where new securities (not previously traded on any exchange) are issued for the first time through Initial Public Offerings (IPO). It's the initial step where a company offers securities to the public to raise capital for corporations, governments, or other entities. The issuers exchange public securities (stocks, bonds, other derivatives) for money from investors [4]. The primary market may also be called the New Issue Market (NIM) [5].

Example: Company ABC wants to expand its business and for that they need to raise money. Company ABC decided to go public for the first time, and they hired the services of an Investment Bank to determine financial details of its IPO. The underwriters from the Investment Bank detail the issue price of Company ABC's IPO to be $20 and list it on New York Stock Exchange (NYSE). Investors can then buy the IPO at this price directly from the issuing company through NYSE.

The secondary market is where existing shares, debentures, bonds, etc. are traded among investors. Securities that are offered first in the primary market are thereafter traded on the secondary market. In this process, the issuing company is not involved in the sale of their securities [5]. In the Primary Market, security can be sold just once, but Securities can be sold any number of times in the secondary Market.

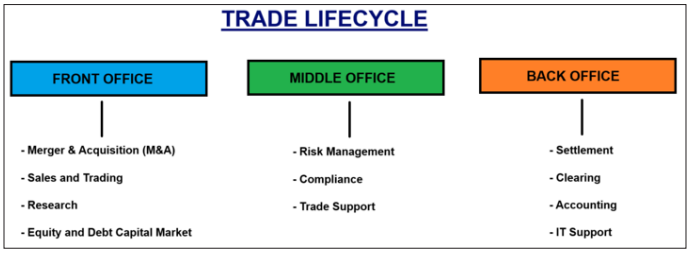
Example: Once Company ABC has issued its IPO and Investors have bought it; Investors can further sell or buy stocks Company ABC through Secondary Market. In this case NYSE itself acts as Secondary Market allowing Investors to Buy or Sell stock of Company ABC at any Price, as per the demand of the stock.
Whether the capital raised by selling IPOs goes to the Corporations initiating the IPO in the Primary Market, or to the Seller of the Security in Secondary Market, Investment Banking firms act as middleman in initiating these transactions and get a commission out of these transactions.

We have not listed all the details of Primary and Secondary Market, but just gave an idea of what these Markets are, and their main function. Later we can use this knowledge to understand quality assurance that needs to be performed on Primary and Secondary Market applications.

Trade Lifecycle

Doing Quality Assurance in IB space, would mean going through Trade Life Cycle in your Projects, or at least it is important to understand Trade Life Cycle, even when You might be doing testing for one of the stages of trade life cycle. In Investment Banking, there are 3 stages of Trade Life Cycle:

- Front Office
- Middle Office
- Back Office



Front Office: Front office is involved in revenue-generating activities and client interactions in Investment banking domain [6]. Functions in the Front office include sales, trading, investment banking, and research in Equity and Debt Capital Markets.

- Front office sales teams interact with clients to understand their investment needs and recommend suitable financial products or services.
- Traders in the front office execute buy and sell orders for financial instruments such as stocks, bonds, currencies, and derivatives. They aim to generate profits through trading activities.
- Investment bankers advise companies on mergers and acquisitions, capital raising, and other corporate finance activities. They facilitate transactions and provide strategic advice to clients.
- Research analysts in the front office conduct financial analysis and market research to provide insights and recommendations to clients and internal stakeholders.

Middle Office: Middle office provides support functions that help facilitate front office activities and manage risk. Middle Office does activities which include risk management, compliance, and trade support [7].

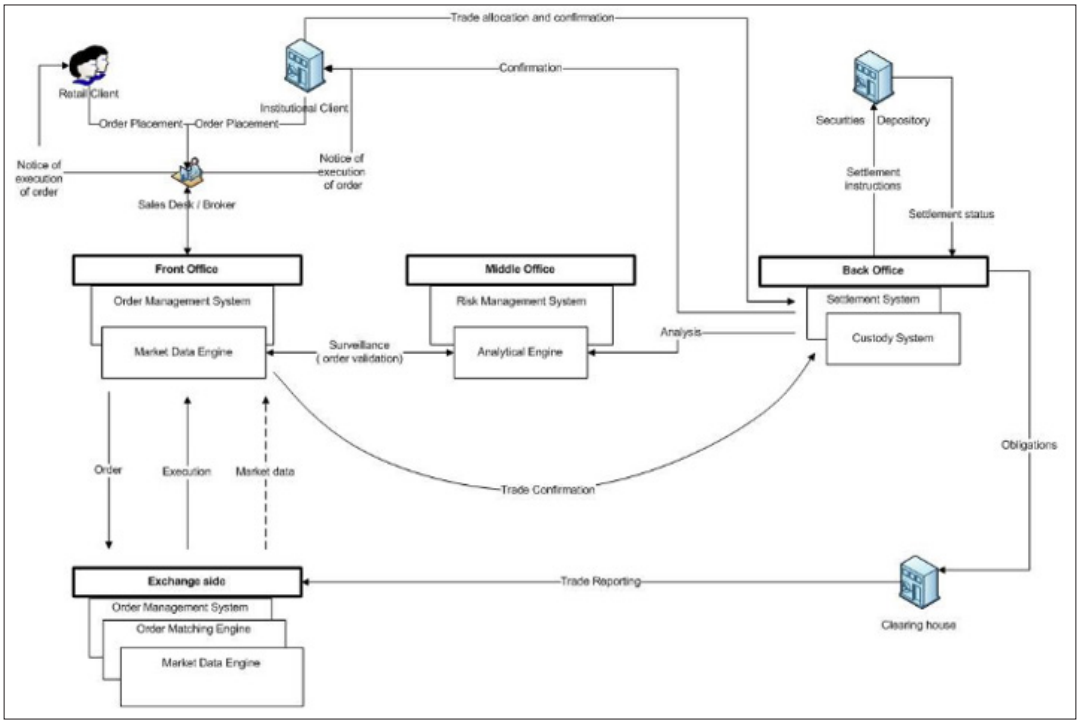
- Middle office teams assess and manage various types of risk, including market risk, credit risk, and operational risk. They monitor trading activities, evaluate risk exposures, and implement risk mitigation strategies.
- Middle office compliance teams ensure that the organization adheres to regulatory requirements and internal policies. They conduct surveillance, monitoring, and reporting to ensure compliance with laws and regulations.
- Middle office trade support teams provide operational support for trade execution, confirmation, and settlement. They liaise between front office traders, counterparties, and back-office operations to ensure smooth transaction processing.

Back Office: Back office provides essential operational and administrative support functions that enable the smooth functioning of the organization. Back office functions include settlement, clearing, accounting, and IT support [8].

- Back office settlement teams facilitate the post-trade processing of transactions, including the confirmation, clearance, and settlement of trades. They ensure that securities and funds are transferred accurately and efficiently.
- Back office clearing teams work with clearinghouses and counterparties to clear and settle trades. They ensure that transactions comply with clearinghouse rules and regulatory requirements.
- Back office accounting teams handle the recording and reconciliation of financial transactions, preparation of financial statements, and compliance with accounting standards and regulations.
- Back office IT support teams manage technology

infrastructure, systems development, and maintenance to support the organization's operations. They provide technical support and troubleshooting for trading platforms, risk management systems, and other technology solutions.

The detailed diagram showing responsibilities of Front Office, Middle Office and Back Office activities is shown below [9]:



Collaboration between these three areas is essential for the success of investment banking operations.

Quality Assurance in Investment Banking

Quality Assurance in Investment Banking (IB) domain is essential for ensuring robustness, reliability, and accuracy of their complex applications. Some of the key aspects of quality assurance to look into are:

Functional Testing: Some key aspects of doing Functional Testing for Investment Banking Applications are listed below:

- **User Authentication and Authorization:** Investment banking applications have different logins for different users like brokers, dealers, individuals or investors etc. Verify the logins of appropriate users with their login IDs as per their permissions for accessing the application.
- **Transaction Processing:** Test the functionality for initiating various types of financial transactions, such as deposits, withdrawals, fund transfers, and payments. Test transaction limits and restrictions to ensure compliance with regulatory requirements and risk management policies.
- **Order Execution and Trading:** Verify Users are able to Buy and Sell Financial Instruments. Order execution needs to be tested to ensure trades are executed promptly and at the expected prices as they were traded on. Validate order routing to ensure orders are directed to the correct trading venues or counterparties.
- **Portfolio Management:** Test portfolio management features for creating and managing investment portfolios. User should also validate portfolio analysis tools for assessing risk exposure, performance metrics, and asset allocation strategies.
- **Reporting and Compliance:** Test reporting functionality for generating various types of reports, including account statements, trade confirmations, and regulatory filings. Verify that reports are generated accurately, with the correct data and formatting, and are delivered to the intended recipients. Test compliance features to ensure that the application adheres to regulatory requirements such as Know Your Customer (KYC), Anti-Money Laundering (AML), and Dodd-Frank Act compliance.

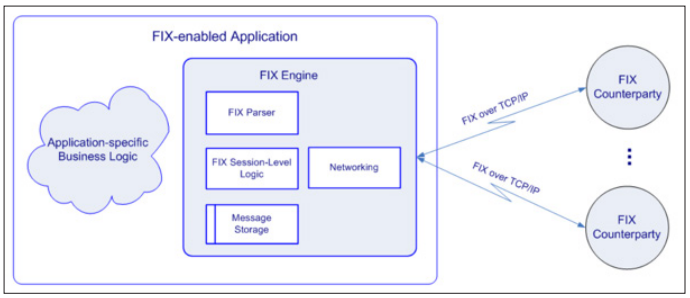
Above are only a few areas where Testers should put their focus on. But there could be many more functional testing scenarios based on the business specifications of what is being developed or upgraded.

Integration Testing

A complex system is designed by incorporating different applications, especially in the case of IB Applications it could be other upstream, downstream and other applications like User Information portals, pricing engine, market data, Client and Dealer systems, etc. 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. Depending on the number of systems that IB Applications interact with, a greater number of test scenarios can be added to verify integration between them.

API Testing

APIs (Application Programming Interfaces) are used for communication between various components of the trading ecosystem. Most of the Trading Systems use FIX (Financial Information Exchange) Protocols to interact through the APIs [10].



API Testing is to make sure that these FIX messages are flowing through with the correct values to different systems that IB applications interact with. 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 [11]. Test tools allow analyzing high volume of data promptly, reacting to deviations in the system's behavior from requirements, and troubleshooting [12].

Performance Testing

Performance Testing of trading systems is highly important as the system behavior needs to be validated for stressful market conditions and handling high trade volumes. Performance Testing measures the performance and scalability of the system under different workload conditions, including peak trading hours and high-volume trading days. It Identifies and optimizes performance bottlenecks, such as slow response times, high latency, or resource constraints, to improve overall system efficiency [13].

Security Testing

Security testing in software testing is the process of evaluating your software to identify vulnerabilities or weaknesses that could be exploited by hackers or attackers leading to threats like Phishing, ransomware, and malware. Security testing involves verifying the software's compliance with security standards, evaluating the security features and mechanisms, and conducting penetration tests to identify weaknesses and vulnerabilities that might be exploited by malicious actors [14]. IB Applications involves big complex transactions and carries sensitive data which includes company/ trader information, trade information and other sensitive information, due to which security testing should be an integral part of the overall risk management strategy of IB firms.

Regression Testing

Regression Testing is to make sure that the code for new functionalities being developed in IB Applications, has not impacted the existing flows supported by the application. Regression Testing is performed in the end after all the above testing types are completed.

Automation Testing

Automation testing of banking applications helps improve testing efficiency, accelerate release cycles, reduce manual effort, and enhance the overall quality and reliability of software systems in the banking industry. It involves the use of automated tools and scripts to perform various types of testing on software applications used in banking and financial services, to fasten the execution process. All the repeatable Tests that can be used later as well to ensure defect free system, should be automated. So, all the Functional, Integration, API, Regression, security Tests should be automated to have better efficiency of the system.

But developing an effective automatic testing solution which confidently covers all functional requirements for enterprise software systems is crucial because a defect in the system may have a huge business impact [15]. A good example where Tests should be Automated is for Algorithmic Trading, where manual inputs can be slow and may not perform the desired action at a specified time, but Automation tests can be fast enough to verify Algorithmic Trading checks. Algorithmic Trading is where computer programming combined with financial markets is used to execute trades at precise moments [16].

Sanity Testing/ Adhoc Testing

IB applications being complex, not every defect can be found through different forms of testing types mentioned above. So, it is very important to do sanity testing and/ or the Adhoc Testing on IB Applications, to make sure no defect is left missing.

Conclusion

Investment banking applications play a critical role in supporting the complex operations of investment banks, enhancing efficiency, enabling informed decision-making, and ensuring compliance with regulatory requirements. The landscape of investment banking applications continues to evolve with advancements in technology and changes in regulatory frameworks and market dynamics. So, it is very important that Investment Banks and Financial Institutions give the required time and money to quality assurance activities to make their applications more robust and reliable. Overall, quality assurance plays a vital role in safeguarding the integrity of investment banking operations, protecting client's interests, and maintaining the stability and reputation of the financial markets.

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