



Market Research

Trading and Clearing Test Environments Recommendations

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Introduction Note

Over the past two decades, as for many other industries, the financial industry has been increasingly relying on technology for ensuring its core business. Exchanges, Clearing Houses and related market participants are no exception here. But, at the same time that the use of technology propelled businesses by unveiling new opportunities (trading faster, broader, deeper), it did not go without creating risks of a new nature. Software malfunctions, network instability, hardware troubles, insufficient release management methods, poor change control procedures, not to mention natural disasters or deliberate sabotage acts among others are as many risks that technologists need to take into consideration when designing, deploying and maintaining systems.

Back in 2013, various technical glitches that occurred at the exchanges and brokers levels across the globe severely impacted the financial community, with a consequence of diminishing the credibility of financial markets among certain type of investors and more broadly among the general public. Obviously, those issues also increased the attention of regulators on the theme of IT System Risk Management and IT Governance.

Looking at the trading ecosystem (excluding here the exchange matching engine and related data-dissemination systems), those concerns naturally raise the question of the resources the exchanges and clearing houses make available to the financial community for the safe development, testing and validation of their mission critical applications handling the market-data and trading related transaction flows.

Keeping in mind the already-announced (and expected) technology changes for Japanese Exchanges and Clearing Houses, the Futures Industry Association Japan (FIA Japan) would like to present in this document some best practices and suggestions that should apply to the test environments provided by exchanges and clearing houses. Indeed, the FIA Japan expects that, if exchanges and clearing houses were to follow those recommendations, the quality of the solution delivered by technology shops, broker in-house development centers or any other IT Service providers would increase, reducing thus risks of impactful issues for the financial markets and their related participants.

The FIA Japan is an industry body, with representatives from the Exchanges, Brokers, Banks, Investors, Independent Software Vendors (ISV) and Infrastructure Providers who are active in the Japanese financial markets. The following recommendations and practices have been collated by the FIA Japan Technology Committee from inputs from Japanese and Foreign brokers and Financial Industry Technology companies, including firms who are not FIA Japan members and firms who are operating in overseas markets, through survey, internet research and direct feedbacks. Comments from FIA Japan Market Operations Committee and Market Development Committee



have also been taken into account for the creation of this document. As such, the ideas presented here are a fair, balanced and representative view of opinion. Best practices and recommendations gathered during this Market Research have been classified under six distinct categories: Recommendations on Test Environments Types, Recommendations on Test Environments Accessibility, Recommendations on Test Environments Availability, Recommendations on Test Environments Functionality, Recommendations on Test Environments Cost and Any other Recommendations not falling in the previous five categories. For each recommendation and feedback, an indication of how many of the Market Research participants have shared the same view will be included using the following scale: all / almost all / many / several / a few / one Market Research participant(s).

It is also to be noted here that, since the recommendations and suggestions have been collated from a variety of market participants connecting to exchanges and clearing houses for diverse business purposes, this document does not cover in a dedicated manner the potential needs and recommendations pertaining to the specific development, deployment and maintenance of Automated Trading Systems and other HFT solutions. Indeed, due to the unique challenges as well as the technical complexity intrinsic to the use of those Automated Trading Systems, a dedicated Market Research would be required.

By sharing those concrete suggestions, our objective is to further foster a constructive exchange of ideas between all markets participants on how to reduce operational risks related to trading technologies, aiming thus at increasing the safety, stability and overall attractiveness of our Japanese financial markets.

Tokyo, Japan, March 17, 2014

Bruno ABRIOUX

FIA Japan, Technology Committee Chairman



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Recommendations on Test Environments Types

This section includes recommendations on the ideal number, type and nature of test environments. Survey and interviews were conducted under the assumption that the Exchange and Clearing Houses are running a current version of their systems in production (version N) while preparing their next system release (version N+1). Questions such as the below ones have been asked:

- ✓ Would your release and development cycle be improved if you had access to a version N test environment (debugging, demo, issue reproduction) and a version N+1 (new release development)? Why/how does it improve the quality of your deliveries?
- ✓ Should test environments be an exact replica of production environments? If not, what could be the acceptable differences simplifying your development / QA work without compromising the quality?

Without any exception, feedbacks from all participants have been consistent in saying that continuous availability of two test environments, N (Production replica) and N+1 (Next generation), was the ideal situation for vendors and members to insure uninterrupted production support (e.g.: reproducing an issue, testing a new feature required by a customer, validating new algorithms...) while developing new features introduced by the Exchange.

It is also suggested that, if the Exchange cannot provide that service continuously, it is a must at least when going through a major migration where the new environment does not offer full backward compatibility with current binaries and that till the Go-Live of the new system (when environment N+1 becomes environment N).

One participant commented that, outside major migration phase, the Exchange should consider the number of new features/instruments they plan to introduce every year. This conditions the need of two environments. Alternatively, an exchange-provided simulator that can perfectly mimic the production system dynamic and message kinematics can be a second best option if two environments are not possible.

It is to be noted that most of the major exchanges around the world provide N and N+1 platforms service: ASX, SGX, SEHK, CME, and LIFFE, SWXESS, MEFF/SIBE (to mention a few) provides availability all year long, or at least a few months during migration.

All Market Research participants also agreed to comment that Test environments must be an exact replica of production in terms of API version and available features and business process flows as “standard test capabilities” service offer. It includes for example: order/quote/instrument/trade and risk management. Test environment should



mimic production trading hours, especially for markets with night sessions and/or market managing multiple trading days in the same calendar day.

Many of the Market Research participants shared the view that, ideally, Test environments should also offer “advanced test capabilities” to test system resilience to high volumes and failover/recovery scenarios. Software providers can easily detect software bottlenecks, as well as flaws in the synchronisation mechanisms that could cause production issues with major business impacts. Pre-scheduled stress test sessions for both market data and order sending, especially during Exchange migration projects gives a great opportunity to vendors to confirm the performance of their software in “production like” scenarios. Availability of back-up/DR environment for failover testing should be considered as a good to have in test environment.

Several participants added also that, in standard industry practices, advanced test capabilities are usually available in production environment only during week-end tests or evening. To some extent, it looks acceptable to them. One participant commented though that, since an ISV does not have a production access, it will depend on client to test on its behalf which bring unnecessary responsibility on the member who does not own the software development. If Exchange were to provide advanced testing capabilities in production environment only, then it should support:

- ✓ Monthly week-end tests (throughout the year and not only during migration phase).
- ✓ Possibility for vendors to connect to production environment during those schedule tests (network test ports rerouting...)

This participant commented here as well that, according to him, it is crucial to allow those advanced tests to happen in the very early stage of a migration: indeed, from its standpoint, contrary to order flow/mapping issues, fixing problems related to performance and synchronisation can have a significant impact on the entire software design, forcing vendors to run full regression/integration testing. It is therefore not desirable to introduce those types of change in the last days before a migration.



Recommendations on Test Environments Accessibility

This section focuses on the technical connectivity requirements to test environments and acceptable divergences from production systems. Among others, the following questions have been asked:

- ✓ Should the test environment be an exact replica of production environment including infrastructure access in order to ensure a situation as close as possible to production or should accessibility be favored by proposing VPN access for example (to allow remote/centralized teams to easily access those environments at low cost wherever they are located)
- ✓ What about when running trading solutions in co-location for production? How should the test environment be built and accessible for developing and testing those solutions?

Several of the Market Research participants provided the same feedback that VPN should systematically be offered as a connectivity alternative to regular connection method (network access point, leased line...) for obvious cost reasons. Indeed, according to them, Exchange has to be considerate of vendors developing and supporting Exchange connectivity in remote regions. Those participants though understand that VPN will drastically reduce the capacity of their systems to test latency and volumes. Yet, their view is that VPN access is sufficient to validate business work flow for both order routing and market data processing, while capacity testing could be performed during weekend tests for example, against member-provided environments. It is to be noted that VPN access to test environments are offered by many Exchanges in both APAC and EMEA regions.

Regarding the development and validation of systems hosted in colocation, participants had various diverging opinions. On one hand, several participants recommended indeed that they should be able to connect to the Test environment from the co-location rack, as long as the segregation of duty between production and staging environments is clear from a technological standpoint (physically and/or logically, depending on exact architecture design). Benefits mentioned for this case are of a cost nature: Investors/brokers avoid the costs of having network connection to the broker/test market to connect to the test market. Investors avoid the costs of having separate racks to keep their development and production kits. On the other hand, other participants proposed that the connectivity to Test environment for system development purposes should be achieved from a location other than the co-location rack. The reason referred to is the reduction of operational risks by maintaining an unambiguous segregation of duty between production set-ups running in colocation and staging environments. More details on access to staging environment in case of colocation can be found in the chapter N.3 “Access/connectivity to the test environments from within colocation” of the FIA Japan Market Research Document labeled “Market Research of Mechanisms to Improve Participation and Activity in Japanese Financial Markets” issued by the Market Operations Committee in 2012.



Recommendations on Test Environments Availability

In this section, comments and recommendations regarding the availability of the various test platforms and their related support services (be it technical or functional) have been summarized. Answers to the following questions had been requested:

- ✓ In case N and N+1 environments coexist, what is your expectation in terms of availability? Ideally, when should a N+1 environment be available prior to a release (assuming English specifications for new exchange release have been released)?
- ✓ In case of N+1 environment, do you prefer the exchanges to patch their system each time they have a change or do you prefer to have a roadmap of patches?
- ✓ Do you expect the N and N+1 environments to be open 24/7? What would be the minimum availability not impacting the quality of your delivery?
- ✓ Do you expect to get support 24/7 (regardless of the technical availability of the platform)? For what type of support (technical, functional, development specific...)?

As stated in the recommendation on Test Environments Types (section 1 of this document), N and N+1 Tests environments are strongly recommended by all participants. In terms of availability, the following conditions were proposed as reference point by one participant:

- ✓ If an Exchange introduces more than three or four changes a year, N and N+1 should be available all year long (ASX model with ETE = Enhanced Technical Environment and FTE = Functional Technical Environment was provided as an example here)
- ✓ When upgrades are less frequent (one to two a year) N+1 Test environment availability depends on the type of migration: 6-8 months in advance for significant migrations (the longer the better), 2 months for minor-medium changes.

Many participants agreed to say that, unless a major issue needs an immediate patch, vendors would tend to prefer release roadmap to better allocate their internal resources in preparation of the upcoming changes.

All participant feedbacks insisted that, during Migration phase, extended testing hours, especially in the evening (e.g. Monday – Friday till midnight), is necessary for Development, QA teams located in different time zones, to test all downstream applications. Depending on the Market Research participant, suggested timeframe for availability varied from a “Monday-Friday till midnight” recommendation to a “24/5” one. Nonetheless, in case the test platform availability is extended, it was also pointed out that the behavior of the test environment should still mimic the



production as much as possible and should ensure availability of all needed functionalities as applicable in production. It was suggested that this could be achieved by dividing the environment into 2 sessions day and night: the day session should mimic the behavior of production environment and night session can be used to simply provide extended availability. In that case, having prior knowledge on test environment schedule will help vendors in proper planning and delivery of the software. One participant suggested here a 2-month advance notification as bear minimum.

As far as the support services are concerned, all participants highlighted the need for a support in English. Almost all participants mentioned though that an extended support service is not seen necessary the whole time that the test platform is open. The availability of the test platform itself remains the most important element. In summary, as long as the test platform is available in an extended manner and the support is responsive during regular working hours (in English), extended support is a plus, but definitively not a requirement according to most of the Market Research participants.

A few participants also observed that, in some cases, (mostly when the Exchange does not own the technology of its trading platform) longer expected time is required for technical issues to be investigated or technical questions to be answered. One participant suggested that what can help under those conditions is:

- ✓ Access by the exchange support team to monitoring tools to quickly locate orders in the system
- ✓ Access by the exchange support team to simulating tools (to reproduce specific scenarios depending on Exchange input)
- ✓ Development of local experts of the exchange system technology or setting-up of fast escalation path to exchange system vendors



Recommendations on Test Environments Functionality

This section describes feedbacks and suggestions related to the level of functional framework required for ensuring safer solution deliveries. This included a range of questions around potentially beneficial functionalities such as the ones below:

- ✓ Should exchanges and clearing houses provide specific scenario supporting development validation? If yes, to which extent and in which format?
- ✓ Should exchanges and clearing houses provide reinforced scenario-based conformance?
- ✓ How should exchanges provide high-volume testing? (How often? On-demand? On specific schedule with prior notification)
- ✓ Should exchanges systematically provide “extreme conditions” scenario (conditions that would trigger trading halt / pause)
- ✓ Should exchanges systematically provide market data replay on high-volatility-high-liquidity days? (e.g. post March 11 Tohoku earthquake)
- ✓ What about expectations on publication of calendar for trading session?

Several participants commented that exchange should help vendors and members to validate their solution by providing predefined testing scenarios that enforce the validation by the industry of a common scope (it was mentioned that some exchanges request a sign off from members after validation is completed). It reduces the risk for go-live by ensuring all members have done due diligence. Two ways to achieve this were proposed by one participant:

- ✓ Exchange to publish a guideline to list the mandatory scenarios to run and successfully pass conformance. This documentation adds a new dimension to the specifications as it highlights specific workflow and logic not easily represented in the technical specifications.
- ✓ Running on Test environments pre-scheduled functionality aimed at replicating cases that cannot be played without Exchange assistance. Among many others, some examples are connections scenarios (failover-disconnection, sequence number gaps, password expiration/changes), abnormal market phases (circuit breakers, auctions), special order management (off-Exchange orders, unsolicited eliminations, execution bust)...

Several participants raised the point that, concerning stress tests, ideally it should be available in the test environment through specific pre-scheduled sessions. Frequency of those tests can vary (from a couple a weeks to once a month). If not possible during regular testing hours, week-end or evening tests should be organized with possibility for vendors to participate to those sessions with their test logins/connections. Also in that specific case of limited frequency of stress tests, one suggested recommendation is to get the notification at least 3 months in advance and



offers at least 3 possible different dates so that ISV, system integrators and brokers have sufficient time to coordinate themselves (from commercial matters to resource and technical constraints)

A few participants suggested also that, in general, Exchange should published guidelines around anticipated market data volumes (average and maximum peaks of message/second) for the next 6-12 months, with related bandwidth requirements.

A few participants also commented that, in general, it is perceived that issues on test platforms are quite limited to miscommunication about different technical teams accessing for different purposes or teams not being aware of the availability schedule for testing. Therefore, for all those test sessions, Exchange should publish on its website a monthly or bi-monthly calendar showing availability of the test platform and the date/times of the specific testing sessions. As stated in the section above, one participant suggested here a 2-month advance notification as bare minimum.



Recommendations on Test Environments Cost

This section gathers suggestions around recommended pricing schemes to apply to test environments. Questions asked to the participants were for example:

- ✓ Would you suggest a Daily cost scheme? Weekly cost scheme? Monthly cost scheme? Usage-based cost-scheme? A hybrid scheme?
- ✓ For your company, what is a reasonable cost for test environment so that development and QA decisions are not based on economic factors?
- ✓ Should it the same pricing model apply for ISV, for ISV offering ASP or co-lo, for members, for members in co-lo or are there interesting variations to consider?
- ✓ Should there be various pricing levels depending on what you access / how long you access / the support service you request?

All participants operating on multiple markets agreed that costs to access Test environments highly differ from one exchange to another. It is recognized that the usual practice is that Exchange will have vendors/members pay per login on a monthly basis. Some exchanges though (SEHK for example) have a more flexible approach where they charge per day of usage, automatically detecting when logins are connected to the system. This permits a better cost control, but could generate more administrative work for both parties. Some others will have yearly costs for logins. In some other cases, test access is free for the first set of logins (e.g. one order routing login and one market data login), extra login being then charged.

While all participants admitted that the lower the cost of the Trading and Clearing Test platforms, the better, they also clearly recognized that Exchanges bear a cost for the deployment and maintenance of such environments and acknowledged that this cost needs to be shared with participants to some extent. One participant proposed though that charges should ideally be exempted or reduced during Exchange migration or roll-out of new mandatory features, especially when vendors and members are forced to update their software and pass certification with the Exchange. The exemption could apply from the availability of N+1 environment until go-live (when N+1 becomes N).

It was also observed from several participants that their budgets approval process was going increasingly complex and slow. Therefore one participant suggested having a minimum monthly fee that covers all services and would require only once internal approval as opposed to a-la-carte test sessions that would need legal, technical, commercial and senior management to get involved on a too-frequent basis. In the same way, it was also recommended by this participant that the Application forms should be simplified: If there is no contract implication, company seal should not be required to have application form processed in order to get the overall process more fluid.



Any other Recommendations not falling in the previous five categories

This final section simply gathers any recommendations not falling in the previous five sections.

- ✓ One participants recommended to set front-to-back combined testing days to give an opportunity to test the entire chain from order entry to clearing and settlement processing (including EOD and SOD files processing for example)
- ✓ All non-domestic participants agreed that documentations and primarily API specifications should be released in both English and Japanese at the same time. In most of the case, the English version comes several weeks after the Japanese version. The risk related to that points are: cost of development high as translation of the specification needs to be done temporarily while waiting for English specifications, possible delay in development as analysis cannot start unless specification is translated, possibility of incorrect coding and implementation due to incorrect understanding of the specification due to language issues, delay in delivery... Also, on top of sharing the English specifications document, one participant confirmed the need for workshops / explanatory sessions to be organized with all participants during a migration. Those sessions should also be offered in English to remote stakeholders (via webex, conference call...) and should include the distribution of the presentation material.
- ✓ A few participants requested to get provided with access to Exchange and Clearing terminals on Test environments (when available): this helps to have an external view of the order book and possibly detect gaps. This comes as a helpful resource when supporting the following features: on behalf of trading, drop copy or proxy user solutions. Having access to Exchange trading GUI for middle/back office development teams also allows an independent testing of their downstream solutions without having to rely on the Exchange or other parties to generate trades.
- ✓ On the topic of Automated Trading Systems and Algorithm Trading testing, one participant mentioned the need to ideally have all related involved in the automated chain of decisions (market-data providers, exchanges, PTS in the case of SOR...) to coordinate their test sessions
- ✓ According to one participant, when a throttling limits is set per login (depending on the exchange), the Exchange should be in a position to quickly change this throttling limit (in 24h max) on the participant request, so that testing can be easily done against different client's settings.