

HKEX Public Report

Conclusion of Incident Review: Derivatives Market Suspension on 5 September 2019

28 December 2020

EXECUTIVE SUMMARY

Hong Kong Exchanges and Clearing Limited (HKEX) has completed the review of the derivatives market trading suspension on 5 September 2019 (Incident), from 2:00 p.m. onwards including the afternoon and After-Hours sessions. HKEX has taken into account recommendations from the Securities and Futures Commission (SFC) and an independent consultant, as well as feedback from Exchange Participants and other key stakeholders, when implementing a range of enhancements measures. We have taken this incident seriously with the Board and a subcommittee was formed to oversee the investigation, review and implementation of the enhancement plan. An external consultant was engaged in both independent review and implementation of the action plan. The focus on implementing these measures has been on strengthening our resiliency, improving overall incident handling capabilities and ensuring timely communication of information to the public in the event of major market incidents. The independent consultant has reviewed and confirmed that the key resilience enhancing measures that were recommended have been implemented.

The cause of the Incident was an isolated software issue in the derivatives market's vendor-supplied system, ultimately causing system disconnections. After successful testing and verification of the interim solution recommended by the software vendor, trading resumed successfully in the derivatives market on 6 September 2019. Since the Incident, the derivatives market has operated without major incident. Working with the vendor, and following extensive testing and successful completion of a market practice session, we have now deployed a permanent fix to the software that caused the malfunction.

The enhancement measures, which focus on incident prevention, detection and handling, mitigation of incident impact, and communication during incidents, will provide greater support to Exchange Participants, investors and other stakeholders in the event of future incidents. HKEX will continue to commit its resources to achieve its goal of operating a highly resilient, fair, informed and orderly market.

ROOT CAUSE - VENDOR SOFTWARE ISSUE

The root cause of the Incident related to a specific order generation processing logic for the Combination order of Two-Sided Price Quote (Combination MO37). Combination MO37 enables two-sided price quotes (i.e. both a buy and a sell instruction in the same message) against a combination of futures contracts with different expiry months. The problematic software logic caused some of the orders generated by Combination MO37 to be inserted into the orderbook twice. Such duplication caused one of the matching engines to become unresponsive. As the matching engine stopped responding, orders queued up and eventually caused the connective gateway to drop connections. As a result, a number of Exchange Participants experienced connectivity issues in accessing the Hong Kong Futures Automatic Trading System (HKATS).

Working with the software vendor, and upon completion of testing and verification, we applied an interim solution by suppressing the problematic order generation function of Combination MO37 before successfully resuming trading on 6 September 2019.

FOLLOW UP ACTIONS

Following the Incident, HKEX has thoroughly reviewed the Incident and submitted an incident report to the SFC. The SFC has provided its full recommendations in an assessment report to HKEX. An independent consultant has also conducted a review of the Incident, including conducting onsite management and staff interviews, and documentation and process reviews. The independent consultant has provided its recommendations in a comprehensive review report.

HKEX has committed a significant amount of resources to review the Incident, assess and implement the planned enhancements, as well as to complete the roll-out of deliverables. HKEX has taken into account the recommendations from the SFC and the independent consultant, as well as feedback from Exchange Participants and other key stakeholders, when assessing and formulating the planned enhancements.

HKEX has also worked closely with the SFC in the implementation of the enhancement measures and deliverables, to ensure that the SFC's recommendations are addressed. The independent consultant has reviewed and confirmed that the key resilience enhancing measures that were recommended have been implemented.

KEY AREAS OF IMPROVEMENT

HKEX identified the following key areas of improvement:

- Incident prevention: preventive measures for major market incidents that may lead to trading suspension;
- Incident detection & system monitoring: detection of potential system issues through enhanced system monitoring;
- Incident handling: assessment protocol for decision making to determine whether derivatives market trading should be suspended;
- Mitigation of incident impact: mitigation of the market impact of major market incidents; and
- Communication: timely communication of key developments to the market during major market incidents.

ENHANCEMENT MEASURES AND DELIVERABLES

Incident Prevention

The independent consultant assessed HKEX's change management, testing and deployment processes, and concluded that these processes adequately support our low risk-tolerance levels. The independent consultant also acknowledged that HKEX's testing procedures are governed by thorough and well-enforced policies, procedures and infrastructure.

We have deployed a permanent fix to the software that caused the malfunction in the order generation logic of Combination MO37, after extensive internal testing and quality assurance testing by the software vendor, as well as successful completion of the market practice session with Exchange Participants. Nevertheless, we continue to suppress the order generation function of Combination MO37, which eliminates any potential risk of reoccurrence of the software logic issue that caused the Incident.

We have conducted a comprehensive risk and benefit assessment for the order generation function on all order message types, including Single-Sided Order Entry (MO31), Two-sided Price Quote (MO37) and Mass Quote Transaction (MO96). The only other order type in our derivatives market that has an order generation function apart from MO37 is MO31. Unlike MO37, which enables two-sided quotes (i.e. both a buy instruction and a sell instruction in the same message); MO31 only supports single-sided orders (i.e. either a buy instruction or a sell instruction only in the same message).

The software issue that caused the Incident only affects two-sided quotes; it does not affect single-sided orders. We have decided to retain the order generation function of MO31 after considering both technical and business factors.

Both MO31 and MO37 have the capability to perform both Single and Combination orders while MO96 only performs Single order and is not applicable to Combination orders. Given no order will be generated without Combination order, the software issue that caused the Incident does not apply to MO96.

From a technical perspective, our software vendor has conducted a thorough review of the order generation function to assess its robustness, and concluded that such order generation logic incorporating HKEX specific modifications is suitable for production usage. Nevertheless, in order to ensure that the software fix did not inadvertently affect other message types, we have completed User Acceptance Testing (“UAT”) and automated testing to verify the continued robustness of the matching engines.

From a business perspective, the order generation function enhances market efficiency by linking up the liquidity pools of Combination orders and Single orders. It facilitates the execution of trades between these two orderbooks. We have surveyed a majority of the users of Combination orders on their business needs for the order generation function on MO31 to assess the potential system and operational impacts on these users if the order generation function is suppressed. Based on these users’ feedback, there was a genuine business need to retain the order generation function on MO31. More than half of these users raised concern regarding trading volume and liquidity impact if we suppress the order generation function for MO31.

Since the Incident, our software vendor has expanded the test coverage by increasing the number of automated test cases and scenarios, and the tests are executed on a daily basis in the vendor environment. The aim of the testing is to detect early and eliminate coding errors under complex and extreme market conditions.

The above measures including suppression of the order generation function of Combination MO37, the permanent fix of the software, and the expanded test case coverage, have helped to reduce the likelihood of major market incidents occurring due to software issues.

Incident Detection & System Monitoring

To enhance the monitoring of trading systems and to improve detection of potential system issues, we have implemented a new tool to monitor the responsiveness of matching engines. The tool generates alerts if any matching engine fails to respond with an order processing completion message within a specific timeframe. The tool enables HKEX to detect the malfunctioning matching engine much quicker and significantly reduces the problem diagnosis time.

We have deployed a health-check monitoring feature to confirm the continued healthiness of the trading system (HKATS). This check is performed daily, in preparation of the derivatives market opening. We can also deploy this mechanism on an *ad hoc* basis during derivatives market trading hours to collect information to investigate and analyse whether a suspected issue relates to the network or other components of the software.

We have also stepped up monitoring of real-time information relating to derivatives market activities and our system activities. Information that is key to identifying trading abnormalities is easily accessible by our teams to facilitate early detection of potential problems and assessment of market impact for investigations and root cause diagnosis. Such real-time information will be made readily available in the incident handling decision process.

Incident Handling

The independent consultant concluded that the root cause analysis of the Incident was appropriate, and the temporary workaround that was implemented at the time had minimal impact on the market.

Following the Incident, we have comprehensively reviewed our firm-wide policies and procedures on incident diagnosis and decision-making processes. The aim of this has been to enhance our incident handling processes and facilitate the assessment of whether a trading suspension is appropriate under various circumstances.

The updated HKEX incident management framework for incident managers, incident coordinators, and other staff who undertake incident management functions include the following key changes:

- An enhanced set of incident management policies and guidelines setting out the actions required to ensure readiness to effectively manage incidents, including incident investigation, classification and decision making;

- Specific roles and responsibilities across three focused work streams are clearly defined, namely the Analysis Stream, Technology Stream and Communication Stream. We aim to speed up incident escalation by setting out the key items to be considered by each stream. We encourage more comprehensive post-incident reporting through collaboration across the work streams and application of the key principles governing the updated framework;
- We have set out a list of criteria to facilitate comprehensive assessment of various scenarios, including incidents where the potential cause is unclear. This list helps expedite the incident escalation and assessment processes;
- We have created a cross-market impact assessment matrix, which provides useful information on the relationship among various markets and products. The matrix provides a holistic view of the potential business impact to facilitate prompt cross-market assessment and actions. It also facilitates our communication with various segments of the market, including investors, product issuers, Exchange Participants and market makers; and
- We have introduced a polling mechanism to collect prompt feedback from key Exchange Participants in an affected market, in the event of a major market incident. This feedback will be collated in a systematic and auditable manner to assess market impact.

Our newly launched centralised incident log provides further granularity and rigor around the incident handling process and greater visibility across relevant HKEX divisions. We have implemented incident templates, developed a centralised incident portal and rolled out the supporting training programme in HKEX.

In August 2020, we conducted a major incident drill focusing on the derivatives market and the HKATS system. The drill helped to enhance our incident handling readiness, and put into practice the updated HKEX incident management framework. The drill also helped us verify the effectiveness of the relevant enhancement measures we implemented. HKEX will continue to perform regular drills to ensure ongoing incident readiness and continue to enhance the incident management framework as required.

The above key measures have largely enhanced our incident handling process and improved our decision-making process in a more timely, structured and informative manner. The enhanced incident management policy set, together with clearly defined roles and responsibilities, expedites incident escalation along with comprehensive assessment processes. The establishment of the cross-market impact assessment matrix and market suspension criteria facilitate better preparation of high quality and precise information to make incident management decisions. Furthermore, the introduction of the Exchange Participant polling mechanism enables accurate judgement of the actual market condition and more structured incident response processes.

Mitigation of Incident Impact

We have implemented a range of enhancement measures that aim to mitigate the market impact of major market incidents. Currently, HKATS has multiple matching engines, and each matching engine matches trades in a designated group of derivatives products. If a failure occurs in one matching engine, it may affect the other unaffected matching engines, impacting trading in the entire derivatives market. We have deployed new tool to isolate a malfunctioning matching engine from HKATS, in order to confine the impact of software issues to the impacted matching engine. Such functionality gives us the option to suspend trading only for the product groups designated to the malfunctioning matching engine, and not the entire derivatives market. With this new functionality, market participants can continue to trade other products supported by the unaffected matching engines.

We conducted a market practice session in May 2020 to simulate the scenario of a malfunctioning matching engine. Exchange Participants were able to familiarise themselves with the operational arrangements where a failure occurred in a specific matching engine. All participating Exchange Participants have provided positive confirmation of their capability to perform normal trading activities relating to products designated to the healthy matching engines under the contingency scenario. Based on the satisfactory results of the practice session, we have verified Exchange Participants' capabilities to perform normal trading activities on the unaffected matching engines under a contingency scenario. The isolation tool was able to isolate the malfunctioning matching engine and allow operations to continue without any impact on other healthy matching engines.

We have provided a tool for Exchange Participants to define their own order cancellation parameters according to their own risk appetite when they encounter any disconnections from the trading system. This enhancement provides flexibility for Exchange Participants to manage their outstanding orders in the event of a disconnection issue due to a network or software problem, minimising the impact of the contingency.

With our recent rule changes, Exchange Participants may now make use of more flexible block trade price and quantity parameters in the event of major market incidents. Exchange Participants will find it easier to help clients book futures and options trades executed over the counter to our market via block trade facilities, under more accommodating price parameters and minimum volume thresholds.

Communication

We always aim to provide accurate and timely information to the market to ensure sufficient notice of key developments during a major market incident. Since the Incident, we have implemented a number of enhancements to our communications policies and procedures. The following changes allow us to provide the market with better information and proactive updates during potential future incidents:

- We have formalised the communications principles for regular and timely dissemination of key developments during major market incidents. This includes a commitment for timely publication of news releases and other communications, incorporating a commitment to updating the market at least every 90 minutes during market hours following the first notification of a major market incident. Also, during major market contingency situations involving trading suspensions, news releases will be published on key developments, including but not limited to market suspension and market reopening;
- We have introduced a new category of news release dedicated to matters relating to the market (“Market News”). This helps to distinguish between HKEX corporate news and announcements, and other news relevant to the developments in the market. A dedicated home page for announcements that relate to market-wide suspensions, status updates, and trading resumptions is now available;
- We have implemented scenario-based communications guidelines, together with relevant example templates to standardise the requirements for the mechanics, content and frequency of communication as part of our corporate communications policy; and
- Communication to the market will be made in a more structured manner with different approaches as set out in our communications guidelines deployed according to the level of business impact of the incident.

In the event that HKEX's websites become inaccessible, contingency websites will be used to host key information, such as news releases and circulars to ensure timely information dissemination. We will also appropriately utilise other communications channels such as social media to broaden the means of communication in the event of a major market incident. These communications channels include news releases, circulars, market communications, social platforms, telephone calls, face-to-face meetings, market/client portals, and HKEX websites.

LOOKING FORWARD

HKEX is committed to operating a resilient, fair, informed and orderly market. We have invested a significant amount of time and resources to review the Incident, the lessons learned, and to implement the appropriate enhancement measures. We will continue to commit our resources to ensure that we can achieve these goals at all times.

In order to sustain a high degree of operational reliability, we will continue to work on several additional longer-term measures where appropriate. For instance, in November 2020 we launched a new markets status page on our website highlighting any potential service issues in respect of our core market systems. We will continue to conduct regular major incident drills to ensure our incident handling readiness.

We are confident that the enhancement measures implemented have strengthened resiliency, efficiency and risk mitigation. We remain wholly committed to the long-term success of Hong Kong as a leading global financial market.

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