

1.1.2 OSC Staff Notice 23-702 – Electronic Trading Risk Analysis Update

OSC STAFF NOTICE 23-702

ELECTRONIC TRADING RISK ANALYSIS UPDATE

I. Introduction

This Notice is an update from staff (OSC Staff or we) of the Ontario Securities Commission (OSC or Commission) on our electronic trading risk analysis that included a review of National Instrument 23-103 *Electronic Trading* (NI 23-103), which establishes the regulatory framework for the oversight and management of the risks associated with the use of electronic trading on Canadian marketplaces. The regulatory requirements in this rule are intended to provide better protection for investors and support the integrity and efficiency of the capital markets of Canada. In order to ensure our regulatory framework is effective and robust, we have engaged in a review to assist us in:

- Analyzing the tools and controls on electronic trading in Canada;
- Assessing whether there are any gaps in NI 23-103; and
- Seeking recommendations on any identified gaps that should be addressed.

NI 23-103 and Companion Policy 23-103CP came into effect on March 1, 2013, and the Canadian Securities Administrators (CSA) have issued amendments to expand upon the framework to manage risks associated with direct electronic access (DEA).

The OSC regulates Ontario's capital markets in the context of rapid developments in market structure, technology, investment products and the global regulatory regime, among other things. As stated in its 2013-14 *Statement of Priorities*, the OSC has identified the evolution of market structure a key area of focus in 2013-2014: "The OSC will examine the issues associated with the evolution of the markets, including the impact of the order protection rule, algorithmic and other electronic trading and market data fees, to determine what regulatory responses may be required." It is in this context that we are, and have been, examining the issues surrounding electronic trading. These potential risks include those raised by high frequency trading strategies and use of sophisticated technology and algorithms. While this work does not measure the impact of the increased use of high frequency trading strategies on market quality, the Investment Industry Regulatory Organization of Canada (IIROC) has an initiative underway that will examine order and trade information and conduct an analysis of the impact of high frequency trading on the market.¹

II. The OSC and the Electronic Trading System Risk Analysis

As part of our review, the OSC retained an independent consultant, Fionnuala Martin and Associates (Consultant), to provide us with an assessment of the risks posed by electronic trading and whether any gaps exist in NI 23-103.² This assessment included interviews with market participants and other research regarding:

- Electronic trading practices, procedures and controls;
- The risks posed by electronic trading;
- The sufficiency of the current regulatory framework and whether any gaps exist in that framework; and
- How to best mitigate electronic trading risks.

The Consultant presented her report to the Commission. The report contains the Consultant's analysis, views and recommendations relating to electronic trading risks and is attached as Appendix A to this Notice. The report states that NI 23-103 provides comprehensive and adequate controls for the identified risks associated with electronic trading and that no gaps in NI 23-103 were identified. The language in NI 23-103 was considered by market participants to be clear, providing a good risk management framework for electronic trading. As a result of NI 23-103, according to the report, "The industry now has electronic trading rules and guidance on effective risk management through financial and supervisory controls for marketplace participants, regardless of the types of electronic trading they support."

¹ The HOT Study, Phases I and II of IIROC's Study of High Frequency Trading Activity on Canadian Equity Marketplaces, Trading Review and Analysis – Analytics Group, Investment Industry Regulatory Organization of Canada, 2013.

² Fionnuala Martin has over 30 years diverse experience in the Canadian markets providing trading technology related consulting services to a marketplace, a number of investment dealers, and a service vendor.

In addition, the report includes several recommendations for possible improvements relating to industry testing, protocols and standards for marketplace operations. OSC Staff are reviewing the recommendations of the report carefully to consider any appropriate next steps. We recognize that as the speed, capacity and complexity of trading securities increase, the OSC must continue to consider the appropriate safeguards necessary to mitigate the risks of changing technologies and continue to gather information and examine whether regulatory requirements are complete, robust and effective. We also understand that electronic trading safeguards must continue to evolve as markets evolve and any requirements must be considered in the context of fair and efficient capital markets. This review and the Consultant's report is one example of this undertaking.

III. Electronic Trading Risks and How Canadian Regulators Address Them

The increased use of complex trading technology and strategies, including high frequency trading strategies, has introduced additional risks to the markets that can impact dealers, marketplaces, and investor confidence. Three key electronic trading risks and the regulatory mechanisms in place to address them are described below. These risks and controls were also considered as part of the Consultant's analysis.

(i) Credit Risk

Credit risk includes the risk that a dealer will be held financially responsible for trades that are beyond its financial capability. It also includes the broader systemic risk that may result if a dealer is unable to cover its financial liabilities and this failure spreads to the market as a whole. An additional risk exists where a dealer provides DEA in that the dealer is held financially responsible for the execution of all trades by its DEA client. Without adequate controls, the speed at which orders are entered into the market by dealers or their DEA clients increases the possibility that executed trades surpass a dealer's financial capability.

In response, Canadian regulators have instituted a number of controls under NI 23-103 and the Universal Market Integrity Rules (UMIR) to mitigate this risk, including:

- Pre-trade risk control requirements;
- Requirements regarding the monitoring and cancellation of orders;
- Requirements related to the use of automated order systems;
- Marketplace thresholds;
- Circuit breakers; and
- Guidance on the regulatory treatment of erroneous and unreasonable trades.

1. *Pre-Trade Risk Controls*

NI 23-103 and UMIR require dealers to have risk management and supervisory controls, including pre-trade risk controls, which limit the financial exposure of the dealer. Specifically, these controls prevent the entry of orders that exceed pre-determined credit or capital thresholds as well as pre-determined price or size parameters set by the dealer.

2. *Order Monitoring and Cancellation*

The risk to a dealer's credit is exacerbated if a dealer cannot keep track of the orders that it or its DEA clients enter or if a dealer lacks proper controls to stop the execution of erroneous orders. To address this issue, NI 23-103 and UMIR require a dealer to have mechanisms in place to ensure that the dealer monitors all orders it enters as well as those entered by its DEA clients and that a dealer is able to immediately stop or cancel any of its orders or orders entered by its DEA clients. To further address the possibility that orders from a DEA client can pose a risk to a dealer's credit, NI 23-103 and UMIR mandate that a dealer must be able to immediately stop, when necessary, any direct electronic access it provides to a client.

3. *Use of Automated Order Systems*

The use of automated order systems³ is widespread. With the speed at which technology is employed in today's trading environment, an error in the programming or execution of an automated order system can quickly impact a dealer, or with the possibility of contagion, the market as a whole. This can affect investor confidence.

³ An "automated order system" is defined in NI 23-103 as a system used to automatically generate or electronically transmit orders on a pre-determined basis.

When an automated order system such as an algorithm is used, an error with respect to its output or its programming, such as the creation of a loop that sends erroneous orders into the market, can quickly make a dealer responsible for trades that are beyond its financial capability. This can have a negative impact on the market, especially if the erroneous orders impact a wide number of market participants or the price of a security or number of securities.

To mitigate this risk, we have imposed controls on the creation and use of automated order systems. NI 23-103 and UMIR require that dealers ensure that automated order systems are tested on a regular basis and that dealers have controls in place to immediately stop any automated order system and prevent the orders generated by an automated order system from reaching a marketplace if necessary. For example, this may include the use of a kill switch or other mechanism that will stop run away algorithms as soon as possible.

Because automated order systems can produce many orders in a very short period of time, understanding the type of order flow that will be generated by an automated order system is critical so that a dealer can better manage the risks to its business of electronic trading.

To address this risk, NI 23-103 and UMIR require a dealer to have an understanding of any automated order system that it or any of its clients use. Knowing the expected behaviour of an automated order system will not only help with setting pre-trade risk controls, but will also help the dealer to quickly determine if an automated order system is functioning abnormally and decide whether to shut off the automated order system or cut off a client's access.

4. *Marketplace Thresholds*

NI 23-103 also prohibits a marketplace from executing orders that exceed set price and volume thresholds. Since orders over a certain size or value will not be able to be executed on a marketplace, the extent of volatility in trading that can occur on our markets and the risk to a dealer's credit is contained. The specific thresholds are to be determined by a regulation services provider such as IIROC or by a recognized exchange that directly monitors the conduct of its members, such as the Montréal Exchange. We note that IIROC is currently conducting consultations as to how best implement this requirement.

5. *Circuit Breakers*

IIROC has implemented circuit breakers which are another mechanism to stop trading during unusually volatile trading periods to allow investors to reassess their trading positions and strategy. Single-stock and market-wide circuit breakers operate at multiple levels and the triggers for each level of market-wide circuit breaker is co-ordinated so that they work effectively to address unusual market volatility.

Single-stock circuit breakers are the first level of circuit breakers and halt the trading of a security for five minutes if the price of that security swings 10% or more within a five-minute period. This is helpful when a particular security is experiencing unusual trading volatility.

Market-wide circuit breakers constitute the second level of circuit breakers. These types of circuit breakers come into play when many securities experience large fluctuations in price. Market-wide circuit breakers pause trading on all securities after a decline of a predetermined size of the S&P 500 Index. These trigger levels and pause lengths are tied to those in the United States due to the interconnectedness between the two markets.

6. *Guidance on Regulatory Treatment of Erroneous and Unreasonable Trades*

Despite the controls described above, all trading errors cannot be prevented. When these errors occur, IIROC has the ability to vary or cancel a trade to maintain fair and orderly markets. IIROC has published guidance to provide transparency to investors as to how erroneous or unreasonable trades will be dealt with by IIROC.

(ii) *Market Integrity Risk*

Another risk of electronic trading is market integrity risk. Market integrity risk refers not only to the risk of non-compliance of a dealer with regulatory requirements but also the risk that the integrity of and confidence in the market is diminished if there is a lack of compliance.

With the ability to rapidly enter orders comes an increased risk of violations of regulatory requirements. To address this issue, the pre-trade risk controls mandated in NI 23-103 and UMIR must also be designed to prevent the entry of orders that do not comply with all applicable marketplace and regulatory requirements that must be satisfied on a pre-trade basis where possible. These regulatory requirements include compliance with the Order Protection Rule.

NI 23-103 and UMIR also require a dealer to be satisfied that a prospective DEA client has reasonable knowledge of regulatory requirements before providing DEA to that client. Once DEA is provided, NI 23-103 further requires a dealer to update its DEA

clients about relevant changes to regulatory requirements to help ensure each DEA client maintains its reasonable knowledge of regulatory requirements. This is important to ensure that those that are sending orders directly to Canadian marketplaces understand the rules of trading and contribute to the maintenance of market integrity.

Market integrity risk is further mitigated through the NI 23-103 requirements for dealers to ensure each DEA client is assigned a unique identifier and that this identifier is included in each order sent by the DEA client. These identifiers will allow regulators, including IIROC, to identify DEA trading more readily and determine the specific client behind each trade more easily. This will improve the ability of regulators to investigate suspicious trading and market abuse.

In addition, the marketplace thresholds, circuit breakers, and guidance on erroneous trades described above also act as protections to ensure a fair and orderly market and therefore help to address market integrity risk as well.

(iii) Technology or Systems Risk

Technology or systems risks relate to the possibility for failure of systems or technology and the impact of that failure. The potential problems may be due to systems failures, lack of capacity or programming errors in or by marketplaces, dealers, vendors or clients. These risks are exacerbated by the high degree of interconnectivity and rapid speed of communication among marketplace, dealer, and DEA client systems required by electronic trading resulting in potentially wide-reaching consequences should something go wrong in any one component. In addition, technology or systems failures that impact the ability of investors to trade or the prices that they receive for execution or the availability of those prices, introduce the possibility of cancellations or variations of trades. All of these could impact investor confidence in the market.

To mitigate these risks, requirements related to marketplace systems have been included in National Instrument 21-101 *Marketplace Operation* (NI 21-101). In addition, in Ontario, key market infrastructure entities are also required to comply with an Automation Review Program (ARP) as described below.

1. *NI 21-101 Systems Related Requirements*

NI 21-101 imposes requirements on marketplaces to develop and maintain adequate systems of internal control and information technology general controls with respect to their systems, including order entry, order routing, execution, and data feed systems. To ensure this occurs, an independent systems review (ISR), must be conducted by marketplaces on an annual basis by a qualified third party.

To help ensure that marketplaces will be able to operate during periods of higher than normal trading volumes and during disasters, NI 21-101 also requires marketplaces to meet certain systems capacity, performance and disaster recovery standards which are consistent with prudent business practice.

2. *ARP Requirements*

The ARP, as mandated by the OSC, applies to key market infrastructure entities, including recognized clearing agencies and exchanges. The ARP has three main components:

- A systems reporting procedure that requires entities to provide the OSC information on material system outages, other systems related issues, planned major production system changes and significant systems incidents on a timely basis;
- An annual ISR as described above; and
- Technology reviews which involve a review of the entity's systems and procedures with a focus on one or more particular systems related issues.

The information obtained from the ARP components provides the Commission with relevant information to conduct its oversight of the systems of key entities while also helping to strengthen the key entities' own internal processes through responding to and implementing ISR recommendations.

IV. Robust Regulation of Electronic Trading

In our view, the measures described above constitute a robust and effective response by the OSC, CSA and IIROC to help ensure that marketplaces and market participants appropriately manage the risks associated with electronic trading. Although the risks of technological failure or human error can never be completely eliminated, having a number of layers of controls substantially mitigates the risks of such occurrences and we expect them to minimize the impact in the event of an error or failure.

It is important for us to keep abreast of developments in trading technology and market structure and enhance our understanding of how innovations impact markets, market participants and investors. We will continue to be proactive in strengthening the oversight of marketplaces and trading in appropriate alignment with the regulatory principles for fostering fair and efficient markets and investor protection. This review and the Consultant's report is one example of this effort.

As we continue to examine the issues associated with electronic trading, the Consultant's recommendations, along with industry input beyond the anonymous feedback provided to the Consultant, and other pertinent information and factors will be considered. With respect to marketplace systems oversight, we are currently considering:

- Whether ARP requirements for key infrastructure entities, including recognized exchanges, require updating or supplementing; and
- The U.S. Securities and Exchange Commission's proposed Regulation Systems Compliance and Integrity (Regulation SCI) to assess if any of the proposed provisions would enhance our regulatory framework.⁴

Our examination to enhance the marketplace systems oversight framework may necessitate changes to NI 21-101. Any new requirements relating to electronic trading risks will be proposed and dealt with within the normal comment processes where required. We will also look for opportunities to further enhance the marketplace systems oversight framework through our ongoing oversight of marketplaces and market participant feedback.

Moreover, we will continue to work with the CSA and IIROC to identify and address electronic trading risks, where appropriate, through policy development and through consultations with market participants, investors and international regulators, in particular, the International Organization of Securities Commissions.

The OSC is working with other regulators and co-operating with market participants towards mitigating the risks to markets and investors in the context of rapidly evolving global capital markets. By implementing specific requirements for appropriate controls, policies and procedures relating to electronic trading, we endeavour to foster investor confidence in the integrity of our capital markets.

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APPENDIX A

[Editor's Note: Appendix A follows on separately numbered pages. Bulletin pagination resumes at the end of the Appendix.]

⁴ Regulation SCI would require certain market participants to have comprehensive policies and procedures in place for their technological systems.

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Ontario Securities Commission

Electronic Trading System Risk Report

Delivered July 2, 2013

Prepared by: Fionnuala Martin

Fionnuala Martin and Associates

Table of Contents

1	Electronic Trading System Risk Report.....	3
1.1	Methodology.....	3
1.2	NI 23-103 ETR.....	4
1.3	Risks Due To Industry Complexity and Pace of Change.....	4
1.3.1	Transparency of marketplace functionality and changes.....	6
1.3.2	Insufficient notice to make the changes.....	7
1.3.3	Ability to test new functionality in a marketplace test environment.....	7
1.3.4	Ability to test operational procedures in a test environment.....	10
1.4	Risks of Inconsistent Handling of Marketplace Interruptions.....	11
1.4.1	System Outages and Errors.....	11
1.4.2	Security freezes and halts on a marketplace.....	12
1.5	NI 21-101 and CP - Marketplace Operation Review.....	13
1.5.1	Auditors and Independent System Reviews (ISR).....	14
1.5.2	Suggested Areas for Enhanced Standards for Marketplaces.....	15
2	Recommendations and Closing Comments.....	17
2.1	Consultant's Recommendations.....	17
2.2	Consultant's Closing Comments.....	17

1 Electronic Trading System Risk Report

The market technology risks exposed through events such as the Facebook and BATS IPO challenges, the impact of high frequency trading on the markets, Knight Capital Group losses, ongoing fat finger losses and continued marketplace interruptions have highlighted the level of risk associated with electronic trading. These high profile events continue to elevate the importance of industry awareness of, and adherence to, risk management and controls with respect to electronic trading.

The OSC wanted to ensure that there were no electronic trading risks that were missed during the drafting of NI 23-103 Electronic Trading Rules (ETR) and so it engaged the services of Fionnuala Martin (the Consultant) to assess whether there were any gaps in ETR.

1.1 Methodology

A number of factors were considered before deciding on who should be invited to participate in this review. The Consultant recommended that a cross section of stakeholders be interviewed to ensure that a variety of views, including those of the major financial institutions, were heard. These stakeholders included representatives of independent brokers; brokers with a domestic as well as global presence; DEA clients including High Frequency Traders (HFT); the buy side; the vendor community as well as Canadian exchanges; selected ATSS and IIROC.

It was considered important that a confidential forum be provided to allow interviewees the opportunity to speak candidly without concern that their competitors would hear about their proprietary business models or “secret sauce”. In the Consultant’s opinion, the benefits of a confidential forum were greater than the limitations. For example, a public forum limits the level of detail a firm is willing to reveal. The SEC Technology Roundtable on October 2, 2012¹ offered a public forum for a number of U.S. firms to communicate their views on electronic trading risk and mitigation strategies. The Consultant felt that the information presented during the Roundtable applied in many respects to the Canadian context. The Consultant took the view that a confidential interview process would better yield information specific to Canadian risks that would not surface otherwise.

In the Consultant’s opinion, the firms who did participate in this analysis represented a cross section of stakeholders.

The Consultant prepared and circulated a number of questionnaires targeted at the various stakeholder groups to provide them with a sense of the topics to be covered during the interviews. The questionnaires included, but were not limited to, understanding the industry participant’s electronic trading risk controls, testing practices and criteria that must be met prior to approving the release of

¹ The SEC Technology Roundtable hearing is available at <http://www.sec.gov/news/otherwebcasts/2012/ttr100212.shtml>

code into production, error prevention and error correction strategies, and electronic trading failure scenarios and mitigation strategies. Firms were asked to provide a high-level overview of their electronic trading systems and where their risk and supervisory controls fit in prior to the interviews. The OSC and the Consultant discussed their responses as well as gathered their views and ideas on how these risks could be mitigated.

The Consultant watched the SEC Technology Roundtable Webcast and reviewed participant submissions to the SEC on this topic.

The Consultant reviewed the relevant rules on ETR, NI 21-101 on Marketplace Operation and its Companion Policies. The Consultant also reviewed a cross section of audited Independent Service Reviews submitted to the regulators for a number of exchanges and ATSS. This included marketplace testing requirements and implementation controls for marketplaces and dealer access to their systems.

In addition to the efforts described above, the Consultant performed her own independent research on the topic.

Most of the interviewees who participated in the review expressed appreciation for the approach used by the OSC. Some commented on the constraints of speaking in public forum, such as the SEC Technology Roundtable which was considered “politicized”. Most interviewees appreciated the OSC’s willingness to offer a forum for expressing candid views in an informal and confidential environment.

The following report reflects the findings of this process and the Consultant’s observations and recommendations. This report was not reviewed in advance by any of the firms that participated in the process.

1.2 NI 23-103 ETR

There were no gaps in ETR or its companion policies identified throughout the interview process.

Overall, participants believed they would be ready to implement ETR on March 1, 2013 although as the interviews moved closer to the implementation date there were more questions about the scope of asset classes covered by ETR. It was noted that regulatory guidance on the asset classes pertaining to ETR was published in an FAQ and now that the implementation date has passed this may no longer be a concern.

The language in the ETR rules was considered clear providing a good electronic trading risk management framework for the industry. The principles-based approach of ETR was considered appropriate for CSA-level regulation and, for some, ETR represents a best practices framework for the industry.

1.3 Risks Due To Industry Complexity and Pace of Change

Most interviewees felt that the pace of change in the industry represents the most significant risk to participants and marketplaces, both domestically and internationally. Competing regulatory and

marketplace demands to meet, in some cases, short timelines in such a complex environment can result in less comprehensive testing of changes than is desirable, or prudent.

It was acknowledged that there will always be software and system outages and that this is to be expected. It was also noted that the human element is a critical factor in creating and resolving electronic trading risk. If the user does not design, test or interpret trading system messages correctly then negative consequences can occur. What is equally important is the way a service interruption is handled. Effective risk management is predicated on understanding the risks and accurately assessing the probability and impact. The more consistency and clarity in understanding regulatory and marketplace reaction to events, the better the likelihood that risk mitigation strategies can be developed and issues resolved faster.

There is a considerable cost to a participant to access a marketplace when connectivity costs, testing, trading fees, market data fees and vendor fees are taken into account. Complete trading systems² are built from many complex elements and run on critical infrastructure components - hardware, software and networks - all of which must interoperate with each other. Each participant has its own business model, trading platforms and technology infrastructure meaning there is no “one size fits all” with respect to the level of analysis, system changes, development, testing and implementation activities. An upstream change at a marketplace or market data vendor may have significant downstream impact since it may affect mid and back office systems and risk management platforms. As such, it was felt that the more documentation provided, the better. This increases the likelihood the change made is correct and reduces the dependency on knowledge that staff have in their heads. In an environment where staff turnover is high, the more information on how marketplaces work, that is published proactively, the less risk there is.

The Canadian brokerage industry relies heavily on third party vendors to provide trading and trading related services. Since vendors are not regulated, it is left to the participants to negotiate development effort for the necessary regulatory changes. Canadian changes, whether marketplace or regulatory, may compete with the vendor’s global development plan for product enhancements and result in resource and scheduling conflicts. Ultimately, it is up to the client of the vendor to ensure the platform meets their business and regulatory needs.

Participants noted that they, and their vendors, are often challenged with justifying the resource investment to their executive and lack the necessary information to support the costs associated with the

² A complete trading system at a participant involves a variety of trading and trading related systems, which could include, but not limited to: order gathering from clients, order management and trade execution platforms, post trade processing back office service providers, risk management systems amongst others all using different market data products. Depending on the size of the firm, there could be multiple trading platforms, including legacy systems, supporting different asset classes and lines of businesses as well as a number of smart order routers to support equities trading. Any change upstream may have a significant downstream impact on one or more of these systems.

changes. If regulatory and marketplace changes are not funded adequately then risks to the firm, and potentially the street, increases.

Many commented that changes and innovations being introduced by marketplaces often target niche customers benefiting a small population while the cost and potential risk is borne by the industry overall.

Individual changes by a marketplace, or regulator, on their own may not represent a significant amount of effort, however, it is the interaction of multiple changes and their interaction with trading technologies, business process changes and testing where risks are compounded. The complexity of a change may not be apparent upon the initial announcement and there may be unexpected and potentially complex implications to the changes.

Participants and vendors schedule many non-marketplace and non-regulatory changes to manage their business growth, and as such, the concerns may not be identified for some time. This lag in reaction to planned changes may be perceived by a regulator as not taking the changes seriously but is more likely a reflection of the natural conflicts that businesses face when trying to maintain or grow their business. If marketplaces do not co-ordinate changes with other marketplaces then the ability of the participants and vendors to prepare for the changes is even more challenging.

There were many best practices identified and in use by various interviewees that helped mitigate risk such as effective on-boarding processes with clients to set appropriate risk limits, use of drop copies for reconciliation and cancel on disconnect features offered by marketplaces.

It was acknowledged that there is substantial information in the public domain covering the software development life cycle and that the regulators should not get involved in this area. FIX.org is an important industry resource for documentation and best practices, which should be leveraged by the industry. The Consultant is supportive of requiring marketplaces to provide standardized services for connectivity and UAT services, amongst other areas, which will have a significant benefit to the industry facilitating a reduction in electronic trading risks and testing costs.

Anything regulators and marketplaces can do to increase transparency of information associated with a change, and demonstrates that they have considered the implications on the industry, will be well received and help the industry manage the changes more effectively.

1.3.1 Transparency of marketplace functionality and changes

Many interviewees felt there is insufficient transparency offered by marketplaces for planned changes, such as new order types³, their interaction with other order types and other functionality, such as a trading engine. In some cases, a firm may not intend to use the order type but still needs to prepare for

³ It was noted that while the number of Canadian order types in place is small when compared to other jurisdictions, there still needs to be a clear understanding of how new order types interact with existing functionality.

its interaction within its own environment which may cause unexpected behavior detrimental to the participant's systems or market integrity.

It was suggested that marketplaces provide more detailed information on the benefit and impact of changes and innovations so participants can better understand and justify the necessary investment.

1.3.2 Insufficient notice to make the changes

The nature of trading electronically is inherently complex and fast-paced. The pace of change in the industry at the regulatory⁴, marketplace, and technological level is considered a serious technology and financial risk since many organizations feel they do not have sufficient time or resources to fully understand and/or prepare for the changes.

There was a general consensus that more time needs to be provided to the industry by regulators and marketplaces to allow sufficient time for participants and vendors to analyze the proposed changes, make the system changes and test and implement them. IIROC acknowledged that the traditional 90 day notice period might not be sufficient for participants to prepare for marketplace or regulatory change and that there is a conflict when implementation dates for different marketplace changes are scheduled too closely.

A number of suggestions were made by the interviewees to address these risks including more industry consultation to ensure regulators and marketplaces understand the impact at the individual firm and industry level, as well as within the context of other regulatory initiatives. It was suggested that marketplaces be required to provide more information and notice before implementing major changes such as a new trading engine or major upgrade.

Participants and vendors are generally reactive to changes made by marketplaces and regulators and while specific work will not start until the changes are finalized, participants could do more to communicate pending changes internally. Regulatory websites could be an effective mechanism to highlight upcoming changes and a valuable resource for market participants to monitor.

1.3.3 Ability to test new functionality in a marketplace test environment

The complexity and interconnectedness of electronic trading with various counterparties, exchanges, vendors and internal systems has made the ability to test internal and external changes both daunting and expensive.

There was a common view expressed that the Canadian industry does not have sufficient minimum standards defined for marketplaces with respect to user acceptance test (UAT) environments or

⁴ For example, depending upon the type of trading a broker engages in, it needs to monitor regulatory changes at CDIC, OSFI, CSA, the provincial/territorial regulator it operates under, IIROC, M-X and the MFDA. In addition, it needs to monitor marketplace, vendor, clearing, trade reporting, depository changes as well as the CRA. While this is a cost to doing business, the risk of missing something carries additional risk.

standardized test symbols across all marketplaces for all asset classes traded. The more standards there are around these foundational technical elements, the easier it is for the participant or access vendor to connect to and deal with multiple marketplaces.

Many felt that marketplace UAT environments do not sufficiently mirror production trading environments for connectivity or the behaviour of system features and functions. The marketplaces interviewed were of a different view and felt that generally their UAT environments did reflect production. This is not an easily reconcilable conflict.

It was also noted that it is important that participant personnel, and their vendors, understand the trading technology they are testing, what the test scripts are trying to accomplish, as well as the business and regulatory context in which the testing is performed. There was a general perception that some smaller industry participants are not investing in comprehensive testing which could result in electronic trading risks at the marketplace and by extension, at the counterparty participant level. It was also noted that technical and trading staff must invest in understanding the standardized FIX messages and more importantly the custom tags in use to ensure the resultant behavior is well understood and interpreted correctly⁵. Inadequate testing could be due to a lack of funding for resources to perform the testing or an assumption that other firms will test the vendor changes and they do not need to.

Larger firms reported that they addressed these constraints by recreating shadow marketplace test environments. While this is an expensive and complex process that requires significant investment in maintaining the shadow environments viability, for some firms it is the cost of doing business. It was considered unrealistic to expect that smaller firms would be able to support the cost of creating their own test environments or afford the cost of accessing vendor test environments to connect to all marketplaces.

Many interviewees felt the lack of minimum marketplace UAT environment standards increased electronic trading risk because marketplace participants and or their DEA clients “test” code changes and new Algorithms (Algos) in production environments or do not test for the changes at all.

Participants and marketplaces acknowledged that the lack of realistic market data in marketplace UAT environments makes testing very difficult to execute test scripts and/or simulate conditions that would be experienced in production. A number of parties suggested that participants with a defined percentage of market share be required to provide UAT market making services to simulate production trading. This suggestion was well received and a number of firms stated they were willing to perform this service.

It was considered impossible to anticipate and model the universe for all conditions, whether it is another 9/11 or a Hurricane Sandy event. A best practice is to ensure the technology at backup sites is

⁵ This point applies to any communication protocol in use.

operational by periodically performing production trading from these sites versus relying on an annual check of business continuity planning and disaster recovery (BCP/DR) systems.

It was also considered a best practice for firms to perform comprehensive end-to-end testing from entry of orders right through to clearing and settlement. Many firms reported that they use drop copies to perform intraday or real-time reconciliation of trading positions and that this is very helpful in understanding and mitigating their electronic trading risks. Drop copies from an independent source, other than the trade execution platform, was also considered a best practice. It was noted that performing intraday or real-time reconciliation of trading positions is an expensive undertaking that may not be affordable or practical for smaller firms.

A number of marketplaces raised concerns about having production test (ProdTest) symbols available in their production environments. They were concerned that some parties might abuse the purpose and conduct performance-testing activities that could negatively affect the production environment compromising market integrity. A number of suggestions were made to mitigate this risk either through throttling the ProdTest connectivity to limit the number of messages or by having a separate ProdTest server. There was general agreement by the marketplaces interviewed that providing standardized UAT services would be beneficial and that a number of options were available to address this risk. If standardized ProdTest services are pursued, then it was considered important to educate the industry on the enhanced UAT services and limitations.

In addition, it was pointed out that marketplaces perform their own internal testing on weekends and have different upgrade cycles. Availability of weekends for participant testing is limited. It was noted that when weekend testing is coordinated, some marketplaces do not provide the same connectivity or trading engines as used in production. These differences create additional risk and effort associated with reestablishing connectivity for production trading.

A number of suggestions were made to address these challenges including, but not limited to, establishing minimum marketplace standards to ensure UAT environments mirror production; creating standardized production test symbols; ensuring UAT market data is realistic; and a requirement that all marketplaces participate in at least one weekend test annually⁶ using production connectivity and their production trading engines.

It was recognized that the challenges noted above might not be resolved without regulatory assistance and that regulation may be necessary to implement best practices⁷ in this critical area. Thorough testing

⁶ It is recommended that this weekend test date should not be the same date as the annual BCP/DR test, which should focus on those activities.

⁷ Nancy G. Leveson was a guest speaker at the SEC Market Technology Roundtable on October 2, 2012. She commented on the challenges of operating in a complex digital world where the drive for innovation and change conflicts with “safety” in whatever form. She commented there is no such thing as perfect software and that problems will happen. Successful industries who effectively manage risk have effective government oversight

of all system changes is considered a best practice but the conditions need to be in place to support it. While it may be expensive for the marketplaces to make these changes to either provide production test systems or coordinate mirrored UAT environments, it was generally felt that the benefits to the industry in reducing electronic trading risk and controlling industry costs are worth the investment.

It is worthwhile to note that IIROC has recently introduced improved standards for transmission of marketplace regulatory feeds, which represents a good example of standardization benefiting the SRO. In many areas of marketplace operation⁸, participants and vendors would like to see this level of standardization and specification for the marketplaces to which they must connect.

1.3.4 Ability to test operational procedures in a test environment

Many participants felt it is difficult to validate compliance for rules when marketplace UAT environments are different from production environments or a UAT environment is just not available.

Without standardized ProdTest symbols, it was considered difficult for participants or vendors to effectively test the different smart order routers to ensure best execution obligations are met or test other trading functionality end-to-end. As noted above, many felt that standardized ProdTest symbols would allow participants to test some of their ETR risk controls for single securities and have evidence that these controls are in place for when the SROs perform trade desk reviews. If standardized ProdTest symbols are implemented then there may not be a need for additional weekend testing dates.

A number of interviewees noted that they are unable to perform effective testing of their smart order routers for the reasons outlined above. Unless marketplace UATs support standardized ProdTest symbols, then testing for best execution is difficult, if not impossible. Most access vendors have their own smart order routers which increases the complexity and effort of testing. In many cases, the vendor is expected to perform the testing on behalf of the client and while they know their technology and functionality, they may not have the expertise that a firm's trader would. Without trader expertise, some trading scenarios might be missed by a vendor increasing the likelihood of an unexpected interaction at a marketplace.

Many of the interviewees stated they would leverage standardized marketplace production test or mirrored UAT environments to perform testing of their ETR financial and system risk controls for single securities.

There was strong support for regulators assessing that participant financial and supervisory risk controls are documented, attested and proof of validation in an environment that mirrors production.

where public confidence is critical, limit software functionality and complexity to achieve the goals of the system component; and apply systems thinking and system engineering so that software errors do not cause mayhem when they do occur. She suggests that the financial sector could benefit from applying these best practices.

⁸ A summary of suggested marketplace operation changes and recommendations are contained in section 1.4 of this report.

1.4 Risks of Inconsistent Handling of Marketplace Interruptions

Many interviewees commented on the financial risks associated with system errors or outages and security freezes or halts.

1.4.1 System Outages and Errors

A number of interviewees felt that marketplace or regulatory reactions to system outages or errors are sometimes inconsistent. While there was an appreciation that there may be different root causes, they felt when the symptom of a system outage is similar, there should be better predictability as to how the issue will be addressed.

It was acknowledged that identifying and assessing duplicative or anomalous trading activity from valid trading strategies may be difficult and that experienced, knowledgeable staff is essential to speedy resolution whether at the participant, regulatory or a marketplace level.

It was noted that even with the introduction of multiple marketplaces in Canada, if the primary market has a significant outage preventing access to its order book, the street usually waits until service has been restored on the primary market to resume trading rather than moving its orders to another marketplace. Marketplaces that offer cancel on disconnect services has been beneficial to many participants although this is not a feature generally used by retail firms given the size of their order book.

It is anticipated that through full implementation of ETR, the frequency and impact of events such as runaway Algos, will be reduced.

There was general consensus among interviewees that marketplaces should have the ability to terminate a participant's access but not without contacting the trading desk to consult on the situation first. In the event the marketplace cannot reach someone or if the issue is injurious to the trading engine and/or market quality, then terminating access is reasonable. The general consensus was that marketplaces should not terminate access by a participant without contacting the trading desk to consult on the situation. In the event the marketplace cannot reach someone or if the issue is considered injurious to the trading engine and/or market quality, then a marketplace should be able to terminate access. Marketplaces interviewed reported that they have not had any issue contacting someone at a trading desk to discuss a situation. All participants interviewed were appreciative of a call from a marketplace and take them very seriously.

The marketplaces interviewed acknowledged they have different handling for risk controls from other marketplaces. Many marketplaces plan to offer, if they do not do so already, additional financial and system risk management tools to participants and believe that clients will pay for tailored message thresholds and trading limits on an opt-in fee for service basis.

It was noted by some that while an event, like the one Knight Securities experienced, is unlikely to occur in Canada, it could occur and the impact would be significant. Participants feel there is financial risk with system outages and would like to see clear and predictable responses from IIROC so they can

confidently determine if they need to hedge their positions in another market. It was acknowledged that recent IIROC Guidance on Regulatory Intervention for the Variation or Cancellation of Trades has resulted in improved consistency, however, some were of the view that more improvements could be made.

1.4.2 Security freezes and halts on a marketplace

There was general consensus that if a security is frozen or halted in one marketplace and is allowed to trade in another, then this can have a negative impact on market quality and represent financial risk to participants and potentially their clients.

It was pointed out that freezes are often the result of trading anomalies and are triggered when the stock is correcting itself from a run up or down in price, and as such, consistent handling by all marketplaces is desirable. Standardization of volatility controls would reduce market quality issues that might necessitate the cancelation or amendment of trades by IIROC.

It was also noted that market orders, on-stop market orders and pegged orders could represent a different type of risk than a runaway Algo would because these order types are properly formulated for consumption by a trading engine and resultant volatility may not be as easily detectable as a runaway Algo.

As noted above, participants would like to anticipate what might happen during an outage or freeze so they can mitigate any financial exposure that might result. Increased transparency of marketplace volatility controls is considered an essential tool in mitigating trading risk.

Some participants feel the different risk controls amongst marketplaces makes it more challenging to anticipate behaviour during anomalous trading. Understanding how marketplace help desk personnel will react to an issue is important so they can better plan for what action they might need to take. In some cases it was pointed out that the financial exposure of an outage could be, and has been for some, significant. Participants need to know whether to hedge their position in another marketplace during the analysis and decision making process of an interruption. There was general consensus that all marketplaces should have effective volatility controls but it was not expected that these controls should behave the same way.

It was noted that coordinating halts in inter-listed securities carries risk since different regulators are involved in the decision making. Any delay in invoking a halt across all markets carries additional electronic trading and financial risks for participants and their clients.

The ETR requires marketplaces as well as participants engaged in electronic trading to have policies and procedures for managing risks and supervisory controls in place. IIROC is currently addressing freezes, halts and marketplace volatility controls as well as single stock and market-wide circuit breakers. Eventually, industry concerns are likely to be addressed, however, issues can still arise during the interim. IIROC intends to publish additional guidance and an implementation date for when all controls will be in place.

Predictability is considered key to effective electronic trading risk management and increased transparency on how issues will be addressed by marketplaces or regulators is important. How volatility controls work at a marketplace plays a significant role in firms understanding and anticipating marketplace behaviour not only for regular trading and smart order routing handling but for runaway Algos as well.

It is difficult and costly for participants and vendors to customize documentation based on the unique handling by a marketplace and develop testing scripts, prepare trading desk procedures and risk management strategies when marketplaces all behave differently in this most important area.

1.5 NI 21-101 and CP - Marketplace Operation Review

The Consultant reviewed the Amendments to NI 21-101 *Marketplace Operation* and its Companion Policy as well as the confidential Independent Service Reviews (ISR) of a number of marketplaces. Some of the objectives of these amendments were to update and streamline the regulatory and reporting requirements and to align the requirements applicable to all marketplaces, increase transparency of marketplace operations, and address certain issues with conflicts of interest, outsourcing and business continuity plans, etc.

These amendments were published prior to the OSC Electronic Trading System Risk Review initiative and did not have the benefit of the findings from this project. A number of insights on improving the delivery of services by marketplaces and the benefits of enhanced minimum standards for marketplaces were raised that would be beneficial to pursue. Additional suggestions have been made to reflect the Consultant's observations and recommendations for changes based on experience, consultations with colleagues, and general research.

As noted above, there is a considerable cost to a participant to connect to a marketplace when connectivity costs, testing, trading fees and market data fees are taken into account. It is desirable that marketplaces deliver non-functional requirements⁹ in a standard way. This reduces the cost and complexity of delivering trading services to their client base and vendors. These non-functional requirements should operate in a reliable, available, testable, manageable way and performed in a secure, scalable and extensible fashion. This is not to suggest that all marketplaces have to be exactly the same just that in technical and governance areas, defined minimum standards should be met prior to approval to operate if participants are expected to connect to them to fulfill their Order Protection Rule

⁹ A [non-functional requirement](#) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviours of that system. For example, non-functional requirements might be processing in real-time, availability, business continuity, etc. This is contrasted with a [functional requirement](#) that defines specific behaviours of functions. For example, the way an order types works or the way a trading engine works would be considered a functional requirement.

(OPR) obligations. The Consultant's view is that the implementation of a set of enhanced minimum standards will not hamper marketplace's ability to be competitively different.

The Consultant identified what she felt were a number of areas where Marketplace Operation could be enhanced to the benefit of the industry as a whole. As noted above, these standards could be developed through a consultative process, possibly facilitated and led by the OSC.

The OSC could consider approaching FIX Protocol Limited (FPL) to act as a coordinating body for industry participation since it is already performing this role in developing industry standards¹⁰. Over a number of years, FIX has become the de facto standard for electronic communication in the brokerage industry. According to FPL, the success of the FIX Protocol is primarily due to the voluntary efforts of its [member firms](#) from the buy-side, sell-side, vendor and exchange communities who work together to help achieve the FPL mission statement: "To improve the global trading process by defining, managing and promoting an open protocol for real-time, electronic communication between industry participants, while complementing industry standards."

Currently the FIX Protocol Organization has regulatory participation by IIROC¹¹, the SEC, and other regulators, through the [FPL/FIF Regulatory Reporting Working Group](#). FPL already plays an important role in connectivity standards and is now engaged in the development of industry reporting standards. In the Consultant's opinion, it would be a natural extension of FPL's industry role to participate in the development of enhanced minimum marketplace standards.

The Consultant recognizes that marketplaces are regulated under CSA through NI 21-101 with ATSS also regulated by IIROC. Depending on the type of minimum standards defined the regulators would determine the best mechanism for formalizing and publishing any agreed changes.

1.5.1 Auditors and Independent System Reviews (ISR)

A review of the ISR reports indicated, at least on the surface, that there isn't a consistent approach to the criteria used by the CICA auditors in evaluating marketplaces. It may be that the auditors selected their own criteria for the ISR report and that they all use a common CICA library of controls against which the evaluation was conducted or the auditor selected.

While it is reasonable to expect that a senior marketplace would be delivering a higher, more sophisticated set of services to its client base, all marketplaces should be evaluated against the same minimum standards, with the same rating systems. This also ensures that the results of a marketplace review can be easily tracked for emerging or concerning trends with respect to compliance.

¹⁰ The Consultant spoke with a number of FPL members who were supportive of its involvement in setting such standards.

¹¹ IIROC has adopted FIX 5.0 to support its FIX-based market regulation feed specification for market surveillance and transaction reporting.

The OSC should consider a requirement for marketplaces to have a baseline ISR audit conducted prior to operation. It is also suggested that the marketplace auditor retain, if they do not do so already, the expertise of an IT professional with brokerage or marketplace expertise to probe more deeply during the audit process.

The Order Protection Rule should not apply to marketplaces if a critical control is not in place. This would allow new marketplaces to get up and running quickly but would provide some protection to participants by not requiring them to connect until the defined minimum standards are met. The audit review should also require actual testing of critical controls vs. confirming that documentation is in place and checked off.

1.5.2 Suggested Areas for Enhanced Standards for Marketplaces

Through the review of the ISRs, the Consultant identified a number of gaps and deficiencies where the OSC should consider if enhanced standards should be introduced. This list is not intended to be exhaustive. There are a host of other areas where enhanced minimum standards could be developed.

- a) *A requirement that marketplaces have critical internal policies and procedures, roles and responsibilities and escalation documentation finalized prior to approval to operate¹².*
- b) *Minimum service level standards (SLA) for marketplaces should include a service desk, incident management, escalation and reporting requirements¹³.*
- c) *Require marketplaces to have standardized business recovery processing.*
- d) *Require marketplaces to have equivalent BCP/DR to that of participants.*
- e) *Require marketplaces to provide market data in a machine-readable format.*
- f) *Require marketplaces to publish access requirements and connectivity certification standards for all supported protocols.*
- g) *Require marketplaces to publish information about their testing systems such as hours of operation and a description of any differences from the production environment.*
- h) *Require industry-wide production test symbols for all asset classes, reporting of these test trades on the broadcast feeds and drop copies of these test trades.*
- i) *Require a minimum number of weekend industry wide testing dates with mandatory participation by all marketplaces¹⁴.*

¹² For example, marketplaces should have controls in place to ensure only authorized users have access to production systems either for trading or coding/releases/upgrades, etc.

¹³ Effective incident management and record keeping is one way to ensure the marketplace and their participants understand what the outstanding defects are and the differences between the production and test environments.

¹⁴ Additional weekend production test might not be necessary if a requirement for industry wide production test symbols is implemented.

- j) Require marketplaces to support standardized start of day¹⁵ and end of day processes for vendor and participant access.*
- k) Require marketplaces to ensure that no single point of failure should exist in which marketplace files are integrated with dealer systems.*
- l) Require an explicit service level agreement (SLA) for outsourcing arrangements with some minimum elements defined such as penetration testing for security breaches, technology testing, patch testing for vendor software upgrades with an annual review.*
- m) Consider requiring centralized management of trader ids and their approved markets for trading¹⁶.*

It is the Consultant's opinion that there is an important role the regulators can play in ensuring the conditions exist for participants to balance maintaining the pace of change in the industry at the regulatory and marketplace level against their financial, system and human resource constraints. The OSC is well positioned to be the lead facilitator in developing enhanced minimum marketplace standards for the industry.

¹⁵ For example, symbol uploads from a marketplace should be standardized to ensure participant systems can consume them without issues.

¹⁶ This could be a commercial opportunity for a vendor to manage this process.

2 Recommendations and Closing Comments

The following summarizes the Consultant's recommendations and suggested priority.

2.1 Consultant's Recommendations

1. *The OSC should consider requesting that IIROC and the Montreal Exchange highlight ETR as a separate link on their websites making access to all relevant rules and guidance information easier to access.*
2. *The OSC should encourage IIROC to make implementation of volatility controls a priority and try to shorten the implementation timeframe if possible.*
3. *The OSC should encourage IIROC and equity marketplaces to be more transparent in the behaviour of marketplace volatility controls through detailed information on their websites, including use of scenarios to illustrate the way the control will work in production.*
4. *The OSC should consider whether marketplaces should be required to supply additional information on order types, including expected behaviour scenarios and trading engine functionality than is currently required of the marketplaces under NI 21-101. Refer to section 1.4.2 for further detail on the suggested marketplace standards.*
5. *The OSC should consider the creation of a centralized marketplace order type library with an appendix covering trading engine functionality and expected behaviours.*
6. *The OSC should consider posting this library on the OSC website and also suggesting to IIROC that this library be posted on its website as an enhancement to the [“Summary Comparison Of Current Equity Marketplaces”](#) document.*
7. *The OSC should assess current ISR criteria to determine if it is sufficient to effectively audit a marketplace.*
8. *The OSC should consider inviting other Canadian regulators to consider whether the industry would benefit from enhanced minimum marketplace standards than currently outlined in NI 21-101.*
9. *If the recommendation to enhance marketplace standards is pursued, then the OSC could consider inviting Canadian regulators to participate in an industry committee with representation from marketplace participants, vendors and all marketplaces to introduce minimum standards for delivery and availability of testing services by marketplaces. The regulators would determine the most appropriate way of formalizing and communicating these changes to the industry.*
10. *The OSC should consider FPL as a coordinating body to develop enhanced minimum marketplace standards with OSC participation as the lead facilitator in the process.*

2.2 Consultant's Closing Comments

The OSC has completed an important consultative process with the industry on whether there is electronic trading risk that was not covered in ETR. It is a testament to the thorough and consultative approach that the CSA took when it developed these rules that no gaps were identified.

The industry now has electronic trading rules and guidance on effective risk management through financial and supervisory controls for marketplace participants, regardless of the types of electronic trading they support.

Through the flexible and open approach to gathering concerns and opinions of those interviewed, the Consultant feels that the OSC now has a better understanding of the complexity and interconnectedness that electronic trading in a multiple marketplace environment entails.

It was noted by some interviewees that there appears to be a tolerance of the unknown by many industry participants as to the behaviour and interaction of different order types and system changes, which increases electronic trading risk. Changing the culture of risk is probably the most challenging of all undertakings and not something regulators can mandate or control. Firms can buy technology and intellectual talent but they cannot buy culture. Culture is that uniquely human product that is complex, ambiguous, slow to develop, difficult to change and hard to analyze. It is the “tone from the top” that sets and maintains a culture of effective risk management and without it a firm is less likely to be as careful as they should be.

It has been over 10 years since the rules promoting competition in the Canadian marketplaces were implemented. Initially there was considerable resistance by the participant community to welcome marketplace competition. In the Consultant’s opinion, that resistance paved the way for many unexpected challenges, costs and complexities that were of the industry’s own making. This resulted in a more reactive approach to the evolution of new marketplaces than would have been desirable.

When the ATS and Marketplace Operation rules were being drafted, it is unlikely that anyone could have anticipated the challenges and complexity that ensued, let alone the evolution of electronic trading by participants, buy side clients, DEA and High Frequency Traders.

The electronic trading risk review project has identified many risks that can be addressed or mitigated through standardization of marketplace processing, UAT services and improved communication. This time, the resistance might come from the marketplaces to make the necessary investment to address these risks.

It is possible that if increased standardization amongst marketplaces can be defined and implemented, participants may be less resistant to the introduction of new offerings if they can reduce the costs associated with connecting to a new market and the ongoing costs of maintaining connectivity to existing marketplaces.

Regulators expect the industry to be compliant with the rules it implements. We learned through this process that the conditions currently in place sometimes makes this difficult. It is the Consultant’s opinion that there is an important role the regulators can play in ensuring the conditions exist for participants to balance maintaining pace with changes in the industry at the regulatory and marketplace level against their financial, system and human resource constraints. Participants need the ability to effectively test changes in functionality but also confirm that they are compliant with their obligations under the rules and regulations.

It is important to note that even when rules, regulations, policies, procedures and risk management controls are in place, we all operate in an environment where the wild card is being human and humans make mistakes. Humans are increasingly sharing control of systems with automation and moving into positions of higher-level decision making with automation implementing the decisions. All human behavior is influenced by the context in which it occurs. There is an opportunity for the industry to approach some of the known issues and move to correct them when they can.

The Consultant believes that the OSC can play an important role in leading these changes through leadership, facilitation and/or regulation.

The Consultant appreciates the opportunity to have worked with the OSC on this project.

END OF REPORT