The Rationale for AT 9000:

An ISO 9000-style Quality Management System Standard for Automated and Algorithmic Trading

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Abstract

AT 9000 is an industry-specific quality management system standard for automated and algorithmic trading. The aim of AT 9000 is to address the safety issues inherent in automated trading by way of industry self-regulation. While the project is being developed under the ANSI/X9 umbrella, the goal is that AT 9000 become a global standard. After a brief introduction, in this paper we present the final version of the rationale document used to propose this standard.

The unpleasant memories of well-publicized mishaps in the financial markets have been caused, at least partially, by technological failures of market participants. Two of the most widely cited instances are the flash crash of May 6, 2010 (see CFTC and SEC [2010]) and the Knight Capital meltdown of August 1, 2012 (see Schaefer [2012]). Such mishaps may have a direct impact on the financial viability of trading firms themselves, as well as that of other market participants. Moreover, regulators are concerned such mishaps erode society's confidence in the structure and fairness of financial markets.

Many prescriptions have been proposed by lawmakers, regulators, and the media, as well as industry organizations such as the Futures Industry Organization (FIA) in the U.S., and the Futures and Options Association (FOA) in Great Britain. These prescriptions include, for example, adding viscosity (i.e. inefficiency) to the trading process through circuit breakers, minimum resting periods for orders, transaction taxes and minimum tick increments. More Orwellian suggestions include having regulatory bodies vet trading strategies and systems prior to their introduction.

An alternative approach can be found by examining the self-regulatory practices of other industries, especially those that have encountered analogous problems[1]. The advantages of self-regulation are obvious—adaptability, flexibility, customization by people with domain expertise. The drawback is that such standards may be perceived as self-serving, or lacking completeness simply by the nature of their origin. These industries have turned to standards based on quality management systems. Overcoming the skepticism of the public and regulatory authorities was achieved through third-party oversight of the development process and certification of compliance with them. For many of these standards, the third party is the International Organization for Standardization (ISO).

[1] The aerospace industry is an example.

In August 2012, we proposed AT 9000[2], an ISO 9000-style quality management system standard for the automated trading (AT) industry, by way of a rationale document. AT 9000 is an industry-specific quality management system standard for automated and algorithmic trading.[3] The standard is being developed under the X9 umbrella[4]. Within ANSI[5] X9 is the accredited standards committee for financial services.

ANSI does not itself author standards. Rather, it "guarantees that the standards writing group used democratic procedures that gave everyone who will be 'directly and naturally' affected by the use of the standard an opportunity to participate in the development work or to comment on the document's provisions (ANSI [1996])." AT 9000 intends to encompass design and development (D&D) and operation and control (O&C) of automated trading systems, products and services. The requirements and recommendations in the standard apply to all automated trading industry organizations (ATIOs), including exchanges, trading firms, broker/dealers, clearing members and independent software (and hardware) vendors.

What follows is the final version of the AT 9000 Rationale document. Earlier drafts of this AT 9000 Rationale document were linked to in various financial industry media outlets, including Institutional Investor.com, Automated Trader.com, John Lothian Newsletter.

[2] Originally the project was named HFT 9000. However, the scope has been expanded to include all automated trading systems, products, and services. The name AT 9000 reflects this expanded scope.
[3] High frequency trading (HFT) (whatever its definition) is a subset of automated trading.
[4] The official title of the X9 working group is D14.
[5] ANSI (American National Standards Institute) is the U.S. component of ISO (International Organization for Standardization).

What is Automated Trading?

The term automated trading can mean a variety of things, depending on one's perspective. For the purposes of this document, the defining characteristic of an automated trading system is neither the duration of its trades nor the volume of messages it routes to the exchange, but rather the risks it poses to the marketplace. Any automated or algorithmic trading system that enters or handles computer-generated order requests gives rise to immediate risks in the event of its strategic or technological failure. Such systems, broadly defined, may engage in high frequency strategies, market making, index arbitrage, statistical arbitrage, or any number of other strategies that provide or take liquidity by way of automated decision-making. Likewise, such systems could be, for example, exchange facilities, internal crossing systems, or clearing systems.

Therefore, we define automated trading systems to include any computerized task in the trading process whose unexpected behavior gives rise to immediate market disruption and the potential for significant financial loss.

Is Automated Trading Ethical?

Financial markets enable price discovery. Price information and price discovery are generally considered to be good for the public. As many automated trading systems make use of limit orders, they provide liquidity to financial markets. Limit orders add information to the market. Thus, automated trading systems add to price information and, therefore, price discovery. Likewise, the preponderance of academic evidence shows that automated trading increases liquidity and decreases volatility (see for example Brogaard [2012], Jovanovic and Menkveld [2011], Hendershott et al. [2011], Hendershott and Riordan [2011]. "The net benefit is that we have a better market with the participation of [automated traders]" (Fabozzi et al. [2011]). Thus, this activity cannot be construed as inherently unethical.

We view automated trading as one more step in the evolution of expedient information flow. It is in itself neither good nor bad. Therefore, rather than a discussion of the ethics *of* automated trading, this document discusses ethics *in* automated trading. By ethics, we mean those standards of conduct that apply to ATIOs. The primary ethical responsibility is market safety.

What risks do automated trading systems pose?

Each automated trading system is a proprietary technological component of the global trading network. The performance of such components affects potentially all markets, either directly or indirectly. An out-of-control automated trading system can flood a market or markets with order requests on a time-scale that precludes human intervention. Such flooding can affect market prices, the profitability of other trading firms and exchanges, as well as societal confidence in the sustainability and safety of the financial markets. The strategic or technological failure of an automated trading system could be catastrophic for these stakeholders in the global trading network.

What are examples of conflicts *in* automated trading that create risk?

These systems can only modify the outcomes of their decisions using the structures embedded in their software. The need for low latency gives rise to a conflict between speed (necessary for profitability) and the inclusion of fail-safe code that may add latency (necessary for safety of external stakeholders). An inherent conflict also exists between minimizing costs and satisfying obligations to, for example, paying for research and development of real-time risk controls and/or redundant systems. As time to market for an automated trading system matters, production pressure also lead to launch of risky trading systems. Without industry standards

governing D&D and O&C, some firms may find the expediency of lax development and control standards irresistible.

What are the responsibilities of firms engaged in automated trading?

People involved in automated trading have both internal responsibilities to their firm and its profitability and external responsibilities to ensure the safe operation of their systems. The problem is that there are many different, and often competing, views on the exact definition of those responsibilities.

Automated trading is an interdisciplinary endeavor requiring the input of traders, computer engineers, and quantitative analysts. Each of these disciplines has its own perspective. Traders, for example, often take seriously their principal function and obligation to maintain orderly markets. Computer engineers have their own ethical standards which require avoidance of unsafe practices and fail-safe design. (These concepts are most often embedded within the topic of software quality.) Responsibilities in quantitative analysis revolve around staying within the strategic bounds defined in exchange rules and government regulation and, furthermore, are largely thought to be superseded by adherence to mathematical truth.

Additional perspectives are added to the automated trading sphere by people and organizations outside the automated trading firms as well. The exchanges have their perspectives on fair markets, as do people in different parts of the world. Exhibit 1 shows the perspectives involved in automated trading (see Davis et al. [2012]).

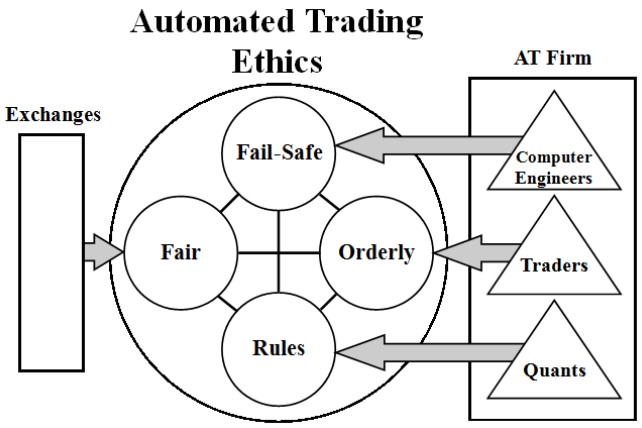

Exhibit 1: Ethical Perspectives in Automated Trading

Each of these perspectives may not take into consideration the interaction with the others. Thus, different automated trading firms may recognize different responsibilities based upon the internal political dominance of one profession. No framework exists in automated trading that considers cross-disciplinary responsibilities of safety to those who might be harmed—external market participants and society. The new discussion needs to focus on *organizational* responsibilities. Likewise, as the global trading network spans multiple AT firms, exchanges and countries, it is important also to consider the *industry-wide* obligations to create confidence in financial markets and their sustainability.

What is the AT firm's organizational responsibility?

The SEC and the CFTC have recently lowered the bar for proving market manipulation from intent to recklessness, implying (in the case of automated trading, necessarily organizational) imprudence or irresponsibility (see SEC Rule 10b-5 and CFTC Rule 17 CFR Part 180.1). So, in the case of failure of an automated trading system, how can the organization prove it was responsible, i.e. prudent, in its automated trading system D&D and O&C? The answer is provided by AT 9000, that the firm was responsible because they followed a recognizably

prudent process, one that proved and documented that the firm was justified in believing the future performance (i.e. stability) of its automated trading system.

What is a quality management system?

Quality management is the study of how we ought to do business in order to satisfy obligations to stakeholders. A quality management system consists of the organizational structure and processes necessary to implement a quality policy. The ISO 9000 family of standards is the most widely recognized quality management standard. In other industries (where societal safety must be ensured), the ISO 9000 family of standards define how firms ought to do business in, for example:

- Aerospace (AS 9100)
- Chemicals (for example The Dow Chemical Company Quality Management System Manual)
- Medical devices (ISO 13485)
- Health care (for example The National Committee for Quality Assurance (NCQA))
- Food safety (ISO 22000).

In automated trading, quality management demands a structure and processes to prove the prudent D&D and O&C of their systems. This includes processes for, and documentation of, research into quantitative trading and risk control techniques, backtesting, simulated trading, and probationary trading in order to prove the strategic stability of each automated trading system. (Statistical methods for proving stability of automated trading systems and for real-time monitoring have been developed (see Cooper and Van Vliet [2012], and Bilson et al. [2010]). This also includes processes for and documentation of software and hardware testing that prove

the firm has demonstrated that an automated trading system functions properly, is operationally safe, and robust to behave acceptably during potential extreme events.

The ability of automated trading firms to prove the stability of their systems depends upon the availability of execution venue simulation facilities to fully test those systems. Such simulation facilities must enable testing against all manner of extreme market and infrastructure events.

By following ISO 9000-style standards, an automated trading firm can satisfy their organizational obligations to prove and document that its automated strategies and technologies will operate safely and profitably. There is also a wide body of literature demonstrating that the use of quality management systems increases the financial performance of the firm.

What does a quality management system in automated trading look like?

The goal of any quality management initiative is to arrive at automated trading systems that operate in control and in accordance with specifications. Violations of expectations must trigger shut off events before they worsen and/or cascade through the financial system. Yet, AT 9000 is agnostic with regard to D&D and O&C methodologies[6]. All firms should engage in the activities it prescribes, but not necessarily in any specific sequence of stages or steps. Firms are left to perform in their own study of methods, and define internal processes that satisfy their own quality policy and quality objectives. These processes will be unique to each firm and its organizational environment, and potentially to each automated trading system D&D project. The intent is not to imply uniformity in the structure of an automated trading firm's quality management systems or uniformity of documentation.

What is AT 9000?

[6] For example, the K|V methodology described in Kumiega and Van Vliet (2013) is a quality-driven D&D and O&C process for automated trading.

A quality management system standard specifically designed for the automated trading industry is being developed as an alternative to regulation or major changes in market structure. The effort is branded as AT 9000. An official designation will be assigned via national (ANSI) and/or international (ISO) protocol upon completion. The goal of the AT 9000 project is to specify how all ATIOs should build and operate their systems through process-driven D&D and O&C. By adhering to AT 9000, firms can satisfy their organizational obligations of safety to external market participants and society. While the probability of failure of any system can never be driven to zero, quality management systems have proven very successful in other industries that pose external risks.

Quality management systems require that organizations adhere to a set of industry practices and maintain suitable documentation of their adherence to these practices. The full requirements of AT 9000 are being defined using the ISO 9000/9001 and ISO 90003 documents as inputs, and incorporating guidelines already developed by the industry and regulators.

Each ATIO has unique challenges in preventing market disruptions. Nevertheless, all systems will incorporate two basic concepts: 1.) Any automated trading process should have key performance variables with distributions of expected performance. Every automated trading system should have a method for detecting performance of these variables outside of their expected distributions, as well as procedures and processes in place for handling such occurrences; 2.) Every automated trading system should be designed and developed using quality system engineering practices, so as to prevent performance outside of expectations as well to provide a documented structure for diagnosing and remedying root causes.

Conclusion

The working group overseeing development of the AT 9000 documents is proceeding with the document structure shown in Exhibit 2.

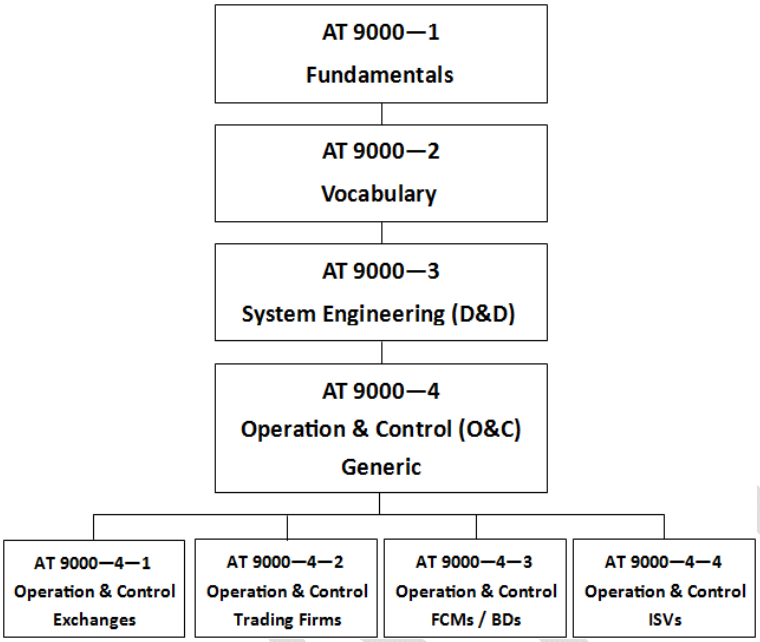

Exhibit 2: AT 9000 Document Structure

People and organizations that are interested in learning more about or participating in the AT 9000 project are encouraged to visit www.AT9000.org.

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