

Insights into UK investment firms' efforts to comply with MiFID II RTS 6 that governs the conduct of algorithmic trading

Journal:	<i>Journal of Financial Regulation and Compliance</i>
Manuscript ID	JFRC-12-2022-0144.R2
Manuscript Type:	Original Article
Keywords:	capital markets, algorithms, MIFID II, RTS 6, trading, brokerage

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Some professional insights into UK investment firms' efforts to comply with the provisions of MiFID II RTS 6 that govern firms' conduct of algorithmic trading

1. Introduction

On 3rd January 2018 the second Markets in Financial Instruments Directive (“MiFID II”) entered into force in the European Union (“EU”). MiFID II introduced EU-wide organisational requirements for firms engaged in algorithmic trading (hereinafter, “AT”) for the first time (Schu and Lee, 2022). Capturing trading “where a computer algorithm automatically determines individual parameters of the orders with limited or no human intervention” (Schu and Lee, 2022), the reforms sought to address anxieties caused by events such as the Flash Crash (Busch, 2016). Largely enshrined in Commission Delegated Regulation 2017/589 (still commonly referred to as “RTS 6”, the abbreviation for “Regulatory Technical Standard 6”, the regulation’s pre-adoption name), the requirements prescribe the implementation of pre- and post-trade controls to fulfil the aspirations of Article 17 MiFID II. These include: requiring firms to devise clear methodologies for the testing and deployment of algorithms, the establishment of change control processes, annual assurance, setting price collars¹ and execution throttles² and the employment of real time risk monitoring. That these requirements were enacted by a delegated regulation rather than through its parent directive (MiFID II) was intentional³. Policymakers sought to limit scope for variation in their interpretation between EU Member States, some of whom were perceived to be pro-innovation (particularly the UK, Ireland and the Netherlands) and others sceptical thereof (particularly France and Italy) (Karremans and Schoeller, 2020).

Central to the aims of RTS 6 is the mitigation of conduct risk⁴(Culley, 2020) (Stangl, 2015). For example, Article 5 states that the prevention of disorderly conduct motivates the “behavioural testing” of order execution algorithms (Raschner, 2021). However, supervisors do not have the resources to fully scrutinise firms’ AT environments. Accordingly, RTS 6 places reliance on human oversight performed

¹ For a definition, please see the section entitled “Pre and post trade controls (Articles 15 and 17, RTS 6)”.

² Per note (1), above.

³ In the EU regulations are directly applicable in Member States, i.e. they do not need to be transposed into domestic legislation. By contrast, a directive only becomes applicable in a Member State once that state has transposed it through the enactment of national legislation.

⁴ For a definition of “conduct risk” considered in the context of AT, see Culley (2020).

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3 by firms' senior managers and control functions in lieu of constant external supervision, e.g. by a
4 regulator or trading venue⁵ (Schu and Lee, 2022) (Stangl, 2015). Consequently, the quality of that
5 oversight is heavily dependent on firms' recruitment, training and organisational structure (Stangl,
6 2015). RTS 6 was retained in the UK after the end of the Brexit Transition Period. The UK Financial
7 Conduct Authority ("FCA") has supplemented RTS 6 with its own guidance to wholesale trading firms
8 (2018). Some argue that this has gone further than RTS 6 in expressly demanding that firms "do more
9 work to identify and reduce potential conduct risks created by their algorithmic trading strategies".

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11 Drawing upon insights gained from practitioners upon whom MiFID II's effective implementation is so
12 dependent, this article seeks to analyse UK investment firms' efforts to comply with RTS 6. This article's
13 specific focus is the substantive provisions of RTS 6 governing algorithmic deployment (found in
14 Chapters I and II). Accordingly, this paper does not address business continuity (Article 14), security
15 (Article 18), direct electronic access (Chapter III, covered elsewhere, for example in Culley (2022)) or
16 the additional controls that clearing members must implement (Chapter IV). This paper finds
17 practitioners have a good understanding of the requirements in RTS 6, even if some lack knowledge of
18 algorithms, coding and algorithmic strategies. Interviewees' firms have, in the main, used best efforts
19 to implement RTS 6 and broadly support its aims. Fatigue, complacency, cost pressures, an
20 overreliance on external knowledge and generous risk parameter calibration pose the greatest risk of
21 undermining the effectiveness of firms' controls.

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23 The remainder of this paper is structured as follows. First, a literature review considers previous
24 analyses of MiFID II's AT regime. This review helped to identify the opportunity for further research
25 that is the subject of this article. Second, the methodology used to conduct the research is stated. The
26 third section details the findings from the research. The findings are set out under each of the specific
27 provisions of RTS 6 to which they relate. Next, a discussion section relates the paper's findings to those
28 of previous works studied in the literature review. This section also makes some recommendations for
29 practice, regulatory reform and future research. Finally, a conclusion summarises the paper's
30 implications for the future performance of AT in the UK.

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⁵ Commission Delegated Regulation (EU) 2017/584 (still commonly known as "RTS 7" to MiFID II) requires EU based trading venues permitting AT to adopt a range of systems and controls to mitigate the risks arising therefrom. RTS 7 is outside the scope of this article.

2. Literature review

MiFID II and particularly its regulations governing AT have hitherto been under researched topics in the financial market literature (Karremans and Schoeller, 2021). Early analyses have predominantly, but not exclusively, been conducted through: (a) a legal lens; and (b) are not based on original empirical data. To date, these critiques offer evaluations of MiFID II's AT regime from one of two broad perspectives. The first, a macro-regulatory perspective, considers, for example, whether: (a) the scope of the AT regime should be extended to cover order routing as well as execution and investment decision making algorithms (Pereira, 2020); and (b) developments in artificial intelligence ("AI") are already rendering it obsolete (Azzutti, 2022). The second, a micro-regulatory perspective, considers, for example, whether (a) the self-testing of algorithms pursuant to Article 7(3) RTS 6 is desirable from a public policy perspective (Raschner, 2021); or (b) RTS 6's annual notification requirement is too generous to keep pace with firms' constantly evolving business models (Comana et al., 2019). An initial analysis of the MiFID II AT package contended that it was too premature to draw conclusions about how market participants would receive it, i.e. at the micro-regulatory level (Woodward, 2017).

This study's focus is micro-regulatory: how investment firms which have been dubbed the "first line of defence"⁶ in the oversight of AT (Azzutti, 2023) have grappled with the operational requirements in RTS 6. Accordingly, the remainder of this literature review will focus on other contributions that have sought to weigh the effectiveness of RTS 6's AT related provisions.

The AT regime in RTS 6 was forecast to impose significant compliance costs on investment firms (Yeoh, 2019). This is because RTS 6 places reliance upon firms to act as gatekeepers (Čuk and Van Waeyenberge, 2018). The technical resources and expertise required to comply with RTS 6 could act as a barrier to entry that inadvertently benefits larger firms (Čuk and Van Waeyenberge, 2018). Furthermore, it is argued by some that the regime's complexity frustrates consistent application (Sadaf et al., 2021). European legislators may have underestimated the impact of certain provisions in MiFID II's AT package on firms deploying simpler order execution algorithms (Conac, 2017).

Constrained by technical and knowledge limitations, investment professionals are compelled to operationalise the rules in ways that undermine their effectiveness (Sadaf et al., 2021). For example,

⁶ In traditional audit practice, a firm's "business areas are the first line of defence" in a "three lines of defence model" where the second and third lines refer to the control and internal audit functions respectively (Bank of England, 2023).

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3 algorithms are categorised subjectively for the purposes of determining the rules that apply to them
4 (Lenglet, 2011). However, given that regulators are even more remote from firms' algorithmic
5 processes granting some latitude regarding how to apply the requirements enshrined in RTS 6 was a
6 necessary compromise (Seyfert, 2021). This was the key driver for MiFID II's designers opting for a
7 more principles-based approach to its construction, as opposed to the rules based approach taken in
8 its sister initiative, the Market Abuse Regulation ("MAR") (Sadaf et al., 2021). A case in point is MAR's
9 prescriptive approach to defining what constitutes market manipulation in the context of high
10 frequency trading ("HFT")⁷, whereas MiFID II holds that anyone involved in the deployment of trading
11 algorithms could, in principle, be held responsible for such behaviour (Čuk and Van Waeyenberge,
12 2018).

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15 In the UK which is perceived by some observers to favour "light touch" regulation, political dynamics
16 are likely to encourage even more decentralisation in the implementation of RTS 6 than in many other
17 European states that remain members of the EU (Karremans and Schoeller, 2021). Still, the UK is one
18 of the few jurisdictions in Europe whose competent authorities and trading venues are known to have
19 intervened where weak control environments that relate to matters of the kind outlined in RTS 6 have
20 been detected (Schu and Lee, 2022). Notable examples include: (i) ICE Futures Europe taking
21 disciplinary action against Allston Capital LLC (2022a) for failing to prevent its employees from engaging
22 in disorderly trading in Euribor and Gilt futures using trading algorithms; and (ii) a firm adjusting its
23 algorithm and control framework in response to concerns raised by the FCA's surveillance unit (2021t).
24 In addition, the FCA has built on RTS 6 by issuing good practice guidelines that encourage firms to: (i)
25 maintain inventories of their algorithms and associated risk controls; (ii) perform due diligence to
26 identify conduct risks posed by their algorithms; and (iii) assign a dedicated project manager to oversee
27 such processes (Schu and Lee, 2022). Moreover, in doing so, the FCA makes a clear connection
28 between RTS 6 and its expectations basis the Senior Managers and Certification Regime ("SMCR")
29 (Schu and Lee, 2022). The SMCR imposes standards of accountability on firms' key employees that are
30 currently unique in Europe (2023a). This is significant given that, paradoxically, some commentators
31 have asserted that the complexity of RTS 6's requirements has increased conduct risk (Stangl, 2015).

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34 Challenges associated with the practical implementation of exacting AT related legislation were
35 explored by Coombs (2016) in the context of Germany's Hochfrequenzhandelsgesetz (English "High
36 Frequency Trading Act", hereinafter "German HFT Act")(2021p). Widely acknowledged as the
37 inspiration for much of RTS 6 (Karremans and Schoeller, 2021; Seyfert, 2021; and Lenglet and Mol,
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⁷ Per Autoriteit Financiële Markten (2023) "a technique that allows for extremely fast signal processing and/or order execution".

2016), the German HFT Act entered into force in 2013. Drawing upon data collected from 15 individual and group interviews with key stewards in AT governance processes, including compliance officers, IT (Information Technology) staff and regulators, Coombs's study found that:

- (1) some small enterprises were openly non-compliant with obligations imposed by the German HFT Act because of a lack of understanding concerning the functioning of algorithms developed by third parties;
- (2) "creative interpretation" of the German HFT Act's rules is commonplace, particularly with regards to the "tagging"⁸ and notification of algorithms, leading to inconsistencies between firms; and
- (3) notification requirements often struggle to keep pace with the evolution of algorithms, undermining their utility to regulators; but
- (4) despite some of its shortcomings, some believed the German HFT Act had had a "professionalising impact" on the culture of proprietary HFT trading firms.

Although it does not pertain to MiFID II, Coombs's research offers insights into the possible challenges, and benefits, arising from the implementation of RTS 6. Given that many start-ups labour under tight resource constraints (Sheridan, 2017), Coombs's findings continue to be relevant to firms grappling with the pan-European RTS 6.

The dearth of academic research into the functioning of RTS 6 has not precluded the European Securities and Markets Authority ("ESMA") from conducting its own consultation into the functioning of the MiFID II's AT regime (2021u). ESMA's review was wide ranging. This paper's focus is solely investment firms' feedback on the elements of RTS 6 that directly govern their AT operations. First, to avoid uncertainty, most respondents were in favour of retaining the current definition of AT in RTS 6. A minority saw value in making a distinction between "simple" and "complex" algorithms, arguing that this would aid a more proportionate application of RTS 6's requirements. Based on the feedback received, ESMA decided against making any changes to the definition of AT. Second, most respondents were in favour of improving RTS 6's "behavioural testing" regime, primarily to make it more realistic.

⁸ "Tagging" refers to the practice of assigning an algorithm a unique identifier so an investment firm retains a clear audit trail of when it has been used to execute a transaction. This practice was incorporated into EU wide legislation through Article 9 Commission Delegated Regulation (EU) 2017/590.

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3 It was widely felt that current stress testing obligations were conducive to generating artificial, and
4 therefore, unhelpful results. Allowing for greater interaction between test and production
5 environments⁹ as well as promoting consistency between the test environments offered by trading
6 venues were among the proposals made to address this. To reduce the possibility of conflicts of
7 interest undermining testing, some called for testing to be performed by a dedicated team
8 independently of developers. Third, participants in the review were not in favour of ESMA defining
9 “disorderly trading conditions” as it was thought that this might not accommodate the myriad
10 differences between different market structures and trading styles. Finally, many practitioners felt that
11 the annual self-assessment requirements in RTS 6 suffered from a lack of guidance, leading to varied
12 output that is of questionable use to national competent authorities. Even so, there was a consensus
13 against the introduction of a templated self-assessment that could lead to the genesis of a “one sized
14 fits all” “box ticking” approach across firms and markets.
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25 An extensive review of the UK’s onshored¹⁰ AT regime was absent from the HM Treasury’s recent
26 Wholesale Markets Review (2022i). An examination of the FCA’s latest Regulatory Initiatives Grid
27 published in May 2022 (2022f) suggests that a review of the UK’s AT regime like that conducted by
28 ESMA has not been in UK authorities’ immediate plans. It remains to be seen whether “Big Bang 2.0”¹¹,
29 originally advanced by Prime Minister Rishi Sunak whilst serving as Chancellor with the intent of
30 boosting the UK’s competitiveness as a global hub for financial services (Parker et al., 2022), will
31 prompt a change in this position. Yet, UK regulators have recently solicited views on whether to refine
32 or extend it to meet challenges posed by the growth of AI in financial services (2022c).
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40 Concerns about the transparency and “explainability” of models are among the AI related challenges
41 that have become a source of anxiety for regulators. Often referred to as the “black box problem”
42 (Azzutti et al., 2023), related knowledge gaps are perceived to undermine the effectiveness of articles
43 2 and 3 in RTS 6. These articles require that staff have a minimum level of understanding as to how a
44 firm’s AT systems operate (2023d). Some commentators such as Azzutti et al. (2023) forecast the
45 imminent displacement of rules based, human calibrated, execution and trading algorithms by
46 algorithms which use the output from machine learning models to trade (2023d). If this were to
47 materialise, it would be very difficult for firms to observe the principle of accountability which is so
48 fundamental to RTS 6. Be that as it may, there is a consensus among practitioners that AI dominated
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58 ⁹ A “production environment” refers to the deployment of an algorithm in live trading.

59 ¹⁰ Refers to EU legislation retained by the UK after the end of the Brexit Transition Period.

60 ¹¹ The original “Big Bang” refers to reforms instigated by Prime Minister Margaret Thatcher’s Government to liberalise access to the UK’s securities markets in the 1980s.

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3 markets are far from a reality. At the time of writing, rules based algorithms continue to predominate
4 in trading, with many machine learning models still relatively immature (2023b) (Culley, 2022)
5 (Gozman et al., 2019).
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8 9 3. Methodology

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12 This paper aims to assist in reducing the existing gap in understanding, identified by scholars such as
13 Woodward (2017), regarding: (a) how investment firms have interacted with RTS 6 since its
14 implementation; and (b) associated implications for the AT regime's effectiveness.
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18 The paper focuses on UK investment firms' efforts to comply. Most firms that would have been subject
19 to RTS 6's requirements when it was promulgated on 3rd January 2018 would have been based in the
20 City of London. Whilst the Brexit Transition Period ended at midnight on 31st December 2020, the
21 findings of the literature review suggest that there has not yet been any significant divergence
22 between the EU and UK approaches to implementing RTS 6. Some divergence is possible as ESMA acts
23 in response the findings from its review into the AT regime. Nevertheless, this paper's findings should
24 still be insightful for practitioners and regulators working in EU Member States. In particular, future
25 researchers could compare the findings herein to the practices of firms active in EU Member States.
26 This could help test for potential differences in the firm level implementation of MiFID II's technical
27 standards, a possibility raised by Karremans and Schoeller (2020).
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31 Insights were obtained from 19 practitioners working for, or with, UK investment firms between
32 Spring-Summer 2021 using semi-structured interviews. Headline topics were prepared in advance but
33 questions were not scripted to facilitate flexible and natural discussion. The topics included:
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- 36 • investment firm sector/sub-sector and goals;
- 37 • design, deployment, (re) calibration processes;
- 38 • surveillance tools currently used;
- 39 • staffing, and the ability of staff to spot conduct events caused by algorithmic activity; and
- 40 • the effectiveness of the UK's approach to mitigating algorithmic conduct risk.

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43 Interviewees were recruited from the author's professional network, including personal connections
44 and second degree connections to whom the author was referred. Interviewees were selected for their
45 knowledge of: (a) AT as conducted by investment firms; and (b) the regulatory framework that governs
46 it. Participants included:
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- 49 • 13 senior personnel employed by investment firms (a chairman, a chief executive officer, two
50 chief compliance officers, the founder of a quantitative hedge fund manager, two heads of
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3 anti-financial crime functions, a chief risk officer, senior sales, and distribution professionals,
4 two heads of a front desk, and a senior surveillance officer);

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6 • three regulators who were recently involved in the supervision of firms that deploy
7 algorithms;
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9 • two trade surveillance experts: one working for a firm and another who works for a technology
10 vendor that supplies market abuse monitoring tools to firms; and
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12 • a third party algorithmic trading expert who regularly assists firms in strengthening their
13 systems and controls.
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17 Adopting the classification of different AT operations outlined by the Dutch regulator (the Autoriteit
18 Financiële Markten (2023d)¹²), the activities of the investment firms from which the participants were
19 drawn include:
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23 • automated traders (use algorithms to automate a proprietary trading strategy for a fund or
24 own account):
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26 ○ a quantitative hedge fund (subject to the provisions of RTS 6 indirectly as a “taker” of
27 liquidity from sell side firms);
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29 ○ an algorithmic market maker;
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31 • automated executors (use algorithms to execute clients’ orders intelligently):
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33 ○ five brokerages active in transacting in a mixture of asset classes for a broad range of
34 wholesale and, in some cases, retail, clients using electronic and traditional channels,
35 for example using voice telephony; and
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37 ○ a retail brokerage (using online platforms).
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41 As has been highlighted in earlier research into AT that seeks access to operational insiders, particularly
42 Culley (2022) and MacKenzie (2018), obtaining that access is challenging. This also applies if a
43 researcher is seeking engagement from an extensive professional network, as in the author’s case.
44 Time constraints, concerns about confidentiality and claims of insufficient knowledge were advanced
45 by some who were invited to participate. The research project received approval from the Ethics
46 Committee at the author’s university. Approval was conditional upon participants being: (a)
47 guaranteed anonymity; and (b) provided with an information sheet prior to committing. This was not
48 enough to reassure everyone, however. Notwithstanding this, the author managed to gain the trust of
49 a sufficient number of practitioners so that this obstacle did not seriously limit the study’s findings.
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58 ¹² Selected for recency (published in 2023). Furthermore, the Netherlands is widely reported to be the UK’s
59 main rival as the European destination of choice for AT firms post-Brexit. Accordingly, Dutch regulatory
60 initiatives pertaining to AT are likely to be highly influential in the UK and vice versa.

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3 As the UK was subject to COVID restrictions at the time the author sought to conduct the interviews,
4 all were held remotely, primarily using Microsoft Teams. The interviews were recorded and transcribed
5 using Nvivo software. Once transcribed, Nvivo was also used to assign codes to segments of the
6 interviews, making it possible to identify common themes.
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10 This paper forms part of a broader project that seeks to examine the identification and mitigation of
11 conduct risk in AT. The research design adopts that set out in Culley (2021). The interview protocol is
12 included in the Appendix.
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15 16 4. Findings

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20 This paper's findings are structured to address specific AT related requirements in RTS 6, where these
21 were commented on in sufficient detail by participants.
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24 (i) Role of the compliance function (Article 2, RTS 6)

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27 Article 2(1) requires investment firms to ensure that the compliance personnel have, as a minimum, a
28 "general understanding" of their AT operations. Additionally, compliance personnel must be in
29 "continuous contact" with those persons within a firm who possess expert knowledge of its algorithms
30 and related systems. A senior compliance professional appeared unconvinced that his firm had
31 achieved compliance with Article 2(1):
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37 "I think knowledge is siloed at the moment. And for the most part, I think
38 that...very few people outside of the front office and developers would
39 understand in basic terms what each algo did." (2021h)
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43 Several professionals said their firm had tried to use the FCA recommendation to maintain a register
44 of algorithms to improve understanding (2021f) (2021h) (2021s). Opinion was that these are only
45 partially effective because maintaining them in "layman's terms...still requires a certain level of
46 knowledge" (2021h) and "...perhaps sometimes [people] just take them for granted." (2021s).
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51 Another compliance professional who had spent time at several firms in senior roles before and after
52 the implementation of MiFID II concurred with the sentiments of his counterpart, suggesting that
53 "continuous contact" of the nature demanded by Article 2(1) may be counterproductive:
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58 "the compliance people are the second line of defence, and I don't know if they'll
59 be good enough to catch capture of the algorithms can do because most
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3 compliance people don't come from an algorithmic trading background. So they're
4 only going to go what they're told by the programmer, not really an independent
5 sort of second line of defence check there." (2021o)
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10 To reduce reliance on other functions, this compliance professional had sought to recruit directly from
11 other areas of the business:
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15 "...clearly not everybody would make it on the trading floor. But it means it doesn't
16 mean to say they're not very good at understanding what was going on. Maybe it
17 wasn't for them. So I think the almost the best sort of monitors would be from
18 people who have done the underlying program and or done the underlying
19 trading.[sic]" (2021o)
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25 Interviewees from other functions (for example, trading or operations) agreed, contending that
26 oversight functions are "lagging behind" (2021a) front office functions who "would pull the wool over
27 the eyes of compliance people..." (2021l). One even exhibited resistance to compliance staff being
28 involved in the supervision of AT activities at all, exclaiming: "How closely do we want them
29 [surveillance staff] involved in our trading activity?" (2021f). Compliance staff in smaller firms are
30 inclined to agree since they often struggle to manage competing priorities such as dealing with
31 complaints and financial promotions (2021i).
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38 Article 2(2) requires that compliance functions be provided with either direct or indirect access to
39 functionality used to "kill", or switch off, unexecuted orders (see "kill functionality", below). Whereas
40 numerous participants stated or intimated that their firms had a kill switch, the subject of access to it
41 was not raised in the interviews. The exercise of kill functionality would probably be a delicate event
42 due to the possible economic and reputational consequences for a firm and their customers alike.
43 Therefore, this might suggest that neither the participants nor their firms have ever been in a live or
44 test situation requiring exercise. Then again, it is possible that reputational concerns simply inhibited
45 forthright discussion of this.
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53 (ii) Staffing (Article 3, RTS 6) 54 55

56 Article 3 RTS 6 stipulates that firms shall maintain adequate human resources to manage their AT
57 operations. In particular, Article 3(1) states that staff must have "sufficient technical knowledge" of:
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3 (a) "the relevant trading systems and algorithms;"
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6 (b) "the monitoring and testing of such systems and algorithms;"
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10 (c) "the trading strategies that the investment firm deploys through its algorithmic trading
11 systems and trading algorithms;" and
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15 (d) "the investment firm's legal obligations."

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18 Apropos these obligations, one participant said that regulators should require that staff involved in
19 the performance of algorithmic related operation sit examinations:
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23 "I would be very keen to see exams come in pertinent to algorithmic trading and
24 being able to monitor and stay on top of what's going on." (2021o)
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28 The FCA does currently prescribe examinations for persons involved in certain retail client facing
29 activities, for example, the provision of investment advice. Such requirements do not, however,
30 currently extend to wholesale trading activities.
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35 In addition to, or instead of, requiring that persons supervising AT operations obtain specific
36 qualifications, some firms seek to recruit expertise from their commercial ranks. An interviewee said:
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40 "I think the almost the best sort of monitors would be from people who have done
41 the underlying program and or done the underlying trading....[accordingly] my
42 natural inclination would be to sort these people from the trading floors or the
43 programming floors. In other words, almost like a career path." (2021o)
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48 A regulator charged with overseeing firms' algorithmic practices said that he had been:
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52 "...advocating here that on every board of at least certainly the large brokers that
53 we deal with that they should have ahead of it [algorithmic trading]. That is
54 prominent in a position that sits on and understands those risks to the firm...So
55 I've gotten a bit of pushback here about that, saying we should be pushing telecom
56 firms what the makeup of their board, but I've been increasingly arguing that
57 brokers are becoming I.T. companies." (2021d)
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5 On the ability to maintain knowledge of applicable legal obligations, a participant said:
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8 “I think the knowledge base within firms sometimes is not going at the same pace.
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10 And it's not because of anything, you know, it's a problem with the firm. It's just
11 that the regulatory framework is constantly playing catch up to the new
12 technology that's coming in.” (2021q)
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16 Another suggested that internal training programmes that seek to promote knowledge of applicable
17 legal obligations should be broadened to include persons in non-revenue generating roles:
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21 “I think it's most likely to be borne out of a lack of understanding from the guys
22 developing these algorithms as to what market abuse could look like. Traditionally,
23 market abuse has been something that training programmes have focused very
24 much on the front office and the guys that are developing these algorithms have
25 the potential to have a far greater impact on the market..” (2021h)
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31 Too much, or poorly focused educational initiatives risk “regulatory fatigue” and concomitant
32 disengagement though. One c-suite level senior manager insisted that tracking “continuing
33 developments” in the AT arena:
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37 “may overburden the responsibilities of those people who are managing the
38 business, and that in itself is potentially a risk...” (2021j)
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44 (iii) IT outsourcing and procurement (Article 4, RTS 6) 45 46

47 Article 4(1) makes clear that firms continue to retain regulatory responsibility for any outsourcing or
48 use of third party vendor technology in the context of AT. This is a well-established principle of wider
49 UK financial regulation. This probably explains the lack of comment about Article 4(1) in the interviews.
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53 Article 4(2) demands that firms are sufficiently knowledgeable about any outsourced or vendor
54 supplied AT solutions they procure. This is relevant to most investment firms because unlike “tier one
55 investment banks” they often lack the resources to develop AT systems themselves:
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3 “Well... we would love...not [to] outsource, but we would look to third parties to
4 provide the technology predominantly because of the development resource
5 there would need to go into developing a suitable system or framework.” (2021h)
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10 Investment firms’ reliance on external vendors poses opportunities and challenges. Efficiency was
11 cited as a significant advantage of this model (2021q). One participant averred:
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15 “I just think it's more efficient for a technology vendor to roll out one change
16 process for a change in regulation that...100 clients can benefit from than it is for
17 those 100 clients each to replicate that effort.” (2021h)
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21 Conversely, an alleged consolidation of vendors is putting pressure on firms’ budgets:
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24 “Costs are spiralling upwards from just because they are...[dependent upon]...the
25 same sort of single actor...you know, it's the guys who sell the shovels and make
26 money during managing the gold rush. I think in that scary space where there's
27 only a few vendors left in the industry because they've acquired everyone else
28 who dominated. [sic]” (2021m)
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34 Such cost pressures may encourage some firms to become too dependent on the knowledge and
35 expertise of their AT related system vendors, particularly if they have smaller financial or non-financial
36 resources at their disposal.
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41 It is common for UK investment firms to be controlled by foreign actors in international conglomerates.
42 One interviewee implied that this poses a challenge to ensuring compliance with obligations such as
43 those enshrined in Article 4(2):
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48 “...where I'm working now [we] are highly dependent on decisions coming from outside the
49 UK and from a regulatory environment that are completely different from the UK...in this
50 particular case, it is the US...Any decisions that relate to [procuring] new I.T. or to get new
51 suppliers are made at group level. [sic]” (2021n)
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57 (iv) Testing, deployment and review of AT systems and strategies (Sections I-2,
58 RTS 6)
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3 Section I of RTS 6 sets out detailed requirements for the development and testing of algorithms, AT
4 systems and strategies (together “AT systems”). To summarise, these include:
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- 8 • **oversight:** designating a senior manager as being responsible for authorising the deployment
9 or substantial update of a AT system, and ensuring the appropriate allocation of
10 responsibilities for performing the processes outlined in Section I;
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- 13 • **recordkeeping:** ensuring the firm’s AT launch and change management processes are fully
14 documented;
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- 17 • **conformance testing:** to minimise the risks of flawed interaction, testing the conformance of
18 AT systems with the systems of a relevant trading venue, for example in the case of initial
19 deployment or material updates;
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- 22 • **using dedicated testing environments:** to conduct pre-production testing; and
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- 25 • **setting pre-defined limits:** on the “number of financial instruments being traded,” “price,
26 value, and numbers of orders,” “strategy positions” and “number of trading venues to which
27 orders are sent.”
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36 The core objective of the requirement in Section I is to reduce the risk of errant AT contributing to
37 disorderly market conditions.
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40 According to Section 2, post-deployment management is comprised of three components:
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- 43 (1) **annual self-assessment and validation** (Article 9): of a firm’s compliance with RTS 6 and AT
44 systems and strategies;
45
- 46 (2) **stress testing** (Article 10): of AT systems and controls under simulated conditions of stress or
47 increased order traffic; and
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- 49 (3) **management of material changes** (Article 11): to ensure robust review prior to release into
50 production.
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56 Several interviewees spoke of their firms’ interaction with the “normally...quite prescriptive
57 conformance testing” operated by trading venues. Participants commented on the limitations of strict
58 conformance testing, particularly where a firm is tasked with scrutinising their clients’ AT systems.
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3 These limitations include: (i) limited visibility, because clients are protective of their intellectual
4 property; and (ii) an inability to carefully scrutinise vast amounts of code (2021m). One critic of
5 conformance testing went further to argue that it was encouraging the surveillance departments of
6 exchanges to become fixated on process failures at the expense of pursuing actual market abuse:
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11 “I'm just thinking the exchanges...if they do take action against... an algorithm, it
12 tends to because it's placing too many orders or they someone tested an algorithm
13 in live, that type of issue, as opposed to a genuine for six months we saw this
14 complete abuse.[sic]” (2021o)
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20 Another postulated that mandatory conformance tests could encourage an unthinking approach to
21 risk management:
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25 “You've almost got to...do a technical KYC (Know Your Customer) on each client
26 from that perspective and even each algorithm...You can't just say we adhere to
27 the venue conformance testing...that would just tick boxes. We have our own
28 conformance testing to a much higher level. [sic]” (2021f)
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33 To this end, several participants stated that their firms operated exacting processes to understand
34 algorithms prior to sign off and deployment. Carefully managing the relationship with vendors
35 (2021f), this involves testing, taking the following factors into account:
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- 40 • the proposed strategy and, if relevant, a client's objectives;
- 41 • the potential impact on the market, particularly from a conduct perspective; and
- 42 • in the event of proposed changes to existing algorithms, whether these are
43 material and, if so, would necessitate: (a) additional stress testing; and (b) the
44 submission of prior notification to relevant trading venues. Even apparently minor
45 changes to an algorithm require scrutiny because they could alter how a trader
46 interacts with them (2021h) (2021o) (2021s).
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53 Others were less certain about their firms' systems and controls. One blamed a “lack of understanding
54 of the regulations” for undermining efforts to comply:
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58 “...I think one month before going live [3rd January 2018] basically they hired a
59 consultancy firm and asked [them] to just do the minimum requirements that
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3 were needed...[sic]" (2021n).
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6 Complexity was mentioned as a factor that can frustrate recordkeeping efforts:
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9 "...a lot of [machine learning] decisions [are] so complex [that] they're very
10 difficult to track and...they don't have a very clear audit trail..." (2021a)
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14 An inability to read code could limit the usefulness of reviews performed by control functions.
15 However, this weakness may eventually disappear as personnel become more technically proficient:
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19 "I've been heavily involved in algorithmic compliance for a lot of my career, but I
20 can't read code. So let's be completely straight: [one can only be so useful]...when
21 you're trying to attest to the conduct of your algorithm...it's probably a good thing
22 that you're seeing a lot more people who enter into the market now with Python
23 experience...so you're going to get more people in control functions with that
24 [experience]...[sic]" (2021s).
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30 Despite these impediments, interviewees could not recall any incidents emanating from a failure of
31 pre-deployment controls:
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35 "I don't think of any significant conduct issues that have [arisen because] an
36 algorithm has been mishandled or poorly signed off." (2021s)
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41 Nonetheless, one interviewee said the deployment processes were integrated with his firm's
42 operational risk framework. This setup allows his firm to: (a) identify the root causes of any issues
43 arising; and (b) learn from them to make refinements (2021i).
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47 The annual self-assessment and validation process was not thought to be something which "represents
48 a significantly greater constraint than any other particular regulation" by a regulator interviewed for
49 this study (2021c). However, a consultant who specialises in assisting firms achieve compliance
50 with AT obligations claimed to have witnessed significant differences with the expectations
51 and approaches of an overseas regulator (the US Securities and Exchange Commission ("SEC"))
52 and the FCA to annual reviews. One example he gave was of a greater focus of the SEC on the
53 potentially toxic interactions of algorithms (2021a). The implication was that, by contrast, audits
54 in the UK tend to be more process focused, for example examining monitoring that is undertaken or
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3 whether elements of an AT programme have been “signed off” properly (2021i).
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7 (v) Kill functionality (Article 12, RTS 6)
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10 As outlined in subsection (i), several interviewees declared their firms have a “kill switch” to stop
11 trading that could bring the market “into disrepute” (2021j) (2021a) (2021l).
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14 The form “kill functionality” takes between firms appears to vary, based on some interviewees’
15 responses. For some, a “kill switch” is a chain of direct human intervention:
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19 “You know, in terms of intervening...if there was any disorderly markets...on the
20 investment side, I've seen the...industry...move towards...not using [the] kill switch
21 as a last resort, but actually more of a sort of more human intervention early
22 on.[sic]” (2021a)
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27 For others, the “kill switch” is either integrated with the automated trading process (2021a) or non-
28 existent:
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32 “I don't need to worry about this [because] we're not dealing on our own
33 account.... So... we don't have a kill switch per se...” (2021k)
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38 The lack of a significant AT related “event” during the volatile period triggered by the world’s response
39 to the COVID-19 pandemic could be fuelling complacency. An expert in trade surveillance mused
40 whether kill switches were still relevant:
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44 “...if you think about some of the really noxious things that we’ve seen in the last
45 couple of years...with regards to the pandemic...you’re still not seeing the kind of
46 spikes that flash crashes that we used to see back in the early noughties. Again,
47 [its] mainly because a lot of these [algorithms] are now better coded...they know
48 when to pull out of the market or...they’ve got kill switch....I don’t know. It’s just
49 a personal feeling. You just feel like you see less of this stuff at the moment that
50 you have done in the past. [sic]” (2021s).
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3 A regulator who was heavily involved in the supervision of AT firms was asked if he could ever
4 envisage the FCA taking over responsibility for activating a “kill switch” given the potential
5 inconsistencies in firms’ approaches:
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10 “...it's [firms’ maintenance of a kill switch] never going to be quite as good as a
11 regulator because...we get in theory...the whole view...we can get across on
12 different exchanges and get some asset classes, whereas they [firms and trading
13 venues] can't. But I think it's a long way off before regulators got a kill switch...I
14 don't honestly believe [we] would see it that quickly...to be able to react to it.”
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18 (2021b)
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22 (vi) Automated surveillance system to detect market manipulation (Article 13, RTS
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25 6)
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29 Investment firms are required by Article 13 to establish and maintain an automated surveillance
30 system to monitor orders and transactions submitted through its trading systems for potential
31 indications of market abuse. The system used must be appropriate to the size, nature and scale of a
32 firm’s trading activities and current regulatory obligations. Alerts generated by the system must be
33 generated on a trading day plus one (“T+1”) basis. Firms are obliged to calibrate their surveillance
34 systems to minimise the generation of false positives or negatives. Calibration should also compare
35 the completeness of trade and account information, particularly when reconciled with the records of
36 trading venues, clearing houses and other key counterparties.
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43 Automated surveillance systems pair a firm’s trading activities with externally sourced market data. If
44 the system detects a divergence, or suspicious relationship, between the firm’s activities and those in
45 the wider market, an alert is generated. However, firms regularly protest that market data is too
46 expensive (2022d). Trading venues are alleged to “abuse” their privileged position to charge high fees.
47 Faced with high costs and diminishing returns, investment firms are tempted to invest the bare
48 minimum in non-revenue generating systems and controls:
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55 “When you are a brokerage firm and you see the license prices, they have to pay for
56 all the data that's going to go through, which is not your own data. This is the data
57 from outside, uh, from the outside world. Basically, the majority of the time they try
58 to cut corners as much as possible [sic].” (2021n)
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5 Regulators insist that firms calibrate surveillance tools to meet challenges posed by their specific
6 business models. All the same, the costs and difficulty of procuring bespoke systems (2021d)
7 encourages firms to implement sub-optimal solution. This is especially the case as algorithms based
8 on AI increase in popularity:
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13 “I haven't seen many tests that are up to that point [monitoring AI powered
14 algorithms] yet... [although] that doesn't mean that they are missing transactions
15 in any way” (2021r)
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20 (vii) Real time monitoring (Article 16, RTS 6)

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23 Article 16 mandates that an investment firm routing orders to trading venues monitors all trading
24 activity taking place “under its trading code” for indications of “disorderly trading”. This obligation
25 extends to the activities of an investment firm’s clients that utilise a firm’s trading code. Article 16
26 requires the monitoring to be performed both at desk level and by an independent risk control
27 function. The system used to perform the monitoring has to produce alerts within five seconds of the
28 detection of potentially disorderly trading.
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35 Participants were unconvinced about the usefulness of real time monitoring. One trade surveillance
36 professional at a software vendor that supplies investment firms said:
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40 “Yeah, we support real time...I prefer T+1 [monitoring] myself, because...you're able
41 to analyse the data [prior to] the event as well...So... if I was looking at something like
42 a price ramping alerts, I may want to look at what happened to the price in the
43 instrument after the price and event had taken place....whereas with real time, I find
44 that you just [what is there] at that time....[sic]” (2021r)
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50 He continued:

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53 “There are some, there are some clients that take the real time, but it seems as though
54 they use the real time for different uses, a more transaction monitoring, position
55 monitoring and certain things like that, rather than the traditional surveillance T plus
56 one surveillance monitoring.” (2021r)
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3 Another inferred that his firm had developed basic functionality to meet the requirement:
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6 “We have both...real time surveillance, we have an in-house system and that that only
7 looks at the rapid increase in older activity, so that's quite a crude surveillance tool, I
8 would say.” (2021h)
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13 A very experienced trade surveillance professional could not foresee his duties expanding to include
14 real time monitoring duties anytime soon:
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18 “We look at patterns and exceptions after the event, not in real time. So that would
19 be a fundamental change in the responsibility of a compliance function if that were to
20 be a real time surveillance process as well. And therefore push back to the business to
21 say you need to look at the impact in real time.” (2021g)
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26 The lack of fully-fledged real-time monitoring functionality did not pose a concern to the (generally)
27 confident professionals interviewed for the study (2021e). Still, one did confess that is firm had:
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31 “...deliberately slow[ed] down some algo[s] specifically, so they wouldn't be subject
32 to some of the more onerous requirements...”(2021g).
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36 (viii) Pre and post trade controls (Articles 15 and 17, RTS 6)

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40 Article 15 makes the imposition of the following pre-trade controls mandatory upon order entry:
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- 42 • **price collars:** to automatically block orders for prices outside specified parameters;
- 43 • **maximum order values and volumes:** to prevent the transmission of orders of
44 uncharacteristically large size;
- 45 • **order execution throttles:** over the number of times an AT strategy has been applied. Once a
46 pre-defined limit is reached the strategy is automatically disabled until re-established by a
47 human after an examination; and
- 48 • **market and credit risk limits.**
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55 Article 17 dictates that investment firms continuously operate post trade controls. Central to this
56 requirement is the monitoring of credit risk and market risk. Again, both traders and risk managers are
57 expected to operate post trade controls simultaneously, with appropriate action being taken in the
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3 event one of the controls is triggered. For example, this could include recalibrating or withdrawing the
4 algorithm in question.
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8 The requirements of Article 15 and 17 drew little comment from participants. There are a range of
9 potential explanations for this. First, monitoring levels of credit and market risk is well established in
10 the investment sector, with one participant stating hyperbolically that professionals have been
11 considering these “for thousands of years” (2021k). Second, this could indicate that price collars,
12 throttles and maximum order values are set so generously that they have caused little friction. Third,
13 AT has fallen down the regulator’s list of priorities, causing firms to “set and forget” trading
14 parameters. A regulator that had recently left the FCA at the time of being interviewed supposed:
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21 “There will be some sort of flash crash or some sort of issue involving an algorithm,
22 and that will prompt the regulator to suddenly start working in this space again.
23 But I doubt it will do anything.” (2021b)
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28 A senior sales and trading professional did opine that pre trade controls are too focused on latency to
29 the potential detriment of other risk factors:
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33 “...everything is about messages per second, everything is about your what happens
34 in price movements....that doesn't necessarily tell you ...what.. the underlying aim of
35 the strategy [is]” (2021q).
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41 5. Discussion

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44 The implementation of RTS 6 formalised the position of sell side investment firms as “gatekeepers” in
45 the conduct of AT on EU and UK trading venues (Čuk and Van Waeyenberge, 2018). Concerns in the
46 literature about the potential impact of resultant costs on firms’ implementation are supported by the
47 findings of this study (Čuk and Van Waeyenberge, 2018). Anxieties about market data charges and the
48 availability of specialist headcount may encourage firms to “cut corners” in their AT control
49 programmes. As forecasted by Conac (2017), some may even exit the market completely:
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56 “Excessive regulatory obligations...is that going to drive people away from this type
57 of business? I think there is a possibility that shareholders...are going to feel, you
58 know what? The returns are not really worth the risk. [sic]” (2021j)
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7 (i) Policy proposal one: introduce mandatory AT qualification requirements for key
8 staff
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12 Echoing the concerns expressed in Sadaf et al. (2021) and Coombs (2016), there are indicators that the
13 desire to control expenditure is encouraging firms to over rely on trade platform vendors to calibrate
14 AT related parameters and perform testing. This “de facto” outsourcing appears set to continue in the
15 near term, although professionals with advanced coding skills are gradually starting to enter the ranks
16 of firms’ control functions because of natural demographic change. Building upon SMCR, regulators
17 could seek to accelerate the pace of this change by mandating that key staff in AT deployment possess
18 mandatory AT related qualifications. The University of Oxford has already launched an AT short course
19 aimed at professionals (2023e). Were the FCA to mandate training, other professional course providers
20 would surely enter the market.
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29 Introducing mandatory training would also help to alleviate the inherent operational resilience risks
30 posed by firms relying on their vendors (2020b). Furthermore, mandatory training would reduce the
31 risks posed by international groups. The Threshold Conditions require that the “mind and
32 management” of an FCA regulated investment firm is based in the UK (2022h). Despite this, in
33 international groups key decisions are liable to being made by staff based overseas who have limited
34 knowledge of the UK regulatory system.
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41 (ii) Policy proposal two: lessen the requirements in RTS6 for automated executors
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44 Faced with skills shortages and cost pressures, firms may be tempted to take a “tick box” approach to
45 fulfilling the requirements in RTS 6 if they are not perceived to be useful. The “creative interpretation”
46 that has hitherto characterised the implementation of AT related initiatives is at risk of giving way to
47 fatigue. Some aspects of the RTS 6 regime, such as the conduct of annual assessments and compilation
48 of algorithm inventories, are not considered particularly burdensome. Nevertheless, they could reduce
49 AT compliance to a preoccupation with process especially where firms face competing priorities.
50 Regulators could build upon the *Wholesale Markets Review* to examine where some of the
51 requirements in RTS 6 could be lessened, especially for firms that do not support the deployment of
52 trading or machine learning algorithms. This would be conducive to a more outcomes focused approach
53 to compliance.
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9 (iii) Policy proposal three: introduce a Recognised Software Vendor (“RSV”) regime

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11 An alternative, or supplement, to refining the mandatory requirements on AT firms enshrined in RTS 6
12 would be to accept that reliance on third party vendors is inevitable and perhaps even desirable. In
13 doing so, policymakers could expand the notion of “critical third parties” (“CTPs”) in the context of AT
14 to capture a broader array of technological infrastructure providers. Currently, UK regulators forecast
15 that:from:
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22 “...certain third parties providing data and artificial intelligence (“AI”) or machine
23 learning (“ML”) models could emerge as future potential CTPs as a result of the
24 increasing use of these data and models in trading systems, which could in turn lead
25 to herding or procyclical behaviours” (2022b)
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30 ~~to capture a broader array of technological infrastructure providers. The mitigation of systemic risk~~
31 ~~posed by CTPs is a core aim of the UK Financial Services and Markets Bill which, at the time of writing,~~
32 ~~is currently progressing through Parliament. Yet, expanding the concept of Coined “TechReg” by~~
33 ~~(Apfelbacher and Jasmina, 2019) by, regulating vendors directly could offer additional benefits. In~~
34 ~~addition to just mitigating systemic risk, a core aim of the UK Financial Services and Markets Bill which,~~
35 ~~at the time of writing, is currently progressing through Parliament. After all, dData hungry AI models~~
36 are likely to be out of reach for most sell side brokerage firms for the foreseeable future owing to the
37 same cost and expertise constraints that drive to rely on their vendors. Besides, those firms that do
38 have the financial and technical firepower necessary to develop the types of AI based AT operations
39 described by the likes of Azzutti et al. (2021) are anticipated to significantly shrink their staffing levels
40 as a consequence (Kelly, 2021). For these reasons it is recommended that UK policymakers consider
41 expanding Part XVIII of the Financial Services and Markets Act 2000 (“FSMA”) to include a new type
42 of recognised body: the Recognised Software Vendor (“RSV”).
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54 Currently, Part XVIII makes provision for the recognition of the following types of market
55 infrastructure providers:
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- 59 • Recognised Investment Exchanges (“RIEs”), for example the London Stock Exchange;
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- Recognised Clearing Houses (“RCHs”), for example LME Clear Limited; and
- Recognised Central Securities Depositories (“CSDs”), for example Euroclear UK and International Limited.

By obtaining recognition, an RIE, RCH or CSD is exempt from having to obtain permission from either the FCA or Prudential Regulation Authority (“PRA”) to conduct regulated activities in the UK (2022e). Nonetheless, to become recognised, an aspiring RIE, RCH or CSD must be able to demonstrate that it meets exacting governance, financial resource, and system and control requirements as set out in the Financial Services and Markets Act 2000 (Recognition Requirements for Investment Exchanges and Clearing Houses) Regulations 2001 (SI 2001/995). For example, in the context of AT, rule 2.5 of the FCA’s RIE Sourcebook (“REC”) (2022g) implements RTS 7 by requiring RIEs to:

- take measures to ensure AT systems deployed by market participants do not create or contribute to disorderly trading conditions;
- ensure their trading systems are resilient to cope with high message volumes and market stress; and
- ensure orders generated by AT are flagged for ease of identification.

Adopting parts of the Part XVIII FSMA 2000 and RTS 6 frameworks, conditions for becoming, and remaining, a RSV could include:

- **stress testing algorithms that a RSV has incorporated into its trading platform software:** using aggregated historic market data crowdsourced from all its investment firm clients, an RSV could perhaps achieve more meaningful testing than if those firms were acting by themselves;
- **organising coordinated “market-wide” kill functionality simulations** with investment firm clients based on this data;
- **procuring periodic external assurance reviews and technical certifications as a “single source”**, reducing the scope for duplication and “performative” compliance by investment firms that lack the know-how to do this effectively;

- **the “single source” maintenance of trading algorithm inventories:** again, moving this to an RSV from individual investment firms would help reduce duplication. This would enable a regulator to focus its own limited resources on scrutinising fewer, higher quality, inventories as part of a periodic RSV audit programme; and
- **being included in the proposed extension of SMCR to other market infrastructure providers (2023c):** like RIEs, RSVs would be freed from the incentive structures that are often accused of encouraging investment firms and their staff to take excessive risks. This, together with an extension of SMCR’s accountability requirements to RSVs, would ensure that technology companies have “skin in the regulatory game”. This should help motivate staff employed by RSVs to use their expertise responsibly.

Whilst the introduction of a RSV regime should complement a more proportionate application of RTS 6, it is acknowledged that complete reliance on third party vendors would not be suitable for all firms engaged in AT. This would particularly be the case for automated traders deploying proprietary algorithms. If an RTS regime were implemented regulators should have additional capacity to focus on business models that pose the highest risks. It is also acknowledged that UK trading venues require trading platforms developed by non-member, third party, software vendors be tested for conformance to their requirements prior to live deployment (or following a material change). However, such conformance testing is relatively limited in scope (Azzutti, 2023), even if some participants felt that it is very prescriptive. For an example, see: *LMeselect and LMEsmart Testing Services* (2020a).

An obvious drawback of introducing an RSV regime is that it would result in increased costs for software vendors. Compliance and risk management personnel would need to be recruited to implement the requirements of the new regime. Existing software may also need to be adapted, although major changes would probably not be necessary. This is because an RSV regime would enhance the operation of RTS 6 rather than replace it. For example, investment firms would still monitor their own trading activity for compliance with the UK MAR. In addition, investment firms would work with vendors to test algorithms. Idiosyncrasies in a firm’s specific operating environment or demands for a custom built algorithm would necessitate the supply of firm-specific simulated trade data. Even so, vendors would probably pass any additional costs on to firms using their platforms.

To limit the burden on firms and RSVs involved in the deployment of AI trading applications, the regulatory treatment for more deterministic (and controllable) systems could be lessened. Conversely, ML-based trading raises a number of additional uncertainties that require greater regulatory scrutiny. For example, an RSV might coordinate market-wide kill functionality simulations for ML based algorithms more frequently than would be the case than for deterministic algorithms.

(iii) Limitation and opportunity for further research

Finally, the lack of comment on the effectiveness of some pre-and post-trade controls required by RTS 6 represents a limitation of this study's findings. This could indicate that these requirements are not controversial. Firms may have implemented such controls prior to the promulgation of RTS 6. Alternatively, parameters may have been set so generously that they cause little noticeable friction in daily operations. One can only speculate. Therefore, an opportunity exists for future researchers to probe this further.

6. Conclusion

Some might argue that the lack of a notable AT related events during the extremely volatile periods spurred by COVID-19 and Russo-Ukrainian War is testament to the effectiveness of firms' implementation of RTS 6. Others may ascribe the lack of incident to luck, particularly given that, to date, no major AT related events have reportedly occurred outside the UK or the EU either. The evidence presented in this article offers some support to both perspectives.

On the one hand, the professionals interviewed for this article demonstrated a good understanding of the requirements in RTS 6. They ascribed value to them. On the other hand, this does not necessarily translate into effective controls. Practitioners should pay particular attention to: (1) a lack of knowledge of the algorithms, code and strategies that are the subject of RTS 6; (2) regulatory fatigue; (3) a temptation to cut corners in an era of rising costs and squeezed returns; (4) overreliance on platform vendors; (5) governance in international groups; (6) the deliberate calibration of risk parameters to reduce friction; and (7) complacency arising from a lack of incident. In a follow up to the *Wholesale Markets Review*, policymakers could consider targeted refinements to the existing rules and the introduction of a RSV regime to reduce process and focus oversight on riskier AT models. As well as increasing firms' focus on outcomes, such a move could persuade firms with tighter budgets to stay

in the market. A loss of smaller investment firms would result in increases in concentration and liquidity risk, and in turn amplify the risk posed by poor conduct.

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Appendix: Interview protocol

PART A	BACKGROUND	<ul style="list-style-type: none"> • Investment firm sector/sub-sector • Investment firm's goals • Types of algorithms deployed • Types of strategies employed • Any machine learning / artificial intelligence algorithms? • Design, deployment, (re) calibration process • Understanding of conduct risk, firm's internal framework
PART B	EMERGING CONDUCT RISKS AND THEIR IMPLICATIONS FOR HUMAN ACCOUNTABILITY	<ul style="list-style-type: none"> • Firm's perception of conduct risks associated with algorithmic trading in sector/sub-sector, current and future • Likely levels of self-calibration: near, medium and long term • Knowledge/levels of understanding of algorithms and conduct risk: senior management, front office, support staff. Improving or declining? • How do humans in firm stay abreast of algorithmic developments and behaviour? • Description of conduct risk incidents involving algorithms – past 3 years • Plans to reduce overhead because of increased automation of trading? Which areas?
PART C	MACHINE-TO-MACHINE REGULATION	<ul style="list-style-type: none"> • Approach to machine conduct mitigation • Preventative: any embedded ethical / conduct standards?

		<ul style="list-style-type: none"> • Detective: Surveillance tools currently used? • Ability of humans to spot conduct events caused by algorithmic activity • Ability of regulators and markets to identify issues • Horizon developments, 'build, partner, buy' • Incentivising machines • Deterring machines • Punishing machines
PART D	INITIATIVES TO MITIGATE CONDUCT RISKS AND LESSONS LEARNED	<ul style="list-style-type: none"> • Industry / sector wide initiatives, collaboration levels • Involvement / reliance on third party vendors • Merits of legislative versus industry lead solutions • Likely effectiveness of UK's approach versus approaches of competitor jurisdictions, e.g. US, EU/EEA • Lessons learned: <ul style="list-style-type: none"> ○ incidents within trading industry ○ incidents extraneous to trading industry • Principle concerns for the future

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Reponses to reviewers – round two 13/05/23

Recommendation	Response
<p>“p. 3 - In internal auditing practices, the phrase “first line of defence” generally refers to the people responsible at the front line of business practices, in this case the “human operators”. Consider whether it is appropriate to include at least a note to clarify the distinction between this definition and the one provided in Azzutti, 2023.”</p>	<p>Note added per recommendation.</p>
<p>“p. 5 - In the list of references “(Karremans and Schoeller, 2021, Seyfert, 2021, Lenglet and Mol, 2016),”: the different works should be separated by a SEMICOLON (;).”</p>	<p>Amended per the recommendation.</p>
<p>“P . 6 -There is a published version of the work cited Azzutti et al. (2022). The author may wish to update the reference throughout the article. See: • Azzutti, A., W.G. Ringe & H.S. Stiehl, ‘Regulating AI Trading from an AI Life Cycle Perspective.’ In: N. Remolina and A. Gurrea-Martinez (eds.), Artificial Intelligence in Finance: Challenges, Opportunities and Regulatory Developments (Edward Elgar 2023) 198-242.”</p>	<p>I have substituted the citation per the recommendation.</p>
<p>p.7 -“...it would be very difficult for firms to observe the principle of accountability which is so fundamental RTS 6.” There seems to be a preposition missing between “fundamental” and “RTS 6.”</p>	<p>“To” added to the sentence in question.</p>
<p>“p. 8 -Is there a specific reason why the author uses the Dutch regulator’s taxonomy of algorithmic traders? Is it really relevant and useful to support the clarity of the paper to have it here?”</p>	<p>Added per the recommendation of the second reviewer. I have added a note here to explain the rationale. The Netherlands is often reported to be the UK’s main rival as a destination for algorithmic traders post Brexit. Accordingly, each jurisdiction’s initiatives are likely to very influential on the other.</p>
<p>“p. 23-26 -The author presents an interesting policy proposal. To my knowledge, this is the first paper to develop a specific idea on regulation of third-party providers, although it is not the first to argue for proportional requirements for algorithmic trading based on different levels of risk. However, this section could be further developed to include a discussion of the “cons” inherent in such a proposal. And how the proposal would interact with existing regulatory requirements for trading venues (e.g., regarding compliance testing and oversight of trading activity). While acknowledging that the author is doing his best</p>	<p>Per the suggestion, I have added an additional paragraph at the end of the relevant section which seeks to address these points.</p>

<p>1 2 3 to adhere to the journal's word limits, one-two 4 sentences here would suffice."</p>	
<p>5 6 p. 23 – "The section on "Policy Proposal Two" 7 could conclude by highlighting the difference in 8 regulatory treatment that different AI trading 9 applications may entail. For example, while the 10 regulatory treatment for more deterministic 11 (and controllable) systems may be lessened, 12 ML-based trading raises a number of additional 13 uncertainties that require greater regulatory 14 scrutiny."</p>	<p>I have incorporated the suggested wording at the end of the relevant section and added an example to show how this might work in practice.</p>
<p>15 16 p. 23 – "to capture a broader array of 17 technological infrastructure providers. Coined 18 "TechReg" by Apfelbacher and Jasmina (2019), 19 regulating vendors directly could offer benefits 20 in addition to just mitigating systemic risk, a 21 core aim of the UK Financial Services and 22 Markets Bill which, at the time of writing, is 23 currently progressing through Parliament." 24 There are some problems in the structure of 25 this sentence. The author needs to revise it." 26 27</p>	<p>I see the issue. I have reworked the sentence.</p>