Government Office for Science

Foresight

# Standards in computer-based trading: a review

Driver Review DR31

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# Standards in computer-based trading: a review

A short review of published literature on the role of standards in the real economy. A review of existing standardization initiatives in the computer based trading space. Some observations on where standards could play a larger part in financial services and help to deliver greater transparency, greater trust, easier policing and lower end-user costs.

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This review has been commissioned as part of the UK Government's Foresight Project, The Future of Computer Trading in Financial Markets. The views expressed do not represent the policy of any Government or organisation.

# 1. About this paper

This paper has three aims. In part A it discusses standards and their importance and how they can be used as tools in policy. It reviews the evidence of the role of standards in the real economy. It draws heavily on the reports of Professor G. M. Peter Swann. The UK Government's Department of Trade and Industry commissioned the first of these reports in 2000, and its successor the Department of Business, Innovation and Skills provided an update in 2010. In part B it makes an assessment of standards in relation to computer based trading and in part C it makes recommendations for policy based on the findings and observations articulated in parts A and B.

# 2. Introduction[1]

World War 2 highlighted the need for international standards, sometimes with dramatic effect. The British Eighth Army, fighting the panzers of Germany's Afrika Korps in the North Africa campaign, was eagerly awaiting spare parts for their tanks from their American allies. The spares arrived but when the British tried to repair their tanks, they discovered they were unusable because of different thread pitches on the nuts and bolts used in the parts. The British abandoned their tanks in the North African desert, as they were un-repairable.[2] [3]Following this, the American, British and Canadian governments joined forces to establish the United Nations Standards Coordinating Committee (UNSCC). After the war this initiative grew to include nations from neutral and former enemy countries and in 1947 became the International Organisation for Standards (ISO) headquartered in Geneva[4].[5]

The business services and finance accounting sector accounts for a 31% weighting in the United Kingdom's GDP[6]. Financial services represent about 1/3 of this. Britain's national interest is closely tied to financial services, and standards should play more of a role in this sector of the economy.

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[1] Acknowledgements: This report is a consolidation of many documents, books, research papers and websites that I have read and reviewed over the last 18 months. If I have failed to credit anyone, that is my omission and I can only apologise for it. If I have plagiarised anyone's work without giving due credit please inform me and I will add the author to the citation list. I have drawn extensively on the work of Professor GM Peter Swann, Lawrence Busch, Tim Buthe and Walter Mattli and wish to extend my thanks for their work that I build upon. As with any derivative work the praise should go to the original thinkers but the errors and omissions are entirely mine.

[2] Robb, "Significance of Company and National Standards" (1956), 296

[3] James Surowiecki, "Turn of the Century" Apr 2011, http://www.wired.com/wired/archive/10.01/standards_pr.html

[4] http://en.wikipedia.org/wiki/International_Organization_for_Standardization

[5] The New Global Rulers, The Privatization of Regulation in the World Economy, Tim Buthe and Walter Mattli, ISBN 978-0-691-14479-5

[6] Office for National Statistics GDP page, http://www.ons.gov.uk/ons/rel/naa2/second-estimate-of-gdp/q2-2011/stb---q2-2011.html#tab-GDP-in-detail

Standards contribute an additional £2.5 billion to the UK's real economy[7]. They increase transparency, engender trust, drive innovation and increase economies of scale. As such, the UK actively promotes their adoption and use.

In comparison, the financial services industry suffers from a lack of standards; they play a much more limited role than they do in the real economy. Partly as a result, we do not see the same levels of competition, innovation, openness, transparency, or the economies of scale that we see elsewhere. This lack of standards leads in part to a lack of transparency and trust in financial services and renders the system more prone to possible financial instability. Driver Review 30, "Trust and reputation in financial services", explores the subject of trust in financial markets further.

Standards play an important role in other sectors of the economy where there is considerable interest from non-contractual parties in the outcome. Driver Review 26 examines one of these, "Computer trading and systemic risk: a nuclear perspective".

In 2000, the Department of Trade and Industry commissioned a report on "The Economics of Standardisation"[8]. In 2010, its successor, the Department of Business, Innovation and Skill, commissioned a follow up report. These reports are available on the BIS web site. This driver review makes much use of those two reports to provide an evidence base for the role of standards in the real economy. From this, it then draws inferences for the possible role of standards in the computer based trading arena.

# 3. Part A – Standards, the evidence from the real economy

## 3.1. What exactly are standards and why are they important?

A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.[9] Many of the aspects of standardisation that we discuss later in this paper are concerned with interoperability. Interoperability in this context means "the capability to run business processes seamlessly across organizational boundaries[10]".

Standards in the real economy touch upon almost every aspect of our daily lives.

Users of this document, for example, will either print it on a printer or read it on a computer screen. Standards govern how we connect the printer to the computer and how we connect both to the electrical wall sockets. Standards govern the dimensions of the paper onto which

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[7] Evidence base for the economic benefits of standardisation, http://www.bis.gov.uk/policies/innovation/standardisation/economic-benefits

[8] The Economics of Standardisation, http://www.bis.gov.uk/assets/biscore/corporate/migratedd/publications/f/file11312.pdf

[9] ISO Website, answer to question "What is a standard", http://www.iso.org/iso/home/standards.htm

[10] Financial services messaging - Business benefits boosted by interoperability, http://www.iso.org/iso/home/news_index/news_archive/news.htm?refid=Ref1536

we will print this document. After reading it, we might phone a colleague on our mobile phone, using standards that govern the interoperability of the cellular networks that connect our call.

We could continue this illustration of the role of standards in the real economy, but the point is that standards play an important role in our lives. Standards allow us to achieve interoperability between systems, they allow us to ensure quality levels, they allow businesses and consumers to realise economies of scale and they allow the easy and transparent distribution of information.

> "Standards govern the design, operation, manufacture, and use of nearly everything that mankind produces. There are standards to protect the environment and human health and safety, and to mediate commercial transactions. Other standards ensure that different products are compatible when hooked together. . . Standards generally go unnoticed. They are mostly quiet, unseen forces, such as specifications, regulations, and protocols, that ensure that things work properly, interactively, and responsibility. How standards come about is a mystery to most people should they even ponder the question." (U.S. Congress, Office of Technology Assessment, Global Standards: Building Blocks for the Future, TCT-512 (Washington, DC: U.S. Government Printing Office, March 1992).)[11]

> "Standards, in one form or another, have always underpinned trade and business. Standards, including codes of practice and guides as well as formal standards, support compatibility and drive down costs through use of common parts, specifications and methods. They can also help open markets, create new industries and realize the potential of new technologies. Standards are so much a part of our daily routine that we use them without even being aware of doing so, and without giving thought to how they are created or the benefits they provide." (United Kingdom National Standardization Strategic Framework, Foreword (2003))[12]

### *Interoperability*

Interoperability is the aspect of a standard that allows devices or protocols to work together, enabling common connectivity and/or sharing of information or data through a common interface.

One example of interoperability is the single European standard for mobile phones to use micro-USB as their common charging interface. A group of ten of the world's biggest mobile phone manufacturers agreed to use a common charger in 2009. This standard enables a single

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[11] U.S. Congress, Office of Technology Assessment, Global Standards: Building Blocks for the Future, TCT-512 (Washington, DC: U.S. Government Printing Office, March 1992)., http://www.fas.org/ota/reports/9220.pdf

[12] National Standards Strategic Framework, http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/NSSC/UK%20NSSF.pdf, taken from this URL as www.nssf.info does not seem to be maintained but it the reference URL in the document.

universal charger to work with a variety of manufacturers' handsets, thus improving user convenience and vastly reducing the waste of discarded chargers.[13]

Another example of interoperability is the HDMI (High-Definition Multimedia Interface) standard, which enables any compliant audio-visual devices (televisions, DVD players, Blu-Ray players, games consoles, etc) to connect to each other through a standard digital interface. [14]

### *Quality*

Quality is the aspect of a standard that ensures products or services meet certain criteria in order to conform to that standard. When there is no easily distinguishable measure of quality, producers of higher quality goods cannot compete on price with much lower quality goods. In some circumstances, this may not matter, in others it can lead to bad decisions. It also creates confidence amongst consumers that products and services will be fit for purpose.

One example of where quality comes into play is in the BS 1363 standard for UK mains electrical plugs and sockets, which stipulates (amongst other things) how plugs are fused and how sockets must have closed shutters, in order to ensure a greater level of safety and to minimise the risk of electric shocks.[15]

### *Economies of scale*

Standards allow for economies of scale and mass production because once there is a standard for a particular item, producers can build the necessary infrastructure to manufacture those items in large quantities, rather than having to produce custom-made items to constantly changing specifications.

For example, a set of standards, ISO 68-1, ISO 261, ISO 262 specify a standard screw thread, and preferred combinations of diameter and pitch. This standard ensures bolts, nuts and screw threads are compatible with each other.[16] This means that a manufacturer - knowing that there will be a certain level of consumer demand for such nuts, bolts and other threaded components - can invest in the necessary machinery to produce standardised components in large quantities. Furthermore, competition between manufacturers of these commoditised components means that they are available cheaply benefiting end consumers.

### *Measurement and Information*

Without agreed standards, it would be impossible to measure things in any meaningful way.

Measurement standards have existed for thousands of years, with one of the earliest examples being the Egyptian cubit. The introduction of the cubit provided ancient Egyptians with a

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[13] EU Announcement about micro-USB as standard for phone chargers, http://europa.eu/rapid/pressReleasesAction.do?reference=IP/10/1776

[14] HDMI Standard, http://www.hdmi.org/

[15] BS1363, Wikipedia Entry, http://en.wikipedia.org/wiki/BS_1363

[16] ISO 68-1, metric screw threads, http://en.wikipedia.org/wiki/ISO_metric_screw_thread

system of measurement; the sacred cubit was a standard cubit that allowed them to describe accurately building components. People other than the builders could then make these components, allow the builder to focus on assembling the buildings.[17] This in turn introduced specialisation, the division of labour and the productivity gains that we now associate with modern industrialised processes. More recently the global adoption of the SI system, most recently by the United States of America shows the benefits of a consistent and shared system of measurements in trade. The US National Institute of Standards and Technology stating that the adoption of the SI system was in the American national interest particularly in light of "... the importance of foreign trade and the increasing influence of technology in American life."[18]

Measurement systems, such as the SI system, need to be used consistently across entire industries or organisations to deliver the maximum long term benefit.

### *Innovation*

Standards can influence innovation in a variety of ways. They can reduce uncertainty, for both producers and consumers, by specifying technical requirements around products or services. Standards can create a framework, and markets, within which innovative products or services are developed.

One example of how standards, in this case proprietary, can help foster innovation is the massive success of iPhone apps. Every app developed for the iPhone has to conform to a clearly defined set of standards (regarding the operating system, the user interface, etc), but every day thousands of newly developed apps are released to a hungry market, and some of them are hugely innovative.

Standards can also constrain innovation: for example, an existing standard can be very difficult to displace if something better comes along. You not only have to displace the standard but also the entire infrastructure that forms the ecosystem around that standard. An illustration of this would be the current introduction of Blu-Ray discs to replace DVD's. Introduced in 2006 Blu-Ray is only now starting to show significant adoption.[19] To adopt Blu-Ray, an adopter is not only committing to buying a Blu-Ray player, but also to changing all their existing players over time as their stock of Blu-Ray movies grows, so that for example their children can watch them on car journeys. To borrow and lend movies to their friends it is necessary for their friends to also upgrade to Blu-Ray and so on. This resistance to change is far worse where there is also a significant network effect to overcome, and there is at times a need for coordination to ensure that the early adopters of a technology are not the only adopters.

### *Transparency*

Standards can promote transparency in markets by making information about comparable products and services clearer to consumers.

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[17] History of measurement, http://en.wikipedia.org/wiki/History_of_measurement#Units_of_length

[18] The United States and the metric system, http://www.nist.gov/pml/wmd/metric/upload/1136a.pdf

[19] Blu-Ray Wikipedia page, http://en.wikipedia.org/wiki/Blu-ray_Disc

For example, in 2007, the introduction of two new standards (ISO 24711[20] and ISO 19798[21]) around printer cartridge yields, allowing consumers to compare the yields of different makes of printer cartridges, made it clearer to consumers what they were actually getting for their money.

### *Growth*

There is considerable evidence, mostly drawn from the real economy, of the impact of standards on industrial output.

The 2000 studies by the Department of Trade and Industry[22], [23]a forerunner of the Department of Business, Innovation and Skills, found that standards in the real economy accounted for between one eighth and one quarter of GDP growth over the 50 years from 1945 to 1995. Their studies cover the economies of UK, Germany, France, Canada and Australia. Reports have suggested that countries and industries that embrace standards early, help shape, and direct them have a competitive advantage over those that do not.[24]

The 2010 study stated it more succinctly "Standardisation has been shown to contribute some £2.5 billion a year to growth in the UK economy.[25]"

The EU parliament clearly believes that standards drive growth as they have recently passed regulations to deliver standards faster. "EU firms will get swifter access to standard solutions to technical problems, enabling them to cut production costs, help spread best practice, boost competitiveness and drive growth under a new deal, endorsed by MEPs on Tuesday, to modernise the development process for EU standards."[26]

### *Network Externalities*

Interactions can introduce benefits, or costs, not only for those who are party to them but also for third parties. Standards can introduce benefits, or costs, not only for those who implement the standards but also for those who use products and services conforming to the standards.

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[20] ISO/IEC 24711:2006, http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=50016

[21] ISO/IEC 19798:2007, http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=50015

[22] http://www.bis.gov.uk/assets/biscore/innovation/docs/e/10-1135-economics-of-standardization-update.pdf

[23] http://www.bis.gov.uk/assets/biscore/corporate/migratedd/publications/f/file11312.pdf

[24] Congress of the United States, Office of Technology Assessment, Global Standards: Building Blocks for the Future, http://www.fas.org/ota/reports/9220.pdf

[25] http://www.bis.gov.uk/policies/innovation/standardisation/economic-benefits

[26] Delivering standards to drive faster growth, http://www.europarl.europa.eu/news/en/pressroom/content/20120907IPR50816/html/Delivering-standards-faster-to-drive-growth, reported on 11 Sept 2012 and Tuesday referring to the previous Tuesday.

Standards can also have positive and negative impacts on third parties (i.e. network externalities).

A real economy example of a system with significant network externalities would be standardisation around shipping containers; Egyedi (2001) paper [27]on XML and shipping container standardisation contains a useful summary of this. The benefits accrue not only to the users of shipping containers but to end consumers through lower prices facilitated through trade between nations.

## 3.2. What evidence is there on the role of standards in the real economy?

As there is little evidence on the role of standards in the computer based trading sector, we look at the role of standards in the real economy. Later in section 4 onwards and in section 4.5 in particular we comment on parallels with the computer based trading sector.

Professor G.M. Peter Swann's reports are summarised here with a bias towards the aspects that are particularly relevant to computer based trading over the period between 2012 and 2022. Confirming that standards should be market led, e.g. produced by the users to address the needs they identify, these reports also outline the circumstances when there is a basis for government intervention at a policy level to ensure that the standards address the wider public good.

The 2010 report highlights the work done on understanding the detailed mechanisms by which standards influence economic outcomes.

Standards affect a number of areas of business and the correct standardisation infrastructure can yield benefits to growth, trade, productivity and innovation.

***By what mechanisms do standards impact?***

In the 2000 report, most of the econometric studies considered standards as a mechanism, observable purely from the inputs, outputs and transfer characteristics. Standards were considered for the effects of their presence without considering the mechanics of their internal working. When Professor G M Peter Swann completed the 2010 update, there was considerable evidence around the specific mechanisms at play. The 2010 report lists these mechanisms

### Standards and Variety

Variety reduction allows for greater economies of scale and may lead to a reduction in economic transaction costs. A multiplicity of different standards increases economic transaction costs.

[27] Infrastructure Flexibility created by Standardised Gateways: The Cases of XML and ISO Container, Egyedi (2001), http://tbm.tudelft.nl/fileadmin/Faculteit/TBM/Over_de_Faculteit/Afdelingen/Afdeling_Infrastructure_Systems_and_Services/Sectie_Informatie_en_Communicatie_Technologie/medewerkers/tineke_egeydi/publications/doc/KTPStandards_and_flexibility_Egyedi.pdf

### Standards, the division of labour and outsourcing

Standards facilitate the division of labour and outsourcing. They lead to longer more complicated supply chains with a lower total cost.

### Standards, codified knowledge and Institutions

Standards can act as a repository, carrying codified knowledge more widely. Studies show that standards, and institutions that drive them, improve the communication and transport of knowledge about those areas. Illustrating this is the case of ISO9000 quality standards. National standards bodies certify compliance with ISO9000, the British Standards Institute (BSI) in the UK's case.

### Institution and Trade

Standards increase exports. Complex products often require complex legal contracts. Standards simplify this legal process and make exporting simpler, thus increasing exports.

### Standards, Network Effects and Innovation

Standards provide networks of users who become target customers for innovative activities. The Android, iPhone and Windows Mobile ecosystems are good examples from the real economy, albeit a virtual part of it.

### Measurement and Innovation

There is some evidence that standards supporting accurate measurement encourage innovation where the important product characteristics are subject to measurement by the innovator or verification by the customer.

### Standards, Quality and Compliance costs

There is evidence that standards can promote competitiveness for those that meet the most stringent standards, but that the costs of complying with tough standards can create a barrier to trade. The author feels this argument applies to quality standards as opposed to interoperability standards that should lower barriers to trade.

### Trust and Trade

The report finds that there is a causal relationship between trust and trade, and that it runs primarily from trust to trade. In other words, the more trusted a system, the more likely parties are to trade within it.

### Measurement

Measurement supports effective and efficient division of labour, and innovation. Measurement can help in the R&D process in designing products and in the adoption phase by being a useful tool in convincing a sceptical customer. Many market failures stem from information asymmetries and measurement, particularly cheaper measurement, can reduce these asymmetries and the associated transaction costs.

## *Rationale for policy intervention*

The 2010 report outlined the rationale for policy intervention around standards, as summarised below.

There are two sets of circumstances under which policy intervention is justified, market failure and system failure. The report describes market failure as

> "The concept of *market failure* is the idea that while a perfectly competitive market could under some conditions deliver an *optimum* organisation of economic activities, some economic phenomena may cause the actual outcome in markets to deviate from this optimum. The extent of the market failure is defined by the distance between this optimum and the actual market outcome. Industrial or innovation policy takes this optimum as a benchmark or target, and tries to steer the market outcome back towards the optimum."

For a description of the systems approach, one of the cited research papers, Bergek et al (2000), contains the following description of the systems approach.

> "The systems approach stems from a key insight of innovation studies, which is that innovation by firms cannot be understood purely in terms of independent decision-making at the level of the firm. Firms' strategies are central to innovation, but strategic options are shaped and constrained by environmental factors: collaborative patterns, regulatory systems, customary practices, etc., are phenomena which persist in a systemic way and which inflect how innovation may occur. These environmental conditions are often specific to technological, regional or national contexts, but they are also dynamic: their forms of operation change with political conditions, changing technological opportunities, economic integration processes and so on." [28]

So in essence, the systems approach considers the ecosystem that supports innovation as a whole; systems failure, or weakness, results when the approach does not support innovation. Any aspect of the system may be failing and the systems approach tries to pinpoint the failing aspect and suggests what to do about it.

### Economic phenomena that lead to market failure

The report outlines four economic phenomena that lead to market failure

#### *Natural monopolies*

Natural monopolies are discussed under the heading of economies of scale and scope. In terms of financial markets, these seem closely related to pools of liquidity, e.g. meeting places where traders either actually, or virtually, congregate to meet the other side of a trade they want to execute. The conclusion is that natural monopolies should be allowed to exist because their benefits are desirable but that they should be closely regulated to ensure that they do not set excessively high prices.

#### *Asymmetric Information*

The classic situation where asymmetric information leads to market failure can be summed up, essentially cheaper goods will replace high quality goods where there is no mechanism for the consumer to judge quality.

#### *Externalities*

Externalities occur when someone undertakes an economic activity that has an impact on other parties with whom they have no commercial relationship. Positive externalities occur when other parties enjoy a benefit from this relationship and negative externalities occur when they

[28] Functionality of innovation systems as a rationale for, and guide to innovation policy, Anna Bergek, Staffan Jacobsson, Marko Hekkert, Keith Smith (2000) http://www.imit.se/pdf/reports/2007_151.pdf

suffer a cost. This seems to be at the heart of many of the issues manifest in computer-based trading.

*Co-ordination market failure*

Co-ordination market failure can occur with users locked into an old standard when it would be in their joint best interest to switch to a new and better standard. This is illustrated by the history of the QWERTY keyboard [29]and the attempts to improve upon it.

Circumstances leading to systems failure

In addition, there are six categories of circumstances that lead to systems failure

*Infrastructural failures.*

Here the focus is on the infrastructure to support innovation, be it physical infrastructure (roads, airports etc) or the science and technology infrastructure (universities, patent systems, education etc). Both approaches to policy intervention, market failure and system failure, recognise that these are public goods and that they would not receive sufficient support if privately financed.

*Institutional Failures.*

These focus on the institutions and institutional processes. Hard institutions refer to the actual institution and processes. Soft institutions refer to the culture and values of a system.

*Interaction Failures.*

These focus on the interactions within the peer group that can converge into a tendency to lock into the conventional wisdom. Group think is popular slang for this phenomenon.

*Transition Failures.*

To again quote from the report, which says it more concisely than I can.

> "These occur when firms are unable to adapt to environmental changes, and as a consequence may get locked-in to existing technological paradigms.[47] Smith (2000) writes of the inability of firms to adapt to new technological developments. He points out that new technologies not only have to compete with components of an existing technology, but with the *overall system* in which it is embedded. These systems comprise a complex of scientific knowledge, engineering practice, process technologies, infrastructure, product characteristics, skills and procedures. It is exceptionally difficult to compete against all this."

*Capability and Learning Failures.*

Capability and learning failures are failures in competencies and resources (technological, organisational, etc.) which restrict the firm's ability to learn and be innovative. The author considers with financial services ability to attract some of the brightest and the best, and with strong incentives to adopt any technology that yields a competitive advantage, that this does not often manifest itself in computer based trading.

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[29] David, P.A. (1985) "Clio and the Economics of QWERTY", http://www.econ.ucsb.edu/~tedb/Courses/Ec100C/DavidQwerty.pdf

*The Use of the 'Systems' Approach as a Development Tool*

Some governments have now recognised the importance of national systems for innovation and growth. In the current malaise following the credit events of 2008, a growth agenda is becoming important across the G20 nations.

Cliff et al make the point that many view London's vibrant financial centre with envy and would gladly replace it with their own. In light of that, the following quote from Tassey (2009) seems chillingly percipient.

> "In these economies, government, industry, and a broad infrastructure (technical, education, economic, and information) are evolving into increasingly effective technology-based ecosystems. Should the U.S fail to follow suit, its manufacturing firms will continue to compete largely as independent entities against these national economies. That is a race we cannot win."[30]

From the author's experience much of the justification for policy intervention in standardisation in computer based trading seems to stem from market failure related to negative externalities and systems failure related to infrastructural weaknesses.

### *Areas for policy intervention*

The report goes on to list nine areas for policy intervention, which briefly are

Engagement of stakeholders

Swann's 2010 report suggests involving all relevant stakeholders in the setting of standards. Unrepresented parties in the standards process often include those who may benefit or lose because of externalities.

*Process Reorganisation*

The report talks about whether traditional formal standard setting bodies remain the best approach for setting standards or whether smaller consortia provide a more agile approach, albeit with different compromises.

*Updating the Stock of Standards,*

Old standards can discourage innovation and lock out better approaches to a problem. If old standards lead to market failure there may be policy justification for replacing them, however if the scale of the market failure is small this probably does not warrant policy intervention.

*Education about Standards,*

The 2010 report suggests more education about standards, and along with most of the report, the author supports this and feels it is relevant to computer based trading.

*Big Issues*

Paraphrasing the 2010 report. "While the main focus of interest in standardization has been on how to improve the workings of the economy, there is now equal interest in exploring how

[30] Tassey G. (2008) "Modelling and Measuring the Economic Roles of Technology Infrastructure", Economics of Innovation and New Technology, 17, 615–629. The author has not been able to find a copy of the original paper, and so relies on the quote extracted from the 2010 report.

standards can be used to address some of the big issues facing society in the 21st Century, including climate change, sustainability, health and safety, waste, social inclusion and consumer needs. Progress in this direction calls for the ability to think of the economy as an immensely complex system, where beneficial activities in one part may lead to unexpected and undesirable side-effects in another part."

There are many big issues at play around the area of computer based trading. A few of them include fairness of the markets, are high frequency traders a good or bad recent development? Are markets serving their purpose? Are regulators adequately equipped to police them? Standards are a tool that can help to address these issues.

*Integration with Research and Innovation*

Tighter integration between standard setting and the research process requires involving more researchers and innovators in the standard setting process. This could improve standards quality and many of the techniques examined for high performance interfaces have relevance in the high performance computing space.

*Access to Standards and Pricing,*

The report presents a mathematical econometric model that suggests that access to standards should be free, as the extra benefit of wider adoption will outweigh the extra revenue generated from charging for access to the standards. The author supports free and open non-proprietary standards but recognises that standards bodies have to pay their bills. This section of the report should be of interest to anyone involved in standardisation.

*Coordination of Different Government Activities*

The EXPRESS report [31]on "Standardization for a competitive and innovative Europe: a vision for 2020" states that "Better coordination of and between Directorates General with the ESOs[32], including at early stages in policy development, is needed for standardization to deliver the greatest benefits for the economy, society and public policy."

*Better Regulation through Standards*

Standards do have a role to play in regulation and the existing standards bodies in computer based trading often support new regulatory initiatives. We could achieve better regulation by working more closely with regulators. We could achieve better standards by regulators becoming an active stakeholder in the standardisation process.

In section 4.5, we discuss ideas for areas of standardisation, and an analysis of which area of either market failure or systems failure are addressed by them.

[31] Standardization for a competitive and innovative Europe: a vision for 2020, http://ec.europa.eu/enterprise/policies/european-standards/files/express/exp_384_express_report_final_distrib_en.pdf

[32] ESO's are European Standardisation Organisations, in this case CEN, CENELEC, ETSI and others. In the computer based trading space, FPL, SWIFT, FpML, XBRL and others.

# 4. Part B - Existing standardisation in Financial Services

## 4.1. Standardisation in Financial Services

There are existing standards in financial services and in computer based trading in particular. Standards play a role in many parts of the market but other parts that would apparently benefit from a greater role for standards continue without them.

Regulatory pressure for greater transparency is increasing. There is a need to avoid future financial instability. This is leading to standards playing a greater role in the global Financial Services industry. The UK faces a choice between both embracing and leading this initiative, or running the risk of losing its primary position in the industry. This increased role for standards has already started to materialise. The author in his role as co-Chair of the FIX Protocol [33]Global Technical Committee has seen a dramatic increase in activity to support regulator initiatives. FpML and FPL are working on the changes needed to support the Swap Execution Facilities and Organised Trading Facilities that are required by the US Dodd Frank Act and the anticipated changes from EMIR and MiFID 2. Less anecdotally, the Financial Stability Board (FSB)[34] has called for improvements in accounting standards and the adoption of international standards.[35]

## 4.2. What standards currently exist in Financial Services?

There are many standards in computer based trading today. Each standard is governed and funded differently, and each has, at times complementary and at times competitive, standardization goals.

The main standards are:

- **SWIFT** (Society for Worldwide Interbank Financial Telecommunication) – standards are used in the securities market place for settlement of cross border trades; SWIFT standards are also used extensively in the payment space.

- **FIX** is the FIX trade-messaging standard used for routing orders from the buy-side to the sell-side and to certain market places, for distributing quotes and market data and for some post trade, pre-settlement activities.

- **FpML** (Financial Products Mark-up language) – is used to represent complex derivatives contracts in a computer readable format.

- **XBRL** (eXtensible Business Reporting language) – is the machine readable format for encoding financial statements.

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[33] FIX Protocol Limited, http://www.fixprotocol.org/, a trading standard organisation setting standards for the electronic trading industry.

[34] Financial Stability Board, http://www.financialstabilityboard.org/

[35] Improving Financial Regulation, Report of the Financial Stability Board to G20 Leaders http://www.financialstabilityboard.org/publications/r_090925b.pdf

The FIX, SWIFT and FpML standards focus mostly on the messaging aspects of the trade lifecycle. FIX messages focus on the pre-trade and trade section. SWIFT's MT messages focus on the post-trade and settlement part and FpML provides a description for complex derivative instruments. XBRL focuses on encoding financial statements, balance sheets, etc., into a common XML format. Their user communities drive all four of the standards bodies.

In addition to the four standards outlined above, a number of proprietary standards are widely adopted in the Financial Services industry. With no central governance, these de facto standards suffer from fragmentation as each implementer takes a common base and puts their own spin on it.

There are also other standards used in computer trading that are either codifications of reference information, such as the ISIN standard for instrument identification which are peripheral to the trading process.

Finally there are proprietary standards where a single platform producer has implemented a single standard sufficiently widely that it has become a de facto standard. This driver review limits itself into those standards used principally and with their main purpose as part of the trading lifecycle.

Examples of such proprietary standards include ITCH and OUCH. ITCH is the direct data feed protocol technically owned by NASDAQ, but also used by other exchanges such as BATS/Chi-X, who modify it to suit their own requirements. OUCH is the simple order and execution protocol often used as the basis for exchanges proprietary interfaces. Despite many interfaces building on ITCH or OUCH to connect to multiple exchange platforms, you need to use multiple implementations rather than a single connector.

Although not officially sanctioned, these proprietary de facto standards have become widely adopted.

### 4.3. Who are the main beneficiaries of these standards?

As FPL, SWIFT and FpML are all effectively consortia of banks and vendors, the standards they have developed, and promote, originally addressed the private interests of the banks and vendors in those consortia. Rightly, those firms continue to promote their interests.

This is not to say that the public has not gained from these standards. The benefits have not necessarily always fallen where the original participants intended. For example, following the introduction of the FIX protocol, Salomon Brothers would ideally have preferred to lock Fidelity's order flow into their own firm (and the few other brokers who adopted FIX), but as the protocol became much more widely adopted, it increased competition and resulted in reduced commissions all around.

Within the existing Financial Services standardisation infrastructure, however, it is difficult to see a mechanism to deliver public benefits into the market. This is because there is currently no governance targeting both private benefits and public benefits that serve the interests of end consumers and society as a whole.

There is currently no agenda-setting process at the highest level of standards governance in Financial Services, to target or deliver these public benefits. Often the standardisation efforts do not have all the stakeholders at the table at the onset so the standards do not consider or address externalities.

## 4.4. What do standards need in order to achieve adoption?

For any standard to be widely adopted it needs to satisfy two key criteria. First, it needs to be open, meaning all participants in the marketplace readily and easily adopt it. Second, market participants need to believe that the standard is credible, i.e. that there is a good chance the standard will be adopted.

### *Openness*

It is certainly possible for closed (i.e. proprietary) standards to become widely adopted, but that usually results from a monopoly situation, where a single supplier or manufacturer has exclusive control of a market.

Generally, where such a monopoly situation does not exist, a standard still needs to have a degree of openness to stand any chance of being widely adopted.

Open standards offer a number of advantages. They promote a greater degree of interoperability; they reduce (or even eliminate) reliance on a single vendor; they often result in lower cost solutions due to increased competition amongst vendors; and they can be more reliable and robust because of increased community involvement in the development of the standard.

### *Credibility*

Credibility is the other important factor in driving the adoption of a new standard. Users of a standard need confidence that a standard will be adopted otherwise the first implementers face an unacceptable commercial risk in adopting a standard that no one else adopts. This risk often prevents the adoption of new standards in the financial services space. FIX for example has implemented extension packs for many process improvements that would yield cost savings to the industry and ultimately to end users but implementation remains low owing to a lack of certainty that they will become the standard process for doing something. Ensuring standards have credibility is important to ensuring they are adopted. Where externalities affect stakeholders, particularly regulators and those in charge of ensuring financial stability, they should make their voices heard.

Some factors that undermine credibility of standards include the US patent system, timing and underfunding, each of these is examined in turn:

#### US patent system

The current US patent system currently grants patents liberally, without any proper review process. US patents in general are not subject to scrutiny before they are challenged in the courts.

The US is one of only a few countries in the world that allows the patenting of a business process, rather than its underlying technology.

This situation has led to a massive growth in “patent trolls”, essentially firms of lawyers who are hoping to sue banks for a “quick buck” based on dubious patents. These companies often make no actual products nor sell an actual service. Some banks have made this problem worse for themselves, and the industry, by repeated and early settlement of any legal action, regardless of merit.

The danger with any proposed new standard is that holders of poorly granted patents might claim that the new standard infringes their patent. Clearly, this situation means that users of new standards cannot be sure the standards will be widely adopted under the current US legal system. This situation also undermines the credibility of any new standard brought to the market: after all no one wishes to spend millions on lawyers' fees defending an unjustified suit.

For legal reasons illustrations cannot be given as there are cases on the court calendar in the US at this time.

#### Timing challenges around introducing new standards

Standards can both threaten and nurture innovation. Poor standards can damage innovation by cementing bad technologies into supply chains. Good standards can encourage innovation and competition by providing the building blocks needed to foster innovative solutions and providing the market scale that encourages competition.

We should consider the life cycle of standards. The timing of the introduction of standards is important. Standardize too early and you risk stifling innovation in the emerging area and potentially locking out better technology, standardize too late and you stifle innovation that could build on top of the standards.

Powerful network effects can also prevent the adoption of better solutions than the standardized one, since nobody wants to be the first to move, particularly if it could isolate them from their trading partners.

A previous version of a standard can prevent the adoption of an updated version because no-one wants to move first.

#### Underfunding as a threat to credibility

Of the major standards bodies in Financial Services, FPL, FpML and XBRL rely on funding by voluntary memberships, yet the standards are available to all, so "free riders" receive as much economic benefit as paying members. In an industry dominated by firms with very short term horizons and a structure that puts private benefit ahead of public good, this is only too likely to continue. The ISO standardisation effort, supported by SWIFT has a sounder source of finance, but it too is under pressure as SWIFT is increasingly operating as a for profit business, and most medium size, for profit businesses would not maintain a 20 man team focused purely on producing standards.

### 4.5. Observations on Part A with reference to computer based trading

#### *History of the FIX Protocol*

Since its inception in 1992 as a bilateral communications framework for equity trading between Fidelity Investments and Salomon Brothers, the **F**inancial **I**nformation e**X**change Protocol[36], FIX, has become the messaging standard for pre-trade and trade communication globally within the equity markets. FIX is also now widely used in computer based trading of foreign exchange and is seeing significant uptake in fixed income products and derivative instruments.

FIX illustrates many of the effects discussed in Part A and they are detailed here.

[36] Financial Information Exchange Protocol, http://www.fixprotocol.org/

FIX was created when Fidelity Investments asked Salomon Brothers to find a way for passing information about pre trade liquidity and trades between their offices in Wall Street and Boston. Over time this initiative grew and other firms implemented the FIX protocol. These early implementations were driven by the broker's narrow private interest, i.e. keeping their high commission earning relationship with Fidelity, and other large asset managers, sweet. This helped drive adoption of a common language that would ultimately serve the public interest by increasing competition and reducing commission rates from 25 - 40 basis points to between 3 and less than one basis point today. Whilst in this case the public good benefited from private benefits driving standardisation this is often not the case. Either standards that would benefit the public are not associated with private benefits and so do not get implemented or they are fall foul of industry bickering as each non aligned private benefit argues their corner. This reinforces the point about all stakeholders having a voice in standardisation.

In Financial Services, as in most business endeavours, there is also a cultural deference in that everyone defers to money, particularly to the payers of large fees. In some cases, this deference can serve the public interest, but in many cases, it does not. Fidelity's pivotal role in establishing FIX illustrates this.

FIX is maintained by FIX Protocol Limited, FPL, a not for profit company that manages the specification. The actual IPR of the specification is owned by a trust that holds it in trust for the public benefit. FPL is funded by market participants voluntarily becoming members and their membership fees are used to promote the protocol. Because FIX is an open protocol that can be used by anyone, FIX suffers from the free rider problem. The free rider problem is that firms do not contribute to something can still benefit from it. Firm that do not join FPL can continue to use the protocol and others will fund the protocols costs. The author has been a partner in a firm that used FIX extensively and when he tried to persuade them to become involved as paid-up members of FPL, was simply asked "What would be different if we joined?", to which the answer was, "Nothing, and others will continue to pick up the tab." Obviously to date others have continued to pick up the tab but the constant fear of a funding crisis dissuades the standards bodies from thinking longer term, or addressing the bigger issues. This illustrates the points made in section 4.4.

FIX is most commonly used for routing orders from the buy side to the sell side, which was initially published in 1993 at a time when electronic computer based trading was in its infancy. At the time of FIX's inception, we placed a high premium on human readability and all FIX messages use ASCII encoding. This makes them slow to parse and presents a slight inferiority to binary protocols. In spite of this an industry has evolved around FIX with a large number of vendors, many staff fluent in FIX, managers who understand how to deploy FIX and the processes to manage connectivity using it. Because of this, various standards initiatives to move beyond this human readable format have floundered, as they have failed to overcome the network effect of the existing FIX ecosystem. In defence of FIX, it is possible to achieve very high performance from it; it can move messages at network speed or 6.25 million messages per second on a 10G network. This is not a serious weakness as the additional overhead that FIX's human readability imposes is only a few tens of nanoseconds in the best implementations. For its original purpose of routing orders requiring manual execution between the buy side and sell side it remains fit for purpose.

In the Financial Services industry, FIX is an example of a standard that was arguably standardised too early, section 3.2, as it is a sub-optimal technical solution for the fast-evolving high performance trading space, either for routing direct access orders between buy-side and sell-side or placement of orders into exchanges.

Evolution of the FIX protocol is also subject to the critical mass factor. If FPL were to come up with a better, faster standard but there was no mandate that firms adopt it, then take-up would most likely be zero, because critical mass would not be there. Firms would want to know how many of their counterparties they could talk to with the new standard and with the answer being "none so far"; nobody would use it. This is an example of a coordination market failure as discussed in section 3.2.

FIX also suffers as technology that has been around for too long, with a low refresh cycle, that has to work against the network effect. FIX's dominance as the standard for order routing and the network effect has produced islands of FIX adoption around specific versions. Each version has achieved success in an asset class where either there was no adoption previously hence no network effect to battle against or where there was a large external event to drive migration from a previous version. FIX.4.0 and FIX.4.2 are widely used in equity markets, FIX4.4 in FX and it looks like FIX.4.4 will be adopted for the new swap execution facilities. The move to the 4.x versions of FIX in the equity markets was greatly helped by the concerns around if earlier versions of the protocol were year 2000 safe.

FIX is an example of interoperability, section 3.1, within computer based trading as it facilitates the routing of order and execution information between buy-side and sell-side order management systems. There are hundreds of buy-side order management systems (OMS) and dozens of sell-side order management systems, yet any buy-side OMS is able to route orders to, and receive executions from, any sell-side OMS because of the existence of FIX.

We see economies of scale, section 3.1, in an example from computer-based trading. Unless a FIX engine has some additional non-functional benefit to its end-client they become commodity items with little value attached to them, owing to the large number of producers. The market for FIX engines has matured so that only those offering additional features such as high performance or compatibility with other downstream systems retain value. Market scale means vendors deliver these higher value solutions at a price far lower than if users had to create their own components and the vanilla functional FIX engines are available at a commoditised price.

This competition leads to innovation as vendors try to create better products section 3.1. Some measure of this can be seen from the FPL web site. This site lists over 500 firms as vendors of FIX engines or FIX based systems[37]. Some of these are straight clones of other products but many are innovative solutions with each firm believing it is bringing something unique to the market that adds value.

Oxera (2009) identified numerous positive network externalities, section 3.1, with the adoption of the FIX Protocol and listed them in their report. The second order effects they identified included easier switching for investment managers between brokers, increased competition in the provision of services between brokers and the proliferation of new execution strategies, channels and venues available to investment managers.[38]

[37] FIX Protocol Vendor Page, http://www.fixprotocol.org/products/

[38] The Benefits of the FIX Protocol, Oxera (2009), http://fixprotocol.org/documents/4924/TheBenefitsOfTheFIXProtocol.pdf

### *FpML*

The International Swaps and Derivatives Association (ISDA) [39] and Financial products Markup Language (FpML)[40] would be illustrations of how to do use standard to describe complex products within the computer based trading space. ISDA sets up the complex legal contracts for swaps transactions and FpML deals with codifying them for use within computer based systems. This is an example of easing trade by making documentation of a trade easier, as discussed in section 3.2.

### *Notes from efforts to introduce a single market protocol*

Shortly after FIX became popular, exchange platforms began offering FIX gateways as a way of making it easier for market participants to connect to their platforms.

Many platforms now offer both a FIX based exchange gateway and a proprietary binary gateway that offers more performance than the FIX based gateway.

Standards bodies have been trying to create an agreed binary protocol that would allow all parties equal access to financial markets, but exchange operators have repeatedly told them that their highest volume customers do not want such interfaces.

The diversity of exchange interfaces essentially doing the same job is illustrated in section 4.6.

Exchanges continue to produce proprietary interfaces for a number of reasons:

- - Exchange client firms generating the bulk of the exchanges' volumes are asking for them. Exchange clients may encourage exchanges to develop custom one-off interfaces because it raises the barrier to entry for potential competitors.

- - With the US patent situation, there is an argument that many independent exchange interfaces represent less of a target for patent trolls. Suing a single exchange for patent infringement is less profitable than suing an entire industry.

- - Exchanges feel they would lose the ability to adapt their product to address their customer's needs. In reality, this is not the case as the proposed standard would be a gateway technology and would not constrain this freedom.

- - Exchanges are now technology providers. They believe they can write a better protocol than any proposed standards. The reality is that this might gain them a few nanoseconds but would not be a major advantage and the negative externalities in terms of moving them outside a standardised eco system where they could fit into a single regulatory and supervision model are large.

- - Exchanges do not want to share plans with their competition. Their view is that a shared protocol would level the playing field too much.

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[39] International Swaps and Derivatives Association, http://www2.isda.org/

[40] Financial products Markup Language (FpML), http://www.fpml.org/

- - It takes more effort to come to consensus and a common approach via a standards body.

The inability of the market to overcome this coordination problem, in the equities markets, has led technology costs to go up massively, (as people have written all sorts of technologies to cater for high-performance message flow, where no standard is deemed credible). A second complementary standard for the binary encoding of the information flows between exchanges and their users would address this, but only if plans for widespread adoption are credible.

A common gateway technology would reduce barriers to entry, decrease information asymmetries and allow economies of scale in any process that needed to connect to these platforms. The greater transparency this would create could be an important step in restoring trust in computer based trading.

### *The G20 and the LEI*

The G20 decided in its meeting of June 2011, that because of the problems experienced during the credit crunch it was necessary to have a single global system of Legal Entity Identification (LEI) for Financial Contracts, a Universal Standard for Identifying All Parties to Financial Contracts. This is an important part of a broader effort to understand and monitor systemic risk across banks and capital markets. In this action, the G20 made the strategic policy decision to create the LEI and created the mandate to drive it forward. This mandate created credibility that ultimately a LEI solution will be delivered.

In the LEI example the G20 through the financial stability board, FSB, formed an expert group to drive forward creation of the LEI code standard and its implementation and adoption. This expert group, after much discussion worked directly with ISO to assign the ISO 17442:2012 LEI standard. [41]

The first implementations of LEI like systems are now taking place with Depository Trust & Clearing Corporation (DTCC) and SWIFT acting as the initial facilities manager, for the Commodity Futures Trading Commission (CFTC) usage of CFTC Interim Compliant Identifiers ("CICIs") until a global federated LEI system is delivered, which will receive, review and publish entity information.[42]

The long term ambition is the CICIs will become LEIs once the global system is delivered.

### *Post Trade Consolidated Tape*

Currently within financial services, there are initiatives underway to create a post trade consolidated tape. The driver for this is an articulated requirement from the European Securities and Markets Authority (ESMA)[43] and standards for it are under preparation by

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[41] A Global Legal Entity Identifier for Financial Markets, http://www.financialstabilityboard.org/publications/r_120608.pdf

[42] DTCC and SWIFT launch CICI utility, http://www.dtcc.com/news/press/releases/2012/cftc_interim_compliant_identifier_utility.php

[43] European Securities and Markets Authority, http://www.esma.europa.eu/

members of Association for Financial Markets in Europe (AFME) [44]using FIX standards. There is a clear lack of direction from the driving stakeholders in this exercise, and it is likely to result in many competing solutions, all with slightly different approaches. Many banks and vendors are working on their own solutions, which will lead to great waste. Ultimately, pension and other long-term savers will pay for this waste in the form of either higher fees or lower returns. This is another area where accurate synchronised timestamps will be important, see 0, as without an accurate synchronised time source it will not be possible to determine the order of trades within a given time period.

### 4.6. Examples of where standards are needed in Financial Services

In Financial Services, we need standards in areas of the market where they will deliver public benefits such as greater competition, transparency and financial stability, as well as in areas where their adoption will defend the economic interests of participants in the market place.

Standards will also lead to innovation in Financial Services, but innovation that can be monitored and controlled, rather than innovation that uses a lack of transparency to cloak, at best, large margins and at worst major systemic risk.

The following are four examples of where we need standards in Financial Services:

***Single, high resolution, time stamp***

Currently, exchanges add time stamps to orders, trades and market data by reference to clocks either on the servers generating the information, or to various elements of the data centre infrastructure that the server runs in.

Most exchanges state a time source that they synchronize their server clocks to, but the synchronised servers could easily drift by many milliseconds per day. With trading happening in microseconds, it is impossible to use the timestamps to assemble a record of which trade happened in which order across multiple exchange platforms. Making matters much worse, is the fact that many exchange feeds only have timestamps that resolve to the level of a second. Synchronisation between different parts of an exchange system can also cause problems when they are not all synchronised to the same clock: sometimes parts are synchronised to a time source and others not, which causes confusion. These times also drive operational functions with legal implications, for example opening and closing of the exchanges and meeting legal trade-reporting obligations.

A consequence of this is that time stamps produced on each machine may differ by a considerable margin. Given that complete trading cycles can now complete in less than 37 microseconds[45] (.000037 of a second), piecing together the consolidated record of trading activity by relying on time stamps that may not even be accurate to the second becomes impossible. In fact, one could easily hide illegal activity in these gaps in the consolidated record.

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[44] Association of Financial Markets in Europe, http://www.afme.eu/

[45] X-Stream INET Performance Measurement Details, http://www.six-swiss-exchange.com/download/participants/trading/x-stream_inet_performance_measurement_details.pdf, for SWISS Exchange.

The technology exists to synchronize all the clocks reliably in a data centre at a relatively low cost (only a few thousand pounds per data centre). This would allow meaningful supervision of trading from the accurately synchronized, consolidated record. Without it, possibilities exist today for serious malfeasance to hide in the synchronization gaps.

***Single high-performance protocol for markets***

In today's high-speed markets, most exchanges support both a standards-based application programming interface[46], API, (such as FIX) and a proprietary API, which provides their users with greater performance and functionality. Whilst FIX-based APIs are slower (because of the overhead of transposing a high-level ASCII-based protocol into a low-level binary format), this overhead is small in comparison to the overall automated business process.

The reality of these varying protocols - even those claiming to be based on the same technologies - is that they differ from exchange to exchange, thus increasing the complexity for any participant wanting to connect to more than one exchange.

To connect to three of the leading equity exchanges and three of the leading futures and options exchanges, using the fastest available interface, it is necessary to implement 10 or 11 separate interfaces. This is despite the exchanges fulfilling two basic functions, the trading of equities and the trading of futures and options, both following one basic model, the price time priority central limit order book. The table below illustrates the complexity.

| Market Place | Market Data Protocol | Order and Execution Protocol[47] |
|---|---|---|
| Equities | | |
| LSE | ITCH or FAST[48] | Proprietary |
| Eurex | EBS | ETS |
| BATS/Chi-X | PITCH | BOE |

[46] An application programming interface (API) is a specification intended to be used as an interface by software components to communicate with each other. http://en.wikipedia.org/wiki/Application_programming_interface

[47] Lowest latency protocol selected where there is more than one offering, if there is more than one it is normally FIX or something proprietary.

[48] FAST should be lower latency than ITCH but we have no way of telling.

| Market Place | Market Data Protocol | Order and Execution Protocol[47] |
|---|---|---|
| Futures and Options | | |
| CME | FAST | FIX |
| CBOE | CSM | CMi2 |
| ICE | Impact | FIX |

For some, this acts as a, possibly desirable, barrier to entry. However, for many, such as regulators, smaller firms and academic researchers; this situation frustrates their efforts to obtain the data they need.

Inevitably, the quality of offerings from multiple software providers, each writing bespoke interfaces for each of over 100 separate exchanges, is likely to be lower than if there is a smaller number of interfaces to support. Less testing of each interface means unexpected circumstances are more likely to materialise in operation. Such risks need no better highlighting than the recent situation at Knight Capital where it looks like something went wrong with their software and cost them US$440 million.[49]

An example where an interoperability standard would be useful is connecting to computerised exchange trading platforms. This would make surveillance a lot easier, and reduce costs for all.

As discussed in 0, FIX was introduced to deliver private benefits to individual firms yet has delivered wider public benefits, however, often the narrow interests of existing fee-paying customers act to reinforce the status quo, as many private protocols or linguistic variants represent a sunk cost, and the complexity of these protocols acts as a useful barrier to entry for competition.

***Standardised languages***

In his March 2012 speech entitled “Towards a common financial language[50]”, Andrew Haldane of the Bank of England made the case for standards using a linguistic metaphor, which considers that Legal Entity Identifiers (LEIs) are the nouns of Financial Services standards and that Product Identifiers (PIs) are the adjectives of this new language.

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[49] Knight Capital Group Provides Update Regarding August 1st Disruption To Routing In NYSE-listed Securities, http://www.knight.com/investorRelations/pressReleases.asp?compid=105070&releaseID=1721599

[50] Evidence base for standards, http://www.bis.gov.uk/policies/innovation/standardisation/economic-benefits

However, we would wish to refine this with the LEIs becoming proper nouns and the PIs nouns. This allows us to describe who and what, but we need more than that to have complete conversations. We need verbs, adverbs, adjectives, rules of grammar, sentence structures, etc. Some of these already exist but currently there are gaps in our language and a plethora of dialects.

Why is a common language important?

Between 1970 and 1997, Korean Air Lines had an appalling safety record, one of the worst in the world. [51]Their pilots literally kept flying their aircraft into the sides of mountains, with the obvious disastrous result. Studies of the black box flight recorders from such accidents repeatedly revealed a cultural deference to the senior pilot on the flight crew, in that the first officer would defer to the pilot even as the mountain loomed into view.

This anecdote may appear to have little to do with the future of computer-based trading, until we look at the analysis and solution to this problem. The Korean language, having evolved in a highly hierarchical and deferential culture, actually makes it difficult not to defer to one's superior, even when a crash is imminent. The solution was to change the language used on flight decks of Korean Air Lines aircraft to English[52], so that the crew could politely criticize the pilot when necessary. This history and others lead to the science of Crew Resource Management[53], now an essential part of the Air Transport Pilots Licence qualification.

The technical standards used in financial markets face similar issues. Each standard having evolved in a different culture serves different needs and has understandable biases.

FIX and proprietary trading protocols are relatively compact because of the need for speed, whereas FpML (ISDA's standard for describing complex derivatives contracts) is quite verbose, reflecting both its legal background and the complex instruments it describes. Many of the ISO/SWIFT messaging standards evolved in the back office; their design prioritises the requirement for certainty of delivery over the requirement to be compact.

This is why a complete standardized language and a compelling reason to see the language used consistently by all players in Financial Services is required. These standards will not come about without an external driver. The initiatives of the G20 in mandating the introduction of the LEI and universal PI is a good first step; however they are the linguistic equivalents of trying to form a language with only nouns and proper nouns, whereas what is needed is a complete language.

# 5. Part C – Policy recommendations

## 5.1. Governance

The existing standards organisations are capable of delivering standards when their existing stakeholders mandate them to do so. A major challenge they face is that often they lack the

[51] Korean Airlines Safety Record, http://en.wikipedia.org/wiki/Korean_Air_incidents_and_accidents

[52] The Naked Pilot Aircraft Accidents, http://www.amazon.co.uk/The-Naked-Pilot-Aircraft-Accidents/dp/1853104825

[53] Crew Resource Management, http://en.wikipedia.org/wiki/Crew_resource_management

mandate so their standards either are a good idea that a few members have identified a need for, or are incremental improvements to their existing standards, and a lack of critical mass hampers adoption.

Greater stakeholder involvement is necessary; currently those engaged in the standards process, within financial services, are only those firms with a direct commercial interest in the outcome. In the standards setting process within financial services, most voices come from vendors, the sell side, or exchange platform operators. Three other important stakeholders are largely absent; the buy side, the regulators and the end investing public.

We recommend following a simplified but global version of the hierarchy proposed by the "EU study on the specific policy needs for ICT standardisation"[54]. We recommend the creation of a Policy and Strategy platform, with separate units for policy and strategy. This Policy and Strategy platform would then deliver mandates to the existing standards bodies along with timelines for implementation. Essentially this is a formalisation of the existing process, which followed when the G20[55] asked the FSB[56] to create a standard for the LEI.

The High Level Policy Group (HLPG) element of the hierarchy should consist of sovereign states, possibly the G20 states; possibly a wider group but primarily those states with well-developed financial services sectors and/or large economies. China probably gets a seat despite not having a well-developed financial services sector; Monaco probably does not.

The tasks of the High Level Policy Group should include

- Setting short-, medium- and long-term priorities in various policy areas.
- Clarification of the areas where regulation and standardisation overlap.
- Clarification of those areas where there is no public policy issue and where standardisation can be left to competitive market pressures.
- Identification of problem areas where standards are not being utilised.

Effectively the HLPG would then ask a High Level Strategy Group (HLSG) to manage, or oversee, the creation and adoption of standards addressing the policy areas it has identified.

The High Level Strategy Group would consist of states, public stakeholders, standards bodies, and private interests (banks, brokers, investment managers, hedge funds etc). It is important that all stakeholders are represented at this level, in particular a mechanism must be found that increases the representation of the regulators, the buy side and the end investor.

Consideration needs to be given to who the public stakeholders are, e.g. how do we represent pensioner, retail savers etc.

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[55] Group of Twenty Finance Ministers and Central Bank Governors

[56] Financial Stability Board, http://www.financialstabilityboard.org/

The tasks of the Strategy Group would be:

- Creating consensus
- Drawing policy issues to the attention of the HLPG
- Setting up standards to allow interoperability.
- Promotion of business process standards.
- Management of work programmes
- Monitoring of the implementation of standards belonging to approved policy areas, identifying obstacles and propose solutions to eliminate them.

The HLSG has an advisory role, the decision making and approval powers lie with the policy group, HLPG.

We envisage that the HLSG meet less regularly than the HLPG in much the same way, and for similar reasons, that the executive management of a company meet more regularly than the board of directors.

Finally, there is an operational aspect to all of this. This could reside either within the HLSG or within a lower organisation. The main tasks to address at this level are to:

- Coordinate standardisation initiatives that have been identified by the HLSG but not mandated by the HLPG
- Drive standards that have been mandated by the HLPG

Execution of work programmes. We envisage HLSG allocating work programmes to the relevant standards bodies and those existing structures would drive forward the creation of the relevant standards. Alternatively, private sector initiatives in standardisation have shown that they are also capable, sometimes more so, as they address the funding issue first, of creating standards.

### 5.2. Mapping exercise

We recommend the undertaking of an exercise to map out information flow in the world's financial markets. Where does it cross borders, where does it fail? What formats and standards currently exist etc?[57]

The result would be a grid that shows products (equities, fixed income, derivatives etc) across the top and life cycle down the side (pre trade, trade, post trade pre settlement etc). In each box, we should aim to gather evidence to show four numbers / assessments:

- Systemic risk (H/M/L)

- Cost of broken/failing processes (US$ amount)
- Number of broken/failing processes (number)
- Cost to fix (US$ amount)

In summary, this would also allow us to create a heat map similar to the illustration below

| Life Cycle / Asset class | Equities | | Fixed Income | | Derivatives | |
|---|---|---|---|---|---|---|
| Pre Trade | 300 | 1 | 600 | 2 | 600 | 2 |
| | 20 | L | 30 | L | 30 | L |
| Trade | 600 | 2 | 600 | 2 | 600 | 2 |
| | 30 | L | 30 | H | 30 | L |
| Post Trade / Pre Settlement | 400 | 3 | 600 | 2 | 100 | 1 |
| | 25 | M | 30 | M | | H |
| Settlement | 1000 | 2 | 600 | 2 | 100 | 1 |
| | 30 | M | 30 | L | 10 | H |



The aim of this exercise would be to provide information to the policy group of the proposed new standards governance process, allowing them to make informed decisions about the need for intervention in the standards process. This would allow policy makers to identify and prioritise areas of concern; the main two criteria are probably areas that have a high systemic risk implication and areas that impose a disproportionate cost on the industry and wider society. Where these criteria are not met the financial services industry could address any possible areas of standardisation if it decides to through normal market mechanisms.

A hypothetical example of the type of thing this exercise might pick up would be a backlog in the movement from post trade into collateralising and margining for swaps. Obviously this could have disastrous financial stability consequences as the backlog may not appear in either the trading systems risk or the back offices risk position.

### 5.3. Time stamps

We recommend the adoption of a single synchronised time source for all exchange platforms. All parts of the exchange's operations should use this common time including any timestamps written onto any feeds given to regulators and the market. Timestamps should be sufficiently granular to allow an accurate piecing together of the record of trades and comparison between trading across multiple fragmented venues.

### 5.4. Common Protocol for accessing all exchanges

We recommend a standard, high-performance, binary format gateway technology for all exchanges. Exchanges could continue to implement their own proprietary protocols, but a mechanism must be found to ensure this did not perpetuate the situation where the negative externalities cost wider society considerably.

This would have the benefit of aiding surveillance and compliance/regulation, because with all exchanges using a common interface, regulators could plug a single piece of surveillance software in and monitor all of them. This would also possibly help increase the economies of scale available to firms creating surveillance solutions and lower the cost of such solutions for

all. It would also make it easier for academics to access information and save the industry money by allowing greater economies of scale than the current model of each exchange representing a unique connectivity problem.

This would make it easier for exchanges to use data from each other both for monitoring and surveillance purposes and possibly in the design of area wide harmonised circuit breakers.

### 5.5. Access for academics

There is a dearth of information available to academics for them to conduct studies on various market microstructure issues, including the current areas of controversy, HFT. We recommend developing a standard approach to making data anonymous and encouraging/mandating exchange platforms to make that data available to recognised academic bodies. This should help address a major frustration of the Foresight project, the lack of research into this area.

## 6. Conclusions

This report illustrates the role of standards in the real economy. It argues that circumstances exist where policy intervention in the standards process is justified to achieve desired outcomes.

It has recommended proposed policy options in section 5 and would recommend action.

We conclude that we need additional standards in the computer based trading space to address issues of transparency, trust and to make the market infrastructure fairer.

The main recommendation is to use the standards governance approach taken with the introduction of the LEI as the basis for a new model to ensure that standards address the interests of all stakeholders in financial markets.

We then recommend a number of areas for standardisation; we recommend driving these through this same process.

1. All trading platforms both share and publish information to a common accurate and synchronised timestamp. This will make it far easier to police global markets and simplify comparisons of trading that takes place across multiple fragmented venues.
2. Create a standard interface for all trading platforms. This will allow regulators and customers to connect to multiple markets with the same technology, making proper market surveillance a possibility. It will also probably create a more competitive market place for surveillance solutions.
3. Conduct an engineering process review for electronic secondary markets. Identify areas that create artificially high costs within the industry. Identify areas that increase financial stability risk in transaction processing. Use this information to inform regulation and standardisation.
4. Create a standard process for making order book data available to academic researchers. This must address the concerns of the industry around privacy but also allow the conduct of academic research. This will help create an evidence base for the need for further action or not.

# 7. Appendix A - Major Financial Services Standards

## 7.1. Who created each of these standards and why?

Standards in Financial Services address short-term private interests, rather than public interest. Any public benefits that have accrued to date have been by-products rather than the original intent of the standardization initiative.

**FIX** originated in 1992, when Fidelity Investments, a large buy-side institution, wanted to improve the process of placing equity orders with their main sell-side broker, Salomon Brothers, by introducing automation for message flow between the two parties. Salomon's agreed largely because Fidelity was an important client and it was imperative to maintain a good relationship with the client. There was a private benefit to both parties: for Fidelity the increased automation that a standard would facilitate and for Salomons, the maintenance of a good relationship with an important client.[58]

> "The **F**inancial **I**nformation e**X**change (FIX) Protocol is a messaging standard developed specifically for the real-time electronic exchange of securities transactions. FIX is a public-domain specification owned and maintained by FIX Protocol, Ltd.
>
> Our mission:
>
> To improve the global trading process by defining, managing, and promoting an open protocol for real-time, electronic communication between industry participants, while complementing other industry standards.
>
> The FIX Protocol specification is maintained by the FIX Technical Committee, which receives its direction from the international Steering Committees, the Global Steering Committee, and the various Working Groups comprised of industry participants such as fund managers, brokers, exchanges, and vendors." (FPL Web Site)[59]

**SWIFT,** Society for Worldwide Interbank Financial Telecommunication, originated in 1973 when a group of 239 banks in 15 countries decided that they wanted to move payments around between countries more efficiently. SWIFT has two standards, ISO 15022 which is based on its own encoding and ISO20022 which is an XML based standard.

> "Our role is two-fold. We provide the proprietary communications platform, products and services that allow our customers to connect and exchange financial information securely and reliably. We also act as the catalyst that brings the financial community together to work collaboratively to shape market practice, define standards and consider solutions to issues of mutual interest.
>
> SWIFT enables its customers to automate and standardise financial transactions, thereby lowering costs, reducing operational risk and eliminating inefficiencies from their operations. By using SWIFT customers can also create new business opportunities and revenue streams". (SWIFT website www.swift.com)

[58] What is FIX?, http://www.fixprotocol.org/what-is-fix.shtml

[59] FIX Protocol Limited website, www.fixprotocol.org

SWIFT not only provides its consortium members with a secure infrastructure for moving payments around the world, it also acts as ISO register for financial services and funds this from the surplus of membership fees paid by its members.

**FpML** came about when a group of banks decided that it was taking too long to agree a set of contracts in the increasingly complicated swaps and derivatives markets. Initially ISDA standardised contracts and then they developed an XML-based message standard through FpML.

> "To lower the cost of processing derivatives and thereby increase the profitability of the business, JP Morgan (now JPMorganChase) in 1997 established a research project to develop the methodology by which these instruments can be traded using e-commerce technologies.
>
> PricewaterhouseCoopers was brought on board as a resource, and in 1999 the organizations announced a draft standard for interest rate swaps. At that time, other industry firms were contacted and an independent organization – FpML.org – was formed to develop and promote the Financial products Mark-up Language as an XML-based "lingua franca" for derivatives trading." (FpML website www.fpml.org)

**XBRL** came about as accounting firms decided to start codifying annual financial statements into machine-readable format. It is an XML-based standard.

> "XBRL is a language for the electronic communication of business and financial data which is revolutionising business reporting around the world. It provides major benefits in the preparation, analysis and communication of business information. It offers cost savings, greater efficiency and improved accuracy and reliability to all those involved in supplying or using financial data.
>
> XBRL stands for eXtensible Business Reporting Language. It is one of a family of "XML" languages which is becoming a standard means of communicating information between businesses and on the internet.
>
> XBRL is being developed by an international non-profit consortium of over 600 major companies, organisations and government agencies. It is an open standard, free of licence fees. It is already being put to practical use in a number of countries and implementations of XBRL are growing rapidly around the world.
>
> …
>
> Instead of treating financial information as a block of text - as in a standard internet page or a printed document - it provides an identifying tag for each individual item of data. This is computer readable. For example, company net profit has its own unique tag.
>
> The introduction of XBRL tags enables automated processing of business information by computer software, cutting out laborious and costly processes of manual re-entry and comparison. Computers can treat XBRL data "intelligently": they can recognise the information in a XBRL document, select it, analyse it, store it, exchange it with other computers and present it automatically in a variety of ways for users." (XBRL website www.xbrl.org )

**Private Initiatives** – sometimes groups of interested market participants join forces to come up with standards that address a common need. A recent example of this is the group of 13 broker dealers who joined together to issue common usage guidelines for how to use the FIX protocol to address the connectivity needs of the brokers and customers connecting to swap execution facilities in the United States (SEF's) and organised trading facilities (OTF's) in Europe. With an estimated 40 SEF's and OTF's the logic of them all sharing a common connectivity model seems sensible. (Source http://www.ft.com/intl/cms/s/0/d6a46a16-dede-11e0-9130-00144feabdc0.html#axzz22VVhLzmq )

### 7.2. Who oversees these standards?

Their members perform oversight and maintenance functions for all of the above standards, with the majority of participants being banks and vendors.

The FIX Protocol organization is driven by a group of top-level committees, all of which fall under the organization's Global Steering Committee.

SWIFT is a cooperative society formed under Belgian law, owned and controlled by its shareholders. With SWIFT incorporated in Belgium, the National Bank of Belgium (NBB) is lead overseer.

ISDA (International Swaps and Derivatives Association) overseas FpML, the FpML Standards Committee is responsible for implementing the strategy set out by the ISDA Technology Advisory Board, for making the standard available to the public and for releasing new versions.

XBRL is governed by a Board of Directors that overseas several committee and working groups. [60]

International Securities Association for Institutional Trade Communication (**ISITC**) [61]and Financial Information Services Division (**FISD**) [62]represent user communities within the Financial Services industry, they do not promote their own standards. They work with the existing standards providers to articulate the needs and interests of their members in the standards process. They are included in this section as they are both participant in the Standards Coordination Group that maintains the Industry Investment Roadmap.

### 7.3. How do they coordinate their activity? – Industry Investment Roadmap

The standards and standards bodies discussed in sections 7.1 and 7.2, all evolved separately in response to specific market needs. FIX for pre trade and trade communication; SWIFT/ISO for post trade communication; FpML to describe complex derivatives in a machine-readable format, and so on. Inevitably there was overlap between these standards and to try and ensure that the industry knew which standard to use where, and under what circumstances these standards bodies joined together to issue the investment roadmap. This roadmap shows the applicability of each standard to specific domains within the computer based trading space.

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[60] XBRL Board of Directors, http://www.xbrl.org/BoardofDirectors

[61] International Securities Association for Institutional Trade Communication**,** http://www.isitc.org

[62] Financial Information Services Division of the Software and Information Industry Association, http://www.siia.net/index.php?option=com_content&view=article&id=138&Itemid=4

The Standards Coordination Group, which meets regularly, maintains the investment roadmap to ensure it continues to depict accurately the standards environment.[63] The detailed version of the roadmap is downloadable from the ISO20022 web site[64]. The Standards Coordination Group consists of FPL, SWIFT, FpML, XBRL, ISITC and FISD.

The Standards Coordination Group maintains the investment roadmap that addresses some of the confusion that exists in the minds of users about which standard to use where and for what purpose. However, this stops a long way short of a common agenda-setting process and a mandate that would deliver the credibility and transparency to address concerns about the lack of transparency in the Financial Services industry, particularly when such a lack of transparency places financial stability at risk.

[63] Investment Roadmap, FPL website, http://www.fixprotocol.org/investmentroadmap

[64] Detailed version of Investment Roadmap from ISO20002.org, http://www.iso20022.org/documents/general/InvestmentRoadmap.pdf

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