REG TECH Council

A New Paradigm for Regulatory Change and Compliance

A Whitepaper by the RegTech Council

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About the RegTech Council

Connecting all RegTech participants to define common approaches to regulatory compliance

The RegTech Council is a not-for profit think-tank, which provides a bridge between regulators, firms, academia and the wider financial and technology markets. It is a not for profit association with transparent formal structures and byelaws.

Established in May 2017, the RTC has members across the globe including regulators, financial services firms and service providers.

The aim of the RTC is to provide a forum where regulators, regulated firms and tech firms can consider solutions to the challenges presented by the implementation and uptake of new regulatory technologies and help to ensure that RegTech delivers on its promise to the industry.

The Council's focus is to generate real outputs (papers, taxonomies and proofs of concept), which in turn can be operationalised by our members in order to gain the increases in efficiency, effectiveness and scale promised by RegTech.

For Senior Regulators, Compliance Executives and RegTech Providers
who want a **safe collaboration forum to help shape the future of RegTech**

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Executive Summary

Firms in the financial industry face increasingly complex, costly yet similar problems and challenges when it comes to managing regulatory change, compliance and risk. Regulators share in these challenges as they write rules and seek to supervise and monitor financial firms. For example, it took 30,000 pages and 1.5 million paragraphs to describe the rules in MiFID II and has cost the industry some €2.5bn to date to implement. Much of this cost has been spent interpreting and re-writing the rules into business texts and computer code. And the problem is only going to get more complicated. Over 50,000 regulations were published across the G20 between 2009 and 2012. This rose to over 50,000 regulatory updates in 2015, almost double that of 2012. It seems that much like Moore's law in the field of computing there is a 'Law's Law' that means the volume of regulations will double every few years.

The RegTech New Initiatives Working Group (NIWG) was formed to consider what can be done to address this challenge. At the outset the group believed there is the need for, and potential to move to, a new paradigm that is underpinned by collaboration, technology and semantic standards. Semantically-enabled, Regulatory Technology (RegTech) offers organisations the capabilities to understand the impacts of regulations, enable efficient regulatory change management and lower cost compliance, including better data governance and regulatory reporting. The benefits of this approach are greater efficiencies, reduced fines and sanctions, and greatly reduced costs.

The objective of this paper from the RegTech Council (RTC) is to demonstrate how regulations can be processed using open-standards-based semantic technologies and regulatory compliance made more efficient and effective. Specifically, it sets out to define the benefits such an approach can offer regulators and financial firms by mapping compliance imperatives onto impacted business activities. The primary requirement for the success of such endeavours is collaboration among financial institutions in creating a common language based on human and machine readable integrated regulatory and business vocabularies and rules.

The RegTech New Initiatives Working Group (NIWG) implemented a proof of concept using this approach in order to reduce the costs of regulatory compliance in investment banks. The NIWG includes senior executives from several global systemically important banks (GSIBs), RegTech vendors, and university researchers, with regulators acting in an observatory capacity. This paper describes the findings from the proof of concept and catalogues its **benefits which go beyond cost savings**. Enhanced data governance, quality, and accuracy will also accrue as both firms and regulators understand better regulatory rules and their impact on people, processes, technologies and data. Among other things, the paper concludes that:

► A **new technology paradigm** based on **semantically-enabled digital and computational models** can radically **transform regulatory compliance change management**.

► However, **technology alone cannot solve the problem**: **A change of approach is necessary** among regulators, firms and their suppliers.

► To support this change, **common methods and technology design patterns are required**, along with supporting **capability models** for **good governance**.

► **The prize is significant** and **the faster the collective transition to** this new paradigm, **the greater the savings and the better the outcomes**.

► **Immediate action is necessary to transition from analogue to digital ways of working: if not,** the gains made and ground taken will be lost, as will viable solutions currently in incubation, and costly, inefficient business-as-usual will continue to be the norm.

Introduction

The costs of regulatory change and compliance to financial firms is significant, increasing year-on-year, and potentially unsustainable. Such costs are driven by the volume, velocity and variety of regulations, the complexity of many financial firms, and the challenge of interpreting and implementing regulatory change and compliance. This paper describes research by the RegTech Council's (RTC) New Initiatives Working Group (NIWG) on how a combination of industry collaboration and the application of standards and technologies can radically change the way regulations are written, interpreted, implemented and monitored. This work resulted in a proof of concept that demonstrates a more efficient approach to regulatory change and compliance management, which is accessible to regulators and firms alike.

Bain & Co estimates that Governance Risk and Compliance (GRC) spend accounts for 15-20% of *"run the bank cost"*, and 40% of *"change the bank costs"*.[1] Research published by *The Trade* indicates that banks spent over $100 billion on regulatory compliance in 2016 alone and this cost is rising.[2] Looking at specific regulations, Dodd Frank has cost $36bn to date, while MiFID II has cost a mere €2.5bn to date. Thus, given the above, it is estimated that regulatory costs will rise from 4% to 10% of revenue by 2022[1].

One of the key drivers of this rising cost is the volume of regulations. Over 50,000 regulations were published across the G20 between 2009 and 2012. This rose to over 50,000 regulatory updates in 2015, almost double that of 2012. The scale of the regulatory compliance challenge to the financial industry is indicated by the fact that

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[1] McNulty, L. (2017) 'Compliance costs to more than double by 2022'
https://www.fnlondon.com/articles/compliance-costs-to-more-than-double-by-2022-survey-finds-20170427

US Dodd Frank Act has generated over 22,000 pages of regulations, while the US Federal Tax Code has 74,000 pages. It is also estimated that the EU's MiFID II has generated approximately 30,000 pages of related texts in approximately 1.5m paragraphs. Each week sees an average of 45 new regulatory related documents issued.[3] It would be safe to assume this level of change is now the 'new normal' and business most therefore adjust how the address regulations in this context.

Another driver of rising costs is the complexity of modern financial firms in terms of their business models, legal entity structures, products, and market coverage. Monitoring, interpreting and complying with the current volume of regulations is a challenge, even for the largest firms. For smaller firms the costs and complexity may become prohibitive. "Much of the activity (merger/acquisition activity in 2017) was due to fund companies scooping up rivals that were struggling to cope with the immediate effects of the financial crisis."[2] The business costs of regulatory compliance are being spent mainly on consultants, professional services and project cost, including technology changes.[4] Thus, there is an imperative for financial firms to look at how these costs can be lowered, both in terms of one-off costs and on-going costs.

Regulators also struggle with the costs of understanding and integrating domestic and international regulations. Many regulations are historical and are pre-crisis in their origin. As such, they are significantly *form centric* and highly complex, as they incorporate ambiguous rules that requires lengthy supporting text. In addition, they are purpose specific and cannot be re-used. Furthermore, regulators spend much time understanding and unpicking regulations across their own and related jurisdictions. Then there are the problems of the time and cost of processing and reconciling similar regulatory compliance and reporting data using different taxonomies in and across regulatory agencies. Regulators also struggle with the cost of developing new regulations, which necessitate lengthy consultation periods, often in the order of several years. All of this leads to significant technology challenges related to burgeoning data volumes, multiple bespoke collection systems, and the overarching issue of data governance and quality issues.

So what practically can be done? How can financial firms change their approach to regulations without having to spend even more significant sums on consultants, professional services and projects? And finally, how can this be done for the benefit of all stakeholders, regulators, financial firms, large and small and ultimately customers of financial firms?

In short, the answer is a standards-based approach to regulation established through cross-industry collaborations and the application of new RegTech solutions. To this end the RTC established the NIWG, to explore more cost-effective ways to interpret and assess their impact on a financial firm. Its goals are to develop standards-based models and frameworks that will help firms and regulators alike to:

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[2] https://www.ft.com/content/2f1e77f2-f80c-11e7-88f7-5465a6ce1a00

1. Understand the impacts of such regulations on functional activities, policies and procedures;
2. Identify changes required to business processes, activities, roles and responsibilities;
3. Address the attendant risks associated with people, processes, products and related risk models;
4. Identify the implications for IT systems in terms of data governance and analytics;
5. Ensure that consumer's needs are met in a responsible manner.

This was the challenge taken up by the NIWG. The group included representatives from regulators, financial firms, technology firms and academia across Europe.

From the outset the group believed that a step change could be made but that this could only be done through a combination of collaboration, standards and technology. The group set itself the following aspiration:

That through collaboration between regulators, financial firms, technology firms and academia we can develop practical outcomes that will benefit all participants in dealing with regulatory change and compliance. The key features of this collaboration are:

- It benefits all participating organisations, as there is no supervisory or competitive advantage in uncoordinated individual approaches to regulatory compliance – any perceived advantage is not in the interest of the end consumer;
- The use of fundamental industry standards for sharing knowledge;
- The approach helps small firms and big firms alike to move from using analogue technologies to digital technologies to underpin a new paradigm for regulatory compliance;
- There is a material benefit for all stakeholders, including regulators and consumers;
- The approach is not based on one or more proprietary technologies, but the use of standards permits the integrative use of several technologies and reduces adoption and switching costs.

The group believes there are substantial benefits to be gained and that this will benefit more than just the large financial institutions. In the U.S., for example, Tier 2 & 3 banks are being particularly impacted, with many fighting for their survival.[5] The group believe that the following benefits can be realised by financial firms:

- For the first line of defence – reduced costs in conducting regulatory impact assessments;
- For project teams – reduced project costs through the use of a consistent approach to regulatory projects, better data and a clear definition of the existing business model;

► For the second line of defence – low costs of on-going monitoring because these technologies can help capture applicable regulatory changes as they are issued, provide a traceable definition of impacts and change across the business model;

► Third line of defence – agreed and documented statements of impacts and changes that will support future audits and reviews.

In addition, a survey by the Silicon Valley Bank identified the volume and complexity of regulations as one of great concern to FinTech firms.[6] Alex Lee[7], FinTech investor, board adviser and non-executive chair of FSCom, puts it succinctly:

> *"The greatest challenge facing many FinTech companies is the sometimes overwhelming burden (and cost) of regulation. Many of these early-stage companies simply do not have the in-house expertise, resources or funds to navigate and comply with the regulatory maze that has developed in financial services markets. Whilst the majority of these regulations are well-meaning and aimed at protecting consumers, they can sometimes have the adverse effect of stifling consumer-focused innovation."*

Finally, we should include the potential benefit for regulators considering the roles in writing, implementing and monitoring regulations. Developing new rules are costly and time-consuming. This is due in part to the inefficient manner in which changes are released for consultation and feedback. In some cases, this process can take years to complete. Regulations can be highly *'form centric'*[3] and complex, incorporating ambiguous rules and requiring lengthy supporting text. Regulations can also be purpose specific, for example, the recent Money Market Fund rules, which are built upon existing UCITS rules, must be understood and potentially un-picked and re-written for a specific purpose or sub-set of the market. This becomes an even more complex task when working across jurisdictions. One of the most common issues raised is the issue of similar data being requested in different regulations by different regulators. This can create a complex specification process and internal technology challenges of increasing data volumes, multiple bespoke collection systems and ensuing data quality issues. Regulators can benefit in that they can draft regulations using the same standards. Both the EU and US are focusing on data standards. The U.S. Financial Transparency Act will mandate that financial regulatory agencies adopt consistent data standards for data they already collect from firms under securities, commodities, and banking laws. The European Commission is also developing the Financial Data Standards[4]. All this will help firms become more efficient and transparent in implementing regulations, hence improve their governance, and regulatory reporting. This white paper illustrates how such costs can be reduced using open standards in a collaborative approach by industry members of the Council.

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[3] Often regulators are actually restricted by the structure and content of the forms they employ to gather regulatory reporting data. There is also the matter of how much such forms can be amended during the consultation process.
[4] See https://ec.europa.eu/isa2/sites/isa/files/fisma.pdf

The RTC New Initiatives Working Group Project Objectives

The RTC NIWG was established at the first Plenary meeting in May 2017 and the Group subsequently agreed three immediate objectives:

1. To demonstrate that regulations can be identified and interpreted using open-standards-based semantic technologies;

2. To define the benefits this can offer regulators and financial firms by mapping compliance imperatives on to impacted business activities;

3. To illustrate the enabling technologies and collaborations that are necessary to achieve objectives 1 & 2.

The technology standards to be employed were developed by the World Wide Web Consortium (W3C) and related semantic specifications, notably the Simple Knowledge Organization System (SKOS), the Semantics of Business Vocabulary and Business Rules (SBVR, from the Object Management Group). See the appendix for an overview of such standards, mentioned below. Few of these should be new to the reader as W3C standards, such as Unicode, HTML, and XML, are in widespread use across industry since the 1990s; everything from the Internet, Intranets to Mobile Banking are based on such technologies. Indeed, the Financial Transparency Act's policy that agencies make regulatory information available online as open data, is premised on the use of standards like XML and RDF (or related standards such as Turtle and JSON-LD). Likewise, the UK's National Archives is employing XML, RDF and OWL (Web Ontology Language). Enabling standards-based technologies were JWG's RegDelta and SmaRT from University College Cork's GRC Technology Centre, while Governor Software's Neo4J-based Governor Application demonstrated how proprietary technologies can easily ingest W3C standards-based data.

Bridging the Chasm between Regulations and Business Activities

Exhibit 1 presents a model of the business as usual approach to regulatory compliance change management. Note the potential for information loss and/or overload that occurs between the often voluminous, complex and ambiguous regulations, the interpretations offered by legal firms, professional services firms, and the change management in business governance. Then there are the positions taken by decision-makers across the first and second lines of defence in business and IT functions. The potential for information loss may occur due to multiple actors and steps in the process of understanding regulatory provisions, compliance imperatives, and so on. However, early on, there is also the potential for information overload, due to the multiple interpretations offered by intermediaries such as professional services firms, GRC vendors, and law firms. The more stages and actors in the information pipeline, the

greater the risk of information degradation. This is mirrored by misinterpretation, translations problems, and information loss, particularly in the firms where multiple siloed projects and systems are involved in regulatory compliance processes across overlapping regulations.

Not only does this lead to the problem of *translation*, which is compounded by the multiple communication links between stakeholders, but this issue is made significantly worse by the *Tower of Babel* problem, which results from the different languages employed to describe regulatory provisions and associated compliance imperatives. This is further exacerbated by the multiple, often proprietary, technical languages, standards and specifications.

Exhibit 1 High Cost, Low Efficiency Business as Usual
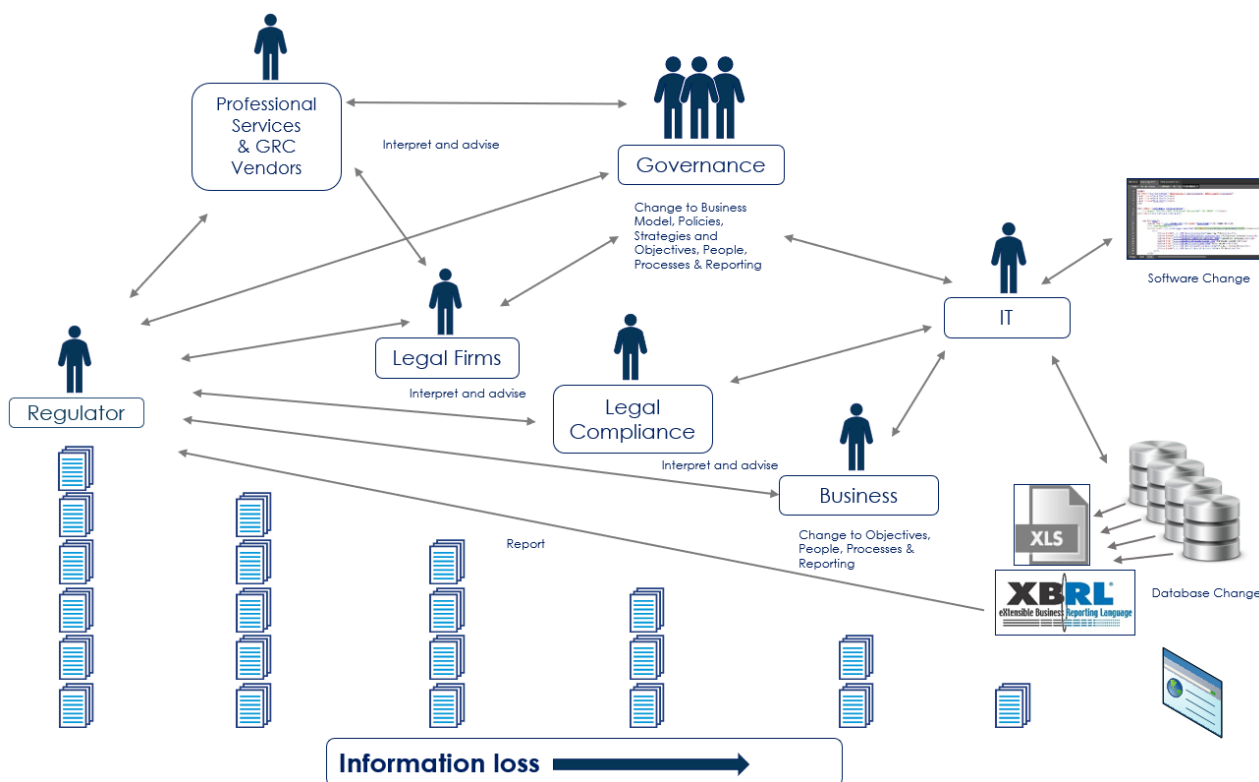
Transforming How Regulations Are Written, Interpreted and Implemented

The NIWG assumed that there is a better approach to the current status quo. This would include:

- ► writing regulations in a different way
- ► using open standards, notably those in the WWW Consortium's (W3C) semantic standards to define information
- ► using software to help model a financial firm, model and interpret regulations and map the impact of the regulations to the financial firm
- ► link interpretations to data models that meet regulatory specification.

The NIWG believes that it is possible to create a vendor-neutral approach that can make it possible to perform intelligent searches of complex regulations, unpack the regulation into human and machine-readable rules and vocabularies, and map these onto the of activities of a financial firm. Exhibit 2 illustrates the object state the NIWG is seeking to reach.

In this model regulations are published in a format that can be read both by humans and computers. The adoption of W3C semantic standards can make this possible. The first step in this process is publishing laws and regulations in XML, preferably using the OASIS LegalDocML standard. The FCA currently publishes its Handbook in HTML and PDF, while its content sits in XML. It is clear that the Handbook's XML could be greatly enriched with a taxonomy and semantic tagging, thereby making more accessible to processing by a machine. Take, for example, the use of LegalDocML by the UK's National Archive enables automated tracking of laws and regulations due to the rich metadata and tagging embedded in each document. The FCA is investigating this next step in making the Handbook machine readable. It is significant that the FCA RegTech Sprint also highlighted how regulators can publish rules and vocabularies using semantic standards and have those processed by a computer to perform regulatory compliance reporting.

## The Proof of Concept (PoC) - Exploring 'Straight Through Regulatory Processing'

'Straight through processing of regulations to achieve regulatory compliance' is an ambitious goal. Exhibit 2 below captures this end state. The first stage Regulatory Publication and Tagging is within reach. The second stage Model Driven Filtering and Tagging of regulations is the subject of this PoC. The third stage, Interpretation and Validation is also researched in the PoC: this will involve impact assessment, legal validation, and review and consolidation of rules. Finally, mapping rules to internal controls and end-to-end visualisation gives a front to back view for management.

Given the significant technical challenges of meeting the above objectives, the NIWG decided to explore a very thin slice of one regulation to develop a proof of concept that would illustrate the challenges which need to be overcome in order for interpretation to become 'straight through'. The scope was limited to the Product Governance domain in MiFID II and how this impacted an Investment Bank. The following regulations were selected to provide the regulatory provisions to be processed.

► Article 24(2) Directive 2014/65/EU (MiFID II)

► Article 10(2) (MiFID II) Delegated Directive (EU) 2017/593

► 3.4 (III) Annex IV, 3.4.3

  ▸ ESMA Final Report, Guidelines on MiFID II product governance requirements (2 June 2017, ESMA35-43-620)

The PoC did not, however, address the 'downstream issues' of how any one firm should apply the common interpretation to their firm.

Exhibit 2 The Role of Regulatory and Business Semantics in enabling Straight Through Regulatory Compliance
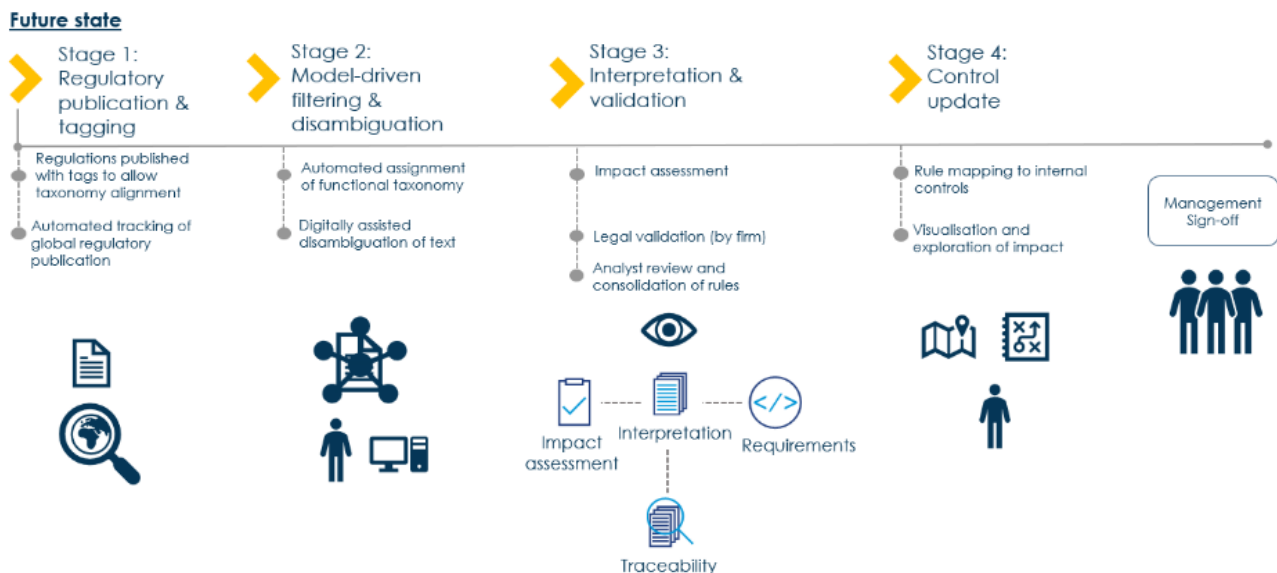
The Approach and Outcome

The following step-wise approach was employed in the Proof-of-Concept, once the target regulations were identified.

Step 1   Develop a semantic model of the Investment Firm – NIWG.

Step 2   Semantically tag regulations by theme, impacted business activities, etc. – RegDelta.

Step 3   Capture Regulatory rules in SmaRT – GRC Technology Centre.

Step 4   Define common models for interpretation of impact for a firm; Where possible, establish agreed data models and common dictionaries to separate data integrity and business rules.

Step 5   Map 1-2-3 in order to visualise and navigate from regulatory provision to impacted activity– Governor Software.

Step 6   Find ways to share the interpretations within and across firms and regulators.

Exhibit 3 highlights the focus of the steps described above. Advances being made by UK regulators aside, the situation facing firms globally is indicated in Stage 1. Stage 2 is the subject of this section. Nevertheless, the current manual, labour intensive and inefficient nature of Stages 3 and 4 are represented. Implicit in this approach are high levels of people, process and technology risk.

The NIWG's first challenge was to have the relevant provisions semantically tagged to demonstrate how machines could be used to reduce the complexity of regulations and identify themes and topics. These could then be mapped to impacted activities in an investment firm. To overcome this challenge, four of RTC member firms shared their reference models for identifying how their firms were organised. The NIWG then created a generic, conceptual or canonical model of an Investment Bank. This set out such a bank's organisation, products, functional activities, roles and responsibilities.

The canonical model was imported into JWG's RegDelta application, which ingests regulatory documents and normalises regulatory content into a single unified XML document structure. RegDelta uses powerful content classification tools to machine read content and semantically enrich paragraphs in regulation with regulatory topic tags. These are derived from RegDelta's rich Skos-based regulatory topic taxonomy. The MiFID II document set was loaded into RegDelta and machine-tagged, resulting in the automated mapping of product governance related clauses and the relevant text was exported in standard formats to the next step of the chain.

SmaRT – the next step of the PoC is a standards-based RegTech application that helps lawyers and legal subject matter experts (SMEs) to unpack regulations into both human-readable and machine-computable formats. The core semantic technologies in SmaRT are based on W3C and industry standard semantic technologies. SmaRT enables legal and financial industry experts to transform complex legislation, related regulatory rules, and other texts containing standards and guidelines into a regulatory natural language (RNL). This standards-based RNL is captured by SmaRT using a combination of human knowledge and expertise augmented by Artificial Intelligence and Machine Learning technologies, such as those in RegDelta. SmaRT may also be applied by regulators to make rules and vocabularies machine readable, as indicated by the FCA RegTech Sprint.

Exhibit 3 Proof of Concept Approach
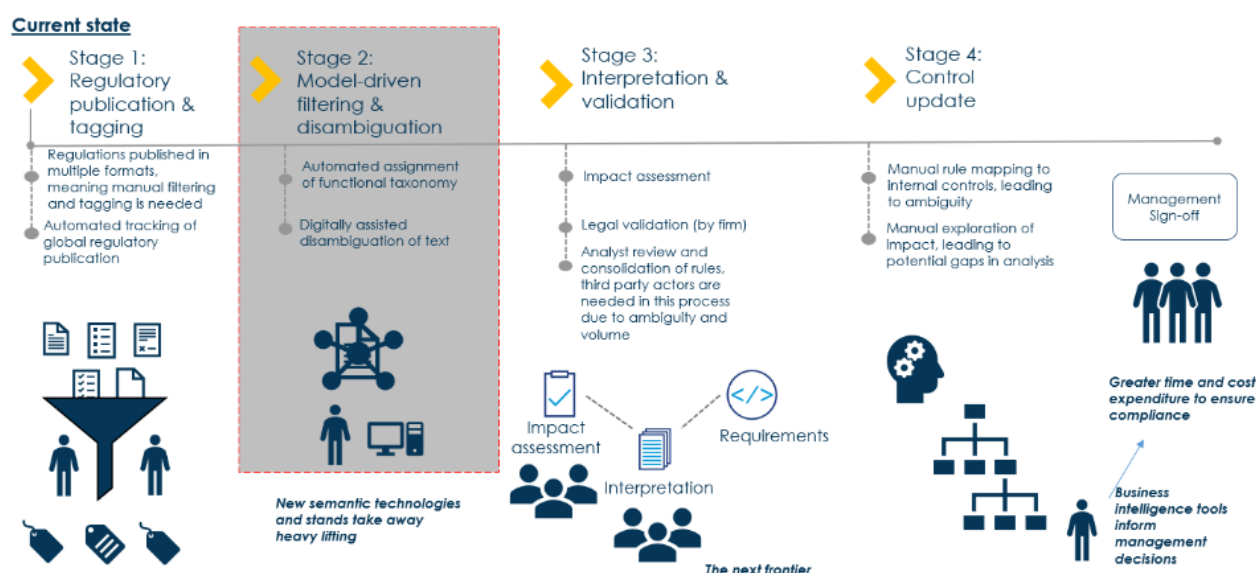
The following Exhibit represents a SmaRT MIFID II rule:

Exhibit 4 A SmaRT Rule
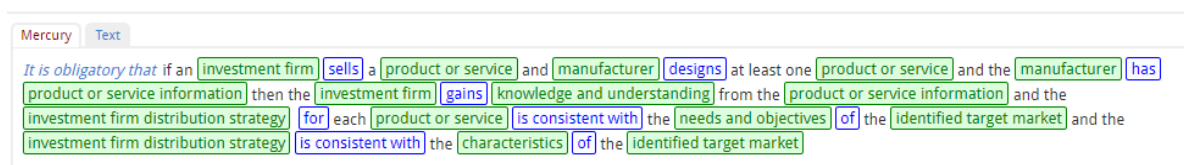
The Rule format follows that defined in the Object Management Group's Semantics of Business Vocabulary and Business Rules. The legal modality of the rule is first declared, i.e. *It is obligatory that* …conditional and logical operators such as *if, then, and, or, at least, at most*, are employed. However, regulatory and business concepts are captured as vocabulary elements highlighted in green. These are arranged in verb concepts (basic subject-predicate-object statements) captured using verbs (blue highlighted text): underline investment firm *sells* product or service. It can be seen that the

above obligation is logically clear and internally consistent. It helps explain the why and how of the original regulatory provision.

The Outcome

Given its ambitious objective, a key deliverable of the PoC was a working demonstration of how a small and specific number of MiFID II rules on Product Governance apply to functional activities in an investment bank. Exhibit 5 below illustrates a navigable model of how the impacts of a regulation can be documented and visualised in a way that permits the user to navigate from regulatory provisions to impacted activities in the first and second lines of defence in an easy to use open standards-based graph-based browse

In order to make this model a reality, the Governor Application was used to ingest the standards-based data from the RegDelta and SmaRT applications. Thus, once the tagged provisions and their semantic interpretation as rules and related vocabularies were captured in RegDelta and SmaRT, the related semantic data was imported into Governor. So too was the semantic model or taxonomy of functional business activities.

Following this manual mapping between regulatory provisions, rules, vocabularies and functional business activities in the front, middle and back office functions were created. Governor presented the model, regulatory provisions, rules and vocabulary as sets of nodes in a graph network. This is captured in Exhibit 5 on the upper right-hand side of the exhibit. The remainder of the exhibit presents a more detailed view. Users could then view the rules, the associated obligations, and impacted functional activities. Hence, users from the first and second lines of defence could follow the relationships through the model and also search and filter nodes to focus on specific areas that concerned them.

Users of such an approach can better understand the downstream effect of changes to regulations or processes, or the impacts of new regulations. In future applications, the addition of status information (e.g. KPIs, assessments) will also make it possible for users to see the status of their various obligations and programs in terms of the regulations as they are presented by the regulator. Applications such as Governor also store changes to the underlying semantic model, thus providing a full audit trail to institutions should they wish to understand what the rules/processes looked like at a point in the past.

Exhibit 5 Mapping from Regulations to Impacted Business Activities
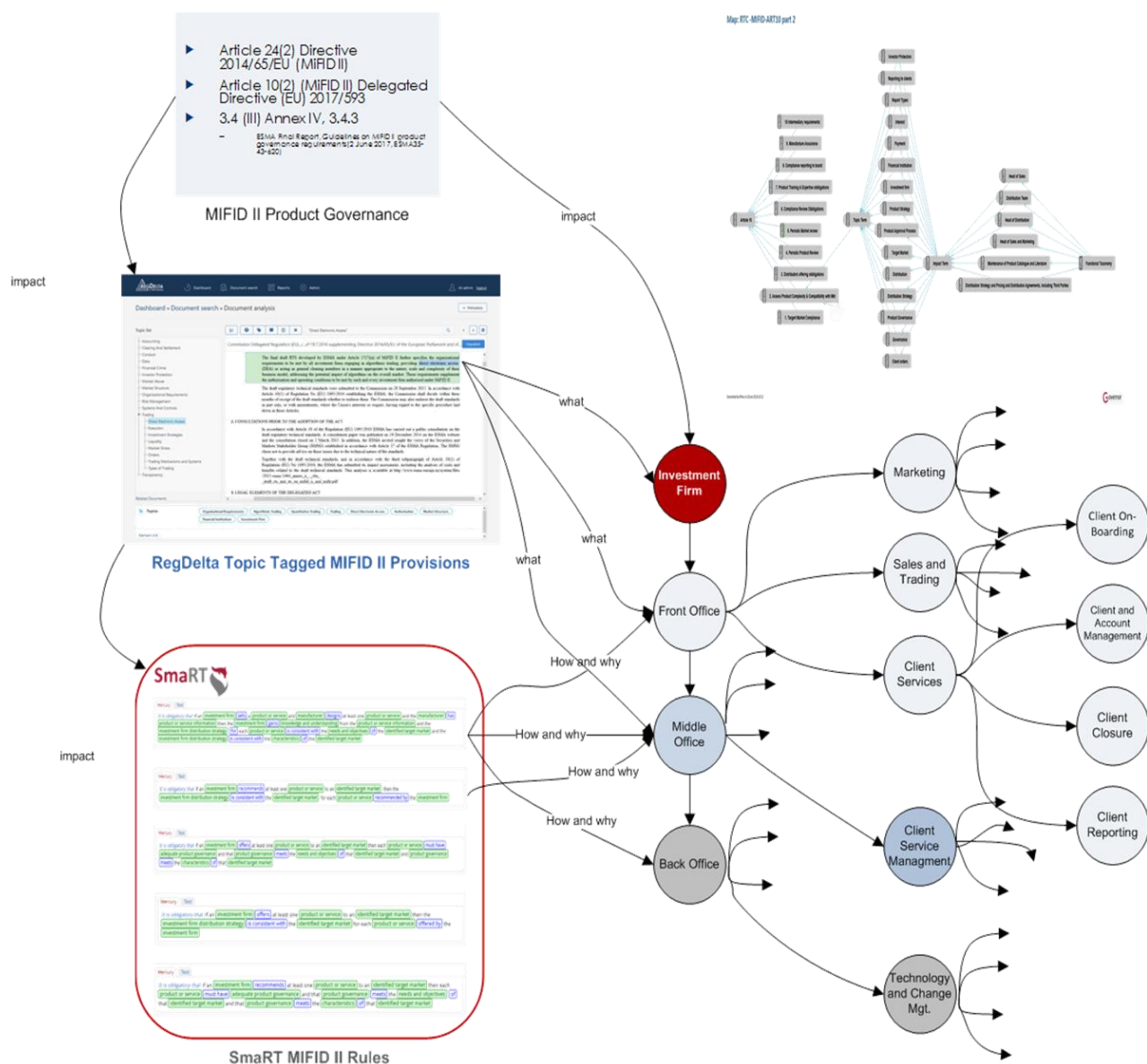
While the paper has described the explicit features and outcomes of the PoC, there are, among other things, several outstanding questions that require attention:

► How can rules be written in way that supports machine processing.
► How can rules impacting a particular activity and the area of business responsible for executing that activity be assessed and presented? (In order to answer the *what* and *where* questions).
► How can changes in rules across multiple regulations and provisions impact business activities?

NIWG Findings

There are several lessons to draw from this proof of concept but the most important one is that the industry requires swift action and support from, for example, institutions such as the RegTech Council, if it is to move to a more relevant and productive paradigm for regulatory compliance management. A number of actions are required to transition from the current chiefly labour-intensive analogue paradigm and leverage the benefits of a standards-based digital paradigm:

► Semantic Standards: Institute a mandate for the use of industry standards for the purposes of creating and managing financial regulations.
► Impact Assessment: Develop a common approach to map the impact of regulation to the financial services people, processes and technologies in the policy development lifecycle.
► RCM Maturity: Design a shared model of regulatory change management (RCM) process capabilities and benchmarking standards to support it.
► Training and Network Building: Develop a set of common materials to disseminate the models and methodologies described above in support of the adoption of the new paradigm.
► Governance: Institute an oversight body to agree and maintain the quality of the artefacts through the RegTech Council.

While it is beyond the scope of this paper to delve into how these goals can be achieved, the NWIG has considered the actions that are required—these are now discussed.

The outcome of the NIWG PoC illustrate that is feasible to move towards a new paradigm in terms of how regulators write rules and how firms interpret them. The financial industry can move away from the existing, analogue-era regulatory compliance processes towards a new paradigm underpinned by semantically-enabled digital standards. There are other initiatives, projects and collaborations currently in play that support this contention. Take, for example, the recent Bank of England/FCA RegTech *Model Driven Machine Readable and Executable Regulation* Sprint. This NIWG initiative shares some of these the former's conclusions.

The application of digital technologies alone, however, is insufficient to solve the problems confronting the industry. Both public and private sectors need to collaborate in order to build the common semantic-based regulatory and business knowledge bases that are needed to ensure the success of the new paradigm. Several initiatives are already underway in GSIBs to develop business knowledge bases. The expression of regulatory and business rules in such models will help reduce regulatory risk and ultimately make regulatory reporting more efficient and effective.

To support the shift to semantic digital models, a number of common artefacts will need to be developed by the industry as a whole. This will require the institution of new

projects, which should be overseen and managed under the umbrella of a governance collective such as the RTC. It is clear that while some firms may bear the initial costs of creating these artefacts, any up-front investment will be reduced through collaboration. The value of such initiatives is enhanced as the outputs would ultimately benefit customers and regulators, thereby creating a positive feedback loop.

An industry mandate will need to be established for the use of industry standards, such as those from the WC3, for example, to underpin the proposed approach. We have observed that large firms have adopted de facto such standards, it merely requires a general consensus that they are employed to underpin collective approaches at mutualising the development of the new regulatory change management paradigm. It is also clear that a common approach needs to be developed for application by large and small firms across industry in order to map the perceived impact of regulations to financial services infrastructures and activities ever before regulatory policy is rolled-out.

The NIWG project provided evidence of this approach through the development of a prototype canonical model of an investment firm. In the context of the NIWG project, the tagged MiFID II regulations, and the SmaRT rules were mapped to product design, manufacturing and distribution activities within an investment bank. This answered the questions of 'what is impacted?' and 'why is it impacted?' This model requires further development and extension to roles and linked to governance policies, operational standards and controls.

The NIWG argues that canonical models can be gainfully employed by regulators as a reference when writing regulations. This approach will allow regulators to assess up front the impact of regulatory requirements on specific functions, activities, processes, products and people. Agreed, open industry-standard models can be mapped to internal, proprietary and firm-specific models. This will contribute to the development of a common language for the industry and help address the persisting *Tower of Babel* problem. The RegTech Council is well positioned to facilitate the type and degree of collaboration required to collectively develop and implement industry standard models and ontologies to help lower the burdensome costs associated with regulatory change management outlined at the beginning of this paper.

The NIWG also concludes that a shared model of regulatory change management capabilities would benefit the industry, with benchmarking to support its adoption and use. In order to achieve this goal, common materials can be developed for professional bodies to help create and train a new category of business professional with the required skills and knowledge of the semantic models required to underpin the new paradigm.

The Business Case

The RTC and the NIWG have given careful thought to the business case for its proposal. Focusing on the second line of defence as a starting point and the compliance function specifically, it is estimated that the U.S. had 273,910 Compliance officers in 2016. On average, financial institutions have 10–15% of their staff dedicated to governance, risk management and compliance. In 2014, Citigroup Inc. had nearly 30,000 employees involved on regulatory and compliance issues[5]. Recently, a survey found that firms typically spend 4% of their total revenue on compliance, with an estimated increase to 10% by 2022. For some GSIBs, the cost of compliance is anything up to $4bn annually[6].

A survey of experts conducted by the RTC indicated that, at a very minimum, a 5% increase in efficiency and a concomitant reduction in costs is expected from the adoption of the proposed digital paradigm. Taking the U.S. with 273,910 compliance officers and assuming an average salary $100,000, the direct costs of compliance is $27.4 bn. A 5% efficiency would deliver a saving of $1.39 bn.

Taking as an example one GSIB. Its revenue in 2016 was $69.87 bn. If this bank's compliance costs are 4% of revenue, as indicated, then this translates to a minimum of $2.794 bn spent on compliance per annum. The savings of applying the new paradigm for this bank would be $139,700,000 at the stated 5% efficiency. If the bank allocated just 5% of these savings ($6,985,000) in an up-front investment, then its RoI on that investment would be 1900%. Of course, this is a very simple calculation. It is, nevertheless, instructive. If the 10 top banks contributed the equivalent of 3-5 FTEs to resource an initiative such as that described herein, then the benefits and the RoI would be considerable.

Conclusions

In transitioning to the proposed new paradigm, there will be significant cultural and institutional obstacles to be negotiated. From a regulatory perspective, "policy" writers will be required to move away from complex, purpose specific specifications that operate typically from a position centric perspective, to a more general purpose, simpler but precise specification that is data centric. For financial organisations, managers across the three lines of defence will have to adopt different mind-sets when considering matters such as the formation of business models, policies,

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[5] Patel, S. (2014) 'Citi will have almost 30,000 employees in compliance by year-end' http://blogs.marketwatch.com/thetell/2014/07/14/citi-will-have-almost-30000-employees-in-compliance-by-year-end/

[6] McNulty, L. (2017) 'Compliance costs to more than double by 2022' https://www.fnlondon.com/articles/compliance-costs-to-more-than-double-by-2022-survey-finds-20170427

strategies, objectives, processes and products. The semantics of each need to be expressed and captured in a business knowledge base.

Ultimately, all stakeholders will benefit in terms of the reduced costs relating to the application of a new regulatory change management paradigm. Human and machine-readable knowledge bases help bring considerable efficiencies and reduce or eliminate the information loss and miscommunication problems presented in Exhibit 1 at the outset of this paper. It is here that the benefits of the new paradigm will be manifested.

Finally, was achieving all this difficult or costly? In the context of the PoC, the answer is no. It was not complicated to get the different applications to work-together because of the use of W3C standards. Neither was it costly to conduct the proof of concept. This does not mean it will be easy to implement a full end-to-end real-world solution, but it does suggest it is feasible and that more work is worth investing in. However, a scaled-up industry initiative could achieve significant results at a low-cost to participants if a truly collaborative approach was adopted and standards are applied; however, this assumption requires market verification.

Furthermore, the models built can be readily shared, given the methods and technologies used, putting aside commercial or intellectual property considerations. However, the NIWG assume that a collaborative approach within industry segments could support and facilitate faster, cheaper and more effective compliance for firms of all size and shape. The significant cultural shift that needs to occur means that the financial industry, as a collective, needs to act sooner rather than later. With the regulatory compliance burden ever increasing, firms need to adopt the new semantic technologies demonstrated in this proof of concept in order to keep pace.

W3C Semantic Web Stack
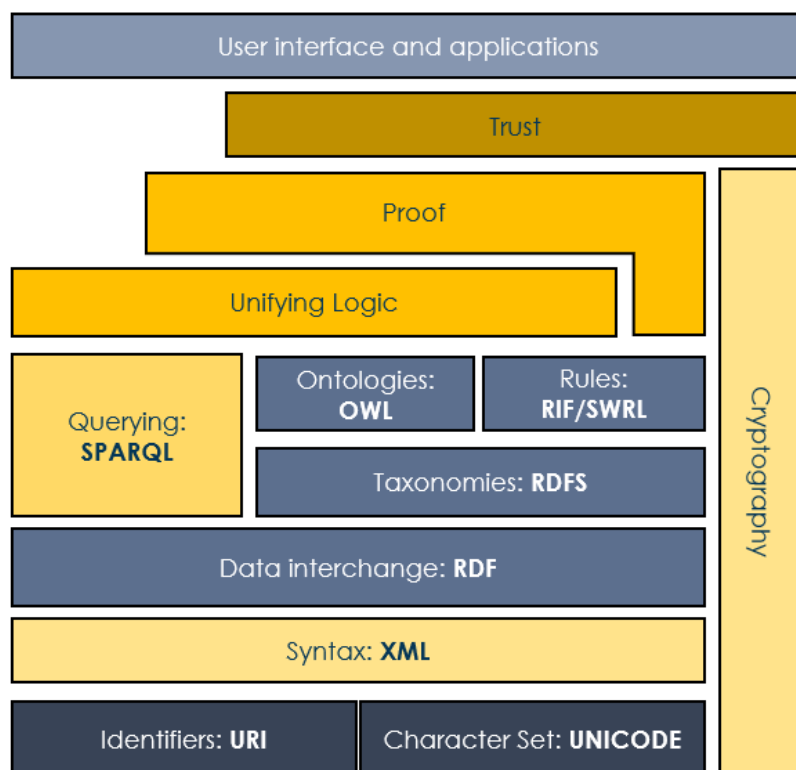
There are several core technologies in the Semantic Stack. At the bottom of the stack is the Uniform Resource Identifier/International Resource Identifier (URI, IRI in Unicode), which is a string of characters used to identify data resources as diverse as interest rates, regulatory provisions, and so on, in a network and to dynamically link to them. Up from this is XML — the Extensible Markup Language — which defines a set of rules for structuring data and documents in a human-readable and machine-readable format — this is used for regulatory reporting using XBRL taxonomies. The upper layers of the stack are built on top of XML. For example, RDF, or the Resource Description Framework, is one of the three foundational Semantic Web technologies, the other two being SPARQL and the Web Ontology Language (OWL). RDF is the data-modelling language for Semantic Technologies. It captures the relationships between concepts in triples, (e.g. investments firm *manufactures* financial products). There are several serializations of RDF, such as Turtle (Terse RDF Triple Language, which is less verbose and easier to use than RDF) and TriG. Many organisations employ JavaScript Object Notation (JSON) as for data-interchange. The W3C's JSON-LD is builds on the RDF syntax and a JSON-LD document is both an RDF and a JSON document. It therefore represents an instance of an RDF data model. This is important as it demonstrates the power and flexibility of such standards. RDF Schema (RDF-S) can be used to define classes, properties and relationships between these concepts. OWL, or the Web Ontology Language, is one step up in expressivity. It is essentially a knowledge representation language that adds semantics to RDF, e.g. defines what an investment firm is, what product manufacturing involves etc., so that a machine can read and reason over such statements. Significantly, RDFS and OWL enable axiomatic definitions of data structures. SWRL is the Semantic Web Rule Language that is used to express rules and logic statements, e.g. regulations governing product manufacture. SPARQL, or the SPARQL Protocol and RDF Query Language, is, as its name indicates, the query language for the Semantic Web and siloed and distributed networked systems. For example, SPARQL can be used to enable querying and integration of siloed financial

and risk data for regulatory reporting and risk management. Using the SPARQL Inference Notation (SPIN) framework, rules can be graphed and executed. SKOS or the Simple Knowledge Organization System applies RDF to describe business taxonomies as concept hierarchies and vocabularies.

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About the Authors

Professor Tom Butler, Business Information Systems, University College Cork is Principal Investigator at the GRC Technology Centre.

A former Government of Ireland Research Fellow, Tom's research focuses on RegTech and RiskTech solutions for the Financial Industry viz. (a) Semantic Technologies—both RegTech and FinTech —to address the challenges faced by banks and other financial institutions in the area of regulatory compliance; (b) RegTech for diagnosing and analysing Conduct Risk; (c) Building and applying vocabularies, ontologies and related semantic technologies to address the challenges posed by regulatory, operational, and conduct risks; (d) Designing Business Models for FinTech and RegTech innovations. His recent research successes include participation in the Bank of England/Financial Conduct Authority (FCA) RegTech Sprint and in the RegTech Council's New initiatives Project. Tom has generated over €8.3 m in research funding, written 71 conference papers, 82 full research papers, 22 book chapters, edited 2 books and written a range of other articles, including 11 RegTech invention submissions.

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Paul is Head of Product Management across the EMEA region within BNY Mellon Asset Servicing. In this role Paul has responsibility for overseeing the enhancement and development of products that support clients across the 107 countries in the EMEA region. Prior to joining BNY Mellon in early 2006, Paul was an executive within the Investment Operations business for JP Morgan Chase Worldwide Securities Services where he took a leading role in the development of its investment operations outsourcing business infrastructure. Paul has significant experience in the financial services industry and has held various senior positions across business development, IT, operations and project management during his career to date. Notably he spent 15 years with Accenture, three of these as Partner, charged with responsibility for several major client relationships. During his tenure at Accenture Paul worked on various IT and operational architecture, change management and outsourcing projects. He also served as a partner in the asset management group. Paul lives in Oxfordshire and holds an honours degree in Mechanical Engineering from Imperial College of Science and Technology.

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John runs the data architecture practice within Technology at the Bank of England and was formerly part of the Chief Data Office responsible for Data Quality Architecture and Standards. John has been at the Bank for three and half years and has been guiding their One Bank Data Architecture program and Master Data Management initiative. John has established the enterprise common logical data model and dictionary to support the MDM and various business projects and provide a facility to share data with external parties. John has also coordinated international, cross regulator initiatives on Legal Entity Identifier usage, and establishing standards for using Granular Data for regulation. More recently John has provided technical expertise to various Semantic Web based Regtech initiatives such as the FCA Techsprint on machine executable regulations. Prior to joining the Bank of England John led various Data Architecture and Data Analytics teams at JP Morgan, Aviva Investors, HSBC and M&G Investments, involved in large scale data transformation and exploitation ventures. John's career over the past 25 years has been focused around data and information within the finance industry particularly in enterprise wide strategy applying a pragmatic, practical perspective. John lives in Essex and holds an honours degree in Geology.