CENTRE FOR FINANCIAL REGULATION AND INNOVATION

Literature review

The Effectiveness of Regulatory Reporting by Banking Institutions

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This paper introduces the regulatory reforms that arose post the financial crisis, and discusses their effectiveness through reference to academic literature. The subsequent heightened reporting requirements, aided by technological developments, became key drivers of regulatory innovation. The term Regtech, which describes the commercial aspect of these, became a key theme in financial markets. The reporting solutions that emerged have the potential to improve regulatory compliance, by ameliorating data issues such as quality, transmission and integrity. The benefit of such developments is an improvement in analysis of reported data which will help cut costs and streamline the regulatory processes. We identify key trends in banking reporting functions that support this trend and we document the downsides of current reporting systems and propose how they can be improved. We discuss the technological solutions and offer some reporting insights proposed by prominent academics.

KEYWORDS
Regtech, Fintech, Strategy, Regulatory models, Innovation, Financial Services, Disruption, Artificial Intelligence, FCA, reporting.

Abbreviations: IFRS - International Financial Reporting Standards; AI - Artificial Intelligence; GFC - Globla Inanfial Crisis. FCA- Financial Conduct Authority.

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1 | INTRODUCTION

An efficiently functioning financial system is seen as a requirement for stable economic growth (King and Levine, 1993). Therefore, it comes as no surprise that the financial crisis of 2007–2008 forced authorities around the world to re-evaluate existing financial regulations, as well as introduce new ones (Alrabiah, 2018). These regulations sought to combat the very risks that materialised during and in the run-up to the financial crisis, such as credit, market and liquidity risks (Aebi et al., 2012). They came at the same time as a number of key digital technological advances, which in turn facilitate what has come to be termed Regulatory Technology (Regtech).

The literature on effective regulatory reporting is important because, according Nouy (2014), both regulatory and financial reporting are cornerstones of effective banking supervision and financial stability. In her role as Chair of the European Central Banks Supervisory Board, she argues that regulatory reporting provides useful information to shareholders as well as regulators. It enhances communication between companies. Given the importance of reporting, the information contained in such reports should be understandable, relevant and comparable across different jurisdictions.

The main difference between financial and regulatory reporting is the audience. Financial reports, such as financial statements prepared in accordance with International Financial Reporting Standards (IFRS), are mainly targeted to investors and creditors, whereas regulatory reports are based on the IFRS or Capital Requirements Directive (CRD IV). Such outputs are largely targeted at banking regulators and supervisors. Due to this difference in audience, financial and regulatory reporting deviate in their scope of application. Regulatory reporting has a narrower focus than financial reporting, meaning that only investment firms and credit institutions are required to adhere to these rules.

The importance of regulatory reporting is clear when looking at the statistics. Every year the Financial Conduct Authority (FCA) receives over 500,000 planned regulatory reports from financial institutions, as well as any additional ad hoc reports (FCA, 2018). According to the Central Bank of Ireland, (2017) regulatory reporting is a crucial piece in effective bank supervision and regulatory returns inform the central bank of an individual bank's risk profile.

The importance of financial reporting, rather than just regulatory reporting, is also significant. Acharya and Ryan (2016) argue that the standard of financial reporting by banks is central in restraining banks' accumulation of debt and risk during economic expansion, while mitigating their harmful (potentially systemic) consequences during economic downturns. The authors state that well-chosen reporting requirements could help banks and their regulators to better understand issues such as liquidity requirements, future macroeconomic conditions and loss exposures. In addition, fraudulent financial statements (FFS) is a prominent issue and can lead to sub-optimal allocation of capital, increased credit risk and loss of public faith Omar et al. (2017). This paper explores these and other regulator reporting issues in further depth through the lens of the literature.

2 | TECHNOLOGY IN BANKS' REPORTING FUNCTION (REGTECH)

Technology is changing the way banks report. Buckley et al. (2019) argue that the abundance of required reports has triggered a 'RegTech revolution' in the heavily regulated European financial industry. RegTech is a combination of the words 'regulatory' and 'technology' and specifies the use of technology, especially information technology, in the space of regulatory reporting, monitoring and compliance Arner et al. (2018)

As the financial industry is becoming more digitized and standardised, more resources have been directed towards better and more efficient use of the regulatory data, both in the interest of reducing compliance costs, as well as generating new opportunities. Indeed, financial institutions are continually forced to invest large amounts of money on

new software and IT systems, in order to ensure compliance with regulatory requirements. Conversely, regulators must invest money in various data management systems capable of handling and analysing the received data. This, in turn leads to more data requested for financial institutions, leading to another RegTech cycle Buckley et al., (2019). 67 per cent of IT managers spend at least USD 250,000 both on the implementation and maintenance of a single regulation and 3 percent spend up to USD 25m (Gordon, 2017). This highlights the importance of RegTech in oversight of financial institutions by referring to a Financial Conduct Authority (FCA) action against the American bank Merrill Lynch for reporting failures in October 2017. The authors state that only through technological solutions could Merrill Lynch have filed the appropriate reports. Conversely, the FCA's detection of this discrepancy was significantly more likely through the use of RegTech than without it.

The FCA (2018) state that a move to a more digital reporting function could benefit both firms and regulators. For instance, the costs of data submissions could be reduced and their accuracy increased and any changes or amedments to regulatory requirements could be put into action more quickly. In addition, lower compliance costs could lower barriers to entry to the market and therefore promote competition.

In order to promote the growth of digital reporting, the FCA collaborated with financial institutions at a TechSprint event where the participants were able to develop a 'proof of concept'. This new development could potentially make regulatory reports machine-readable and executable, giving the firms more control over their data, as well as automate and streamline the process in general (FCA, 2018).

It is clear that financial institutions as well as financial regulators will continue to invest money in solutions based on technologies such as artificial intelligence (A.I.), machine learning, natural language processing and big data analytics. Many academics and authorities have pointed to the lower costs and better regulatory outcomes they such RegTech solutions enable. While Bamberger (2009) argues that the downsides of new technologies are often ignored in the rush of adopting new technologies, only the future will tell whether the industry has been successful in the implementation of these technologies and whether the forecasted pitfalls have been avoided.

3 | THE IMPORTANCE OF FINANCIAL REGULATION

Financial regulation has, post the Global Financial Crisis (GFC) become tighter. Goodhart et al. (1998) pointed to the fact that most of the world's countries had been shown to have a fragile structure in their financial systems. In fact, from the start of the 1980s until the mid 1990s, 133 of the 181 member countries of the International Monetary Fund (IMF) had experiences significant problems in their banking sector, with 36 of these countries having experienced a full-scale crisis.

Goodhart et al. (1998) detail the importance of financial sector regulation. The authors begin by pointing to the two reasons for consumer protection; unsatisfactory business conduct as a consequence of information asymmetry and the failure of a fund-keeping institution, where the latter could also lead to wider systemic issues. The authors explain that the failure of a single institution could potentially instigate a bank run, i.e. a situation where members of the public lose their faith in the financial system and seek to withdraw their savings in the first instance. These bank runs can be highly contagious and can lead to banks becoming insolvent, which can then have devastating consequences for the wider economy

The rationale behind systemic regulation, which is needed when the social costs of a bank failure exceed the private costs, and the potential costs of the failure, are not incorporated in the current bank decision-making. The nature of bank contracts, where in case of insolvency potential loan-buyers have asymmetric information on the nature of the assets, make them difficult to sell on a secondary market. Moral hazard, due to bank safety net arrangements, mean that

central banks act as the lender-of-last-resort.

Jeffers (2013) argues that banks are indirectly encouraged to take on undue risk, as they are aware of the government's backing, which is inevitable in a case of a crisis, thus leading to moral hazard. The term moral hazard is usually used when referring to banks that are 'too-big-to-fail' (also referred to as Global Systemically Important Banks or G-SIBs), that is, institutions whose collapse could potentially trigger a worldwide depression.

As mentioned, the financial crisis changed the backdrop. In this respect, Weber (2010) discussed the objectives of financial regulation from a post-crisis perspective. According to Weber, financial stability, market integrity and trust, in both systems as well as other people, are key areas of regulatory focus. Weber states that financial stability is perhaps the most important area of financial regulation, as it is closely linked to stable economic growth and in general to the performance and functioning of the economic system. Weber states that financial stability can be difficult to define, however a widely used definition is by Schinasi (2006), who defines financial stability as "…the ability of the financial system to facilitate and enhance economic processes, manage risks and absorb shocks".

Weber's second point – market integrity – entails the prevention and mitigation of criminal activity, such as money laundering, corruption and terrorist financing. Weber argues that market integrity is essential a well-functioning market and one of its key tasks is to prevent a loss in public confidence from happening. Lastly, Weber refers to fair conduct of business when discussing the trust aspect in financial regulation. Weber argues that this aspect aims to protect both investors and consumers, along with ensuring the functioning of the financial system and giving financial institutions (FIs) the premise to fulfil their functions in an appropriate manner.

Having reviewed the the rationale of financial regulation, it seems clear that the regulation of financial institutions is needed for a variety of reasons, such as the systemic importance of the financial sector for the wider economy, informational asymmetry between firms and consumers and moral hazard associated with bank safety net arrangements, such as central bank bail-outs. The rationale for regulation is even more clear when examining the statistics brought forward by Goodhart et al. (1998); the recurring significant problems and financial crises within the IMF member countries serve as a good reminder that the GFC was not simply an erroneous step from the financial industry, but rather a continuation of a trend which culminated to the worst financial crisis since the Great Depression of the 1920s and 1930s.

The GFC was a reminder on the importance of consumer and investor protection. Mis-selling of various financial products was commonplace in the run-up to the crisis by high-profile banks such as Lloyds and JPMorgan Chase (Erturk, 2016), which eroded the public confidence towards the industry actors and the financial system in general.

A well-functioning financial system is a requirement for stable economic growth. As public confidence is a central piece of a well-functioning financial system, it is hardly surprising that academics and authorities alike strive to do their best to protect both the safety and soundness of the financial system, as well as ensure that issues regarding informational asymmetry and bank runs are mitigated.

4 | REGULATORY FAILURES EXPOSED BY THE GLOBAL FINANCIAL CRISIS

After the worst of the GFC was weathered, academics started to examine the regulatory frailties uncovered by the crisis. Based on this research, combined with other expert opinions, legislators and authorities started to implement changes to regulatory standards.

Alrabiah (2018) states that the information asymmetry between regulators and banks was a critical issue that was exposed by the global financial crisis. Alrabiah specifically attributes to bank regulatory reporting and argues that inefficient information exchange models, disintegrated business processes and general non-integration between bank

regulatory reporters supervisors impeded proactive intervention by the regulators, which could have mitigated the effects of the GFC.

Jardelot and Mitov (2015), Mochon (2016) and Ehrenfeld (2016) argue that the financial crisis revealed the opaqueness and inadequate supervision of over-the-counter (OTC) derivatives and securities financing markets. Jardelot and Mitov (2015) state that the interconnectedness of OTC derivatives and lack of transparency were key contributing factors in the build-up of systemic risk and systemic contagion. In addition, Jardelot and Mitov point to the limited transparency of market developments and counterparty relationships as being exposed by the crisis. Lastly, Mochon (2016) points to overall lack of transparency and financial engineering as key causes for the GFC.

According to Rattaggi (2017) data quality, consistency, validation, accuracy and timeliness are key when striving for compliance with the Basel II/III regulatory requirements and issues in these areas were exposed by the GFC. Prorokowski (2015) states that insufficient investor protection, unclear derivatives regulations and poor market transparency with respect to trading and investor protection were issues uncovered by the global financial crisis. Tykoczinski (2014) argues that the lack of a strong enough risk management framework for industry participants was one of the reasons that led to the crisis.

Barth and Landsman (2010) meanwhile observed that the level of disclosure regarding derivatives and asset securitizations was insufficient for investors to make informed decisions on the risk levels of banks. This, in part was once of the causes for the GFC. In addition, according to Pinnuck (2012) and Acharya and Ryan (2016), fair value accounting (which could theoretically give the banks the chance to distort their financial statements and thus their financial and regulatory reports), was not in itself a cause to the GFC. However, a weakness might have persisted in the application of fair value accounting that contributed to the crisis (Pinnuck, 2012; Acharya and Ryan, 2016).

The literature does not support the claim that fraudulent financial reporting was a key cause for the financial crisis. Fraudulent financial reporting signifies the manipulation of financial figures by overstating profit, revenue and assets or understating expenses, liabilities or losses (Omar et al., 2017). Instead, Pinnuck (2012) and Barth and Landsman (2010) found more evidence on the insufficient disclosure regarding derivatives and asset securitizations leading to less-informed investors and less-than-optimal allocation of capital.

That is not to say that fraudulent financial statements (FFS) have not been an issue in both the pre- and post-crisis world. In fact, McCuaig (2006) argues that, despite many attempts to do so, corporate financial reporting had not improved in the three decades leading to the global financial crisis. These attempts included reforms such as Sarbanes-Oxley and the Internal Control-Integrated Framework. Instead, fraudulent financial reporting continued being an issue.

Chen (2016) argues that a growing number of fraudulent financial statements have the capacity to damage companies and culminate in significant losses for investors. In addition, Omar et al. (2017) argue that FFS lead to sub-optimal allocation of capital, increased credit risk and loss of public faith. Therefore, Chen argues that establishing a robust FFS detecting model is extremely important and Omar et al. (2017) state that auditors, accountants and companies in general must be more vigilant in combating financial fraud. According to Katsis et al. (2012) auditors are expected to identify this fraudulent behaviour, however, limitations, such as human error, negligence and fraud have been reported issues in the auditing field (Tackett et al., 2004). Lastly, Pinnuck (2012) and Katsis et al. (2012) argue that performance incentives, namely in the executive level, may have led to fraudulent accounting practices by financial institutions, ultimately leading to fraudulent financial statements and reports.

Considering the findings in the literature, it is fair to state that the objectives of financial regulation – as discussed by Goodhart et al. (1998) and Weber (2010) – were not met during and in the run-up to the crisis, as the literature does indeed seem to indicate that various regulatory failures were exposed.

Particular focus was given to the level of disclosure, opaqueness, lack of transparency and poor communication

between firms, regulators and consumers in general. In fact, multiple authors deemed the derivatives market as opaque, inadequately supervised and too interconnected, thus contributing towards the systemic risk and systemic contagion. Consumer protection, especially in terms of information asymmetry, in this case the inability to reliably evaluate the riskiness of an investment and/or institution, was also brought forward.

In addition, while fraudulent financial reporting (a potential threat towards reliable financial and regulatory reporting) did not seem to have a major impact on the recent crisis, certain weaknesses were found in the application of fair value accounting. Additionally, many academics agree that fraudulent financial reporting can increase banking risks and erode public confidence and as stated by McCuaig (2006), the standard of financial reporting had not increased in the decades leading up to GFC, despite many attempts to do so.

Therefore, considering the shortcomings in bank disclosure standards and the importance of the reporting function in general, it is reasonable to assume that regulators should take action and seek to improve the level of both financial and regulatory reporting.

5 | SUBSEQUENT REPORTING REQUIREMENT CHANGES

Authorities aimed to fix the opaqueness of the banking sector by demanding more information from the firms. According to Mochon (2016) and Buckley et al. (2019), various new reporting requirements for financial institutions were implemented post-crisis by the European authorities.

The most important of these initiatives, according to Buckley et al. (2019), were as follows: CRD IV for the banking sector, AIFMD for the asset management sector, MiFID II for financial markets and EMIR for market infrastructure. Other notable reporting requirements include SFTR, REMIT, Dodd-Frank and IFRS 9 (Jardelot and Mitov, 2015; Miu and Ozdemir, 2017; Mochon, 2016). The requirements were largely done to improve the level of regulatory reporting, however, CRD IV and IFRS 9 both contain requirements for improved financial reporting. We break down the reporting requirement changes to specific directives and laws in Appendix 1.

In order to combat the regulatory failures and blind spots exposed by the global financial crisis, the regulators did in fact seem to focus on improving disclosure and market transparency. Possibly the most prominent topic brought forward by academics was the inadequate transparency of derivatives. The regulations MiFID II, EMIR, REMIT, CRD IV and Dodd-Frank were in large part designed to combat the opaqueness of derivatives contracts. Consumer protection, investor protection and information asymmetry were also topics brought forward by academics. Regulations such as AIFMD, SFTR and Dodd-Frank all had provisions intended to combat these shortcomings in regulatory compliance. In addition, the increased level of disclosure was widely intended to increase market integrity and preserve systemic stability.

Prorokowski (2015), Tykoczinski (2014), Cadmus (2012) and Greenberger (2013) also discussed the potential risks included with the implementation of new regulations. Both Prorokowski and Tykoczinski suggested the use of external service providers in handling the renewed technological, as well as informational aspects introduced by the MiFID II and AIFMD regulations. Cadmus and Greenberger pointed to the potential systemic importance of derivatives clearing organizations and argued that access to the clearing market should be kept open.

Nevertheless, the amount of new regulations intended to combat the shortcomings exposed by the financial crisis shows that regulators have at least made efforts in trying to improve the core functions of the financial system. However, it is unclear how the regulatory reforms are going to work in practice and whether any issues arise from the required outsourcing as discussed by Prorokowski (2015) and Tykoczinski (2014). Therefore, additional research is required on this field in the future. We conclude that distributed technologies are a possible regulatory blind spot and one in which

we urge diligent focus on by regulators.

6 | TECHNOLOGICAL INNOVATIONS IN BANKS' REPORTING FUNCTION

The increased reporting requirements have forced both banks and regulators to innovate in their approach to the data handling and data analysis. Buckley et al. (2019) state that the changed regulatory landscape of Europe has forced both the industry, as well as its regulators, to digitize its data collection and regulatory reporting in a comprehensive way. Indeed, as discussed, the goal of the TechSprint by the FCA (2018) was to automate the reporting process, aiming for a more streamlined approach to reporting. Butler (2017) argues that RegTech has the potential to help financial institutions make their regulatory reporting function more efficient and effective.

Kavassalis et al. (2018) argue that flexibility, timeliness and speed are all major features of a regulatory regime that can effectively diminish the potentially dangerous occurrences in the financial system. According to the authors, the current analytical and reporting processes experience vast difficulties in delivering such a high standard of performance, both in terms of organisation, data architecture and technical infrastructure.

In fact, Kavassalis et al. (2018) argue that, while the number of reported derivatives contracts to local trade repositories (TRs) had more than tripled from under 10 million in 2013 to more than 30 million in 2016, there are still major organisational inefficiencies often resulting in data fragmentation and issues with quality consistency of the collected data. For instance, issues with data collection, such as trade execution and price timestamps, aggregating similar data and comparing data from different sources have been frequently reported (Chen et al., 2011; Gordon, 2017). Furthermore, the authors state that the current reporting and analytical processes would experience considerable difficulties in delivering reliable results when dealing in the increasingly complex and automated financial system.

The authors claim that new reporting requirements, such as BCBS 239 , require a 'radical re-engineering' of IT systems used by financial institutions. The inefficiency of these systems, combined with slow industry adaptation, may delay, and thus undermine, the intended benefits of these regulations, which according to Houstoun et al. (2015), is a regular occurrence in the industry.

Therefore, Kavassalis et al. (2018) present a new innovative approach to supervisory reporting and financial risk monitoring, using various technologies such as algorithmic financial contract standards, distributed ledger, document engineering methods and automated legal text. The authors argue that this approach, based on RegTech, has the potential to curb costs associated with compliance and supervision, as well as decrease the operational risk of potentially inappropriate data handling.

In the approach, a bearer service generates and subsequently maintains a Dynamic Transaction Document (DTD), which forms a standardised data facility. This DTD also allows, via a Distributed Ledger (DL), relevant authorities to request and process important contract data received from the transaction counterparties. The authors conclude by stating that anybody with access to the DL can view and verify this 'quasi-simultaneous' data. Kavassalis et al. (2018) find multiple benefits in this new RegTech-based reporting system, such as; integrating reports on transactions and evolution of risk aggregates; closing the gap between the analytical and operational departments; reducing compliance costs; increasing the transparency of the global financial system and; better regulatory compliance outcomes.

According to Grody (2018), the distributed ledger technology (DLT) has the potential to revolutionize many areas of the financial industry, including regulatory reports. DLT's could provide a ledger which could be used by regulators and various market participants for activities such as data analysis and records storage. The risks of DLT were mentioned earlier but it is relevant to point out that regulatory reporting is one of the functions that can also be improved by the DLT technology. In fact, Grody sees the standardisation of regulatory reporting as one of the key priorities of regulators

and argues that a key piece in the standardisation, XBRL (eXtensible Business Reporting Language), has various benefits for regulators. XBRL has already been in use in the financial industry since the year 2005 and is currently applied to tax reports, financial statements, income statements and balance sheets among others. While XBRL is a relatively old technology, its use has considerably increased in the past years.

The implementation of XBRL can be attributed to the post-crisis financial environment, where regulators deemed it necessary to have access to more granular transaction data, in order to monitor systemic risk (Grody, 2018). Shah (2018) lists some of the advantages of the XBRL language as facilitating access to more granular data and the overall improvement the reporting function. Shah uses the example of nine Singaporean banks developing a data taxonomy standard based on XBRL, with the aim to streamline and simplify reporting. This change was done after the Monetary Authority of Singapore released a new mandate, requesting access to 300,000 plus data points, an enormous increase from the previous 4,000+ data points. Colgren (2018) and Troshani et al. (2018) state that FIs are swiftly moving on from paper and PDF reports, to a much more automated system. Using technologies such as the XBRL, the reported information is exchanged and analysed without much human intervention. In fact, systems are continuously disseminating new information, allowing for real-time reporting. Business-to-business reporting is happening automatically, entity to entity.

Regulators have tried to achieve industry-wide reporting standardisation in many areas ever since the crisis, for instance in derivatives such as swaps. This is understandable, considering how many have pointed to credit default swaps as one of the main culprits of the financial crisis (Stulz, 2010). Standardisation of the swap transactions data would greatly help in monitoring the impact these securities have on the systemic stability, however, he also agrees that regulators have not yet made adequate steps in this quest to standardisation.

International inconsistency and incompatibility in regulatory reporting is a direct consequence of the increased number of standards and formats brought on by the new regulatory regimes. However, efforts towards more unified standardisation have started in the past years, where regulators are looking to take advantage of technologies such as XBRL, LEI (Legal Entity Identifier) and DPM (Data Point Model). Shah (2018) argues that, beyond its main objective of identifying transaction counterparties in the derivatives market, the LEI can also streamline reporting and analysis operations. Chan and Milne (2019) estimate that the direct savings to the financial industry coming from the implementation of LEI will most likely exceed USD 1bn per annum.

The ISO 20022 reporting standard allows market participants all over the world to communicate with each other, using consistent business terminology and formatting. In fact, the MiFID II regulation already leverages ISO 20022 in helping to standardise and streamline the regulatory communication between firms and regulators. Shah argues that further standardisation is needed in order to ensure the high effectiveness of regulatory reporting in the future.

Alrabiah (2018) found that the data required for regulatory reporting is currently not timely available to banks. The root causes for this are non-value adding activities (waste) and performance variation. Waste refers to the issues in data entry operator jobs, due to insufficient knowledge data and manual data entry, as well as organisational and managerial issues due to insufficient auditing and loss of qualified staff. Performance variation, on the other hand, refers to issues such as not having planning and knowledge management procedures, absence of fully integrated and automated systems that offer consolidation and standardisation for all banks and high employment turnover leading to decreased performance and productivity.

In addition to waste and performance variation, The use of two separate credit risk systems; foundation-internal ratings-based (F-IRB) and advanced internal ratings-based (A-IRB), can lead to faulty data and increase in data variability among banks. Furthermore, the two used systems can generally complicate the validation process and thus affect decision making. Mariathasan and Merrouche (2014) argue that this inability to validate and verify the data gives the chance for banks to manipulate and minimize their capital requirements. In addition, Amorello (2016) and Scannela

(2013) both argue that the complexity and heterogeneity of the banking sector diminishes the efforts of the Basel Committee's to enhance credit risk assessment.

For the aforementioned reasons, Alrabiah (2018) proposed a regulatory reporting framework, which provides a consolidated, standardised and integrated system for all financial institutions in dealing with the heterogeneous banking domain. The framework enhances the regulatory reporting system by integrating a cloud computing network with integrated, automated and standardised features. Alrabiah explains that roles such as Business Process Manager, Data Quality Regulator and Knowledge Management Engine help with the pitfalls of the previous reporting systems; it standardises, validates, verifies and consolidates the gathered data, which is transported via an Enterprise Service Bus, which decreases data entry time and protects the data integrity.

Mochon (2016) argues that as more and more data is created, the traditional monitoring tools are insufficiently equipped in dealing with such a high volume of information, which is why big data solutions are needed. Yoost and Mathaisen (2016) and Blackburn (2015) state that regulatory reporting, along with other areas in risk management can be improved by the use of big data and advanced analytics. Yedavalli (2018) discusses the benefits that Robotics Process Automation (RPA) could potentially have for firms' reporting function, stating that nowadays a large portion of an individual worker's day is spent 'data crunching', leaving little time for the actual analysis.

Companies could potentially completely eliminate time crunching data, instead allowing the workers to spend their time in a more productive way. According to Yedavalli, time could be potentially saved in both financial and regulatory reporting. As financial firms aim for a more cost-effective and efficient approach, some are looking to utilize technologies such as gap analysis, data preparation tools, consolidation and streamlining exercises, as well as third party vendor delegation services in order to aid the analysis of the establishment of a robust foundation to any future regulatory reporting initiatives.

Many academics have tried to combat the issue of fraudulent financial reporting by applying technological solutions to financial statements. For instance Katsis et al. (2012) used an ants-based classification and Chen (2016) used a hybrid data mining approach, both of which returned overall good results. Both of the authors also recommended the use of their classifier as a support tool for auditors.

As an aside, Omar et al. (2017) predicted fraudulent financial reports using an artificial neural network, which outperformed statistical techniques traditionally used to predict fraudulent financial reports. Other studies using technology in detecting fraudulent financial statements are Gray and Debreceny (2014), Huang, Tsaih and Lin (2014) and Huang, Tsaih and Yu (2014). All of the aforementioned studies were able to increase the effectiveness of fraud detection by using a variety of tools, such as topological patterns, neural networks and text analysis.

Having reviewed the technological developments in banks' reporting functions, it seems clear that a 'RegTech revolution', first alluded to by Buckley et al. (2019), is well underway. This is fairly unsurprising, as many academics, such as Kavassalis et al. (2018), Shah (2018), Alrabiah (2018) and Grody (2018) argue that technology has the potential to alleviate the major inefficiencies that exist in the current reporting systems. These inefficiencies include; data issues such as fragmentation, inconsistency, incompatibility, variability and issues with validation and verification; complexity and heterogeneity of the banking sector; organizational issues such as performance variation and waste and; inability for the current reporting systems to handle the higher volume of information required by the new regulations.

Academics were also able to present potential solutions for these issues. In fact, Kavassalis et al. (2018) and Alrabiah (2018) developed frameworks using various technologies such as distributed ledgers, automated legal texts and cloud computing. Shah (2018) emphasized the importance of various standards such as LEI, DPM and ISO 20022 in conjuction with XBRL. All of the authors argued that a vast number of benefits can be obtained with the implementation of the frameworks, standards and technologies, such as improved monitoring of systemic stability, decreased costs, lower operational risk, more streamlined reporting and analytics processes, improved communication, access to more

granular data and an increased transparency in the global financial system.

In terms of fraudulent financial reporting, various technological solutions, such as hybrid data mining, neural networks, topological pattern and ants-based classification were presented in combating FFS. The results indicate that these technologies can be a great help in assisting auditors and therefore prevent fraud and human error in the auditing process, leading to better financial statements and financial reports.

To conclude, it seems clear that the lack of standardisation is the biggest single weakness of the current reporting processes as pointed by various authors. Therefore, authorities should make the standardisation and harmonization of these global reporting processes their single biggest priority.

7 | ISSUES AND SOLUTIONS - TECHNOLOGICAL REPORTING SYSTEMS

The effectiveness if regulatory reporting can be improved by technology solutions. According to Bamberger (2009), downside risks are often either transferred, played down or even ignored in the rush of embracing new technologies. Butler and O'Brien (2019) argue that this is could also be the case with RegTech; the authors state that many academics, such as Arner et al. (2017), fail to observe risks, such as the 'translation' and the 'Tower of Babel' problems.

The translation problem refers to the gap between the intended behaviour of various automated processes and the meaning allotted to business concepts by business professionals, as well as to the behaviours embedded in software code and the meanings recorded by software engineers and systems analysts in data stores. Bamberger (2009) argues that the translation problem led to financial, compliance and risk systems that concealed risk, led its users into a false sense of security, as well as provided incorrect signals to business executives, ultimately resulting in substandard decision-making on potential key issues.

The Tower of Babel problem is common in the financial industry, for instance by not having homogeneous and generally agreed concepts and terms for similar business processes, objects and products. According to Butler and O'Brien (2019) this is not only an issue within the industry, but also within institutions, where various different terms may be used for similar processes across departments and/or communities of practice. The authors argue that the emergence of FinTech and RegTech will not be able to solve the most fundamental problems in the financial industry if the Tower of Babel risk is left ignored.

Butler (2017) offers a solution based on semantic technologies, which allow meaning to be attached to data – both structured and unstructured. This would, according to Butler, also require an implementation of standards-based approach which would be necessary in addressing the issues of translation and Tower of Babel. Butler further argues that this approach can address regulatory requirements in comprehensive, cohesive and coherent manner, and can even handle complex and voluminous regulatory requirements. In addition, Butler and O'Brien (2019) refer to 'ontology-based meta-data models', which will help make bank systems semantically interoperable, help ameliorate the translation problem and ultimately make digital regulatory reporting feasible for FIs.

Semantic tagging of regulations are viewed as a key part in addressing the Tower of Babel problem. According to Shah (2018) the ISO 20022 –standard can also help in combating the Tower of Babel problem. He argued that the standard allows a more streamlined communication among market participants, using consistent business terminology and formatting.

8 | THE ROLE OF ORGANIZATIONAL CULTURE

Closely connected to the concerns about combating the Tower of Babel problem raised by Butler and O'Brien (2019); Wagner (2018) and Gordon (2018) discuss the importance of organizational processes and culture in the context of successful reporting function.

Wagner (2018) argues that regulatory and financial reports these days receive a diminishing amount of attention, as preparers tend to treat them as compliance exercises only serving to fulfill irrelevant and unnecessary disclosure requirements. This, according to Wagner, is a consequence of the reporting being as complex as the underlying business itself and end users largely do not have the resources to tackle this complexity. Wagner argues that the various disclosure requirements should be principles-based instead of rules-based, which encourage regulatory reporters towards a 'checklist mentality'.

While Wagner, along with many other academics, argues for a more standardised and harmonized approach to global financial and regulatory reporting, he also states that wrong kind of standardisation can easily lead to reporting becoming too superfluous. Wagner argues that a 'one-size-fits-all' approach in regards to reporting is bound to fail and institutions should should be given flexibility in this regard.

The most optimal implementation path for regulatory reporting is determined by a firm's foundation. Moreover, Gordon argues that the way for financial firms to most effectively implement RegTech in their business models is down to the infrastructure and resources they have available and no two paths will be identical between firms or regulations.

After reviewing the literature on the potential pitfalls of digital regulatory reporting, it is clear that some research has been done in the field, most notably by Bamberger (2009), Butler (2017) and Butler and O'Brien (2019). The authors pointed to two main problems, translation and Tower of Babel, which can be extremely harmful if left untreated. For instance, Bamberger (2009) argued that the translation problem can lead to risk concealment and poor decision-making. The emergence of RegTech will not be able to solve the issue of poor communication in the financial industry if the Tower of Babel problem is ignored.

We noted that higher disclosure requirements do not necessarily equal to better regulatory outcomes and that a one-size fits all approach would be 'bound to fail'. The most effective way for a firm to implement RegTech in regulatory reporting is dependent on the firm's foundation, infrastructure and resources.

As pointed out by Butler and O'Brien (2019), many academics tend to ignore the downsides of new technologies. This could be one potential reason for the limited amount of literature. In addition, as suggested by Wagner (2018), close monitoring and academic research is needed on the effectiveness of higher disclosure requirements. Thus, more research is needed in these fields in the future.

9 | SUGGESTIONS

We suggest further research is required into the reporting ecosystem. No research exists, for example, on the connection of higher disclosure requirements and better regulatory outcomes and would therefore stop the efforts towards more disclosure requirements. This may be too harsh of a stance, however there is no denying that financial institutions are facing huge challenges while striving to stay compliant with the new regulatory requirements. Nevertheless, academics should conduct extensive research in the coming years on the link between higher disclosure requirements and better regulatory outcomes.

In terms of actions by authorities; the performance of banks with the new reporting requirements must be monitored, as these requirements effectively require the use of technological solutions, but also outsourcing in some

instances. As listed by many academics, these new regulatory requirements bring their own risks and it is paramount that the developments in the field are monitored closely. After all, the health of the financial sector is crucial for the well-being of the society in general.

To conclude, the move to more automation in banks' reporting function is understandable considering the major inefficiencies discussed in the literature survey. Little doubt exists on the statement that the biggest weakness in current reporting systems is the lack of standardisation and integration. Therefore, authorities should direct their biggest efforts towards combating these issues before any major changes to technological standards are implemented.

10 | CONCLUSION

In this paper, we examined the reasons and rationale for financial regulation, what were some of the key causes behind the global financial crisis, how bank reporting requirements have changed post-crisis, what technological solutions have been offered for a more efficient reporting function and finally, what kind of issues and potential solutions have been brought forward by prominent academics.

Our findings indicate that financial sector regulation is extremely important for a well-functioning financial system and stable economic growth. Secondly, the rationale behind financial regulation includes an assumption of informational asymmetry between financial institutions and consumers. Informational asymmetry, poor market integrity and systemic instability all were major contributors towards the crisis. Major inefficiencies existed in banks' regulatory reporting function. In addition, Despite the regulators' efforts, the level of banks' financial reporting had been poor for decades leading up to the crisis, resulting in fraudulent financial statements.

We examined the various new reporting requirements implemented post-crisis. The literature indicated that regulators had largely addressed the regulatory frailties uncovered by the GFC through regulations such as MiFID II, EMIR, AIFMD, SFTR and Dodd-Frank, which focused largely on increased disclosure, protecting consumers and preserving financial stability. However, these new regulations also posed potential risks and threats to systemic stability, which is why further research is needed in the field.

We documented the effectiveness of current reporting systems and their ability to handle current and future reporting requirements. Various authors pointed to the inefficiencies in the current reporting systems, such as data fragmentation, data inconsistency, performance variation and generally the inability for the reporting systems to handle the higher volume of information required by the new reporting directives. Solutions for these inefficiencies included increased standardisation; the implementation of new technologies such as distributed ledger, XBRL and cloud computing and; renewed frameworks based on globally agreed standards. Benefits of these new solutions included lower compliance costs, improved reporting and analytics processes, access to more granular data and better monitoring of systemic stability.

We focused on the potential problems faced with the implementation of these new technologies. Authors discussed problems such as translation and Tower of Babel, which can both lead to poor decision-making and inaccurate estimations of risk level. In addition, the fundamental issues of poor communication will persist if these problems are left ignored.

The solutions we propose are based on those identified in the academic literature. They are increased standardisation through semantic technologies and ensuring that there is semantic interoperability between reporting systems worldwide. As the implementation of technology tagging in reporting functions is dependent on individual firms, the effectiveness of regulatory reporting using RegTech will depend on the adoption of financial technology and the efficiency benefits that they gain from its roll out.

11 | APPENDIX 1 - REGULATORY REPORTING CHANGES

11.1 | MiFID II

The objective of the Markets in Financial Instruments Directive (MiFID II) reporting obligation is to create a more integrated market environment within the European Union. It is designed to stimulate healthy competition, enhance market discipline, provide clearer regulations for derivatives and uphold market transparency, particularly protecting the buy-side of a transaction (Prorokowski, 2015).

The reporting requirements imposed by the bill include client suitability reports when dealing with retail customers and trade reports for all assets encompassed by the regulation. In addition, the MiFID II regulation imposes near real-time regulatory reporting, where for certain institutions a trade is captured and reported a mere 15 minutes after execution. However, this comes at a cost, and Prorokowski (2015) argues that complying with the MiFID II regulation is generally seen as technologically difficult, expensive and not suitable for all trading models. In any case, Prorokowski states that by approaching data management vendors and outsourcing IT processes is the most efficient way in reducing the MiFID II implementation costs.

11.2 | AIFMD

The Alternative Investment Fund Managers Directive (AIFMD) was designed to enforce a more robust risk management framework for the alternative investment subsector of the asset management industry. The reporting requirements of the directive are aimed to ensure that the information provided by the fund managers are up to date, accurate and truly convey the actual risk profile of the investment vehicles (Tykoczinski, 2014).

Tykoczinski also argues that the huge increase in fund manager duties caused by the directive may prove to be overwhelming to some managers, which is why fund managers may require assistance by external service providers in their reporting duties, particularly regulatory risk reporting.

11.3 | EMIR

In order to counter the opaqueness in derivatives contracts, article 9 in European Market Infrastructures Reform (EMIR) mandated the counterparties to disclose details to an EMIR recognized trade depository, such as concluded contracts or any derivatives contracts that the parties have terminated or modified. Trade depositories then collect and maintain the full record of all derivatives contracts. In addition, to further strengthen the reforms, higher capital requirements are imposed for non-centrally authorised contracts (Mochon, 2016; Jardelot and Mitov, 2015).

11.4 | CRD IV

The Capital Requirements Directive IV (CRD IV) looks to improve standards for counterparty risk, quantity and quality of capital and liquidity and leverage requirements. In addition, the CRD IV regulation sets renewed macroprudential standards, such as countercyclical capital buffers for systemically important financial institutions (Bank of England, 2019).

The reporting requirements mandated by the CRD IV are Common Reporting (COREP) and Financial Reporting (FINREP), which cover areas such as large exposures, own funds and financial information, using the XBRL reporting format (Bank of England, 2019).

11.5 | SFTR

The Securities Financing Transaction Regulation (SFTR) mandates the following; all SF transactions to be reported to trade repositories; information on the use of funds' must be disclosed to investors and; minimum transparency conditions to be met until financial instruments intended to serve as collateral can be reused.

Jardelot and Mitov (2015) state that the EU regulators were unable to quantify the systemic risk emanating from securities financing transactions due to lack of comprehensive and timely data.

11.6 | IFRS 9

The objective of the International Financial Reporting Standard 9 (IFRS 9) is to create principles for the financial reporting of both financial assets and financial liabilities. These reports will present useful and relevant information, which will help in assessing the timing, uncertainty and amounts of an entity's potential future cash flows (IFRS.org, 2019).

11.7 | REMIT

The Regulation on Wholesale Energy Markets Integrity and Transparency (REMIT) regulation necessitates the reporting and disclosure of derivatives trades of physical commodities. The REMIT regulation looks to prevent insider trading and market manipulation (Peters and Vishnia, 2018).

11.8 | Dodd-Frank Act

The Dodd-Frank Act was the most significant of the US post crisis regulation. The Title VII of the Dodd-Frank regulation seeks to minimize systemic risk and provide transparency in the derivatives markets as well as cater credit protection for traders. Under the regulation, Major Swap Participants (MSPs) and Swap Dealers (SDs) are required to provide daily reports of their derivatives activity to a specific Swap Data Repository (SDR) (Cadmus, 2012). In addition, MSPs and SDs are required to provide real-time reporting, for which many institutions have decided to use the services of Derivatives Clearing Organizations (DCOs).

Cadmus (2012) as well as Greenberger (2013) raise the concern of the potential systemic importance of these DCOs, saying that a collapse of a DCO could jeopardize the soundness and stability of the entire financial system. Both Cadmus and Greenberger argue that regulators should focus on making sure that the access to the clearing market stays open

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