Current Status and Challenges of RegTech:
Focused on Machine Readable Regulation*

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<Abstract>
In financial industry, as a representative industry that is heavily regulated, the needs for RegTech is gradually emerging to reduce regulatory risks and costs of reporting. In particular, with the recent advances in artificial intelligence and big data technologies, expectations for effective development of the Machine Readable Regulation and Machine Executable Regulation, which are the core technologies of RegTech, are increasing. For instance, the FCA, the regulatory body of UK, continuously expands the scope of RegTech over time and applies it to regulations in practice. However, Korea is experiencing difficulties due to restricts in developing Machine Readable Regulations for regulatory laws written in Korean. Therefore, the purpose of this study is to analyze the tasks of RegTech by focusing on issues to be considered in the development of Machine Readable Regulation and Machine Executable Regulation in Korea. In fact, managing financial laws as Machine Readable Regulations through RegTech is consistent with the efforts of financial institutions to fulfill their social responsibilities by complying with financial laws and regulations. Moreover, RegTech will be meaningful to supervisory agencies that fulfill their social responsibilities by

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I. Introduction

Financial industry is one of the representative regulatory industry. If the resource allocation by the market fails to achieve the socially desirable optimal state, it leads to market failure and government intervention is required to correct the failure. The financial industry periodically faces such market failures, so it is a highly regulated industry (Stiglitz, 2015). For instance, there are organizations in each country to regulate the financial industry (e.g., Financial Supervisory Service (FSS) in Korea, Financial Conduct Authority (FCA) in the UK; Securities and Exchange Commission (SEC) in the United States). Also, there are international organizations such as Bank for International Settlements (BIS).

The financial crisis in 2008 triggered further strengthening of regulations. In addition, various regulatory costs to supervise financial institutions are increased to reinforce regulations. However, this stronger regulatory environment is not beneficial to both supervisory and financial institutions. For example, from the perspective of a regulator, it is difficult to establish a proper supervisory system, as regulations must be familiarized by the law enforcement resulting heavy workload. In case of financial institutions, failing to familiarize with the regulations leads to tremendous costs and huge losses. In fact, Boston Consulting Group estimates that the amount of fines imposed on sanctioned banks in the US and Europe from 2009 to 2016 is about $321 billion.

Meanwhile, in addition to the increase in regulations after the financial crisis, the convergence of science, technology, and finance developed the FinTech. The emergence of FinTech was not caused by a single factor, but developed by multifaceted factors after the financial crisis. After the financial crisis, the trend of low growth rate and interest rates continued, causing sharp decline in financial institutions’ operating income. In this regards, FinTech is considered as a new growth engine by reducing the limitations of existing financial products and services (UK Government Office of Science, 2015). Science
and finance have been developed together from the era of analog technology. However, such development was primarily for the benefit of financial institutions. However, the current FinTech is a mean to increase the convenience of life with large contact points with customers such as simple payment, P2P, crowdfunding, or to support the financing of startups. It is becoming an alternative finance for areas where the existing financial infrastructure is not mature (FSS Committee, 2019). Also, the problems accumulated throughout the financial industry since the 2008 financial crisis are acting as the drivers of adopting FinTech.

Existing studies have been examined the subjects related to RegTech, but these studies mainly focused on law-oriented regulations (Yoo, 2019). One other feature of previous studies is that they generally explain about the benefits of the implementation of RegTech. For instance, Arner et al., (2017) argue that RegTech's advantages are integrity, safety, and consumer protection. They insist that RegTech's focus has been changed from manual reporting to the digitalization of regulatory compliance. From a perspective of reform in regulation, the development of RegTech in the future can help financial institutions, regulators, and entrepreneurs. Colaert (2017) argues that the mixed views on the implementation of RegTech exist. The advantages include improved efficiency, reduced risk of individuals and reduced responsibility of regulators. On the other hand, as for the disadvantages, the increase in system risk, high cost, data protection problem, and side effects of dehumanization were mentioned. Yang and Li (2018) argue that technology-oriented regulations focused on data monitoring can be a solution to the inefficiencies of existing financial regulations, and can strengthen effective protection for the rights and interests of financial consumers. In addition, the study insists that the technology that can effectively cope with the FinTech risk, which can be seen as a new system risk, can be effectively controlled by the RegTech.

Turning to the recent studies, most of the literature documents the benefits of RegTech technology and describes the direction that RegTech technology should proceed. Since the FCA of UK is already entering to the implementation stage of RegTech technology, Korea calls for the research that organizes the effects of Korean-style RegTech such as designs and suggestions of RegTech. In addition, since most of the existing studies explain RegTech from the perspective of law, studies from the perspective of financial institutions are insufficient. Literature in Korea also shows a similar trend. For instance, Yeng et al. (2016) show that the recent UK regulatory authorities’ actions do not hinder technological innovation, but rather actively support
innovation and investment. For instance, FCA introduces Sandbox as an example of RegTech implementation. Yoo (2019) argue that in the rapidly changing high-tech era, regulatory law cannot prevent or ignore the introduction of RegTech. They confirm that there are many advantages that RegTech can bring in terms of economic restriction. Lee (2019) mentions that in order for Korea to lead the digital era, the Sandbox ecosystem can be used as an intermediates to achieve synchronization in RegTech and FinTech. Also, the paper proposes that the two-way real-time monitoring with regulatory authorities through the implementation of the “Smart RegTech” is as a new regulatory paradigm in Korea.

Therefore, the purpose of this study is to raise the issues necessary for the introduction of Korean RegTech and to present a development strategy. In particular, it conducts a review on what technologies should be integrated into the Machine Readable Regulation for more accurate and efficient implementation of RegTech. Also, current study provides suggestions on the automation of Machine Readable Regulation to financial laws written in Korean.

Our research contributes to the literature in the following ways. First, it is expected to provide implications for future research where literature related to RegTech is relatively rare. Given that a number of recent studies on digital finance are being introduced and the scale of transactions is expanding, RegTech is expected to be a major research stream. Second, from a financial point of view, we would like to deepen the understanding of RegTech. As aforementioned, previous studies on the benefits of RegTech stem from a legal point of view. Lastly, since we are focusing on the technical part, which is the subject matter of RegTech but rarely reported in prior research, our study contributes to related academic area.

II. RegTech

2.1 Concept

RegTech has emerged in order to create an appropriate regulatory environment and meet the needs of regulatory bodies. It is a system that can reduce regulatory compliance costs and enable efficient supervision. From a regulatory perspective,
regulators wanted to supervise and implement various regulations as effectively as possible at low cost. It has triggered the use of high-tech technologies such as artificial intelligence to the regulatory environment (Yoo, 2019). In an era where complex regulations have emerged not only for market participants but also for regulators (lawmakers, regulators) and potential participants such as startups, there is a need to effectively monitor whether regulatory objectives are properly achieved. To create an environment where regulator can observe market participants by spending the lowest costs and efforts, the need for RegTech has emerged (Arner et al., 2017). RegTech is a compound word of “regulation” and “technology”, meaning that the use of technical methods to promote implementation and supervision of regulation in a broad sense (Colaert, 2018). In a narrowed concept, it is recognized as a sub-section of FinTech that focuses on the use of technology to respond more efficiently and effectively to the financial regulation of the UK FCA.

RegTech could be interpreted as a form of digital transformation (DT) in the financial industry, especially to financial regulatory oversight. One of the main reason incurring the huge costs of financial regulation is that regulatory reports are unstructured, untimely (usually spends six weeks), and the definition of law need to be followed is unclear. Therefore, a system which can ensure timely and accurately reporting is needed.

RegTech is a sub-sector of FinTech (FCA, 2016) that focuses on the use of technology so that it can respond more efficiently and effectively to financial regulations than conventional methods. It covers a wide range of functions, from data collection techniques to complex decision-making and behavioral analysis of report subjects (Fröhlich, 2019). As the financial industry becomes more digitalized and standardized, regulatory-related data will be collected in greater volumes, and RegTech will serve as the information technology to make more useful and efficient use of these data. The usefulness herein means that RegTech makes regulatory reporting more accurately and quickly, and also better responding to the changes in regulations (Alamaki & Broby, 2019). RegTech consists of artificial intelligence (Huang et al., 2014; Omar et al., 2017), machine learning (Chen, 2016; Gray & Debreucen, 2014), natural language processing (Butler & O’Brien, 2019), big data analysis technology (Yoost, 2016), distributed ledger technology (Kavassalis et al., 2018), and Blockchain technology (Colgren, 2018). Artificial intelligence in RegTech is interested in detecting and extracting rules from regulatory sentences that usually exist in the form of natural language (Fröhlich, 2019).
2.2 RegTech in FCA

UK’s effort on developing RegTech begins with the perception that effective and innovative regulatory systems are crucial for balancing regulation, innovation, and stability (Yeung et al., 2016). The starting point is led by the FCA of UK.

The UK’s introduction of RegTech can be divided into the first half (from November 2014 to July 2016), when policy and social discussions are the main focus, and the second half (from November 2016 to present) when technical implementation methods are the main focus. The first half includes following efforts. For instance, the FCA launched the Innovate Project in October 2014 to introduce the RegTech to the international community. Since then, the FCA has made various efforts to directly encourage and develop RegTech techniques.

The second half, by focusing on technological part, began in November 2016. TechSprints with the meaning of Hackathon were held twice by FCA and BoE. Since then, the discussion on the development of the current regulatory reporting system (e.g., a system enables more accurate and consistent reporting) has been started. Two TechSprints published the results of proof of concepts and discussions and began to take place on which technologies were being combined to drive DRR. The first TechSprint was held in November 2016, the theme was ‘Unlocking Regulatory Reporting’. The second TechSprint was held a year later in November 2017, and the theme was about ‘Model Driver Machine Executable Regulatory Reporting’.

Subsequently, the first phase of the pilot was driven by FCA and BoE from June 2018 to December 2018. The objective of this pilot was to expand the work on what was previously discussed in the TechSprint. The first-stage pilot test focused on how to match the two processes: converting the statutes composed of natural languages into computer-readable languages and standardizing corporate data. However, in the first phase of the pilot, various restrictions made it difficult for the statutes to be delivered in a computer-readable language, thereby did not produce useful results (FCA, 2019).
2.3 RegTech in Korea

The FSS in Korea also benchmarks the UK’s FCA, making various efforts to become a leader of RegTech in Asia by communicating with stakeholders.

It was 2017 that the concept of RegTech was introduced in Korea. FSS has introduced the concept of Hackathon and held seminars and meetings with various stakeholders, just like FCA did. In October 2017, a seminar was held jointly with the Financial Services Commission and the Korea Institute of Finance under the theme of “Introduction and Revitalization of RegTech”, and since March of the same year, the RegTech Forum was held, which consisted of experts from domestic financial companies, IT companies, and academics.

Currently, PoC has been carried out twice to verify whether RegTech can be implemented in Korean financial laws and now regulatory body seeks for the future development.

2.4 RegTech in Other Countries

The current status of RegTech other than the UK and Korea are as follows. First of all, Vizor, from Ireland, was founded in 2000. It is a company that makes software for regulatory regulation, and has already exported solutions to the central banks of Britain, Canada, Saudi Arabia, and Brunei. Next, Corlytics, also from Ireland, was founded in 2014 and provides solutions to risk management. It made contract with UK’s FCA and provides solutions to customers, especially focusing on global legislation.

Second, the representative company in identity management and control is NewBanking, founded in 2016 in Denmark. NewBanking provides a solution that makes it easy and safe to store, manage, and share personal information with trusted companies for free. Companies and financial institutions who use the NewBanking platform not only have easier and cheaper access to customers’ personal information, but can also perform the customer identification required by the regulatory authorities.

Other non-English speaking countries, including Asia, have yet to see any significant development on RegTech. Therefore, if Korea first implements RegTech, it will greatly open up opportunities to contribute to the implementation of RegTech in non-English speaking countries.
2.5 Machine Readable Regulation

The main purpose of Machine Readable Regulations is to clarify regulatory knowledge and concepts (unambiguity). If regulators provide a Machine Readable Regulation that allows machines, such as computers, to recognize the regulations themselves and automatically implement them, financial institutions and other market participants can easily interpret and follow the regulations by entering the Machine Readable Regulations provided by the computer. It automatically reports the results to the regulators, thereby achieving regulatory compliance (Yoo, 2019).

Another purpose of the Machine Readable Regulations is to automatically generate and submit regulatory reports without intervention from regulatory bodies (Banwo, 2018; FCA, 2019). Therefore, incorporating Machine Readable Regulation is expected to lower the costs associated with regulatory implementation (Authority, 2016).

However, the Machine Readable Regulations are still mostly applied to English-speaking laws and have rarely been verified in non-English speaking regulations. Accordingly, the FSS has been carrying out concept verification projects since 2018, and some laws have already proposed in a Machine Readable state in the form of OWL ontology. By doing so, it is possible to develop a Machine Readable Regulation for laws written in Korean. Nevertheless, many issues are on the table and still need to be resolved for full implementation.

III. Requirements for Korean Machine Readable Regulation

3.1 Machine Readable Regulation for Korean Regulations

The existing Machine Readable Regulation project is mainly written in English because it is being promoted in the Anglo-American region. Also, SBVR, an intermediate expression used to write machine readable registration is produced in English-friendly. For instance, GR3C’s SmartRT project, supported by the FCA, is being developed in the form of Structured English (SE) in accordance with the SBVR’s expression guidelines.

In addition, The Financial Industry Regulatory Ontology (FIRO), which is being
developed as a financial ontology, is also implemented in English terms, so it may be difficult to use as because it must be translated into Korean. Obviously it will not difficult to expand it into European or Latin American languages (e.g., German or Spanish) that have a high grammatical similarity to English. However, it is not easy to apply it to most of Asian languages, such as Korean, which has quite different grammar.

If Machine Readable Regulation can be expressed for Korean regulatory texts, this will be a great opportunity of applying RegTech in other non-English speaking countries. In particular, it will open the way of exports of RegTech to the New Southern regions and Central Asian countries (such as Vietnam and Indonesia) as well as the New Northern regions (such as Mongolia). In fact, it is a positive signal that interest in Machine Readable Regulations in UK, US, and Southeast Asian countries (such as Singapore) is increasing recently.

3.2 Descriptive knowledge vs. Procedural knowledge

When adopting OWL–DL and SHACL like FCA’s DRR2 project, it is vulnerable to expressed in the form of Procedural Knowledge found in general business intelligence because knowledge is expressed in Descriptive Logic or Assertive Knowledge. This is a limitation of the ontology language and requires an additional Procedural Knowledge expression method.

3.3 Productivity of developing the Machine Readable Regulation

An important motivation for Machine Readable Regulations is to reduce efforts of financial companies for preparation and submission of regulatory–related reports. Also, introducing Machine Readable Regulations may decline the ex–ante risk embedded in regulatory report before submitting it. If it takes considerable expertise and time to produce a Machine Readable Regulation, the transition to a Machine Readable Regulation will be ineffective. Thus, the productivity of the Machine Readable Regulation will be an important factor for adopting Machine Readable Regulation.

It is a very professional work that need expertise to automatically converge the regulations and laws written in natural language to machine readable regulation. The FCA’s main concern stems from the same issues. Those are, how to convert to domain–
specific languages (e.g., SBVRs) that are machine-readable and not dependent on a particular development environment and how to develop them into domain-specific languages to be understood by machines (e.g., int CER = (capital/asset) x 100), and how to extract the core concepts of regulation from the original regulatory legislation. Since all the methods rely on experts’ full intervention, it will entail considerable time and cost for initial deployment.

Moreover, the slower the creation and distribution of Machine Readable Regulations, the greater the dissatisfaction of financial institutions, especially in the event of the emergence of new laws or changes in laws. Therefore, there is a high risk of a Machine Readable Regulation crisis, such as a software crisis. In this regards, reliable operation and deployment of a practically applicable Machine Executable Regulation environment requires a methodology to increase the productivity of the Machine Readable Regulation development so that it can respond quickly to the emergence and changes of laws.

3.4 Connection between Machine Readable Regulation and DB from Financial institutions

The terms declared in the Machine Readable Regulations are basically the terms that appear in the targeted financial laws. However, there is no guarantee that these terms will match the names in the DB schema or application adopted in the practice. For this reason, the mapping between terms on the Machine Readable Regulations and terms in each financial company is necessary, because it cannot be mechanically identified. The FSS’s second PoC also developed a separate application to declare and create mapping tables. Based on mapping knowledge, it introduces an approach that uses ORM technology, Hibernate, to generate search commands to build reports.

In the future, it is necessary to develop not only financial laws but also financial institutions–related ontology and ontology–based integration model which would be a desirable approach to establish mapping tables.
3.5 Impact Assessment: sensitivity analysis on financial regulations

An impact assessment is a prior assessment of the impact of a particular regulatory sentence on a financial institution or industry (Banwo, 2018). This could be assumed as a sensitivity analysis to financial regulation because it is linked to analyzing the effects of changes in regulatory sentences.

If the regulatory paradigm shifts from rule-based regulation to principle-based regulation, financial regulation should also be self-regulated by financial institutions. Before conducting the regulatory reporting, financial institutions should be able to identify in advance which regulatory laws are in compliance or violation.

In addition, from a supervisory perspective, if the purpose of the law is not the regulation itself but is the establishment and revitalization of the financial industry, it should be easy to grasp in advance how the enforcement or change of regulatory laws affects each financial institution and how it affects the entire financial industry. However, the FCA project has not yet explicitly considered a sensitivity analysis to how regulatory legislation affects specific financial institutions and the entire financial industry.

This requires the addition of online and offline decision analysis functions such as datamarts or Online Analytical Processing (OLAP) to Machine Executable Regulations. Examples include:

- Possibility of visualization of data in current situations;
- Multidimensional analysis: Ability to produce reports by each report, by bank institutions, by specific index, and by regulatory sentences;
- Rollup / Drill down functions: by bank, by group, by report from each industry;
- Ability to check financial institutions ex-ante for consistency if regulatory rules are changed virtually;
- Business dashboard capabilities;
- Ability to report risks (alert) if necessary after a consistency check.

3.6 Agility: Automatically analyzing changes in regulations

Regulatory laws changes over time. There are various forms of changes, including
the addition of new laws, changes to existing ones, and deletions. If there is a Machine Readable Regulations in place, any changes to regulatory laws will be reflected in the Machine Readable Regulations and will be redistributed through the Machine Readable Rule Book to financial institutions. It would take a considerable amount of time and money for financial institutions to passively identify this and revise the changes to the reports one by one. Therefore, agility is required in changing and reflecting regulations.

A good way to ensure agility is to automate the change of report submission system. In order to achieve this, a system will be established to allow regulators and financial institutions, and software agents if necessary, to exchange and communicate with each other after changes are expressed in a machine-readable form.

IV. Concluding Remarks

RegTech is an information technology necessary to lower the cost of financial regulation and increase the satisfaction of financial supervisory institutions and financial institutions, while conserving IT ethics (Kwon et al., 2019) and economic sustainability (Verana, 2018). However, in order to activate RegTech, laws and regulations related to financial regulations must be managed with machine-interpretable codes, and machine-readable regulations must be changed accurately and timely whenever related laws are changed. However, the Korean-style Machine Readable Regulation method has not yet been developed. Accordingly, this study examined the current status of RegTech around the world and dealt with the strategies for establishing RegTech in Korea. In particular, the necessity and development issues of Machine Readable Regulation that can handle the laws written in Korean are summarized. Through the contents of this study, it is expected that best practices that can lead non-linguistic RegTech will be established.

We posit that managing financial laws as Machine Readable Regulations through RegTech will be meaningful for the financial institutions in fulfilling their social responsibilities by complying with financial laws and regulations. Moreover, RegTech will be meaningful to supervisory agencies that meet their social responsibilities by minimizing financial accidents and maintaining the soundness of financial industry. Even from a biblical point of view, fulfilling corporate social responsibility is very meaningful (Im,
This study only mentions the necessity and expected effects of Korean Machine Readable Regulation, and does not address and demonstrate how to construct Machine Readable Regulation in detail. Therefore, the limitation of this study is that the design and implementation have not been achieved yet. Hence, future research will conduct the natural language processing methods to interpret Korean financial laws, deep learning methods to extract concepts, and business intelligence methods to analyze changes to laws, and verify their effectiveness.

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레그테크 현황과 과제: Machine Readable Regulation을 중심으로*

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