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A GENERIC FRAMEWORK FOR DEVELOPING REGULATORY TECHNOLOGY AND SUPERVISORY TECHNOLOGY

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ABSTRACT

Regulatory Technology (RegTech) is the use of technology to ensure regulatory compliance. RegTech has been used not only by financial industries but also by non-financial industries. On the other hand, Supervisory Technology (SupTech) is the use of technology to facilitate and enhance supervision activities and processes. RegTech and SupTech are underpinned by popular technologies, such as Big Data Analytics, Artificial Intelligence, Machine Learning, etc. However, it is hard to find RegTech / SupTech discussions in computer science or system information disciplines. Hence, no reference can guide an organization to develop RegTech/SupTech. Therefore, it is necessary to design a framework for developing RegTech/SupTech. The framework is developed using Design Science Research Methodology (DSRM). The proposed framework consists of nine components, i.e., regulation, risk management, environment constraint, functionality, technology, data, people, project strategy & management, and repository. Each of the components suggests recommended output(s) in order to develop a RegTech/SupTech. The proposed framework covers the components of existing frameworks and gives two additional components. Hence, this research contributes to provide an alternative framework for developing RegTech/SupTech.

Keywords: *RegTech, SupTech, Development, Framework, Generic*

1. INTRODUCTION

Regulatory Technology (RegTech) is the use of information technology (IT) in regulatory monitoring, reporting, and compliance context [1]. Initially, RegTech was a subset of Financial Technology (fintech) [2]. RegTech was used by fintech companies to help them effectively and efficiently fulfilling regulatory requirements [2]. Some RegTech utilizations are money laundering prevention [3], capital market transaction monitoring, and minimizing compliance violation risk [4]. In its journey, RegTech then became independent and separated from fintech [1], [3], [5]. Furthermore, RegTech can be adopted outside the financial industry, e.g., a tool that helps front-liner social workers decide righteous social programme recipients [6], real estate [7], and ensures compliance in the health industry [8].

Another IT utilization close to RegTech has been adopted by the supervisor authorities. Its name is Supervisory Technology (SupTech). SupTech has been adopted by financial authorities to supervise massive amounts of financial service providers [9]. SupTech was defined as the use of IT to perform supervisory responsibilities [10]. SupTech was also described as the use of technologies to facilitate and enhance supervisory activities and processes [11]. Some others described SupTech as a RegTech in the supervisory context [12], a RegTech that is used in supervision [13], [14], [15], and technology innovation that is similar to RegTech [16], [17]. It can be concluded that SupTech is similar to RegTech as a concept but has different functionality or purpose.

Regulatory compliance is also an important matter in non-financial industry. However, RegTech and SupTech discussions are easier to be found in banking, finance, or law publications. RegTech and SupTech discussion are scarce in computer science or system information research even though they have utilized new emerging technologies (Big Data Analytics, AI, Distributed Ledger Technology, etc.) [18]. Furthermore, based on [19] and other recent times searches, there is no a single reference that can be referred to guide an organization (as general, not limited to a financial organization) in developing a RegTech or SupTech.

Three closest publications was found, i.e., [20], [21], [22]. First, the publication was about a framework for integrating a RegTech with a digital transformation model of bank treasury [21]. Instead of disturbing the applied transformation model, a RegTech should be integrated into the current transformation model [21]. This framework explained the importance of integrating RegTech's functionalities and technologies. This framework was specified for bank treasury and did not explain how to develop a RegTech. Second, the publication was about seeing RegTech from multidimensional perspective [20]. It did not explain about how to develop a RegTech. It explained more about what RegTech is. It gives the reader a complete RegTech concept. However, it still discussed RegTech from a financial point of view. Third, this limited-published publication contained detailed step-by-step RegTech adoption [22]. However, this publication did not show a full explanation and specified only for its members (banks in Hong Kong).

Based on the explanation above, there is still a need for a framework that can be used to help an organization develop a RegTech or SupTech. The research question is "how to design the generic framework for developing RegTech/SupTech?". Hence, this paper's research objective was "designing the generic framework for developing RegTech/SupTech".

2. RESEARCH METHOD

2.1. Research Methodology

Design Science Research Methodology (DSRM) [23] is adopted as the research methodology. DSRM is suitable for information system research with artificial artefacts. DSRM contains six phases, i.e., (1) identify & motivation, (2) define objectives of the solution, (3) design & development, (4) demonstration, (5) evaluation, and (6) communication. The phases' flow is presented in Figure 1. The first phase of the DSRM produces problem identification. According to the identified problems, motivation for research will be formulated. In the second phase, the identified problems and motivation determine a solution. A research objective will then be defined firmly. These first two phases are usually described in the introduction part of a research paper. This paper states the research problem and objective in the introduction section. Thus, the following subsection explains the third phase. The demonstration and evaluation are presented at the Discussion subsection. The communication phase implementation is this paper itself.

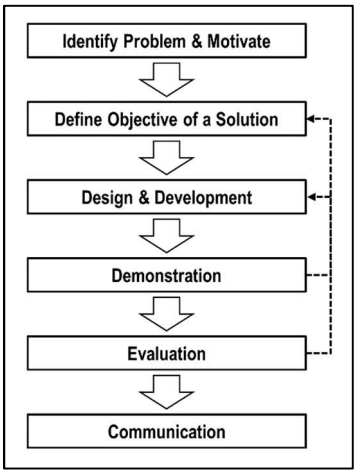

Figure 1: DSRM Phases [23]

2.2. Design & Development

RegTech and SupTech are close concepts. Some researchers said about it, e.g., SupTech is RegTech in the supervision context [12], RegTech that is used in supervision [13], [14], [15], and technological innovation that similar to RegTech [16], [17]. The difference between RegTech and SupTech is in functionality level. Hence, in this paper, a single framework is designed. The framework will be able to be used to develop both RegTech and SupTech. In order to cover all the important component of RegTech and Suptech, the research design follows these four steps: (1) stating the design requirement, (2) comparing closest-related frameworks, (3) combining the components and proposing new components, and (4) adding relation between the combined components. Those steps are presented in these following subsections.

2.2.1. Stating the design requirement

The design requirements will define the quality of the artefact. They must reflect the characteristics that are mentioned as the research objective, i.e., (1) RegTech/SupTech, (2) generic, and (3) framework. Besides that, the design requirements must be mapped into suitable evaluation criteria for information-system artificial artefacts. The first characteristic to be considered is RegTech/SupTech. In order to gain the most essential points from RegTech/SupTech, the most mentioned key words of RegTech and SupTech definitions are extracted. The collection of definitions by [19] are used. From that collection, the words mentioned more than ten times from 35 definitions are picked as key words: (1) technology,

(2) regulatory, (3) compliance, (4) requirements, (5) use, and (6) reporting. The key word number 4 (requirement) always showed side by side with the key word number 2 (regulatory). Hence, requirement is removed as a key word because it refers to the same point: the regulatory. The key word number 3, number 5, and number 6 describe about RegTech/SupTech as a function. Hence, those three key words fall into one general term, functionality. From the previous analysis, it is concluded that three main points of RegTech/SupTech are (1) technology, (2) regulatory/regulation, and (3) functionality.

The second characteristic to be considered is generic. In this paper, generic (characteristic) refers to the use of a component or a terminology that is not industry specific and/or organization specific. The last characteristic to be considered is the framework. The final framework form is the collection of components, their relations, and their descriptions. It is intended to give a conceptual view of developing a RegTech/SupTech and how to develop a RegTech/SupTech solution. From the framework characteristic, there are two main points, i.e., (1) conceptual view and (2) development processes. The design requirements of this research are detailed in Table 1.

Table 1: The Design Requirements

Characteristics	Design Requirements	Explanation
RegTech/SupTech	The main points of RegTech/SupTech concept must be included as components.	The main points of RegTech/SupTech: (1) technology, (2) regulatory/regulation, and (3) functionality
Generic	The framework must use a generic component and/or term.	Generic refers to the use of component or term that is not industrial specific and/or organizational specific.
Framework	The framework must explain the conceptual view and explain how to develop a RegTech/SupTech solution.	The explanation about conceptual view and RegTech/SupTech solution development is the main points of framework characteristic.

After stating the design requirements, the quality measurements for the evaluation phase are formulated. Considering the limited resources, an evaluation criterion is selected, i.e., completeness. Completeness is one of the recommended criteria for evaluating a model-type artefact. As explained in section 3 two aspects are used to evaluate. Because there is only a single evaluation criterion, all the design requirements are fallen into completeness. The evaluation points are shown in Table 2. The maximum possible evaluation point is 4. If this framework gains 4 points, it means that the framework fulfils all the design requirements and simultaneously fulfils the completeness criterion.

Table 2: Quality Measurement of Proposed Artefact

Design Requirements	*Evaluation Points*
The main points of RegTech/ SupTech concept must be included as components.	• The Framework contains a component called 'technology'. (1 point) • The Framework contains a component called 'regulatory'/ 'regulation'. (1 point) • The Framework contains a component called 'functionality'. (1 point)
The framework must use a generic component and/or term.	There is not any industrial specific and/or organizational specific component / term that is included in the framework. (1 point)
The framework must explain the conceptual view and explain how to develop a RegTech/SupTech solution.	• The Framework contains explanation about conceptual view. (1 point) • The Framework contains explanation about RegTech/SupTech development processes. (1 point)

2.2.2. Comparing closest-related frameworks

(a) Closest-related frameworks

In order to gain comprehensive framework components, the components from closest-related frameworks ([20], [21], [22]) are compared. Comparision makes it possible to identify components that have the same context even though they have different names. Besides that, comparison provides an understanding of the weakness of each framework. The first framework is about RegTech development in bank treasury [21]. The research explored the development of RegTech that needed to be implemented inside a bank treasury. However, the bank treasury environment was bounded by its current digital transformation model. This research proposed an integration of RegTech and bank treasury digital transformation model, the Smart Digital Transformation Model (SDTM). This approach can lead to better alignment of strategic decision-making and regulatory management practices. The proposed way to develop RegTech is as follows. First, all regulatory activities are listed and then integrated with other activities inside SDTM. Second, those activities are formed into digital use cases and mapped with suitable technologies. All those steps do not give any practical way to develop a RegTech. Any practical development process is in SDTM. It is not published through this publication. Furthermore, SDTM is not a generic-type framework. Another highlight of this

research is about five RegTech service areas: (1) regulatory reporting, (2) compliance, (3) transaction monitoring, (4) identity management and control, and (5) risk management.

The second framework is Multi-dimensional RegTech Framework [20]. This research provided a comprehensive and multi-dimensional framework of RegTech (Figure 2). Through it, the authors wanted to provide RegTech's main body of knowledge. This research used bibliometric analysis and systematic review to gather the information. The multi-dimensional framework consists of four main dimensions: (1) aspects defining regulation and technology, (2) the role of data, (3) stakeholders and applications, and (4) benefits and risks. In the first dimension, the basic form of RegTech is illustrated. RegTech is formed by regulation and technology. In the second dimension, the framework explains the imperative roles of the data through some examples. In the third dimension, the framework explains various types of stakeholders and the five functions of RegTech. Those five functions are compliance, monitoring, risk management, reporting, and operation. In the last dimension, the framework warns the readers that every RegTech benefit always comes with risk. All the dimensions give the readers a clear understanding of what RegTech is but do not give any detail of how to develop one.

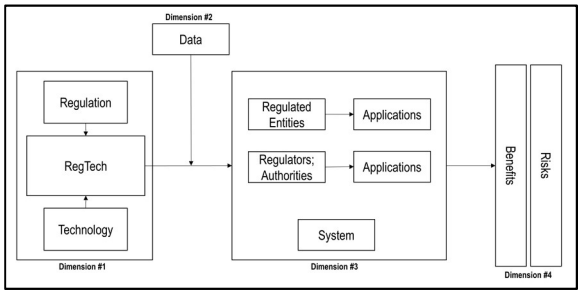

Figure 2: Multi-dimensional RegTech Framework [20]

The last framework is RegTech Adoption Framework [22]. This publication is a practice guidance document. It was designed to provide banks with an overview of RegTech. In this document, a framework for RegTech implementation was introduced. The framework is intended to replace a use case-led approach in developing RegTech. The framework is presented in Figure 3. This framework provides more complete guidance on developing a RegTech than others. However, the details of the framework's components are not available in this document.

(b) Result of the comparison

Some components describe the same things but use different terminologies. Hence, before comparing, the same-meaning-but-different-terminology components are identified and put into the same group. The comparison result is shown in Table 3. From that table, it can be seen that each framework has its weakness. By combining all components of all those frameworks, a set of comprehensive RegTech/ SupTech components is concluded.

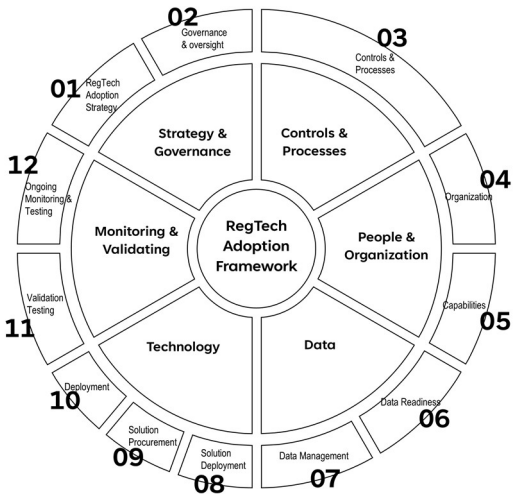

Figure 3: RegTech Adoption Framework [22]

Table 3: Components Comparison

Compo-nents	Availability Check		
	RegTech Integration in SDTM	Multi-dimensional RegTech Framework	RegTech Adoption Framework
Regulation	√		
Technology	√	√	√
Data		√	√
Expertise/ Human/ Actor		√	√
Risk/ Risk Management		√	
Strategy & Governance (Project)			√
Use case/ service area/ functionality	√	√	√

2.2.3. Combining the components and proposing new components

After comparing the frameworks, a comprehensive set of framework components are collected. If there are other important aspects to be considered, new components can be added. From Table 3, it is found that there are seven groups of components. Some groups that have various terminologies are renamed. The seven final components are (1) Regulation, (2) Technology, (3) Data, (4) People, (5) Risk Management, (6) Project Strategy & Management, and (7) Functionality.

Two aspects should be added. First, Developing a RegTech has to consider the currently implemented digital transformation model [21]. In general, a particular constraint needs to be considered in designing or implementing a solution. This constraint can be an enterprise architecture or any IT-related governance. Hence, a new component is proposed. It is called (8) Environment Constraint. Second, because there are approaches of project management concepts and some enterprise architecture concepts in the combined components, it is decided to propose one more component, i.e., (9) Repository.

2.2.4. Adding relation between the combined components

In this last step, the combined components are equipped with relations. These relations give a more understanding of the RegTech/SupTech development. Now, each component has its position relative to the other components. Some of the combined components can be sequenced. Regulation is the core of RegTech/SupTech hence it has to be the driver of RegTech's / SupTech's Functionality requirement. Regulation could also drive risk mitigation. Hence, it is also the driver of Risk Management. On the other hand, risk mitigation could also be a driver for Functionality requirements. Data, Technology, and People need to support the Functionality requirements. The delivery of those mentioned components is done by Project Strategy & Management. All the design artefacts or deliverables are stored in Repository. For simplicity, this relationship is illustrated in Figure 4.

3. RESULT & DISCUSSION

3.1. The Proposed RegTech and SupTech Development Framework

The proposed generic components are shown in Figure 4. There are nine components in it. For simplicity, from here and on, those nine components are called with the name "FW" + each of their number. For example, Regulation will be called FW1, Risk Management will be called FW2, and so on.

(a) FW1 (Regulation)

Regulations drive the requirement of RegTech/SupTech functionality. RegTech/SupTech can be based on a regulation, multiple regulations simultaneously, or even only generic functionality required by all organizations, such as reporting activities [19]. In this paper, the regulation refers not only to a formal one but also to an organization-level internal policy. Some recommended things to be done here are understanding the regulatory structures, the regulation governance and management, and regulation interpretation. The

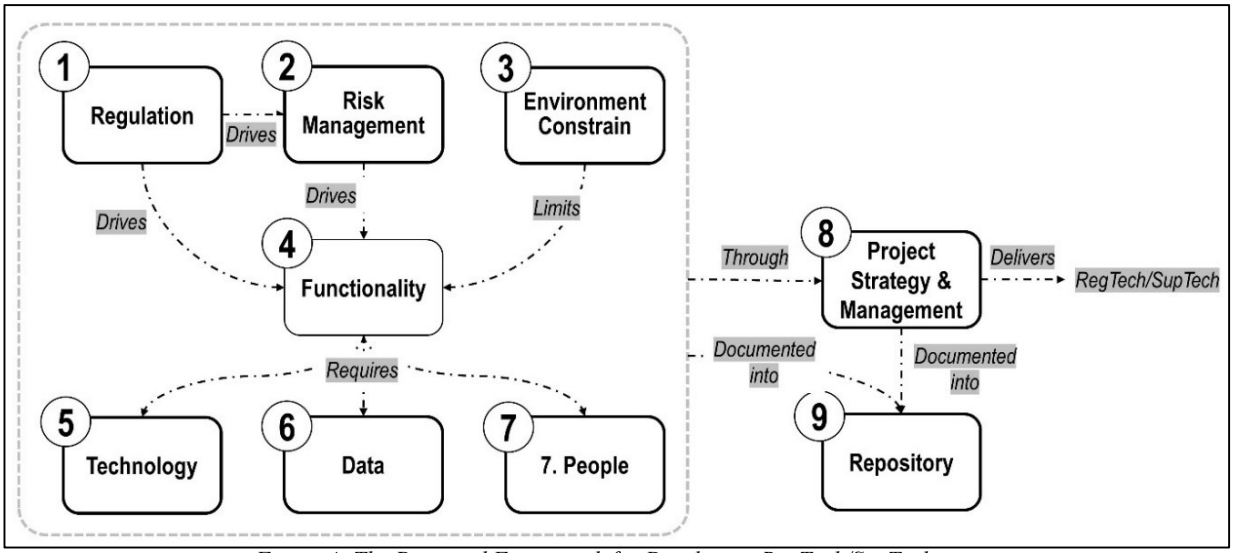

Figure 4: The Proposed Framework for Developing RegTech/SupTech

purpose of this component is to formulate functionality requirements, not complex requirements but somewhat tacit ones.

(b) FW2 (Risk Management)

Newly released regulations drive the organization to re-evaluate its risk register. Every single possible incident due to regulation factors needs to be considered. If the possible incident is terrible for the organization, it becomes a risk. Through risk management processes, every risk has its response. Some of the risk responses can drive a RegTech/SupTech functionality requirement. The recommended things to be done here are understanding the risk register and responses. The purpose of this component is the same as FW1.

(c) FW3 (Environment Constraint)

Nowadays, it is common for an organization to have enterprise architecture. It will provide an organization with a controlled development policy. Implementing RegTech/SupTech in an organization must consider this limitation. RegTech/SupTech development must not disturb the existing implemented strategy. This component's purpose is to give an early warning for RegTech/SupTech developers so they will only design something feasible to implement.

(d) FW4 (Functionality)

This component is intended to bring the tacit idea (requirement) into more detailed requirements. For that purpose, FW3 contains solution defining and business architecture. In FW3, a solution is formulated. A solution architecture concept can be approached with an Enterprise Architecture concept [24]. Hence, solution architecture is elaborated in business, data, application, and technology architecture. The scope of FW3 is only within solution defining and business architecture designing. The recommended things to be produced here are (1) solution design, (2) business architecture requirements, and (3) business architecture.

(e) FW5 (Technology)

Technology requirements are formulated Based on business, data, and application architecture. Technology architecture must be able to serve all three other architectures. In this paper, the technology architecture refers to the same concept with infrastructure architecture. The recommended things to be produced here are (1) technology architecture requirements and (2) technology architecture.

(f) FW6 (Data)

Business architecture (in FW3) drives data architecture and application architecture requirements. In this component, those requirements need to be answered in the form of data architecture and application architecture. The recommended things to be produced here are (1) data architecture requirements, (2) data architecture, (3) application architecture requirements, and (4) application architecture requirements.

(g) FW7 (People)

In the enterprise architecture concept, people is included in business architecture. Some business architecture artefacts must be detailed into actors, roles, or people. Hence, in FW6, it is decided to cover other topics. FW6 has a purpose to design talent needs, communication strategy, and knowledge management.

(h) FW8 (Project Strategy & Management)

This component is an original component from RegTech Adoption Framework [22]. In that publication, this component is used to deliver RegTech into a live system and monitor it. RegTech is delivered through a project. This component has a role as an implementation step. The solution architecture is brought to the implementation by FW8.

(i) FW9 (Repository)

This component is designed to be a storage of the documentations.

3.2. Discussion

This subsection is intended to discuss the usability of the proposed framework and its quality. In order to provide proof of usability, a demonstration is required. After that, an evaluation is necessary to be done to measure the quality of the proposed framework. These two activities are the fourth and fifth phase of DSRM.

First, the demonstration is done through a simulation case. This simulation is based on a real-world case but without a real-world respondent. A case about fraud detection of a financial service provider's (FSP) financial report is chosen. This detection is necessary for preventing further national-level economic instability. This fraud detection will be a massive help for a country's financial service authority (FSA). Before this case is explained into each component, Figure 5 can give a conceptual view of this SupTech development. In this paper, the demonstration does not include the

FW8 and FW9. It is because the delivery (FW8) of the design aspect (FW1-FW7) into a live system requires a considerable number of resources. Thus, the FW9 is also skipped.

(a) FW1 (Regulation)

The National Law appointed an institution named Financial Service Authority (FSA) to govern and manage all financial service providers (FSP). The chief of the FSA is allowed to publish any necessary policy to manage FSP. The National Law demands that the FSA protect national economic stability in any necessary way. In order to fulfil this responsibility, the FSA published a regulation that obligates every FSP to send an annual report about its business.

(b) FW2 (Risk Management)

Based on the responsibility mentioned above in FW1, the FSP has been manually analysing the FSP's annual report. This manual analysis brings considerable risk. The manual analysis takes much time and hence endangers national economic stability. It is necessary to change the manual analysis into machine automation. Besides that, the periodic annual reporting is required to change into pull-access reporting so the FSA can supervise the FSP's internal report when needed.

(c) FW3 (Environment Constraint)

The FSA needs to prepare its enterprise architecture or any other policy related to IT innovation. These documents are needed to formulate design solutions in the following components.

(d) FW4 (Functionality)

In the FW2, the simple solution was mentioned. From that tacit solution idea, then, it is deepened into more detailed design requirements. The design requirements of the fraud detection solution are (1) the solution must be able to read the report, (2) the solution must be able to understand the report, (3) the solution must be able to detect fraud, and (4) the solution must be able to notify whenever frauds are detected. These requirements determine the business architecture of the solution. All business architecture artefacts can be employed here. For example, the business architecture can be presented using BPMN, as shown in Figure 6.

(e) FW6 (Data)

The data component is designed prior to technology. Based on the BPMN, the design requirement of data architecture can be determined. The data architecture must be able to (1) manage structural and semi-structural data and (2) manage catalogue and metadata. The data architecture is explained using ERD, as shown in Figure 7. After designing data architecture, the design requirements

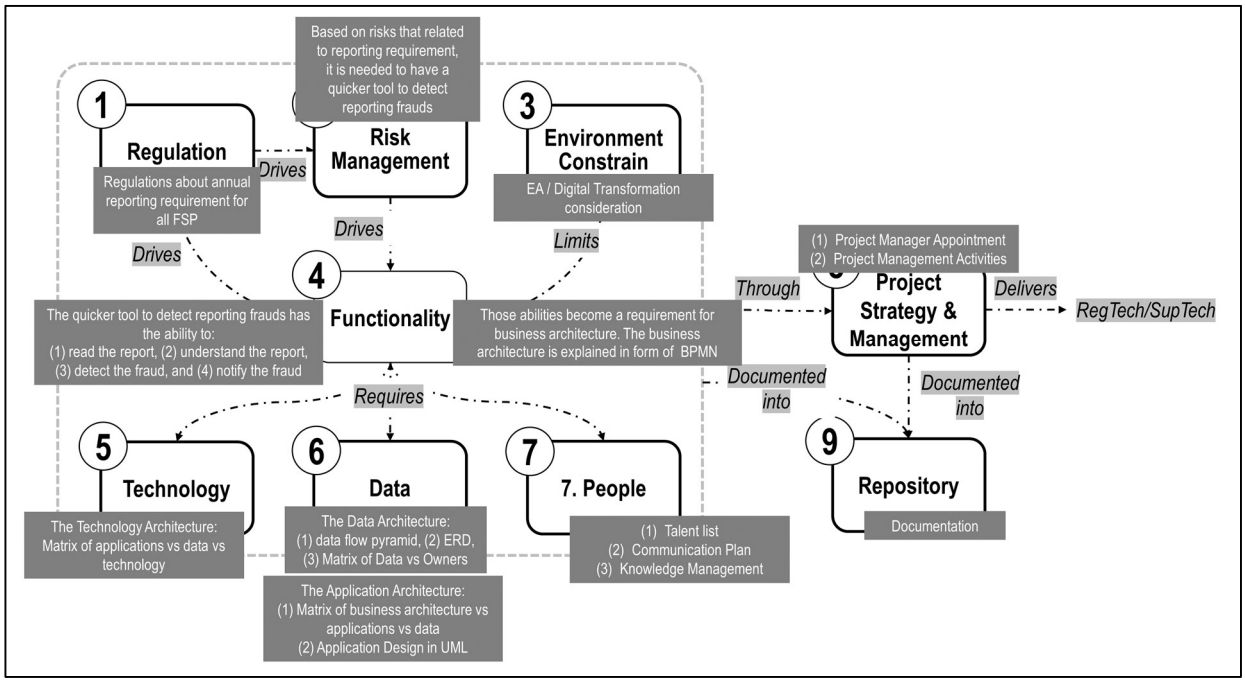

Figure 5: The Overview of the Demonstration

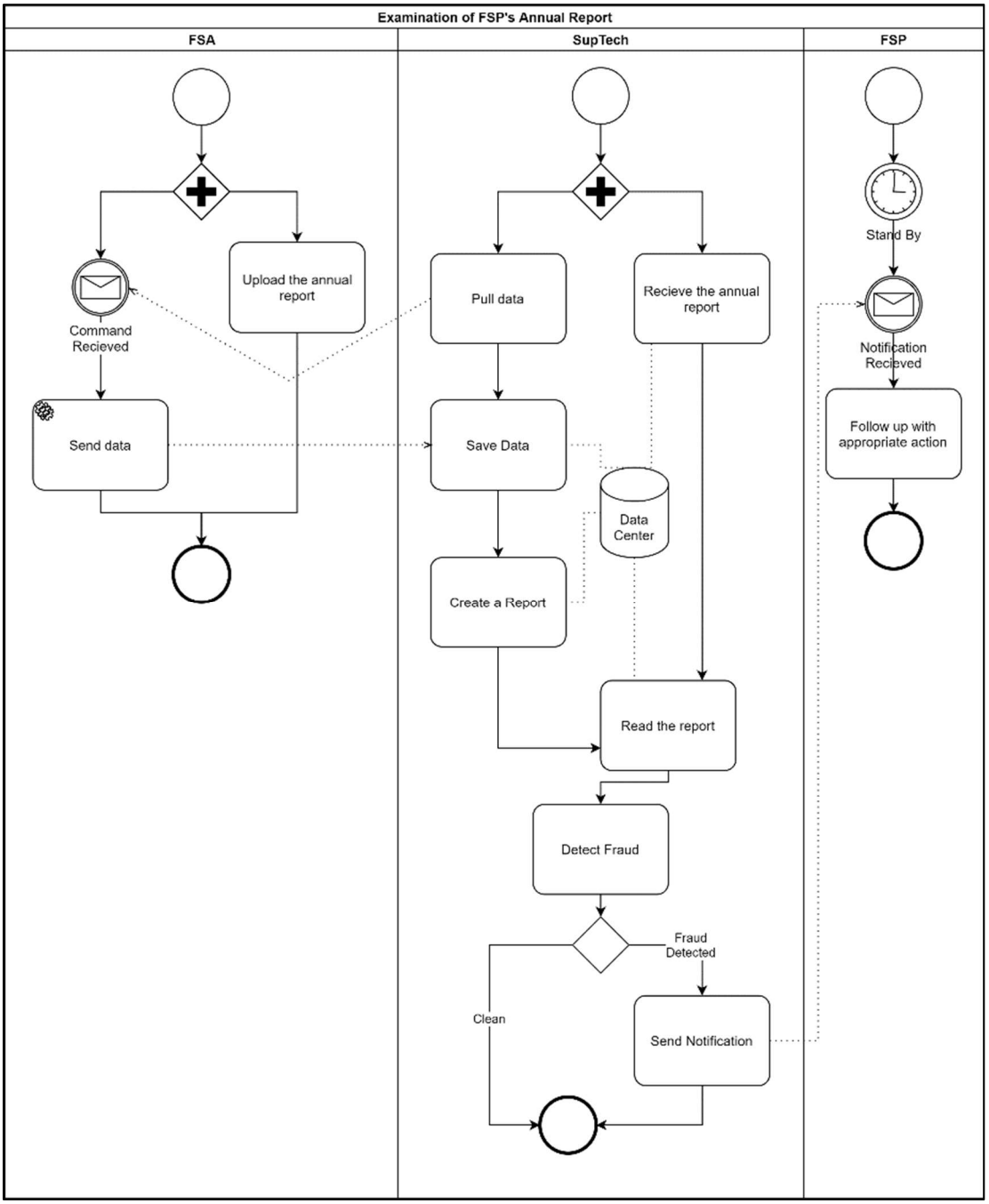

Figure 6: The BPMN of Fraud Detection

of application architecture are determined. The application architecture must be able to (1) handle Create-Read-Update-Delete (CRUD) activities, (2) transfer data from machine to machine, (3) read and understand the report, (4) detect fraud, and (5) handle visualization for human counterparts. The application architecture is explained in Table 4 and Table 5.

(f) FW5 (Technology)

FW5 is designed after business architecture, data architecture, and application architecture are done. Based on other architectures, the requirements of technology architecture are (1) technology that can handle data transfer through API tool, (2) technology that can handle CRUD activities, (3) technology that can handle NLP tools, (4) technology that can handle ML tools, and (5)

technology that can handle notifications. Hence, the technology architecture is shown in Table 6.

Table 4: Application Requirements vs Application Selection Matrix

Application Architecture Requirements	Tools
CRUD activities	DBMS
Machine to Machine transfer	Web API tool
Read & understand the report	NLP tool
Detect a fraud	ML tool
Visualization	Web Portal

Table 5: Data Architecture Layers vs Application Matrix

Data Architecture Layers	Tools
Data collection	API tool, web portal
Data storage & transformation	DBMS, NLP tool
Data analytic	NLP tool, ML tool
Data visualization	Web Portal

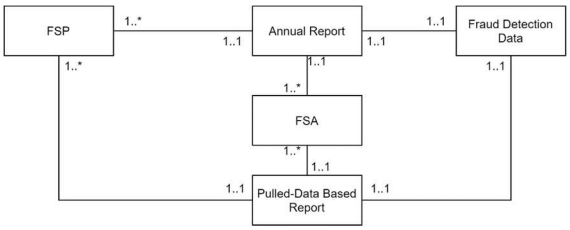

Figure 7: The ERD of Fraud Detection

Table 6: Technology Requirements vs Technology Selection Matrix

Technology Architecture Requirements	Technology
Handle API tools	Web
Handle CRUD activities	Cloud, Data Lake
Handle NLP tools	Cloud, NLP
Handle ML tools	Cloud, ML
Handle Notification	Web, Email, Mobile

(g) FW7 (People)

Some talents needed in developing SupTech are solution architect, data engineer, database administrator, software engineer, data scientist, and fraud analyst. The communication strategy includes board of director meetings, internalization, SupTech course, engineering team meetings, etc. The talent needs and communication strategy should be detailed in comprehensive documents.

(h) FW8 (Project Strategy & Management) & FW9 (Repository)

In this paper, these components are not demonstrated.

After demonstrating the usability of the proposed framework, the evaluation of its quality is conducted. The proposed framework is evaluated by checking the fulfilment of design requirements. Besides that, the evaluation criterion is also checked. Those evaluations are shown in Table 7.

Based on the demonstration and evaluation, it is showed that the proposed framework fulfills the usability and the quality. The proposed framework can be guidance in designing a SupTech. The demonstration showed the outputs of the most part of the framework. The evaluation shows that the proposed framework gains the maximum point, 6 points. Hence, it can be concluded that the proposed framework fulfills the quality, based on the design requirements, and the completeness criterion.

The proposed framework covers all components from previous existing framework and adds two new components. It is mean that, at least, the proposed framework can play as an alternative framework in developing RegTech/SupTech. However, as mention above, the demonstration of this research is done by using a simulation case. This way of demonstration is not sufficient yet to prove the easiness implementation in real case, especially in complex case of RegTech or SupTech. Future research is still needed to perfect the proposed framework.

4. CONCLUSION

RegTech and SupTech was proven in enabling regulatory compliance processes to be more effective and efficient. Because of that, RegTech and SupTech are needed by broader industry, not only financial industry. There is no guidance on how to develop a Regtech/SupTech. A reference is needed to guide in developing RegTech/SupTech. Through DSRM, a framework for developing RegTech/SupTech is produced.

The proposed framework consists of nine components. They are (1) regulation, (2) risk management, (3) environment constraint, (4) functionality, (5) technology, (6) data, (7) people, (8) project strategy & management, and (9) repository. The regulation and risk management component drive RegTech/SupTech development. Those two, with consideration of environment constraint, determine a solution idea, so then the functionality component elaborates it. The functionality requires support from technology, data, and people

component to make a comprehensive solution design. Through project strategy & management, the design will then be brought into implementation. All the activities in the development process are documented inside a repository. A demonstration was conducted to see the usability of the proposed framework. The proposed framework was used to help designing a SupTech. The evaluation of the proposed framework shows that the proposed framework fulfils all the design requirements and completeness criterion.

This research contributes an alternative framework for developing RegTech/SupTech. The proposed framework gives two additional components to perfect existing components from previous framework. Besides that, its generic characteristic allows this framework to be used in various industries. However, the proposed framework still has room for improvement. Some future works of applied research with various fields will be excellent input for improving the framework.

Table 7: Quality Measurement of Proposed Artefact

Design Requirements	*Evaluation Points*	*Evaluation Criterion*	*Point*	*The Implementation*
The main points of RegTech/ SupTech concept must be included as components.	• The Framework contains a component called 'technology'. (1 point)	Completeness	1	FW5
	• The Framework contains a component called 'regulatory'/ 'regulation'. (1 point)		1	FW1
	• The Framework contains a component called 'functionality'. (1 point)		1	FW4
The framework must use a generic component and/or term.	There is not any industrial specific and/or organizational specific component / term that is included in the framework. (1 point)		1	The proposed framework is free from industrial terminology and industrial artefact
The framework must explain the conceptual view and explain how to develop a RegTech/SupTech solution.	• The Framework contains explanation about conceptual view. (1 point)		1	Figure 4
	• The Framework contains explanation about RegTech/SupTech development processes. (1 point)		1	Figure 5
TOTAL POINT			6	

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