Master thesis report

Data Marketplace Aggregator

A study towards designing aggregator business models for data marketplaces

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Master Management of Technology
Faculty of Technology, Policy, and Management

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

The intersection between technology and business management has always fascinated me the most. I believe that business could introduce abundant benefits and impact to the human race. Furthermore, the recent fast development of technology embedded in businesses will only push the impact further for unlimited use in society. For that sole reason, I decided to pursue a Master's Degree in Management of Technology with TU Delft.

Studying at TU Delft has been the most rewarding experience. I was able to learn, discuss, argue, and apply numerous topics that are emerging, insightful, and highly applicable. In addition, all educational and non-educational aspects of the university are impressive. From the supportive professors, friends, and academic staff, cozy study places (I am looking at you, Pulse!) to the cheap and tasty hot drinks from the vending machine. All of these have made my academic journey memorable.

This master thesis project marks the end of my journey at the Delft University of Technology. I always loved the idea of designing digital businesses, especially if the industry was still relatively vague with no certainty. I just could not hold the excitement of stimulating my creativity towards developing new ideas. What makes the project more exciting is the fact that I was able to work on a topic that is still new and yet to be commonly exercised efficiently by the industry, which is the data marketplace.

Beyond the academic endeavor, my journey toward finishing the thesis was not easy. Varying personal issues came along the way. However, I am beyond grateful to have my first supervisor, Mark de Reuver, who was very understanding and supportive throughout the research. During the difficult times, Mark not only provided a suggestion to improve the study but also provided supporting acts to keep pushing me to finish the thesis. He occasionally checked on me and was very compassionate towards my condition. Additionally, I am grateful also to have Antragama Ewa Abbas on board. Antra is the first person that introduced me to the world of data marketplace. Additionally, Antra has always been a great mentor and friend who is always ready to help me. He has always been my go-to person when in need of a quick answer. I am also thankful to have Victor and Elif from the Delft Centre of Entrepreneurship. They always provide meaningful suggestions from different perspectives, especially using the lenses of business managers, which strengthen my research's practical contribution.

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"...And when you are told to rise up, rise up. Allah will raise up, to (suitable) ranks (and degrees), those of you who believe and who have been granted knowledge. And Allah is well-acquainted with all you do"

[Quran, 58:11].

Executive Summary

Problem

Data, perceived as the most important resource, has transformed business, creating enormous value for many industries. The generated data and information from one organization or individual might benefit other organizations. The perception of data as commodities and the benefit of secondary data use leads to the belief that data can be monetized through exchanging and trading data between businesses. Within the EU, the emergence of data marketplaces results in a contrary implication because instead of accommodating data trading between organizations, they, in turn, create another market problem. A fragmented market with no broadly adopted big data marketplace player slows down the process of data discoveries because data buyers have to visit and continuously look for data from different markets. It also creates interoperability issues between data marketplaces.

Many studies have been conducted to overcome market fragmentation issues. However, these concepts of data marketplaces remain conceptual. It is still not clear for data marketplace operators to implement the business model concept in a practical scenario. This lack of practical knowledge may burden the data marketplace operator to justify their decision. This could also in the future lead to market failure. Considering the literature gap presented above, there is value to provide a practical approach to designing business models, especially for data marketplace operators.

From the literature, the Aggregator Business Model is perceived to offer various values in a fragmented market, e.g., navigating buyers to find sellers and settling contextual differences in the market. Considering the issues in the current data economy domain, the idea of Aggregator Business Model implementation could be worthwhile to investigate.

That being the case, the aim of this research is to provide guidance to design Aggregator Business Models in the data trading industry**.** To achieve the objective stated above, the main research question is being asked:

How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?

Methodology

This thesis utilizes the Design Science Research methodology (DSR), because we intend to design a business model. The DSR consists of several steps. The first step is to identify the problem, which already was presented in the previous paragraphs. The next step is to define the objective. From the literature review, it can be derived that the Aggregator Business Model can provide various values considering the issues in the data trading industry. Thus, the objective is to exercise the Aggregator Business Model in the data trading industry. The next part is design and development. We first conduct the theoretical study by conducting a literature review on Aggregator Business Model literature. The study will help us to define the characteristics of the Aggregator Business Model from various literature, and provide us with a basis to further develop the business model. In the next steps, we observe various businesses that implement Aggregator Business Models. It is essential to distinguish one aggregator from another aggregator because

although have similar characteristics, they deliver the service in different ways. The next step is the demonstration part. In this part, we conduct expert interviews and workshops to define the required business model components for the data marketplace. We reflect our finding from the design and development part by using the study as the framework and basis to develop the data marketplace business model. The next step is evaluation. In the evaluation part, we conduct interviews to evaluate and assess the data marketplace business model. The last part is communication, which is translated into this thesis report and presented publicly during the thesis defense.

Findings

From the literature review part on the Aggregator Business Model, we understand several characteristics of the Aggregator Business Model. Aggregator Business Model comprises service aggregation and service composition in their service domain; service integration, service orchestration, and service choreography in their technology domain; partnership, no partnership, and ownership in their organization domain; and financially independent or financially dependent. From the design and development part, we derive four Aggregator Business Model that is differentiated by the services offerings and the degree of the network. These four Aggregator Business Models are a search engine, advanced search engine, comparison sites, and a one-stop shop. We also found out that aggregators change their business model. Towards the demonstration part, we translated our findings on the Aggregator Business Model from the previous part to the data marketplace case. We put the business model components by reflecting on the discussion in the workshop. We put various services from the discussion into our Aggregator Business Model. Lastly, from the evaluation, we found out that the Aggregator Business Model can provide value to the users. The technology is also feasible to implement. Data suppliers are also willing to collaborate. Although the promises, several challenges need to be considered, such as interoperability, data trading risk, and trust.

Practical Implications

This research provides a contribution to the data trading industry by providing a guide to designing a business model for the data marketplace. We not only provide new concepts of Aggregator Business Models but also describe the business activities to demonstrate and realize the business models. Thus, data marketplace operators can use this research as a guide to developing their businesses. For example, Data marketplace operator can use the business model archetypes as the framework to choose business model types, exercise the provided business activities to deliver services to users, and take into consideration the evaluation part to get ready with the potential challenges of exercising the business model.

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Chapter 1
Introduction

In this section, we present the current situation in the data trading industry. We first introduce several economic and business potentials from trading data. Then, we discuss the current issues that exist in the data trading industry. To provide a solution to the issues, we explore the research gap to define our research objective. The research objective is then translated into the main research question.

1.1 Introduction

1.1.1 Data Economy

In the past few years, data, perceived as the most important resource, has transformed society and business, creating enormous value for many industries and changing the lives of many individuals and organizations (Stahl et al., 2014). The advancement of technological development leads to the increasing usage of digital applications that continuously generate new data and information (Fricker & Maksimov, 2017). Data, in the eye of business is perceived as a strategic asset, not only serving as an enabler to create products, but it becomes the product itself (Otto & Osterie, 2015). Thomas & Leiponen (2016) argued that the benefit of data also lies in the secondary use for other organizations. The generated data and information from one organization or individual might benefit other organizations. Thus, the perception of data as commodities and the benefit of secondary data use led to the belief that data can be monetized through exchanging and trading data between businesses (Spiekermann, 2019; Thomas & Leiponen, 2016).

Towards the opportunity of data monetization, various new business has arisen the main operation is to accommodate raw and processed data trading within a digital platform (Spiekermann, 2019; Agahari, 2020), and also to which their main function is to sell data generated from their organizations (Parmar et al., 2014; Thomas & Leiponen, 2016). Many literatures then perceive these concepts as data marketplace. A data marketplace is explained by Spiekermann (2019) as an ecosystem where data can be traded and exchanged through data stream mechanism via a neutral intermediary digital platform. In realizing the opportunity of the data economy in the European region, the EU, via its recent policy paper (EU Commission, 2020) also announced the EU Single Data Market strategies which include the creation of a data marketplace as the main instrument towards realizing the visioned data economy strategies in the EU.

1.1.2 Issues in Data Economy

However, despite the perceived value to monetize data through a data marketplace, data is currently still being traded inefficiently in non-multilateral marketplaces (Borgman, 2012). Within the EU region, the abundant emergence of data marketplaces results in a contrary implication because instead of accommodating data trading between organizations, these data marketplaces, in turn, create new market issues such as market fragmentation caused by a large heterogeneity of the data marketplace that exists in the EU ecosystem (TRUSTS, 2019; EU Commissions, 2020). They mentioned that currently there are more than 400 data marketplaces, owned by different entities, and most of them do not comply with EU's interoperability, security, and privacy regulations. Market fragmentation can lead to many market issues such as data discovery problems, trust issues, interoperability between organizations, and market issues (Miller, 2012; Stahl et al., 2017; Broring et al., 2017; Spiekermann et al., 2018). This could provide a disadvantage for data buyers from having an efficient transaction and getting the desired value from data. Broring et al. (2017) added that fragmentation could also cause low interoperability of users and no broadly adopted platform in the ecosystem. This could disbenefit the data buyers because low interoperability means data buyers cannot simply change to a different marketplace due to high switching costs to adopt the new platform (Broring et al., 2017).

From the above literature, it can be seen that one issue within the data trading industry is the heterogeneity of the data marketplace which led to market fragmentation. In a fragmented market, there is typically no commonly adopted marketplace to buy and sell data (Broring et al., 2017). These issues could create problems in the data trading industry, because fragmentation may slow down the data discovery process. Data buyers have to continuously visit different marketplaces to find data sales. On the other side, data sellers face difficulties to choose which data marketplace to put their sales too, as data buyers might be scattered towards different marketplaces.

In addition to that, the heterogeneity of the data marketplace fabricates the lack of common technical standards that leads to interoperability issues in the data trading industry (Schwab et al., 2011; Broring et al., 2017; Koutroumpis et al., 2017). For example, each entity offers its own technical standards, making marketplace adoption difficult as data buyers and sellers have to periodically adjust to different technical standards. There are many contextual differences between varying data marketplaces that could potentially slow down the data trading process.

All of the aforementioned problems that happen in the data economy industry could lead to inefficiencies in the market creation process, as both data buyers and data sellers find it difficult to find one another, due to the absence of a commonly adopted marketplace. Market inefficiencies could lead to market failure, as reflected by the abundance of failing data marketplace in recent years (Koutroumpis et al., 2017; Spiekermann et al., 2019).

1.2 Research Gap

As argued in the introductory part, data is perceived to benefit society and business in a wide variety of sectors. The value of data lies in its secondary use when the produced data from organizations are reused by other organizations (Thomas & Leiponen, 2016; European Commission, 2020). To realize the potential of secondary data usage, data marketplaces are intended to accommodate the data trading and transfer mechanism between organizations (Agahari, 2020). However, as argued by (Borgman, 2012), data are shared and traded inefficiently. Koutroumpis et al., (2017) argued that trading data possesses more challenges than trading consumer goods in an open market. One major challenge within the data marketplace domain is the heterogeneity of data marketplaces that leads to the data trading inefficiencies, such as slow data discovery process and interoperability issues (Stahl et al., 2017; Broring et al.,2017; Koutroumpis et al., 2017; Spiekermann et al., 2018; Spiekermann et al., 2019; TRUSTS, 2019; EU Commissions, 2020)

In response to the challenges in the data economy industry, many studies have been conducted to overcome those issues. Spiekerman (2019) provides a general framework to explain the concept of data marketplace and provides challenges and trends towards data trading. Fruhwirth et al. (2020) conduct studies by creating business model taxonomies of data marketplaces. Several studies also presented business model taxonomies of data marketplaces (Stahl et al., 2017; Koutroumpis et al., 2021).

However, most of these business model studies are limited to only describing existing data marketplace business models, but it lacks the practicality towards exercising the business model, such as translating the business model concept to product and service offerings, interpreting the business model to actionable

business components, providing direction to choose the appropriate business model, and performing an evaluation to assess the business model. Many of these studies tend to focus on classifying data marketplace business models and only provide brief descriptions and characteristics of the classification.

For example, Fruhwirth et al., (2020) discuss data marketplace archetypes based on platform infrastructure (centralized vs decentralized). Although the study is able to classify various data marketplace business models, it only provides descriptions of the business model but lacks the direction to exercise the classified data marketplace, business model. Spiekermann (2019) not only provides business model classification but also describes various characteristics of each business model component. These characteristics classification can be seen as a direction to differentiate their business model from other data marketplaces. However, although the provided characteristics, it is not clear from the study how to interpret the given characteristics in the business settings e.g., translating the characteristics to service or product offerings.

From the above, it can be seen that many studies, although providing a clear understanding of a business model concept, still fail to introduce direction for data marketplace operators and business managers to exercise the business model. As a data marketplace operator, providing a practical direction to exercise the business models, e.g., translating the concept into product features, could be more beneficial than solely providing the business model classification. From the perspective of users, they reap value and benefit directly from the product features.

Most literature above can also be seen as a more backward-looking study by only describing, grouping, and explaining existing data marketplace business models that were already established prior to the studies (Spiekerman, 2019; Fruhwirth et al., 2020; Koutroumpis et al., 2021). We believe that it still lacks literature that focuses on creating a forward-looking approach by envisioning a new data marketplace business model that could be exercised in the current data economy landscape. This might explain why some literature, although providing insightful theoretical knowledge of the data marketplace business model, still lack practical approaches to overcome the data markets issues. This lack of practical knowledge might in the future lead to market failure (Agarwal et al., 2019; Koutroumpis et al., 2021). The lack of practical knowledge in the data economy domain could also explain why many data marketplace platforms are failing in the market (Carnelley et al., 2016).

Considering the literature gap presented above, there is a need for a data marketplace study that not only describes a new business model but also incorporates practicalities of the business model by translating and interpreting the business model concepts into service and product offerings.

The idea of conducting a more practical approach can be done by designing new business models for data marketplaces. Gregor & Hevner (2008) defined that designing artifacts (e.g., business models) can provide new solutions for known problems. Business model design is perceived as a way to create and deliver value to the customers and society (Osterwalder & Pigneur, 2008). The business model intends to address the needs of society to find a solution to a complex problem (Johnson, Christensen, and Kagermann, 2008).

1.3 Aggregator Business Model

From the previous section, it can be concluded that there exists heterogeneity in the data marketplace causing market fragmentation in the data economy domain. Issues regarding the slow data discovery process and interoperability exist in the fragmented data markets. In response towards the issues, we propose to conduct study that not only focus on describing the business model concepts, but also explaining the practicalities towards exercising the business model, such as translating business model concepts to services offering, evaluating the business model, and choosing appropriate business model.

Various management and information system literature has highlighted that Aggregator Business Model can potentially thrive in a fragmented market. Zhu et al., (2001) explained aggregators as entity collecting information from varying sources. According to Zhu et al., (2001), aggregators provide value by collecting information in one single access point. Papazoglou & Heuvel (2007) also mentioned that in collecting and comparing information, aggregators could settle contextual differences, which is an issue in the fragmented data market.

In many industry, different businesses have started to implement Aggregator Business Models to overcome the fragmented market issues. However, instead of seeing the fragmented market as an issue, they see this as an opportunity to attract users. In the digital finance market, Aggregators act as a "glue" to connect different entities such as governmental bodies, banks, businesses, donors, users, and platform providers (Pillai, 2016). In the consumer sector, an Aggregator in the UK TV industry solves consumers' problem of having an abundant amount of program selections from different providers. The Aggregator helps to reduce searching time by navigating the consumers to the right TV program (OC&C, 2017). In the aforementioned case, Aggregator Business Models benefit the users by having a reduced information discovery time and ease-of-access of different provider selections through a single platform. The Aggregator Business Model is also an emerging business model in the European energy industry. De Clercq et al., (2020) reported that aggregators provide benefits by engaging different system agents and encouraging healthy competition. The Aggregators connect electricity consumers, small or domestic electricity producers, large electricity generators, distribution operators, and even payment platforms. This leads to the benefit of users as the users can easily choose different electricity producers and operators according to their needs, without having to worry about the high-switching cost and strict vendor selection. From these examples, it can be seen that although the existence of aggregators may not necessarily be the solution to reduce market fragmentation, aggregators could potentially help users navigate the trading process in a fragmented market.

1.4 Research Objective and Research Question

Although the prior-stated benefit of the Aggregator Business Model, currently, there is still no data marketplace operators employing Aggregator Business Model in their business. Considering the current data economy landscape that possess market fragmentation issues, the idea to design Aggregator Business Model for data marketplace could be worthwhile to investigate.

Thus, to answer the above-mentioned research gap, this research aims *to provide guidance for data marketplace operator to exercise Aggregator Business Models in the data trading industry***.**

To achieve the objective stated above, the main research question is being asked:

How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?

2

Chapter 2
Literature Review

To provide a significant grounding on this thesis research, several studies from various relevant literature were explored. These studies cover topics such as business model, Aggregator Business Model, data marketplace, and platform. This chapter aims to provide the author and reader with the relevant knowledge required to understand the topic being discussed in this thesis research.

2.1 Business Models

There were massive sources in defining the notion of the business model and its components. Considering there are many different approaches to define the components of a business model, a working framework to select the components of a business model will be chosen for this research project. Making clear the concept of the business model components is important, as it will give a clear direction to find the desired elements to look for in analyzing a specific business model and creating a new one.

Magretta (2002) explained that the business model is the description of the enterprise's work. This work includes components such as customers, customers' values, how to deliver these values to the customers, and how to generate revenue from these customers. The key element in these components can be defined as the value creation for the customers. Morris et al. (2005) explained six key fundamental components: customers, value propositions, economic model, competencies, external positioning, and investor factors. Johnson, Christensen, and Kagermann (2008) argued that the business model includes four key components in creating value: resources, processes, profit formula, and customer value propositions. Business models can also be explained to represent how businesses create, capture, and deliver value by using the value propositions (Teece., 2010; Remane et al., 2017). Osterwalder and Pigneur (2010) developed a framework called business model canvas that provides a systematic and comprehensive tool to create a business model. The business model canvas contains key components as nine building blocks of business models, which include: Key Partners, Key Activities, Key Resources, Value Propositions, Customer Relationships, Customer Segments, Channels, Cost Structure, and Revenue Streams. These nine-building blocks constitute the prior business model elements mentioned by other literature presented above.

Although the Business Model Canvas from Osterwalder and Pigneur (2010) has been widely used by practitioners and academia, there is a limitation with regards to the technical aspects of the business. This research focuses on ICT-enabled business; thus, the technical aspect is a crucial element in determining the value-added of the business to the users. Bouwman et al. (2012) argued that Business Model Canvas only focuses on the analysis of a single entity. This characteristic of the Business Model Canvas can limit the analysis of ICT-enabled business, considering the services usually offered in the ecosystem(s) formed by multiple entities.

2.2 STOF Model to Design Business Model

Bouwman et al. (2008) provide the STOF model that is specifically made to fit with the business model of ICT-enabled business. The STOF conceptual model consists of Service Design, Technology Design, Organisation Design, and Finance Design.

Service Design explains the business' offering to the users in a specific market segment. The service design is the central aspect of this model. Service design focus on the value. Most ICT-enabled businesses start by deciding the specific value to be offered to the end-users, then decide which technical requirement, organization, and financial resources are needed in order to realize the value.

Technical Design explains the technical components utilized in the business model. Technology can be seen as the central role to facilitate the service delivery process. **Finance design** explains the revenue-

generating mechanism to realize the value. **Organization design** explains the configuration of actors and resources to realize the value. Considering that this research project focuses on designing ICT-enabled businesses, the STOF model fits with the topic as it covers the most important aspects of the ICT-enabled business model.

In addition to that, Faber et al. (2003) presented the interdependencies of each component of the STOF model. Unlike the business model canvas model that provides only a static representation of a business, the STOF model provides a correlation between each component. These interdependencies of the components will help demonstrate the value creation and value delivery process between the business model domains. Thus, the research will focus on using the STOF model as a framework to analyze and create the business model.

2.3 Aggregator Business Model

According to Zhu et al. (2001), information aggregation was explained as an activity of collecting different information from a variety of sources and analyzing the collected information so that the information provides value to the right users. The definition of right users means that user groups value the aggregated information more than any user group. The actors who do prior activities were defined as Aggregators. Keuper et al. (2011) explained Aggregate Service Providers or Aggregators as intermediaries who collect existing services or products to create value-added services or products and provide them to the end consumers.

There are three main types of Aggregation, as explained by Zhu et al. (2001). The first one is comparison aggregation, where the aggregators act as the entity to help users to get more narrowed down search results by giving the users side-by-side comparisons. This is the most common type of Aggregator. Trivago, Scopus, and Google Shopping fall within this category. The second one is relationship aggregations. Most internet users have multiple accounts, even within the same sectors, e.g., having multiple banking accounts from multiple banks. A relationship aggregator helps users to manage these multiple accounts by providing users with a single contact point (in conventional business) or single sign-on mechanism. Emma, a UK-based money management app that enables users to manage different financial accounts and subscriptions within a single app, falls in this category. The last type is Intra-organizational and Inter-organization Aggregators. In this type, the aggregators help users; specifically, organizations, find relevant information from different departments and companies. Many consumer research companies, such as Statista and Euromonitor International, fall in this category. This research will mainly focus on the comparison and relationship aggregator and will use the definition by Zhu et al. (2001) to describe the definition of the Aggregator Business Model.

2.4 Platform

De Reuver et al. (2018) argued that researchers should make clear on defining the definition of platform or digital platform in their study. To settle our definition of platform, we would like to present various terminology regarding platform. This definition is important to confirm our view of platform, because in the industry, platform can also be classified as different meaning. For example, Liu (2010) and Aladdin &

Bakin (2018) classify operating system as a platform. In our context, this is not the context that we would like to address. However, we could settle the definition of platform using a multisided platform concept, as an intermediary that mediates different user groups, for example, buyers and sellers (Rochet and Tirole, 2003). This context fit our view regarding platform, because the general idea of this research focuses the intermediating characteristics of the platform. Within this research, adding the technicalities concept is important, because our study will involve various technological terminologies. As also presented in previous part, the STOF model stated that technology is one crucial aspect towards delivering the services. Thus, to add from a technical point of view, a platform is understood not only as an intermediary between user groups, but also as a set of technical modules in which third-party modules can be complemented on top of these modules (Baldwin & Woodward 2008; Tiwana, 2010), which is distinguished by de Reuver et al., (2018) as digital platforms. De Reuver et al., (2018) also provided sociotechnical view of platform, as a set of technical elements that constitute organizational processes and standards. The later definition fits our context, because the terminology focus on using the technical elements as a way to conduct process in an organization, which align with the connection of technology-organization as stated in STOF Model.

2.5 Data Marketplace

Spiekermann (2019) argues that currently, there is still no widely accepted definition regarding data marketplace. There are also many alternative terms, such as data market, data platform, data intermediaries, and data broker, although the first two are the most common terms. These different data marketplace definitions are usually described to correspond with the business model of the marketplace. That being the case, in this research project, a clear definition of the data marketplace is necessary so that it fits with the context of the research project.

Using a neo-classical definition of the market, Stahl et al. (2016) argue that data marketplaces should enable the users to upload, download, buy, sell, and browse machine-readable data using an infrastructure made by the marketplace owner. In addition, one of the business activities of the owner should also provide data/service-related data. Using this definition, Facebook and Twitter can be classified as a data marketplace, considering their function that enables users to browse, upload, and download data between users. Not to mention, according to a report by Leetaru (2019), they also sell data for advertising purposes.

Another definition is explained by Spiekermann (2019), where he described a data marketplace as a digital platform that enables data to be traded. The platform is the intermediaries that enable any registered users to buy and sell data and allow data access through downloads, APIs, web interfaces, and other transfer mechanisms. This platform should also provide regulation regarding data trade. Spiekermann (2019) also describes four elements in the data marketplace ecosystem: data provider, data marketplace owner, data buyer, and third-party service provider. The definition of the ecosystem and the relation between elements is presented below illustration:

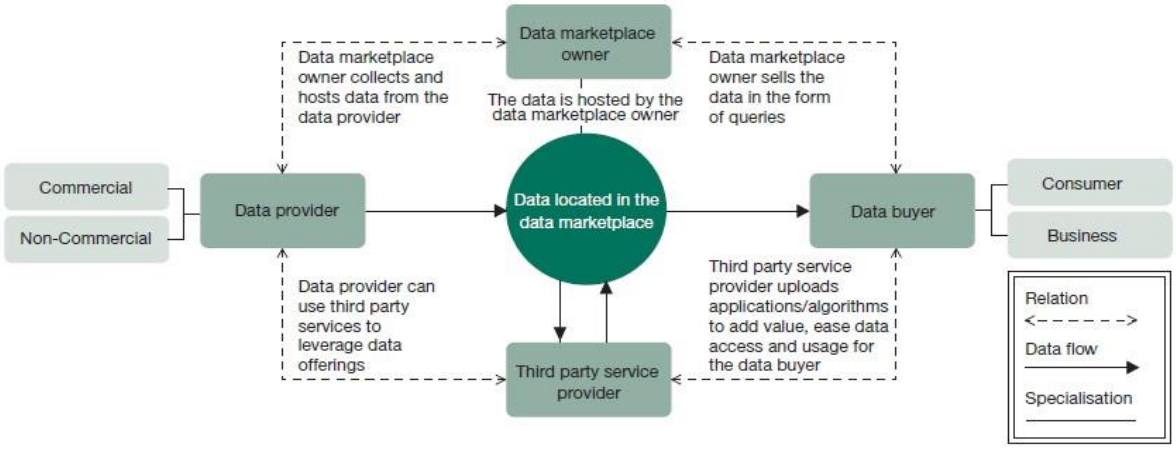

Figure 1: Data Marketplace Overview (Spiekermann, 2019)

The definition from Spiekermann (2019) fits with the context of the data marketplace for this research project because he defines a clear distinction between the data provider and data marketplace owner, which is crucial in determining the different context of data marketplace aggregator and other regular data marketplaces. This research focuses on designing a business model for an aggregator data marketplace. The designed data marketplace acts as a platform (data marketplace owner) that aggregates other data marketplace and data suppliers (data providers). Thus, a definition of data marketplace by Spiekermann (2019) will be used.

2.6 Conclusion

To end this chapter, we would like to conclude our findings from various literature to settle various concepts that will be used in this thesis. We would like to settle the concepts by providing a general idea of data marketplace aggregator. We will use STOF Model to structure our view regarding the concepts:

Service: The service from data marketplace is that they accommodate platform for data buyers and data sellers to trade. Aggregator can be regarded as intermediaries collecting various services, including platforms, accounts, and information, in a single location. Combining the concepts, data marketplace aggregator can be seen as intermediaries collecting various data marketplace in a single location.

Technology: Using the sociotechnical view, Data marketplace aggregator could use platform as the technology aspect to deliver the intermediating and collection services. The business and organizational processes are also done within the platform.

Organization: Actors within data marketplace ecosystem are data provider, data buyers, data marketplace owner, and third-party service provider. While aggregator gather services from others platform owner, and the platform owner acting as the actors that provide the services. Thus, in the data marketplace aggregator, the data marketplace owner that own and operate the platform, can also provide their data sales information to the aggregator.

Finance: The data marketplace aggregator could gather revenue through fees from advertising data sales or from providing the sales itself.

3

Chapter 3
Research Methodology

In this chapter, we intend to provide the research methodology being used in this thesis. The artifacts being studied in this research topic are business model, specifically the Aggregator Business Models. Design Science Research (DSR) is the research methodology that will be used as a basis of this research project. The DSR will be used to guide the authors in defining research question.

3.1 Design Science Research Methodology

Design Science Research (DSR) is the research methodology that will be used as a basis of this research project. Hevner et al. (2004) stated that Design Science Research aims to build and evaluate artifacts as a means to solve problems within the organization. Design Science Research contains rigorous activities to create artifacts that can solve problems, provide academic contributions, perform evaluation of the artifacts, and communicate the output to the intended audiences. These artifacts can be in the form of models, systems, methods, and also installation. In this study, the artifacts are the business models.

Design Science Research (DSR) methodology for Information System Research by Peffers et al. (2007) will be used as a framework to design the artifacts in this research. This DSR methodology is highly cited in the academia and has been widely used as a references and guidelines to design artifacts, especially in the field of information system research. The DSR methodology from Peffers et al. (2007) involves six different activities in a nominal sequence, derived from seven different papers that contribute to defining the appropriate element in the Design Research process. These activities include identify problem and motivation, define objectives for a solution, design and development, demonstration, evaluation, and communication. The process of this methodology is structured in sequential order. However, there is no

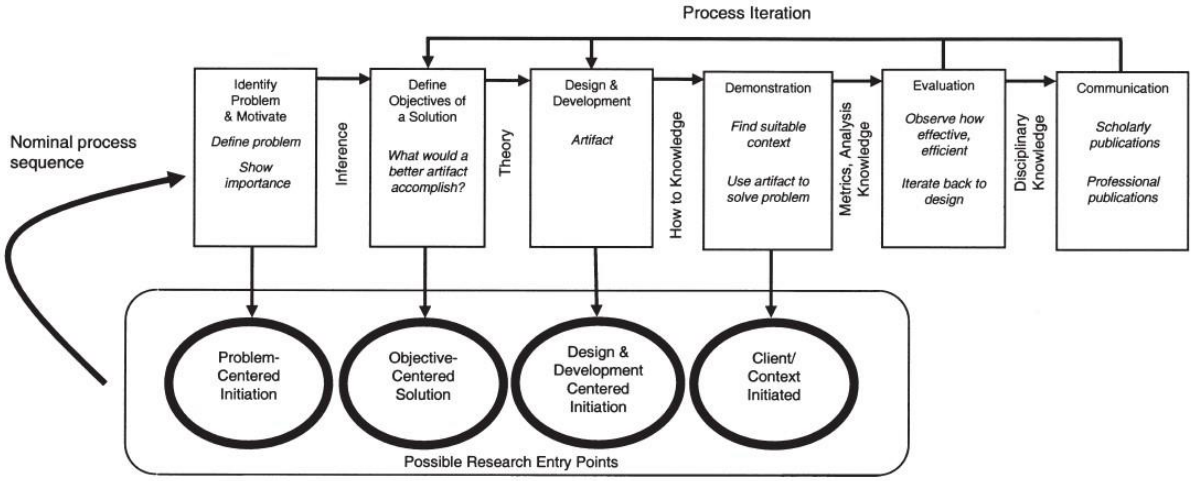

Figure 2: Design Science Research Methodology (Peffers et al., 2008)

obligation for a researcher to adopt the process by starting the research from activity 1. The researcher can start from activity 1 (problem-centered approach), Activity 2 (Objective centered solution), Activity 3 (design and development-centered approach), or Activity 4 (Client-Initiated Approach).

In the case of this research, the objective of this research has been defined and justified in the first chapter, thus an objective-centered approach will be used. The research starts from activity 2, which is to *Define Objectives of a Solution*. All of the detailed process of the six activities will be presented below.

3.2 Reasoning Behind Design Science Research

DSR aims to construct a new reality instead of explaining existing reality (Livari and Venable, 2016), thus providing a new concept and new innovation rather than explaining existing phenomenon. Many data marketplace literature have already tried to understand and explain existing reality (e.g., business model

of various established data marketplace). Towards DSR, we can add further contribution by creating a new reality (e.g., Aggregator Business Model in data economy). Although the benefit in various domain, Aggregator Business Model is still absence in the data economy domain. Thus, by designing Aggregator Business Model in the DSR, it can provide novel contribution by adding new concepts of business model that have not been widely exercised in data economy domain.

DSR is also characterized by its practical knowledge contribution to society, as it explains how to do something (Gregor & Hevner, 2013). Towards contribution to the practical knowledge, business model design is one important aspect for any business practitioners and researchers, as it helps them to rethink its old model and make a new model that fits with the business problem in the environment (Zott & Amit, 2010). Business model design is about delivering value to the society and customers as it adapts to the environmental issues and emerging user needs (Osterwalder & Pigneur, 2008). Most business model literature in data economy domain tend to focus their studies towards describing the existing business model already exercised by data marketplace operator. These literatures finalize their findings by providing business model classification. DSR enables researcher to not only study the business model concepts (e.g., business model classification), but also add further study such as demonstrating and evaluating the business model, which adds more practicality in the study rather than merely providing classification. Through the evaluation part, additionally, DSR can enable the researcher to assess the business model in the current business environment. Considering the fragmented market, the DSR enables us to evaluate the Aggregator Business Model in such environment.

3.3 Research Phase

As stated in the introduction section, the problem identified was that there exists heterogeneity of data market, causing market fragmentation in the data marketplace domains. Both data users and data buyers are facing this issue e.g., interoperability issues and slow data discovery process. Market fragmentation could decrease the trust of data buyers (TRUSTS, 2019), hinder the commercialization process of the data marketplace due to a small user base (Basaure et al., 2020), and market failing (Koutroumpis, 2021). The idea of designing Aggregator Business Model is promising because in various domain, the business models are able to help users navigate the trading process in a fragmented market.

3.3.1 Define Objective of a Solution

As aforementioned in Chapter 1, the objective of this research is to provide guidance for data marketplace operator to design Aggregator Business Models to be exercised in the data trading domain. In order to achieve this research goal, the main research question was asked: ***How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?***

3.3.2 Design and Development

Towards realizing the research objective as stated on activity 2, artifacts are designed. The artifacts are business models, specifically Aggregator Business Models. This designed Aggregator Business Model will be exercised (in Activity 4) and evaluated (in Activity 5).

Before diving deeper into the analysis of Aggregator Business Model, considering that there is a wide concept regarding Aggregator Business Model, preliminary studies will be conducted to determine the working definition of Aggregator Business Model for this research.

In this part, our goal is to define the requirements applied by the aggregators towards realizing the value to the consumers. The requirements will be the starting point for data marketplace operators in defining the business model components. We started this design and development part by conducting deductive research through literature review from existing Aggregator Business Model studies. Next, we categorize our findings from the literature review to the STOF model. We then conduct inductive research by doing explorative study through online desk research of existing aggregators to gather information from various aggregators. We would like to know how current aggregators exercise their business model. We finalize our design and development study by applying cross-case analysis from the previous desk research study to interpret patterns. From the patterns, we will derive various Aggregator Business Models along with the descriptions to exercise the business models.

Conceptualization - Literature Review

Our goal in this step is to identify business model components applied by the aggregators. The business model components are the requirements that specify the way aggregators exercise their business model. From this, the first research question is being asked: ***Which essential requirements define Aggregator Business Model?***

We will construct the concept of Aggregator Business Models through deductive reasoning by studying Aggregator Business Models from various literature, and derive the business model requirements of aggregator from the various studies. Considering a ranging definition regarding aggregator, we believe that it is also important to define our own definition of Aggregator Business Model early in the study to avoid confusion in later stages of the research.

In order to provide guidance in determining the requirements needed to create the business model artifacts, a business model literature will be used as a framework. From Chapter 2, the concept of the ICT-enabled services business model by Bouwman et al. (2008) has been chosen as the theoretical framework to determine the essential components of the business model. The components are grouped into four interrelated domains: *service design, technology design, organization design, and finance design*. These four interrelated domains are also called the STOF model. Each domain contains various business model components that can be reflected with our aggregator literature review.

Upon reflecting the business model components to the STOF model, we will conclude our findings by defining the requirements to design Aggregator Business Model. These requirements will also be used as selection criteria for the next step case studies. The requirements of the business model are based on the specified business model components from this part.

Case Study - Online Desk Research

Many academic literatures studying Aggregator Business Model were published a long time ago, so we perceived that most of these studies are obsolete if used in the current business and digitalization era. For

example, Zhu et al., (2001), Madnick et al., (2000), Madnick & Siegel (2002) focus on services delivery while neglecting technical components behind the services delivery. That being the case, we believe that additional studies are needed to provide us with a deeper understanding regarding the concept of Aggregator Business Model that can keep up with the recent digital business and service innovation concept.

Online desk research will be conducted to involve exploratory research by studying various existing aggregators. The goal of this step is to collect information from a selection of business cases employing Aggregator Business Model regarding the practiced business model components. Thus, inductive research will be done in order to gain recent understanding and new insights about Aggregator Business Models. Cases were selected based on the characteristics summarized in previous literature review steps.

Case Study - Cross-case Analysis

We finalize our design and development study by applying cross-case analysis. The goal of this step is to interpret patterns from our case study. From these case studies conducted in previous online desk research, various platforms that shares the same concepts of aggregators will be selected and compared further. We will compare and analyze the aggregators by reflecting the case studies to the business model requirements we derived in previous chapter. Although sharing the same main characteristics, these aggregators exercise their business model differently. One way to demonstrate the findings from the cross-case analysis is to develop business model archetypes. Archetypes can be defined as reoccurring patterns showed by specific samples.

Thus, from the above statement, the second sub-research question was constructed: ***How can the aggregators exercise the business models that constitute the requirements?***

Toward answering the second sub-research question, four domains of business model from the STOF model will be used as the theoretical framework to analyze the aggregators and present different characteristics of aggregators.

3.3.3 Demonstration

In this part, the business models archetypes derived from the design and development activity will be demonstrated. Towards the demonstration of these aggregator archetypes, a more practical approach to demonstrate the business model archetypes will be exercised in this part.

The demonstration study can be presented by translating the business model archetypes from the design and development phase into the data marketplace business. The translations from the business model archetypes are in the form of business activities. Thus, this part will provide guidance by providing examples of business activities that can be exercised by data marketplace operator.

From this, the third sub-research question are being raised: ***How can the data marketplace operator translate the Aggregator Business Models into business activities?***

Towards answering the third sub-research question, we will participate in a workshop with data market expert panels. In the workshop, we will discuss business models of TRUSTS, an ongoing EU data marketplace project that shares the same similarities with our business models.

In demonstrating the business models, we will also introduce business model transformation of the data marketplace. There are different Aggregator Business Models that can be exercised. Thus, it could be worthwhile to investigate if the aggregator could possibly change its business model to other type of business model. This led to the fourth sub-research question: ***Which Aggregator Business Model transformation can be exercised by the data marketplace operator?***

To answer the above question, an expert interview will be conducted with data marketplace expert to investigate the transformation strategy needed to be taken by the data marketplace operator.

As this research topic is part of the TRUSTS, regarding the expert panel workshop and expert interview as presented earlier, the expert from the TRUSTS will be invited to discuss topics regarding the above research questions.

3.3.4 Evaluation

In this part, we will investigate the possibility to realize the requirements in the business models by taking into consideration the current industry landscape and issues in the data economy domain.

Towards providing guidance, the data marketplace operators can use the results from this evaluation as consideration and justification in exercising the Aggregator Business Model in their business. The results of the evaluation part can guide the data marketplace operator in making decision. Hence, as a consideration in exercising the Aggregator Business Model, the fifth sub-research question being asked: ***To what extent each of the business model requirements can be exercised considering the current data market landscape?***

To answer the sub-research question above, expert interviews will be conducted. As this project is part of the TRUSTS project that accommodate a wide variety of data market expert within the EU region, this part of studies will involve interviewing expert from TRUSTS to discuss the research question asked above.

3.3.5 Communication

The result of this business model design will be documented in the form of a thesis report and will be presented to the public during the thesis defense. In addition to that, there is also a possibility to publish this research as a journal paper.

3.4 Research Methods Summary

To summarize the chapter, the research will be conducted in five phases. Each phase comprises its own research questions and research instruments. The below table summarize the research phases:

Table 1: Research Methods Overview

Research Objective: Provide guidance for data marketplace operator to design Aggregator Business Model in data economy domain			
Research Phase	**Research Question(s)**	**Research Instrument(s)**	**Chapter**
Phase 1: Define objectives of a solution	***Main RQ**: How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?*	Literature review	**Chapter 1 & 9**
Phase 2: Design and development	***Sub RQ 1**: Which requirements define Aggregator Business Model?*	**Sub RQ 1:** Literature review	**Chapter 4**
	***Sub RQ 2**: How can the aggregators exercise the business models that constitute the requirements?*	**Sub RQ 2:** Desk research & cross-case analysis	**Chapter 5**
Phase 3: Demonstration	**Sub RQ 3:** *How can the data marketplace operator translate the Aggregator Business Models into business activities?*	**Sub RQ 3:** Demonstration case study	**Chapter 6**
	***Sub RQ 4:** Which Aggregator Business Model transformation can be exercised by the data marketplace operator?*	**Sub RQ 4:** Semi-structured interview	**Chapter 7**
Phase 4: Evaluation	***Sub RQ 5:** To what extent each of the business model requirements can be exercised considering the current data market landscape?*	**Sub RQ 5:** Semi-structured interview	**Chapter 8**

4

Chapter 4
Conceptualization

In this chapter, we intend to provide guidance for business managers and data marketplace operators in designing Aggregator Business Model. We will provide the guidance by describing the requirements to exercise Aggregator Business Model. The requirements that distinguish aggregators with other type of business model can be identified by conducting literature review from various existing sources that discuss Aggregator Business Model. Thus, we raise the first sub-research question, "***Which requirements define Aggregator Business Model?".*** We will answer the first sub research question in this chapter.

4.1 Introduction

From chapter 2, it can be seen that literatures provide ranging terminologies about aggregators (France et al., 1998; Madnick et al., 2000; Zhu et al., 2001; Madnick & Siegel, 2002; Chang et al., 2003; Lockett & Brown, 2006). We conclude that most literatures lack definition that encompass the characteristics of digitality. These literatures failed to explain the emerging sort of business which incorporate the characteristics of digital services within their definition, which possess a strong concept in the technology. These literatures explain the concept of aggregators by focusing on the services that the business deliver. For example, they were able to understand the concept of aggregator as an intermediary collecting information from various sources (Zhu et al., 2001; Madnick & Siegel, 2002). However, they failed to explain the technicalities behind the information collection.

Certain concepts stemming from the field of information technology and business sciences can be leveraged to understand the concept of aggregators and the digital characteristic behind aggregators. From the business science literature, the concept of service-aggregator, service ecosystem, and business networks can be leveraged to develop our concept of aggregators.

Additionally, recent modern aggregators also constitute the principles of platform, while older literature on aggregators do not specify the technological concept of aggregators. We perceive modern aggregators not only function as mediator between user groups, but also constitute extensible codebase, so it fit the classification of digital platform as argued by de Reuver et al., (2018). We believe that the concept of platform helps explains the technology concept behind the service delivery, it is necessary to indulge the concept of platform from the information technology domain into this study.

On top of that, there are various terminology about aggregators, although possessing a notably similar meaning, these distributed terminologies were derived from different point-of-views and scoping from the authors. Thus, each terminology could arise a different meaning and concept. These conceptual issues are frequently found in the information system domain, especially regarding platform and ecosystem. De Reuver et al (2018) recommends to provide a clear conceptualization regarding the platform being discussed. For all of this reason, in order to set our own context and terminology of aggregator for this thesis project, it is important to establish a new perspective of aggregator.

In this chapter, the terminology aggregators will be further discussed in this part. The second part will discuss the concept of service-ecosystem. Classical literatures regarding aggregator tend to only focus on (physical) product and information aggregation, while we intend to define aggregation of services. We deemed that explaining service-ecosystem terminology is important. The fourth part will conduct literature review to identify the components of Aggregator Business Models from the previous literatures. We study the characteristics of aggregators from various academic literature to set the characteristics of aggregator used in our research. We will also present the concept of platform and indulge the notion into our aggregator characteristics. In the last section, we establish a novel view regarding Aggregator Business Model encompassing characteristics of service-ecosystem, aggregators, and platform. We summarize our business model and present our view regarding aggregators in a table.

4.2 Service Ecosystem

Before diving deeper into the discussion of aggregators, it is necessary to firstly introduce the concept of service ecosystem. Within the service ecosystem, aggregators play an important role in such environment, which will be explained further in the later section of this part. Kohlborn et al., (2009) in their paper present the notion of service ecosystem based on merging the concepts of business networks and service-orientation. In the next section, we will present the concept of business networks and service-orientation.

4.2.1 Business Networks

As a results from the transformation of new market structures (Cherbakov et al, 2005) organization become obliged to change their organizational structure. Organization nowadays tends to focus on strengthening their core competence and capabilities as a means to differentiate their business with competitors. These competence and capabilities render the organization's competitive advantage that ensure the success of organization in the market to become a highly specialized organization (Hagel and Singer, 1999). In order to fulfil complex market demands, highly specialized organization are obliged to form collaboration with other highly specialized organizations. Collaboration between organizations originate the creation of business networks or business webs, where each organization in this business webs is accountable for a certain part of value creation (Sanz et al, 2006).

Tapscott et al., (2000) explained the emergence of networks of business, or B-web (business web), as the new model of the firm. This new business model allows each organization to specialize on its core competences and capabilities, and together with other specialized organization delivering value creation to customers. The authors describe that this business webs are formed from the collaboration of different networks of suppliers, distributors, providers, and customers. Schroth (2007) mentioned that significant reduction in developing modern information technology enable efficient coordination between organizations to form collaboration.

Tapscott et al., (2000) and Meier & Ullrich (2008) classified five different type of cooperation that represent various business networks in the market:

- **Agora**: This type of business network represents open and electronic marketplace. The main characteristics of this business networks is the existence of dynamic pricing mechanism, where product providers and product consumers negotiate the price on-the-spot and in a real-time manner. In Agora, the platform owner only provides the platform to accommodate providers and consumers, while the value delivery is provided by the product providers. Prominent example would be eBay and Marktplaats.
- **Aggregation**: Similar like Agora, this type of business network also represents the characteristics of open and electronic marketplace. The main difference is that Aggregation incorporates the role of *aggregator,* a strong intermediary organization that provides the marketplace infrastructure while simultaneously leading the network in a hierarchical manner. Thus, this strong organization deliver the entire value chain from the providers to the customers. Example of these network are

Amazon and Bol.com. As a note, the term aggregator in this concept differs with our term of aggregator.

- **Value Chain:** This type of business networks incorporates the role of a primary company acting as an integrator managing highly integrated value chain for the entire components from detailing specification, managing delivery, and assembling all components to support customer demands. This integrator does not produce the components by itself, rather integrating various components producers and market the final product to the customers through marketing and after-sales services. Examples including most modern manufacturing company such as Samsung and Tesla.
- **Alliance:** This network incorporates the characteristics of a self-organizing and loosely-coupled organizational networks in a non-hierarchical manner or equal partners. They were typically formed through a shared goal, as a mean of finding complementary partner to cover the lacking capabilities of the organization. The network of Linux developers is one of the prominent examples.
- **Distributive Networks:** This type of business networks is characterized by the existence of a distributor. Distributor leads the delivery of material or immaterial product from the product providers to product consumers. Most network service providers and mobile carrier providers are prominent example of this business networks.

4.2.2 Service Orientation

To set the context of service orientation, a definition of the term service is needed. The traditional business literature, the goods-dominant logic pointed out that services are intangible, or in other word what goods are not (Vargo & Lusch, 2004). This traditional notion regarding service focuses on the output of the organizational processes, which is on the basis that organization provides and produces tangible and/or intangible products. Contrary to this traditional beliefs, Vargo & Lusch (2004, 2008) develops service-dominant logic. Vargo & Lusch (2008) in their argumentation regarding the notion of service from the service-dominant logic argued that service is the application of capabilities and competences through a set of process by one actor for the benefit of other actors.

In traditional views, the goods-dominant logic separates the definition between physical products (goods) and non-physical product (services), thus emphasizing on the intangible nature of service. We argued that the separate notion between service and good is not applicable if indulged in the modern business context because business might include tangible product (goods) as part of service. Take a look an example from booking.com, an online ticketing business. The business offers ticketing services, from providing ticket sales information, managing payment, to the delivery of the ticket. The physical product delivered to the consumers, e.g., flight ticket (goods) is part of the whole services being offered by the business.

Contrary to the traditional beliefs, the service-dominant logic views service as a process of doing something for someone by the organization, rather than the units of output produced by the organization as in the traditional business literature. The service-dominant logic view service as what an actor does in solving other actor problem, thus the service-dominant logic focus on the capabilities to solve problem, rather than the distinguished nature of the output of the organization. We see that the service-dominant logic

terminology fit the modern business context. Using the similar case from online ticketing platform, Booking.com, it can be seen that the business is doing a set of activities supporting the travelers to search, book, pay, and deliver the ticket, thus offering booking service to the consumers. Booking.com, as an organization, is capable of solving consumers problem, while in the same time providing intangible and tangible product.

The service-dominant logic provides a consistent terminology of service for our thesis research, but we see that this definition itself is still inadequate for the modern business context. Although the service-dominant logic emphasizes process in its terminology, it is still not fully clear on how the business realize and deliver the process in practice. In the digital business context, especially with regards to our thesis, we bring the concept of digital platform. Digital platform is a technical point of view regarding the delivery of this process.

Using the prior example from Booking.com, it can be seen that in doing the process of solving travelers' problem, the business utilizes web services as a tool in delivering the process of solving traveler problems. From the computer science term, as defined by W3C, web service is described as a software intended to assist the interaction of interoperable machine over the internet network. Web services enables organizations to offer business services in a semi or fully automatic manner (Kohlborn et al., 2009; Sanz et al., 2006). In several business sciences, the term web service is also defined as a service delivered via the electronic network (Rust & Kannan, 2003; Baida et al., 2004).

Thus, merging the notion of service from the service-dominant logic with the notion of web service, we coined the definition of service as a set of processes of applying capabilities and competences of one actor for the benefit of solving other actor's problem using automatic process via web services. This is the definition of service that we would like to use in this thesis research.

4.2.3 Service Ecosystem and Digital Platform

In deriving the terminology of service ecosystem, we can use the concept of business network and service from the previous sections. Several authors have also derived the notion of service ecosystem in their papers (Baros & Dumas, 2006; Riedl et al., 2009; Lusch & Nambisan, 2015; de Reuver et al., 2018).

Baros & Dumas (2006) are one of early academia promoting the emergence of web service ecosystem. They explained service ecosystem as a multitude set of web services incorporating the characteristics of business services. They described that in the service ecosystem, the consumers acquire service functions (e.g., information delivery, payment, relationship arrangement) through multiple service delivery channels. From the organizational point of view, ecosystem can be defined as a group of firms interacting to provide complementary services (de Reuver et al., 2018). To add the lacking technical concept in the definition, from the technical view (de Reuver et al., 2018), ecosystem can also be seen as a collection of complementary service to support the core technical service.

De Reuver et al., (2018) also stated that the term platforms are closely related to the term ecosystem. Deriving from the technical view, digital platform is technical architectures containing extensible codebase complemented by third-party technical modules (Tiwana et al., 2010; Boudreau, 2012; de Reuver et al.,

2018). Although providing a technical concept, this terminology lacks organizational concept, which we deemed important for business research. Thus, we take the definition of digital platform using the sociotechnical view, as a "technical elements (of software and hardware) and associated organizational processes and standards". The later view on digital platform provides both the organizational and technology concept in its terminology.

We can see that the conceptualization of service ecosystem described by these authors comprise the concept of multiple services provided by multiple actors. Thus, the concept of service ecosystem is more closely related to explain the interactions between actors in delivering services. While the concept of digital platform is more closely related as a tool facilitating the interaction in the service ecosystem. Thus, digital platform is the technical architecture facilitating the interactions of actors towards delivering the service.

In the prior section, we derived our definition of service as a set of processes of applying capabilities and competences of one actor for the benefit of solving other actor's problem using automatic process via web services. The automatic process via web services is facilitated through digital platform.

4.2.4. Roles in a Service Ecosystem

Barros & Dumas (2006), followed by Kohlborn et al., (2009) envision the characteristics of actors within a service ecosystem. Kohlborn et al., (2009) describes two basic roles within a service ecosystem: *service providers* and *service consumers*. The descriptions of these basic roles will be explained as follows:

- **Service Providers:** In a service ecosystem, services are outsourced to the ecosystem. Service providers are responsible to outsource services to the ecosystem. Within the ecosystem, service providers can outsource the services at the end-consumers or at other roles in the ecosystem such as service aggregator and service broker. Service providers are responsible in bringing the access point of the service and implementing the service to the targeted entities. Service providers provides access point through web service by providing keywords and enriching service descriptions and information, thus service consumers can query for the context of the service through the internet.
- **Service Consumers:** The outsourced services from service providers are utilized by service consumers. In a web service ecosystem, service consumers typically conduct services discovery through keyword searches mechanism as facilitated by the service providers.

In addition to the roles mentioned above, Barros & Dumas (2006) also describe the role of entities that bring additional value to the service ecosystem by forwarding the services from the service providers closer to the service consumers. Similar with service providers, these intermediaries could also provide access point of the service thus allowing the service consumers to independently discovers and access the services. Regarding the additional value from the service intermediaries, Kohlborn et al., (2009) explain a different type of intermediaries in more detail. The different types are as follows:

- **Platform provider:** Platform provider adds value to the service ecosystem by creating and maintaining platform for the whole service ecosystem operation. The other roles (service providers, service consumers, and service intermediaries) operate and utilize the platform.

Platform provider may also introduce core and additional services in the platform in order to make marketable service.

- **Service Aggregator:** Service aggregator adds value to the service ecosystem through service composition and service aggregation. Typically, service aggregator combines and integrates services from various service providers to offer new service offering (service bundles). Service aggregators then utilize service bundles to forge new business model.
- **Service Broker:** Service brokers characterizes a similar added value like service aggregator. Service broker also provide service compositions and service aggregation. The main differentiator is that service broker typically combines service bundles e.g., combining travelling services (ticket sales and hotel booking) with payment services.
- **Service Mediator:** Service mediators adds value to the service ecosystem by providing translation services of various (computer) formats and standards. The existence of service mediator facilitates the technical transformation required during the service delivery. Service mediator is particularly useful in a service ecosystem with no established standardized computer language.

In this thesis paper, we will put our focus of analysis on the role of service aggregator. Although for most modern service aggregator, it can be seen that these modern aggregators also possess characteristics of platform providers, service broker, and service mediator, which will be explained further in the next section of this chapter. The next section will elaborate further on the concept of service aggregators.

4.3 Service Aggregator

In this chapter, the concept of service aggregator will be elaborated further. The first part of this section will explain certain terminology in the context of aggregator that will be used in the rest of this thesis research. In the second part, different definition of aggregator from various literature will be used, and we will reflect their definition in order to set our definition of service aggregators to better comply with current aggregators.

4.3.1 The Concept of Service Aggregator

The earlier concept of service aggregator was expressed by Tapscott et al., (2000) as an intermediary role connecting service providers and consumers. This intermediary role combines services on specific domain then rebrand and repurpose for an added value to specific customer segment. The value includes convenience, selection, and price matching.

Kohlbron et al., (2009) bring the definition from Tapscott et al., (2000) further by detailing the core service value of aggregator. According to Kohlborn et al., (2009), aggregator is an intermediary entity between service consumers and service providers with a decent knowledge on specific domain. With this domain knowledge, aggregators are able to bring value to service ecosystem through service aggregation, composition, and bundling in a new business model.

Zhu et al., (2001), followed by Madnick & Siegel (2002), explained web aggregator as an entity that offers service of collecting information from various (internet) sources and analyze the collected information as

an added value. The added value of aggregators can be in the form of intelligent comparison (comparison aggregator) or consolidation of service in the same context (relationship aggregator).

Madnick & Siegel (2002) and Papazoglou & Heuvel (2007) elaborate characteristics of aggregators:

- **Access Transparency**: Aggregators is perceived as a normal user by the aggregatee, acting as a user accessing the information.
- **Contextual Transparency**: Aggregator settle contextual differences to provide comparisons.
- **Analysis**: Aggregator conduct post data collection activities by performing analysis of the collected data into a value-added services.
- **Dual Role**: Act as a service provider by offering aggregated service to the service consumers, while on one hand also act as a service consumers for relying on external services provider to maintain its aggregated services.

Reflecting from Zhu et al., (2001) and Madnick & Siegel (2002), the definition of aggregator is established based on information collection services. According to them, aggregator offers value by integrating information collection thus enabling the aggregator to conduct comparisons and manage relationship.

Comparison Aggregators offer value through information collection, typically collecting goods and service publicly available on the internet. Comparison aggregators extract information on specific domain offered by competing providers and analyze the information to provide side—by-side comparison (Zhu et al., 2001). The collected information is also analyzed to provide a recommendation to the consumers (Madnick & Siegel., 2002).

A prominent example of comparison aggregator is finder.com, an Australian website that recommend the latest discounts offering from various sites. The huge amount of information and website has made finding specific discounts from different sites a difficult task. Consumers has to visit each of website separately while at the same time comparing deals from different websites. Consumers might also miss certain deals due to the limited time to visit each website. With the help of deals comparison aggregator, consumers can compare different deals from various sources under one website.

Relationship Aggregators provide value by maintaining and managing client relationship with multiple service providers (aggregatee). Consumers face difficulties in managing relationship with various service providers.

For example, in the financial service industry, commonly consumers have multiple financial account. Each of this account requires account login, thus managing multiple account could be time consuming and complicated. With the help of relationship aggregator, consumers can manage multiple financial account under single login. Relationship aggregator collect consumer's financial information on behalf of the consumers to also perform services and create financial reports. Several financial account aggregators are Dyme (Dutch-based startup), Finku (Indonesian-based startup), and CashEdge (US-based startup).

4.3.2 Service and Value of Aggregator

In the previous part, it is already explained briefly on the concept of service aggregator. Service aggregator is explained by Kohlborn et al., (2009) as intermediary entity that add value to the service ecosystem through service composition, service aggregation, and service bundling. In various domain such as business science and computer science, the term composition, aggregation, and bundling hold an overlapping definition. In order to clarify our view and to avoid confusion in the later part of this thesis, we would like to elaborate further regarding these terms.

Deriving from the information technology domain, Sullivan et al., (2002) describes aggregation and composition as a service that contains sub-service. They describe that ***aggregation service*** provides a single access point that comprises of multiple services. One example of aggregation service is an online investment brokerage. The investment brokerage provides various financial assets and services to service consumers, ranging from stock, cryptocurrency, bonds, to multi-fund assets listings. The investment brokerage created an online platform where people can access and buy these various financial assets in a single location.

On the other hand, ***composition service*** is defined as a tightly-coupled collection of sub-services, thus adding new value of services that are not present in the basic service (Sullivan et al., 2002). They stated that the additional values are introduced as a different service property (e.g., improved convenience, reduced price). For example, the online investment brokerage decided to add feature where users can look another user portfolio and copy their portfolio. This new feature adds a new value and introduce a new service property, which is the improved convenience for investors.

Other term that is less used in the information technology domain but has been commonly used in the business domain is ***bundling service.*** Guiltinan (1987) refers bundling to a service where multiple products (or services) are tied together as one package to consumers, typically for a cheaper price compared to purchasing each of product (or services) separately.

Based on several literature as described above, it can be seen that these different term regarding services offered by aggregator are different. Although all of the terms above are coined to describe the phenomenon of combining multiple product or services, each definition comprise different value for the service consumers. *Aggregation services* focus on combining multiple products of the same type (e.g., financial asset products) under one point of access. Thus, the focus lies on combining a *substitute* product in one location. While *composition services* focus on combining a different type product that can provide a new added value, thus the focus is on combining a *complementary* product in one location. Regarding the *bundling services*, it is not specified if each of the combined products are substituting or complementing with one another, but the focus lies on the reduced price.

It is important to note that there are conventional businesses which also possess similar values and services as stated above. For example, conventional supermarkets hold the same values as service aggregator. They provide aggregation services through selling multiple products of the same type (e.g., various shampoo of different brands), adding composition services through various payment method, and commonly offers

bundled product for a discounted price. However, on previous section 4.2, we already derived our definition of services, which emphasizes not only on the capabilities of organization, but also on the automated process typically enabled on web services. Thus, despite the fact that most conventional marketplaces hold similar values, they are excluded in our definition due to its lack of automated processing capabilities through web services.

4.3.3 Enabling Technologies of Service Aggregator

Conceptually, the services and values offered by service aggregator can be explained using the terms as described above. They are the core services of service aggregators. Although the three core services above are adequate to explain the capabilities of service aggregators in solving other actor's problem, this concept still fails to explain how the aggregators are able to deliver this services and value to the users.

According to Bouwman et al., (2008), services and technology is associated. As explained by them, the requirement to deliver services and value to the end-users define the technology in the organization. From this argumentation, it can be concluded that technology is the object enabling the delivery of services and value, thus answering our issues in previous paragraph.

In addition to the aggregation services and composition services described previously, Kohlborn et al., (2009) also explains that service aggregators also provide *services integration* and *services orchestration*. According to Kohlbron et al., (2009), multiple services and value are integrated to a certain degree that enables the delivery of service aggregation and service composition. They also describe that integration is the core value of business webs. While service orchestration is explained as an autocratic mechanism enabling service compositions through a workflow coordinated by a central controller (Kohlbron et al., 2009; Peltz, 2003).

Although not explicitly stated, from the definition explained previously, service integration and service orchestration possess technological concept that enable the delivery of service aggregation and service composition. These understanding align with the argumentation from Bouwmann et al., (2008), as the technology (service integration and service orchestration) enable the delivery of services and value (service integration and service composition). In order to derive a more robust understanding, we study several literatures to provide a thorough explanation regarding services integration and service orchestration.

Service Integration

Academic literature from the information technology domain has described various perspective about integration. In the field of e-government, there are study about vertical and horizontal integration (Layne & Lee, 2001), and public service digital integration (Kubicek et al., 2003). In the business management field, Ralf (2004) discussed the differences between information integration and business process integration. Within the information system domain, various scholars discussed information system integration, in the topic of web-based information system, social media platform, and e-commerce (Preuner & Schrefl, 2002; Emmerich, 2002; MacMillan, 2012; Lee, 2013; Li & Agarwal, 2016; Ewa Abbas, 2019).

Towards various view from the literature above, the term "integration" is mainly used to explain:

1. Coordinating functions of different organizations, services, and applications.
2. Enabling sharing and exchange capabilities of information or data between organizations, services, and applications.
3. Supporting third-party services (typically complementary services) in developing services that enhance the first-party services.

From the above definition, it can be concluded that service integration is described to coordinate multiple services, organizations, and applications to enable information sharing capabilities. The integration as presented by above literature are referred to either performed through manual process or semi or even fully automated process. In our thesis, the process of the integration is utilized through semi or fully automated process, as explained by us through the definition of services in the previous section. This semi or fully automated process could be explained as a service orchestration and service choreography.

Service Orchestration and Service Choreography

Service orchestration is explained by Peltz (2003) as an aspect of creating business process that can interact with both internal and external web services. The interactions contain logic to perform task execution of a business process covering different applications and organizations. Peltz (2003) describes that service orchestration is characterized by *one entity* controlling the entire execution of business process.

Service choreography is explained by Peltz (2003) as a similar meaning with orchestration of an executable business process between web services across different organizations. While service orchestration portrays one entity as the central controller, the service choreography represents *collaborative characteristics* that enable each entity to define its own interaction and task execution. Although not mentioned by Kohlborn et al., (2009), we believe that service choreography is also one of technological service provided by service aggregators, as it incorporates a similar concept with service orchestration.

To realize service orchestration and service choreography, technical requirements are needed to execute business process in the web services. Peltz (2003) describes that these requirements consist of a workflow language to execute (business) process and the infrastructure to run the workflow. The infrastructure manages the entire process workflow, allocate the required services, and determine step by step process. Peltz (2003) explains that the infrastructures are working automatically through a standardized language (e.g., Business Process Execution Language, Business Process Management Language, and Web Services Choreography Interface).

In our thesis, we do not aim to gain a deeper understanding about the technicalities matter (e.g., programming language) regarding these programming language and standard being used in aggregators, but the example from Peltz (2003) provides us with an understanding that both the service orchestration and service choreography incorporates a process of executing task and workflow automatically through a web-service infrastructure.

4.3.4 Organization and Relationship of Aggregators

Bouwman et al., (2009) explain that an organization needs to form collaboration with other organization in order to obtain resources and capabilities thus able to provide the service to the consumers. These resources and capabilities include technology.

Towards our study on aggregator, we already describe that technology is required in order to deliver the services to the consumers. Organizational arrangements are also needed in order for the aggregator to deliver the service to the consumers through collaboration and strategic interaction between organizations. Additionally, technology can also be generated through organization network. As Bouwman et al., (2009) argued, collaborations between organizations can provide the exchange of information, products, and services thus enabling the organization network to deliver new services to the market. These are the core activities of aggregator, which are service integration, service choreography, and service orchestration. That being the case, we would like to understand the interaction between aggregators and other organizations within the ecosystem.

Madnick & Siegel (2002) describes strategic interactions between aggregators and aggregatee. Aggregatee is an organization which data, information, and services could be aggregated by an aggregator. In the beginning, aggregatees might just started launching their online channel, making them the target of aggregators. They describe that aggregator can appear as a normal user accessing the aggregatees' channel. Thus, aggregators typically appear out of sight and very quickly, without the aggregatee even knowing that their information were extracted by the aggregator.

A formal partnership between aggregator and aggregatee could be arranged in order to reduce integration cost (Madnick & Siegel, 2002). This partnership is arranged as both aggregator and aggregatee realize a mutual benefit. Aggregator foresee a financial benefit by commercializing the extracted information into a value to the consumers (e.g., providing recommendation for a certain product), while the aggregatee find this treatment as an additional marketing to increase demand.

Aggregatees may also decided to establish their own aggregator or to pursue ownership of existing aggregators. They typically seek control of aggregators because they perceive aggregator' strategy as a threat.

The section below explains seven different strategic interaction between aggregator and aggregatee as described by (Madnick & Siegel, 2002):

No Aggregation - Non-Aggregator / Aggregatee

The state of Non-Aggegator/Aggregatee is the basic state where every organization delivering their service through online channels are the target of aggregators, thus classified as aggregatee. The product and services made available online could be collected and extracted by the aggregator. The higher the degree of information fragmentation in the market, the higher the difficulties to compare and absorb information on different services (and product). Thus, making the presence of aggregator valuable in the market.

Aggregation Without Partnership

Financially Independent Aggregator / Unsuspecting Aggregatee

Due to its online presence, the data and information provided by the aggregatee are widely accessible on the internet, making it possible for aggregator to collect and extract the information. No prior partnership arrangement is established between aggregator and aggregatees, because aggregator can act as a normal consumer simply accessing the information. In the perspective of aggregatees, they also cannot distinguish between normal user or aggregator collecting information.

Aggregation With Partnership

A bilateral partnership between aggregator and aggregatee could be formed when mutual benefit could be realized from the information exchange. Such partnership with aggregatees enable aggregators to extract information not publicly available online. The partnership will allow aggregator to retrieve special information from the aggregatees.

Various form of partnership could be established. They can opt to form a limited alliance with selected organizations. They may also opt to establish an either an equal degree or varying degrees of collaboration.

Financially Independent Aggregator with Varying Degrees of Collaboration

An Aggregator could leverage its value as intermediaries between aggregatee and consumers. They could provide a special treatment to certain aggregatee in exchange for a fee. Special treatment by aggregator could be seen by aggregatee as a competitive advantage by differentiating itself with competitors (other aggregatees).

Financially Independent Aggregator of a Limited Alliance

In a competitive market with a high degree of rivalry, aggregatee tend to avoid establishing collaboration with other aggregatee due to the competition. Aggregatee might select a limited number of aggregatee as potential target of aggregators, thus creating alliance of selected partners.

Financially Independent Aggregator with Equal Degree of Collaboration

Aggregator may decide to establish its neutrality as an intermediary in the market. This aggregator typically prefers an advisory role for consumers, thus maintaining a neutrality towards aggregatees, while neglecting the financial gain from providing special treatment to certain aggregatees. They tend to provide equal collaboration with all aggregatees.

Aggregation With Ownership

Instead of collaborating with aggregators through partnership arrangement, aggregatee may opt to directly invest in the aggregator as a means to strengthen and control the aggregator's partnership with other aggregatees. Additionally, a network of aggregatees can also put investment in certain aggregators.

Financially Dependent Aggregator Owned by a Dominant Aggregatee

Aggregatee can directly put investment to an existing aggregator or to develop its own aggregators. Toward this investment, the aggregatee will have more control towards the aggregators e.g., controlling who is included in the partnership, selecting which competitors to be included in the aggregation. Additionally, the information regarding the aggregator's users is accessible by the aggregatee, thus providing a benefit to the aggregatee.

Financially Dependent Aggregator Owned by a Consortium of Aggregatee

On one hand, aggregatees may want to avoid a single aggregatee controlling and dominating certain aggregators. Thus, they can establish a consortium to equally put investment to aggregator.

4.4 Service Aggregator towards the STOF Model.

In this section, we would like to take our findings in the previous section towards STOF Model. In the previous section, we already gain understanding regarding the service of aggregator, the technology enabler, and the strategic relationship between aggregator and aggregatees depicted by various literature. As the objective of this thesis project is to design a business model, we would like to design Aggregator Business Models based on literature previously presented. We will use STOF Model as our basis to derive the business model design. STOF Model comprises of four domains consisting of service domain, technology domain, organization domain, and finance domain (Bouwman et al., 2008).

We will start our analysis from the service domain, as also argued by Bouwman et al., (2008) that the value of a product and service is the starting point for any business model, as the value and service will be the focal requirement to define the other domain.

4.4.1 Service Domain and Technology Domain of Aggregators

Bouwman et al., (2008) argued that the focal issue to design services lies on "value". From the perspective of provider, value is what the provider intended to deliver to the consumers, which consist of intended value and delivered value. They describe that Intended value is defined as the value that the provider want to deliver to the customers. Intended value is the value envisioned by the value creator (provider). While delivered value is defined by Bouwman et al., (2008) as the actual value delivered to the customers.

Bouwman et al., (2008) argued that there lies connection between technologies and services. They explain that technology is implemented within the organization to facilitate the process of delivering the services and value to the users. The connection lies when the *intended value*, a value envisioned by the value creator, define the requirements to specify *technology design*. The technology design is utilized by the service consumers, and enable the aggregator to provide the *delivered value* to the consumers.

In the previous section, the concept of value by the aggregator has been presented. From literature, it can be perceived that the value of aggregator lies on its capabilities to consolidate various (online) information in one location and provide post-aggregation analysis on top of the information consolidation. These are the value that aggregator envisioned to realize to its consumers. Thus, we argue that the intended value of

aggregators lies on the consolidation of information under one location and on its post-aggregation analysis.

We already explained the concept of service integration, service orchestration, and service choreography in previous chapter. These concepts incorporate the concept of technology that enable aggregators to realize its value and deliver its services, thus classifying these concepts within the technology domain.

Service integration, service orchestration, and service choreography enable the delivery of the aggregator's service which are service aggregation, service composition, and service bundling. These three services are the actual value delivered and utilized by the consumers. The consumers are the entities benefited from the services. Thus, these three services are the delivered value.

To summarize our reflection to the STOF Model, it can be explained that aggregator as the value provider envisioned to provide consumers with information consolidation and post-aggregation analysis of the information (intended value). To facilitate the process of providing the value to the consumers, aggregator performs technical activities such as service integration, service orchestration, and service choreography (technology design). Utilizing these technology design, aggregator then able to deliver the actual value to the consumers by offering service aggregation, service composition, and service bundling to the users.

Using the above explanation, it is also good to note that we do not fully agree with the statement from Kohlborn et al., (2009) that argued service integration and service orchestration (including service choreography by definition) as the core services of aggregator. Although if we use the definition of service from section 4.2.2, service integration and service orchestration possess activities and capabilities of one entity to solve consumers problem through web service thus can be classified as a service. However, using the definition from Bouwman et al., (2008) using our explanation in previous paragraph, service integration, service orchestration, and service choreography are more closely related as the tools to realize the services, rather than the services itself. Therefore, we do not put service integration, service orchestration, and service choreography in the service domain and put the definition on the technology domain instead.

Table 2: Service Domain and Technology Domain of Aggregators

<table>
<tr><th>SERVICE DOMAIN</th><th>TECHNOLOGY DOMAIN</th></tr>
<tr><td>Intended Value:
Services Consolidation
Post-aggregation analysis</td><td rowspan="2">Technology Design:
Service Integration
Service Orchestration
Service Choreography</td></tr>
<tr><td>Delivered Value:
Service Aggregation
Service Composition
Service Bundling</td></tr>
</table>

4.4.2 Organizations Domain and Finance Domain

Bouwman et al., (2008) describes organization domain as a value network necessary to deliver the service. *Value network* involves *actors* possessing *resource and capabilities* that *interact* with other actors to perform *value activities* to generate value to consumers.

We previously describe the concept of strategic interactions between aggregators and aggregatee (Madnick & Siegel, 2002). The concept of strategic interaction between aggregators and agregatee (Madnick & Siegel, 2002) confirms the descriptions regarding value network within organization domain (Bouwman et al., 2008). The strategic interactions explain the value network of Aggregator Business Model, consisting of aggregator and aggregatees as the *actors*. The actors each possess their own *resources and capabilities* (e.g., market knowledge for aggregatees and technological capabilities for aggregator) and arrange *organizational partnership* (e.g., aggregation with ownership, aggregation with partnership, and in to some extent aggregation without partnership). Through these different partnerships, *value activities* (e.g., exchanging information between actors, leveraging intermediary function to aggregatee, forming consortium to invest in aggregator) were performed between aggregator and aggregatees. Value activities are the central point to generate both the *technical architecture* and *delivered value* (e.g., developing service integration technology to enable service orchestration for consumers).

We summarize our reflection to STOF Model regarding service interactions between aggregator and aggregatee (Madnick & Siegel, 2002):

Table 3: Organization Domain of Aggregators

ORGANIZATION DOMAIN **Actors:** Aggregator and Aggregatee		
Value Network	**Organizational Arrangements**	**Value Activities**
Aggregation Without Partnership	No partnership	• No established partnership between actors. • Aggregator extract public information without the aggregatee's knowledge.
Aggregation With Partnership	Partial collaboration	• Aggregators provide special treatment to collaborating aggregatees. • Aggregatees pay fees for special treatment to differentiate with other aggregatees.

	Alliance (Limited actors)	• Aggregatees and Aggregator forming alliance. • Alliance limits the number of participants that can be included in the aggregator's list.
	Equal Collaboration	• Aggregator serve as a neutral intermediary providing equal treatment to all aggregatees.
Aggregation With Ownership	Dominant Aggregatee owning an aggregator	• Dominant aggregatee control and maintain the aggregator • Dominant aggregatee can selectively choose which aggregatee to include.
	Consortium of Aggregatees owning an aggregator	• Consortium control and maintain the aggregator • Consortium can selectively choose which aggregatee to include.

Note that we exclude *No Aggregation* strategic interaction in the table, although Madnick & Siegel (2002) include it as one of the relationships between aggregator and aggregatee, we cannot include it in our table due to the absent of value-adding interactions between aggregator and aggregatee, thus failed to fit the definition of organization domain by Bouwman et al., (2008).

Additionally, we include *Aggregation Without Partnership* in our table. Although no prior organizational arrangement was established between aggregator and aggregatees, there are indirect interaction between the actors. The value activity is that the aggregator extracts publicly available information from the aggregator's online channel, thus to some extent enabling indirect interactions. Through this interaction, value and services can be delivered to the consumers. That being the case, it still fit the definition of organization domain by Bouwman et al., (2008).

A connection between Organization domain and finance domain were explained by Bouwman et al., (2008). *Financial Arrangements,* one of component within the finance domain, explained as the way cost, revenue, profit, and investment are divided between involved actors in a value network. Bouwman et al., (2008) in the descriptive model of organizational domain also point out a direct relationship between organizational arrangement and financial arrangement.

Towards the strategic interaction of aggregator and aggregatee from Madnick & Siegel (2008), it was explained briefly about the degree of financial control towards the aggregator. The financial control of the aggregator correlates with the type of value network. For the value network specifically aggregation with and without partnership, the aggregator tends to independently finance their business. While for the

aggregation with ownership, the aggregator tends to dependently financed by the owner of the aggregator e.g., dominating aggregatee or consortium that invest in the aggregator.

We summarize the relationship of organization domain with finance domain in below table:

Table 4: Organization-Finance Domain Relationships

ORGANIZATION DOMAIN	**FINANCE DOMAIN**	**ORGANIZATION DOMAIN**
Value Network	**Financial Arrangements**	**Value Activities**
Aggregation Without Partnership	Financially Independent Aggregator	• Aggregator independently finance their business
Aggregation With Partnership	Financially Independent Aggregator	• Aggregator independently finance their business • Aggregatees could pay fees to aggregator for a special treatment
Aggregation With Ownership	Financially Dependent Aggregator	• Aggregatees or consortium invest and finance the aggregator's business

4.5 Conclusion of Chapter 4

We firstly present various management and information science concepts such as business network, service-orientation, service ecosystem, and digital platform to provide us with a consistent terminology and conceptualization in the later study. The summary of our findings are as follows:

- Business network: collaboration of business actors (including the customers) with its own competencies towards value creation
- Service: a set of processes of applying capabilities and competences of one actor for the benefit of solving other actor's problem using automated process via web services
- Digital platform: technical architecture containing extensible codebase facilitating organizational interactions towards delivering services
- Service ecosystem: interactions of business actors towards delivering the services

In this chapter, to present our concept regarding aggregator, we aim to identify characteristics of Aggregator Business Models. We conduct literature review from various existing Aggregator Business Model publications to provide us with the theoretical concept of aggregators. From the above literature review, we reflect the findings to the STOF models from Bouwman et al., (2008) to explain the characteristics of business model of aggregator. The characteristics are presented by identifying business model components exercised by aggregators. The business model components are presented in table in

section 4.4. The business model components are the requirements to design Aggregator Business Models. This leads to answer our first sub-research question "***Which requirements define Aggregator Business Model?".***

For the next chapter, we aim to select various aggregators to observe its business model to confirm our theoretical concept regarding aggregators. Thus, we derive characteristics of aggregator from this chapter literature review.

From the literature review we conducted in this chapter, we identified the requirements that define Aggregator Business Model:

- Service domain:
    - Aggregation service: combining (and to some extent comparing) multiple services of the same type (substituting services)
    - Composition service: combining sub-services as complementary services to add value to the core aggregation services
    - Both services provide value such as service consolidation and value from post-aggregation analysis
- Technology domain:
    - Service integration: coordinating multiple services, organizations, and application to enable information sharing capabilities
    - Service orchestration: one entity controlling the execution of business process through web services interactions
    - Service choreography: multiple entity collaboratively controlling the execution of business process through web services interactions
- Organizational domain:
    - Aggregation without partnership: aggregator extract information from unsuspecting aggregatees
    - Aggregation with partnership: bilateral partnership of varying degrees can be formed between aggregators and aggregatees
    - Aggregation with ownership: major aggregatees or consortium of aggregatees own the aggregators
- Finance domain:
    - Financially independent
    - Financially dependent

5

Chapter 5

Case Study – Aggregator Business Models

We intend to conduct case studies from existing platform exercising Aggregator Business Models. We will use the STOF model as a framework in conducting the case studies. We would like to observe different way these aggregators exercising the business model by identifying the business model components of the aggregators. We will also reflect the identified business model components to our Aggregator Business Model requirements from chapter 4. The final output of this is to find pattern and similarities from these various aggregators. We finalize our study by presenting business model archetypes of aggregators, thus answering our second sub-research question ***"How can the aggregators exercise the business models that constitute the requirements?".***

5.1 Online Desk Research - Existing Aggregators Business Model.

To gain a deeper understanding regarding Aggregator Business Model, we will conduct online desk research to observe various online platform incorporating Aggregator Business Model. We will analyze the business model of the aggregator business by reflecting the findings with the Aggregator Business Model requirements we derived in chapter 4.

We will also present the business model of the aggregators by using the STOF model format, thus each of service domain, technology domain, organization domain, and finance domain will be presented. The information and data regarding the aggregators' business model are derived from various information published in their corresponding website and publications. Additionally, some information might not be explicitly stated in the platform, thus some information and analysis are derived based on the understanding of the author from having hands-on experiences of using the platform.

In choosing our sample, we use this selection criteria in selecting various platform:

1. The business model of the platform constitutes the Aggregator Business Model requirements we derive in Chapter 4.
2. The platform has been established, meaning it has passed the conceptual stage, has publicly launched, and has gained users.
3. The services of the platform can be fully used.

From the selection criteria above, we look for platforms through various channels, such as selecting platforms that are available on Apple AppStore and Google Play Store; and also look for web-based platform that are available on the internet. We then select 11 aggregators from varying industries, such as traveling, consumer products, leisure, news, professional services, and online services. However, in this part, we will only present 4 aggregators that constitute different characteristics in exercising the business model. The rest of aggregators descriptions can be found on the appendix.

In this part, we will present the business model of aggregators correspond to their latest version of the services.

5.1.1 Trivago Business Model

Service Domain

Trivago is an accommodation platform that help users find and compare accommodation prices (e.g., hotel room prices) from various accommodation websites. Trivago compile accommodation offers from more than 5 million hotels worldwide and 300 accommodation platform such as booking.com, Expedia, hotels.com, etc. (Trivago, 2021). Trivago shows the accommodation selections results based on the location asked by the users in the search bar. Trivago then shows several alternatives of hotels and their prices, along with prices from different booking websites. In addition to the aggregation service by comparing accommodation alternatives, Trivago also provides users with aggregated hotel ratings. These hotel ratings are sourced from various other booking websites. Trivago also shows extended overview of the

accommodation, such as property information, amenities provided, photos, and price trend graph. The above descriptions explain the *service aggregation* offered by Trivago.

In addition to aggregation services offered by Trivago, users can continue the transaction and payment directly within the Trivago's platform. Although the hotel vouchers are provided by other accommodation platform (accommodation aggregatees), users can make payment within Trivago platform. Although, this feature works only for several accommodation aggregatees. This in-platform payment feature is considered as *service composition.*

Technology Domain

Trivago collects accommodation information from various accommodation aggregatees such as accommodation platforms and hotel websites. To integrate between these different websites, Trivago established its own APIs, Trivago FastConnect.

Trivago FastConnect allows hotels websites and booking platform reservation system to provide information related to the bookings directly to Trivago in a real-time manner. Trivago FastConnect enables Trivago to directly enquire information about accommodation availability, live prices information, future listed room prices from the hotel websites and booking platforms whenever the users make search request (Trivago, 2021). The FastConnect enables Trivago to gain access to special information not publicly available, like future prices of the room and room availability

In addition to FastConnect, Trivago also introduced Trivago Express Booking, an API to enable Trivago integrate payment and transaction procedure with the corresponding accommodation aggregatees (Trivago, 2021). With Trivago Express Booking, Trivago let users to finish the transaction and payment within Trivago's site. Thus, Trivago not only displaying and comparing prices of hotels, but also providing direct payment feature, thanks to the Express Booking API.

Organization Domain

Although started as an independent aggregator, Trivago was acquired by a major accommodation aggregatee, Expedia, in 2013 (Jacobs, 2012). Expedia invested Euro 477 million on top of Euro 43 million of common Expedia stock to further fund the development of Trivago. From this, we can classify the partnership as Dominant Aggregatee owning the Aggregators. Upon the acquisition, Trivago management team insisted that they will keep their neutrality towards other accommodation platform (Jacobs, 2012). However, based on author's experience toward the platform, Trivago provide special treatment, such as direct payment, to several platform, especially if the corresponding platform are own or partially owned (i.e., through investment) by Expedia.

Through the FastConnect and Trivago Express Booking, Trivago partners with many accommodation aggregatees, such as booking platforms, hotels, and travel agents. These helps Trivago as the Aggregatees are able to provide special information related to the accommodations, and Trivago helps the platforms by promoting the platforms to increase awareness, reaches and transactions (Trivago, 2021). If more internet users use Trivago to find accommodations, there will be more urgency for the booking platforms or hotel

owners to also collaborates with Trivago, because their platform can be more easily found by internet users through Trivago.

Finance Domain

Trivago implements two advertisement payment models, CPC (Cost-per-click) and CPA (Cost-per-acquisition). CPC means the website owners pay fees according to their bid whenever users visit the websites through Trivago. While for CPA, the website owners pay fees based on the percentage of the transactions whenever a booking is made as a result from the Trivago recommendation through its platform (Trivago, 2021). Trivago receives revenues mainly from these payment models.

5.1.2 Scopus Business Model

Service Domain

Scopus is a journal database aggregator that covers more than 25,000 academic titles, 210,000 books collection and over 9,8 million conference papers compiled from more than 5000 publishers. Most of these publishers also operate their own online channel. Scopus acts as academic paper's repository by sourcing academic papers from these publishers' online repositories and compiled it in under one location.

Scopus delivers value to its target market, which are researchers, students, and organizations, through three main values: search, discover, analyze. Users can search relevant papers from this repository, refine the search results, discover relevant papers, and assess the citations and other information related to the papers (i.e., authors, publishers, h-index, citation, publications date, publishers, etc.) (Elsevier, 2020). This is mainly the core service of Scopus, which we can classify as *service aggregation.*

In addition to that, Scopus allows its users to read papers within its platform and manage references through its platform. That being the case, Scopus provides an all-in-one solution for academic publications services, ranging from paper discoveries solutions, papers and references manager, publications trend and information analysis, to publications evaluator.

Technology Domain

Scopus, as an aggregator, source and collect papers from various publishers that also operate their own platform and gathers the sourced content into single repository. Scopus sources the data through e-Feeds, e.g., PDF and XML, from the publishers' websites (Elsevier, 2020).

To provide the values as described in the previous service domain section, Scopus enables integration with other platforms and websites through Scopus own APIs. Scopus APIs enabled Scopus and other publications sites (publication aggregatees) to extract the papers' metadata from publishers' websites and/or platform (Elsevier, 2021). This APIs also enable publishers to deliver the metadata of the papers to Scopus, enabling users to discover the paper through Scopus site and platform.

The Scopus API also enabled the publications aggregatee to directly integrate the publications digital file (typically in the format of PDF) so that user also able to access and read the paper directly within Scopus site.

From the above descriptions, it can be derived that Scopus API enable Scopus to conduct service choreography and service integration.

Organization Domain

Scopus owned by Elsevier. Elsevier manages and develop Scopus platform and business. In generating the content (scholarly papers) in its platform, Scopus collaborate with publishers. To be included in Scopus repository, publishers pay fees in various format. As stated by Elsevier (2020), through the partnership, the platform owns content delivery agreement with publishers that authorizes Scopus to store, distribute, sell and index papers from the publishers to Scopus's platform. The publishers deliver the content in the form of both digital and print formats. Additionally, to ensure the quality of the content within the platform, Scopus works with Scopus Content and Advisory Board (CSAB). CSAB is a group of international librarians and researchers that responsible to review the papers sourced by Scopus (Elsevier, 2020). That being the case, Scopus maintain *aggregation with partnership* with *partial collaboration*.

Finance Domain

Elsevier as the owner of Scopus, maintain a *financial independency* by maintaining revenues from subscriptions and books/articles sales. Users are given several choices according to needs. Scopus offers themed journal subscriptions (access to specific research areas), comprehensive access subscriptions (full access to Scopus libraries), bundles, or pay-per-view. Scopus also offers sales of their books and papers collection through their platform (Elsevier, 2021).

5.1.3 Google Business Model

Service Domain

Google is a platform to search and find information publicly available on the Internet. Google enables users to find, show, and compare information gathered from a wide variety of websites. Google main values is to provide users with the most relevant and reliable information. Based on this, Google acts as an aggregator that gather information from different website and put it in one location in Google's platform.

In Google's first establishment, the value of Google is through *service aggregation* by aggregating information in a single location, or in common term acting as a search engine. Google helps internet users find desired information or websites for a specific topic. Later, Google not only aggregating information, but also analysing the information on top of collecting it (i.e., live stock prices, currency, weather forecast, COVID-19 up-to-date data, price comparison), thus providing *composition services* to users. These composition services are gathered from various trusted sources, to also eliminate false information.

Technology Domain

To realize the core service of aggregating information to users, Google process information from billions of web-pages available on the internet. During a search query, Google performs a series of information analysis. As stated by Google (2021) this analysis includes crawling, indexing, and serving. Crawling is a process of finding webpages existed on the internet. With the help of web crawlers called Googlebot

(automated bot that search for new pages on internet), Google constantly finds new page and visit the page. After the page discovery process, Google start to index the page. Indexing is the process of analysing the page content, and stored the information gathered in google repository. When a user requests a search query, Google will serve the information from this repository. Based on many factors, Google will rank the most relevant result to the users. For the website owners, a sitemap needed to be organized by the webmasters to enables the content of the website to be reached and analysed by the Googlebot. These entire processes can be classified as *service choreography.* In the entire business process, Google acting as the only entity performing the value activities to deliver service to users.

However, on top of the above explanation, Google also develop various API in order to help Aggregatees receive various benefit from Google aggregation service. For example, Google Analytics Data API enables Aggregatees to provide special information about their site (i.e., site traffic information) to Google, while simultaneously enabling Google to provide metrics and report regarding the Aggregatee website in comparison to others similar site. Some API also enables Google to exchange information with Aggregatees and to jointly execute several business process (i.e., Storage Transfer API, Workflow Executions API, Network Management API). Through this API, Google also enable the *service choreography* and *service integration.*

Organization Domain

The company (Google LLC) is the business model developer and operator of the platform. Google is owned by Alphabet Inc, a technology conglomerate created from the restructuring of Google.

In generating the content (information and pages available from Google search results), Google does not need to collaborate with aggregatees to get authorization or licenses in order to deliver the search results. This is because Google gather publicly available information through Googlebot. Instead, most companies and website owners are competing one another so that their contents and pages can be showed in the first page of Google search results and to be easily reached by Google users.

Although it is not necessary for Google to gather information to the users, some information needed to be collected from trusted and reliable sources i.e., number of Covid-19 cases in particular country. To provide a trusted information, Google collaborates with various organization i.e., WHO, EDCD, and Governmental Bodies by sharing information regarding the number of Covid-19 cases. An API was jointly developed between the parties to enable real-time information sharing between various organization (Dong E et al., 2022).

Based on above explanation, Google is adopting an aggregation with partnership type of collaboration in their business. We also assume that Google adopt all of the three partnership model in their business, depending on the type of information Google intended to collect. For example, Google form alliance with various official organization to publish Covid-19 cases. Google also partially collaborate with e.g., Wikipedia, to publish general information of particular topic.

Finance Domain

For the Google users that use Google as a search engine platform, a free-to-use model is implemented by Google. This helps Google to gain customer base and users. The number of users accessing Google is the platform main competitive advantage, as Google main revenues come from Google Ads. More users visiting Google means the platform is attractive for companies to promote their product (this includes contents, information, digital products, services, and physical products). Through Google Ads, companies and website owners pay fees so that they can advertise their websites pages, contents, and products within Google website. Google also let the advertisers to bid certain fees to make the advertisers' contents and products shows in a more prominent location (such as first in Google search results, displayed in the first page, and appeared more frequently). Thus, Google still maintaining an *independent financial* model for not relying on any aggregatees business financial means.

5.1.4 Feedly Business Model

Service Domain

Feedly is a platform that gather online news, articles, and other form of information (including audio and video-based information) published by various publishers such as news publishers, blogs, Medium articles, Podcast host, Reddit post, Tweets, and YouTube videos into one single platform. According to Feedly (2021), as stated in its website, Feedly's main value is its ability to collect a million of information available on the internet and narrow down the information with the most relevant information based on the user favourite topics. Feedly use AI-based assistant, called Leo, that helps filter information and recommend articles to the user (Feedly, 2021). This feature allows user to save a lot of time from moving towards different sites to search news and articles.

In the company's first establishment in 2008, Feedly focused only on collecting and filtering publicly available online news and articles for users (Feedly, 2021). After more than a decade of development, Feedly also push not only news and articles but also podcast, videos, tweets, blog post, and Reddit post (Feedly, 2021).

Based on above explanation, it can be seen that Feedly core service is to collect various news and articles in one location, thus offering *aggregation service* to news readers. On top of that, Feedly also offer additional complementary features, for example integration with Slack, auto-sharing capabilities to various enterprise software, and integration with various sales platform. Therefore, Feedly not only offering service aggregation, but also offering *service composition*.

Technology Domain

Feedly pull content from various online sources (news publishers, blogs, Medium) by grabbing RSS through Feedly Fetcher. When publishing news and/or articles, Feedly Fetcher will pull the headline, text, images, and other information on that RSS to the Feedly's Cloud (Feedly, 2021). Feedly AI, Leo, will refine the collected RSS and push the indexed information to the user based on user preferences (Feedly, 2021). Users then able to read the most relevant news and articles based on Leo's recommendation.

Feedly also gather articles and other information from other sources such as Twitter, Reddit, YouTube, Medium, and other podcast host. Feedly Fetcher unable to pull this information directly from the sites, as most of this information are not published in RSS. According to Feedly (2021). The Feedly Fetcher enables Feedly to realize *service orchestration.*

Feedly implement API integration with YouTube, Twitter, Reddit, and some podcast sites. Through the Feedly API, this integration enables Feedly to also pull information from these websites if the users grant access to integrate their account, enabling the sites to also provide information and data to Feedly. Through this, Feedly can provide services such as displaying YouTube Video, enabling users to post in Reddit, and tweeting within Feedly site. These services cannot be enabled if Feedly depending only on their information crawler (Feedly Fetcher). The API enable Feedly to realize *service choreography*.

Organization Domain

In gathering publicly available online articles, there are no formal arrangement between Feedly and news providers in delivering the content to the platform. Most news articles from the mainstream media and blogs use RSS format to publish their content. Thus, Feedly can always pull the content directly without any arrangement between parties, with the help of Feedly Fetcher as explained in prior section. Therefore, for most online articles, Feedly implement *aggregation without partnership* relationship with aggregatees.

In pulling other form of content, such as YouTube videos, Reddit post, Tweets, and Podcast, Feedly have to collaborate with these content providers to be able to provide user with these non-article contect. It is because some content might not be available publicly (i.e., protected tweet, exclusive Reddit thread) or the format of the content itself that cannot be extracted easily like RSS (e.g., YouTube videos, podcast audio file). Thus, Feedly form aggregation partnership to be able to extract these contents to the platform.

Through Feedly official blog posts, Feedly announce its integration with Reddit, YouTube, and Twitter (Feedly, 2021) so that Feedly users can use the same services from these platforms within Feedly platform (i.e., watching YouTube videos through Feedly, posting tweets from Feedly, read Reddit thread from Feedly). Based on this, it can be assumed that *aggregation with partnership* in the form of *partial collaboration* are established by Feedly with its content providers (content aggregatees). The content providers benefited from having more reaches, readers, and visits as a promotion from Feedly. The more news providers, the more Feedly attract users, thus increasing the network effects.

Finance Domain

Feedly gain revenues from premium subscriptions, in the form of Pro, Pro+, and Enterprise subscriptions. The Pro and Pro+ are intended for individuals and professionals that want to fully utilize Feedly features. The Enterprise subscriptions targeted for company and developers that also want to utilize Feedly API. Additionally, Feedly also offer a freemium membership that offers the same benefit with the Pro subscriptions, but with a less articles sources and integration with other platforms. The free version users will also periodically receive ads in the platform. Feedly receives revenues from this Ads. The content providers receive no direct monetary benefit from Feedly, but receive more readers, reaches, and brand

awareness from Feedly, therefore more revenues for the content providers. No investment was made by Feedly aggregatees, thus Feedly maintaining financial independency.

5.2 Cross-case Comparison Analysis of Existing Aggregators

In this part, we would like to reflect our findings from the previous aggregators case study to archetypical Aggregator Business Model we derived in chapter 4. We will start our analysis from the *intended value,* as Bouwman (2008) also stated that value is the central issue in service domain.

5.2.1 The Intended Value of Aggregators

Our case study shows that most Aggregator Business Model, although operating in different industry, provides many values to both service providers (aggregatees) and service consumers (users). Service consumers get value from Aggregator Business Model because aggregators help users to collect information from various sources in one platform location. This is beneficial for the consumers because consumers can reduce the time needed to find the desired product based on their respective preferences. Having to cycle and jump to different websites is a time-consuming and tedious process, and in some cases, the result might not fully-satisfy the consumers. Thus, Aggregators helps as an advisor by giving recommendation. For the service providers or aggregatees, they are benefited from the promotion, brand awareness, and users reach by the aggregator. In some cases, e.g., in the case of Google and Scopus aggregatees have the urgency to push their product to the Aggregator because not pushing their product to Aggregator means losing the competition with other aggregatees. Aggregatees might also loss their opportunity for a higher site reach. This is due to the fact that Google and Scopus have a high amount of user-base and most users use these aggregators as a starting point to look for services and information.

5.2.2 Services of Aggregators

The case studies confirm the characteristics of services offered by aggregators. Some aggregators focus on its core offering by providing services comparison capabilities (*service aggregation*) while some aggregators add various complementary services besides comparison *(service composition)*

Some Aggregators focus only on their *service aggregation* capabilities, which is service comparison and information collection. These Aggregators focus on providing a comparison of different services alternatives from different websites and providing a recommendation for a specific service (and information). In the case of Yidio, the platform's main value is to provide recommendation on where to watch a certain movie. However, the user still needs to visit the respective website to separately watch the selected movies. In a more physical-services-centric industry, like DiscoverCars and PriceGrabber, the platforms only help users comparing different products alternatives from different providers. However, the platforms do not accommodate transactions or payments. To complete the payment, user have to visit the website or pay the service offline (e.g., pay car rental service directly to the car rental during the car handover).

Aggregators can also offers *service composition* offerings by building complementary services on top of their service aggregation. In more rich-features Aggregator like Feedly, Scopus, Trivago, and LinkedIn, the

platforms provide various complementary services in addition to service comparison offerings. For example, in the case of Feedly, the platform not only helps users find the most recent news and articles about particular topic, but also enables the users to also share the news to the user's respective social media such as Reddit and Twitter. Users can also experience the same service and features of Reddit and Twitter within Feedly (for example, reading twitter timeline and homepage, posting tweets, creating and managing Reddit thread). Not to mention Feedly integration with various enterprise software. Other case like Scopus, the platform not only helps users find the desired publications, but also enables the users to read the publications within the platform, analyse the publications impacts, store and manage the publications with Scopus's own developed reference manager (Mendeley). Not only acting as a database, Scopus also acts as a store containing thousands of academic publishers. Users can opt to buy, rent, subscribe certain publications from certain publishers through Scopus.

5.2.3 Value Enabling Technology – Information Crawler and API

According to Bouwman et al., (2008) the intended value put requirements on the technical functionalities of the business model. The intended value defines the technical architecture and technical functionalities of the business model. From previous presentation, one value offered by aggregators is to put the aggregated services under one location. To provide the "one location" value, Aggregators translate this into a technical architecture as a platform. Some aggregators build Platform in the form of site (e.g., Scopus, Kimo, Carvago, Google, PriceGrabber, DiscoverCars) and also in the form of mobile-applications (e.g., Trivago, Feedly, Flipboard, LinkedIn).

Towards the other intended value, which is the aggregated service (including post-aggregation analysis in the form of recommendation), aggregators apply different technical architecture to collect information and services. From our case study, aggregators typically deploy either information crawler or API.

Some aggregators use information crawling technology, by deploying AI bots or RSS reader to gather publicly available information on the internet. Yidio use its own developed AI bot to keep monitoring information of movies published in streaming sites. Feedly use Feedly Fetcher as an RSS reader to keep pulling news and articles from various sites. From our study, it can be seen that aggregators implementing information crawler technology tend to focus their offerings on service aggregation. They focus on offering a compact platform to help users find the desired services, thus focusing on the core *aggregation service* without adding much complementary features.

Besides information crawler, Aggregators can also deploy APIs. From our case study, Aggregators develop API to accommodate various process between different organizations and to coordinate the information exchange procedure between two or more platforms. They can periodically exchange information, push and pull contents and information at any time automatically. In many cases, for example, like in the case of Trivago, the utilization of API Trivago FastConnect between Trivago and its aggregatees enables Trivago to add complementary features, such as payment procedure within Trivago site. In Scopus case, the API let Scopus to exchange various publications files seamlessly, thus enabling Scopus to creates its own reference manager as a one-stop-shop referencing solution.

5.2.4 Technical Architecture and Technological Functionalities

Using information crawler restricts the aggregator to only collect information from publicly available sources. Some information not publicly available cannot be extracted by information crawler. Not to mention that it can also be a tedious process in the aggregatees sides to provide this special information to the aggregators. Aggregators *utilizing information crawler* as their technical architecture therefore tends to only relying their own capabilities to gather information and services. That being the case, aggregators with information crawler can only perform *service orchestration,* due to the fact that only one entity (aggregators) performs the entire value delivery process to the consumers. Aggregatees face limitation to also take action in this ecosystem, due to the limited information gathered by the information crawlers.

In contrary, API enables both aggregators and aggregatees to play an active role towards the entire value delivery process. Trivago Express Booking API enables Trivago to acquire special information not published online from aggregatees, while at the same time, aggregatees can provide information to Trivago. For example, aggregatees can periodically updates the number of rooms available in particular hotel through the API. This kind of information cannot be extracted if aggregators only utilize information crawler. Additionally, Trivago FastConnect API accommodate the transaction and payment process between user, Trivago, and aggregatees. API enables aggregators to perform *service choreography* and *service integration*.

From the above study, we can derive several understandings towards the relationship between service domain and technology domain, specifically between the intended value, technical architecture, technical functionalities, and delivered value. As Bouwman et al., (2008) stated, intended value put requirements on technical architecture. Technical architecture defines technical functionalities and these components determine the delivered value to the users. Aggregators intended to utilize information crawler as its technical architecture can only implement limited technical functionalities such as service orchestration, because the entire aggregation service are processed only by the aggregator. While for aggregators implementing API technical architecture, the API enables both aggregator and aggregatees to play an active role towards delivering the service, thus enabling collaborative technical functionalities such as service orchestration and service integration.

In addition to that, we can also confirm regarding the relationship between service domain and technology domain as presented by Bouwman et al., (2008). In chapter 4, we understand that the technology domain of aggregator contains the concept of service orchestration, service choreography, and service integration. However, we perceive these technical concepts to be closely related to the technical functionality component in technology domain. Meanwhile, between technical functionalities and intended value, Bouwman et al., (2008) describe technical architecture between the two components. Deriving the concept from our literature review in chapter 4, we could not find any technical concept that are closely related to fit the definition of technical architecture. However, based on previous case study, we now understand the concept of information crawler and API as aggregator's technical architecture. The information crawler and API realize the technical functionalities: service orchestration, service choreography, and service integration.

5.2.5 Partnership and Embedded Technology between Aggregators and Aggreagtees

In previous part, we presented technology architecture embedded in aggregators. Aggregators can use API that enables service choreography or crawler to realize service orchestration. Bouwman et al., (2008) presents that value activities between actors puts requirements on the technical architecture. Thus, we believe that there lies relationship between the embedded technology of aggregators and the partnership that aggregator established. In this part, we will describe the relationship in more details.

In providing the aggregated information to the platform, some aggregators proactively collaborate with other service suppliers or platform owners (aggregatees), to be able to access special information not available publicly. The established collaboration also let aggregatees to also push information and data to aggregators. Throughout our case study, it can be seen that Trivago partners with hotel owners, various booking sites, and travel agencies so that Trivago can gain special access to pull information from its partners (e.g., number of room available). Scopus also establishes collaboration with publishers to gain access and ownership of the publications and pull the publications metadata into Scopus platform. We classify this type of collaboration as aggregators with *high degree of network*.

In our study, aggregators that implement high degree of network implement integration through API to accommodate information sharing and integrate their platform with their partners' platform. API integration is needed because the information that the Aggregators needed in aggregating content and information are owned by the partners and most of this information are not publicly available online. Thus, aggregatees need to grant access to aggregators and push the information to the Aggregators.

Some Aggregators able to provide aggregated content while establishing no partnership with the aggregatees. Yidio can provides information about movies and streaming sites without having to have partnership with the respective movie owners. Kimo also able to provide various online learning within their platform without establishing any partnership with its aggregatees.

Aggregators with low degree of network use information crawling technology such as AI bots and RSS reader. Most of the information aggregated by these aggregators are publicly available online. Using crawler are enough to gather this information. Aggregators can rely only on the crawler to search for data and information publicly available on the internet, thus no prior partnership need to be established.

5.3 Results – Aggregator Business Models Archetypes

From previous section, we obtain several understandings from the case study we conducted towards various existing aggregators. There are pattern and trends towards different business model domain of aggregators. In this part, we will summarize our findings and derive business models of aggregators.

5.3.1 Services of Aggregators

First of all, from the requirements we derived in chapter 4, it can be understood that the main differentiator of Aggregator Business Model with other business lies on the ability of the aggregators to collect various substituting and complementing services under one location, which can be understood as service aggregation and service composition. Service aggregation means aggregators provide values by comparing

service with other substitute services from various internet sources. Service composition means aggregators adds complementary service on top of the online comparison functions.

These two requirements are classified under service domain in the STOF model. For example, although providing similar services of hotel booking, Trivago as an aggregator compare hotel bookings from various online booking sites, while Booking.com, which is not an aggregator, only provide hotel bookings from its hotel partners.

As a result, we believe that service domain is the main focal point of aggregators. These two components in service domain, such as service composition and service aggregation, are the main focal point of Aggregator Business Model because these two are the business activities that directly providing value to the users. Thus, we put our focus to deeper analyse and understand the pattern of the service domain of aggregators.

Kimo, Yidio, and PriceGrabber for example, focus on comparing different substituting services. Kimo compares and collect online learning materials. Yidio compares different movies. PriceGrabber compare different online sales for physical product. They focus on providing consumers with suggestion to select service.

In the case of Trivago, Feedly, Scopus, they also add various complementary features on top of their aggregation services. Trivago add payment features on top of its hotel aggregation, Feedly add features that enable users to use other social media within the platform on top of its news aggregation, and Scopus adds in-platform reference manager on top of its publication aggregation.

From above findings, although similarly providing aggregated content and post-aggregation analysis in one location, we discovered that from these 11 cases, the way aggregators offer the service is different. Some aggregators only focus on service aggregation offering, while other aggregators adds complementary features. We present the variables with regards to the service domain of aggregators:

1. **Core Service Aggregators**: they focus on providing the core service of aggregators, which is to compare services from various online sources. Their main value lies on the capabilities of the aggregator to provide suggestion and recommendation to choose services, typically substituting services. Thus, this type of aggregator focuses on providing *service aggregation*.
2. **Multiple Services Aggregators**: instead of providing only aggregation service, this aggregator adds complementary features on top of its core service offering. The complementary feature can be in the form of additional service within the platform e.g., payment features, services manager, in-platform reader, and integration with others platform. The value is that the service consumers can be benefited from a wide range of features without having to leave the platform. Thus, this type of aggregator add *service composition* on top of the service aggregation.

5.3.2 Technology and Organization to Deliver the Services

Secondly, from Bouwman et al., (2008), we understand that values are the central focal point of service domain and generally service domain put requirements to generate technology domain, organizational domain, and finance domain. From this, we understand that technology domain and organization domain act as tools to realize and deliver the service domain to the consumers. As services are the most essential

components for aggregators, we believe that aggregators also constitute different organizational and technology arrangements to deliver the services. Thus, we dive deeper to analyse the way aggregators deliver services with their technology and organization domain.

To realize the services, some aggregators may be obliged to establish a partnership with their aggregatees, while some aggregators can establish limited to no partnership with its aggregatees, thus explaining the organizational domain defined by the value. Additionally, aggregators can embed either API or crawler as its technology to realize the value, thus explaining the technology domain to realize the value.

Bouwman et al., (2008) stated that there is a direct relationship between technology domain and organizational domain. Our case study also confirms their statements and shows that there lies relationship between the technical architecture the aggregator uses and the organizational arrangement the aggregator established.

In our study, aggregators using information crawling technology establish no partnership with its aggregatees. Kimo, Yidio, and Carvago can extract the information directly using crawler or AI bots. The information is publicly available on various online sources, thus no prior partnership needed to be established in order for the aggregators to realize their services. Crawler only let aggregators to pull information from the aggregatees but aggregatees cannot push information to the aggregators. Thus, the value delivering process can only be provided by single entity (service orchestration), which is the aggregator.

Aggregators with API technology establish partnership with its aggregatees. Various form of partnership is realized, and for some aggregator, the aggregators itself is owned by the aggregatee (aggregation with ownership). With the partnership, Aggregators are able to pull special information directly from the aggregatees. This information is typically not available in public. Unlike crawler, API enables aggregatees to also push information to the aggregators. Thus, the value delivering process are collaborative. Both actors, aggregators and aggregatees engaged in the value delivering process, thus arranging a *service choreography*.

That being the case, from the 11 aggregator cases, we discover a distinguished pattern on the technology-organization domain. The differences on the pattern are as follows:

1. **Low Degree of Network:** aggregator with no established partnership with its aggregatees. This aggregator typically uses information crawler such as RSS reader and AI bots to gather information. The information they gathered are typically information publicly available on the aggregatees' website. Only aggregator can engage in the value delivering process (service orchestration).
2. **High Degree of Network:** aggregator that has established partnership with its aggregatees. In some cases, the aggregatees own and invest in the aggregator, thus establishing an ownership. The partnership enables aggregators and aggregatees to collaboratively pull and push information between the organizations, thus an API is typically implemented to coordinate the information exchange (service choreography).

It is also good to note that although Bouwman et al., (2008) describe the relationship between technology domain and organization domain linearly, which explained as actors performing value activities define the requirements to develop technical architecture, and we also describe the relationship in a linear manner (e.g., API enables aggregators to establish partnership with aggregatees), we believe that in practice, the relationships are not related in a linear manner. For example, for some aggregators, they need to firstly develop API so that aggregators can collaboratively exchange information with aggregatees. In opposite, some aggregators might need to firstly established partnership with aggregatees in order to be capable of developing API. It can also be that both API and partnership are established concurrently. Thus, the relationship between the two concepts is not linear, but the patterns from our study suggest the existence of the relationship.

From the explanation above, it can be seen that throughout the 11 cases we analyzed, the most distinguished pattern lies between two variables, which are the services domain (single and multiple services) and the technology-organziation domain (high degree of network with API and low degree of low degree of network with crawler). These two variables are explained as follows:

1. **Service Offerings**: explains the services available within the aggregator platform. Some aggregator provides not only services comparison but also add complementary services, such as in-platform reader, payment portal, content re-sharing mechanism, social media integration, in-platform content manager, etc. While some aggregators focus only on providing content comparison or content aggregation without offering any complementary services.
2. **Degree of Network:** explains the degree of partnership the aggregator established with aggregatees. A low degree of network means the aggregator conduct limited-to-no partnership mechanism to gather product information. A high degree of network means the aggregator conduct extensive collaboration activities with aggregates to pull information. Aggregator with low degree of network typically use AI bots or RSS reader to aggregate information. Aggregator with high degree of network typically use API to coordinate between aggregators and aggregatees.

Based on these variables, four business models are derived as follow:

		Degree of Network (Enabling Technology)	
		Low (Information Crawler)	High (API)
Service Offerings	Multiple Services	**Advance Search Engine** (Feedly, Google)	**One-stop-shop** (Scopus, LinkedIn)
	Core Service	**Search Engine** (Yidio, Kimo)	**Comparison Sites** (PriceGrabber, Trivago, Discover Cars, Flipboard)

Figure 3: Aggregator Business Model Archetypes

The four business models are explained as follows:

1. **Search Engine Model:** The Aggregators only focus on *service aggregation*. This type of Aggregators emphasizes the capabilities of the platform in comparing different substituting services and provide recommendation in choosing services. This type of Aggregators operates information crawler technology to gather the information (service orchestration). No prior partnership needed to be established to deliver the value.

2. **Comparison Sites Model:** The Aggregators focus on *service aggregation*. What makes them different is that they implement API to gather information for the aggregation. Due to the API, they can enable collaborative activities in delivering the value (service choreography). Thus, they typically establish partnership with aggregatees. It can be partial partnership, equal partnership, limited alliance partnership, and even ownership by the aggregatees.

3. **Advanced Search Engine Model:** The Aggregators provide additional complementary services in addition to its core aggregation services, thus offering *service compositions*. Although offering additional complementary features, this type of aggregators still uses information crawler technology as its main technology to deliver the service, and only the aggregator is able to deliver the value to the consumers (service orchestration). No partnership needed to be established.

4. **One-stop-shop Model:** The aggregator also provides *service composition* in addition to its core service aggregation. However, there is an API to push and pull information between aggregator and its partnering aggregatees. To some cases, this API integration and partnership are also needed to enable the additional features provided by these Aggregators (service choreography). The partnership between aggregator and aggregatees are also vary, including partial partnership, equal partnership, limited alliance partnership, and ownership by the aggregatees.

5.4 Aggregators Business Model Dynamics

It is presented on the above table that aggregators possess specific type of Aggregator Business Models. This Aggregator Business Model corresponds specific characteristics of the aggregator that differentiate one aggregator with the other aggregator. However, it is further discovered that in exercising the business model, aggregators tend to not stay in a single business model. They also change their business model to other type of aggregator.

As data marketplace operators, to be able to adapt with the market, they do not only need to select which Aggregator Business Model to choose, but may also need to change their business model in the later stage of the business. Thus, instead of only providing guidance to exercise the Aggregator Business Model, it could also be useful to provide guidance in changing the business model too.

The first section describes the dynamics and changes of several Aggregator Business Model. In the second part, an analysis of this change is analyzed further to give insights on the future development of the Aggregator Business Model to be implemented on the data marketplace industry.

5.4.1 Trivago Business Models

Trivago started its business in 2005 as a *search engine* site that focus on hotel search feature by comparing different accommodation alternatives from various online sources. After several years of development, Trivago introduce Trivago FastConnect. This enabled existing booking and hotel sites to integrate with Trivago. At that time, Trivago's main service is only to recommend users in finding the ideal hotel based on the users' criteria. but the introduction of Trivago FastConnect enabled Trivago to only aggregate from trusted sources. Data were pulled directly from the trusted booking site aggregatees. Trivago will then redirect the users to the booking sites to complete the transactions, so payment was not made in Trivago website.

However, as can be seen from Trivago latest publication on Trivago Developers site, Trivago now offers Trivago Express Booking API, that enables users to make direct booking within Trivago platform (Trivago, 2021). This API allow users to pay within the Trivago platform. As a result, Trivago currently not only compares different accommodation alternatives but also manages the accommodation booking and payment.

Based on that prior study on Trivago business model in the past few years, Trivago business model also changed after the introduction of the new service (payment within Trivago) and additional API integration (Trivago Express Booking) with the hotel owners and booking platforms. Trivago first shifted its business model as a *comparison shop model*. Trivago still focus on *service aggregation* in accommodation industry, but instead of comparing different accommodation from online sources, Trivago integrate with its hotel aggregatees to also let the aggregatee push the information to Trivago. Later, Trivago shifts its business model to become a *one-stop-shop model* as now the platform also offers additional complementary services *(service composition)*, which is the payment features. As a one stop shop, Trivago enables users to arrange accommodation booking from a single platform and without having to leave the platform to finalize the booking.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	**Advanced Search Engine** **-**	**One-stop-shop** **Trivago (Express Booking Introduction)**
Core Service	**Search Engine** **Trivago (launch version)**	**Comparison Sites** **Trivago (FastConnect introduction)**

Figure 4: Trivago Business Models

5.4.2 Google Business Models

Google started its business as a *search engine* that focus only on *service aggregation* by providing information to users based on the search criteria. Google functions as a platform that help users to find information from text that is publicly accessible from various online sources.

Towards its development, Google constantly add additional services beyond search engine to find text from online sources. In 2012, Google launch new complementary service called Google Knowledge Graph (Singhal, 2012). This feature enables users to instantly get the most relevant information from the search queries without leaving the google sites. In the previous version of Google, users must visit the respective sites to get the relevant information of the queries. For example, when a user queried "Ajax Amsterdam", Google will instantly display relevant information about Ajax Amsterdam Football Club such as the club's latest match results, the club history, the club latest player transfer news, the club rank in the local league, and the club progress in international cup. Thus, Google also adds *service composition* in this version. In the earlier version, user has to visit different websites to get such information.

In the current version of Google, we recognize that Google Knowledge Features are extended to a greater function. In the current version, Google collaborates with various organizations, platforms and sites to provide a more reliable information from trusted sources. For example, if user type a query of "Covid-19 in Germany", Google will display relevant information about Covid-19 in Germany such as real time number of positive cases and number of recovered patients. This data is sourced from various sources, such as official government site, World Health Organization database, university sites, etc. As most of this data might not be publicly online (especially in a crawlable text format), Google use Knowledge Graph Search API to integrate with these different platforms and pull the information directly from the sources (Google, 2021).

Based on the above explanation, it can be argued that Google changed its business model to comply with the additional new services it offers. During its launch because Google only has one function to search for text from various sites, and because Google can offer this service by utilizing crawling technology, thus it can be classified as a *Search Engine* Aggregator. In 2012, Google started to offer more features by adding complementary services like Knowledge Graph that enable users to find the relevant information without leaving google sites, the business model of Google shift to become a *Single Portal*. In its latest version, as Google now also collaborate with different platform owners to provide the information, its business model shifted again to the *One-stop-shop* aggregator.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	**Advance Search Engine** **Google (Knowledge Graph API)**	**One-stop-shop** **Google (Latest version)**
Core Service	**Search Engine** **Google (launch version)**	**Comparison Sites** **-**

Figure 5: Google Business Models

5.4.3 Feedly Business Model

In its early establishment of the platform, Feedly started as a browser extension that use RSS reader and focus on collecting articles and news from various sites according to users' favorites topics (Lowensohn, 2008; Crunchbase, 2021). During this time, Feedly main service offering is to collect news and articles from online news publishers and blog posts. Feedly first version is a web browser extension that display different news title and heading from various online news publishers. Feedly will then redirect the user to the publisher site (Lowensohn, 2008). Thus, Feedly focus on *service aggregation* during its first establishment.

Feedly then introduce its own sites and application (Feedly, 2012). During this time, additional complementary services were added, like sharing mechanism to other social media and automated curated looks based on user preferences. During this time, Feedly still utilizes its RSS reader to aggregate online articles, although providing *service composition* offerings.

In the latest version of Feedly, the platform provides complementary features such as social media integration. Feedly enables the user to adopt twitter features within the platform. Feedly now also includes tweets (post updates made by twitter users) to the user feeds. Feedly also allows user to tweet (update post via twitter) and retweet (re-posting updates from other twitter users) within the Feedly platform. Additionally, similar like the Twitter-Feedly integration, Feedly also established integration with Reddit. This integration enables users to also receive automated feeds that includes Reddit posts and enables users to also make a Reddit post within the Feedly platform. As a result of this, Feedly users can enjoy the benefit of other social media platform without having to leave the platform.

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	**Single Portal** **Feedly (website version)**	**One-stop-shop** **Feedly (latest version)**
Core Service	**Search Engine** **Feedly (browser extension version)**	**Comparison Sites** **-**

Figure 6: Feedly Business Models

That being the case, Feedly shifted its business model. At first, Feedly started to only offer browser extension to find news and articles from different topics. During this time, Feedly business model is a *Search Engine* aggregator. Later, Feedly's added new offering to not only collect online news and articles from news publishers, but also to share news and curated look on its newly launced websites. Most news publishers publish articles with a standardized RSS format, so Feedly can pull the content of the articles with RSS reader technology, so although introducing new features offering, there is still no integration needed. During this time, Feedly business model was *advance search engine*. In the current version of Feedly, as there are more services added, Feedly started to establish API integration with other platform such as Reddit, Twitter, and YouTube (Feedly, 2021). The integration let Feedly collaborate with its social

media aggregatees by exchanging information and features. As a result, Feedly business model is now classified as a *one-stop-shop* aggregator.

5.4.4 Indeed Business Model

During its launch in 2005, Indeed started its business as a platform that help users find relevant job listings by gathering job listings from various job portal websites (Arrington, 2005). Similar like Google, Indeed uses web crawler to provide recommendation on job listings, so there is no integration needed in gathering information from other platforms. User will be redirected to the respective job site to complete the application process.

In 2011, Indeed launched Indeed Apply to extend its function as a job application portal. Indeed Apply is a complementary features that enable users to apply job application directly within the Indeed sites. Employers can now also put their own job listings within Indeed platform and manage their own employer pages. Within the same year, indeed also add a resume search feature for employers to make job applicant search process easier (Zappe, 2011; Sternberg, 2011). The Indeed Apply integrates Indeed Apply API to exchange information between Indeed and Employers own platform (Indeed, 2021).

Indeed current version extend the platform function beyond job or applicants searching platform. In mid-2021, Indeed launched Indeed Hiring Platform, a platform for employers to arrange hiring processes within Indeed platform, from posting the job, searching, and selecting applicants, conducting online test, to the interview process via the platform's video conferencing features (Indeed, 2021).

	Low Degree of Network (Information Crawler)	High Degree of Network (API)
Multiple Services	**Advanced Search Engine** **-**	**One-stop-shop** **Indeed (latest version)**
Core Service	**Search Engine** **Indeed (launch version)**	**Comparison Sites** **Indeed (post Indeed Apply introduction)**

Figure 7: Indeed Business Models

In the case of Indeed, the platform also shifted its business models. In its first launch in 2005, as the platform focus solely on finding relevant job searches with web crawler, Indeed started as a *search engine* aggregator focusing on *service aggregation* of job listings. The introduction of Indeed Apply shifts Indeed's business model to *comparison sites*, as Indeed Apply feature needs integration through Indeed Apply API and ATS (Applicant Tracking System) with the job sites. Although at this state, Indeed still solely focus on service aggregation. Later, In the current version of Indeed, the platform provides Indeed Hiring Platform that adds additional features of the platform beyond finding job listings. As Indeed now has multiple features and integration with different platform, the platform business model changed to *one-stop-shop* aggregator.

5.5 The Aggregators Business Models

In the previous part, from our case study, we derived four different type of Aggregator Business Model. Our case study shows four different types of Aggregator Business Models: Search Engine, Advanced Search

Engine, Comparison Sites, and One-Stop-Shop. Our four Aggregator Business Models are derived based on two dimensions: service offerings and degree of network.

We previously provide only brief characteristics of our aggregators business model, mainly focusing on the services and network degrees variables. In order to provide a guidance to exercise the Aggregator Business Models, we would like to describe our four Aggregator Business Models using the STOF Model. This will also answer our sub-research questions "***How can the aggregators exercise the business models that constitute the requirements?".***

Our case study shows that the four business models each comprise distinct characteristics. These four business models will be used as a basis to design the business model for data marketplace aggregator in the next chapter. We also reflect the business model requirements we derived from the literature review in Chapter 4. To guide business managers in realizing Aggregator Business Models, we put the business model components from Chapter 4 to our four Aggregator Business Model archetypes.

5.5.1 Business Model 1 – Search Engine Aggregator

Table 5: Search Engine Aggregator

Business Model Domain	Requirements	Business model components
Service Domain	Intended Value	Service consolidation and post-aggregation analysis under one location
	Delivered Value	Service Aggregation
Technology Domain	Technical Architecture	Platform Crawler (AI Bots or RSS Reader)
	Technological Functionality	Service Orchestration
Organizational Domain	Actors	Aggregators and Aggregatees
	Value Network	Aggregation Without Partnership
	Organizational Arrangements	No partnership between aggregators and aggregatees
	Value Activities	Aggregators may extract information without aggregatees knowledge No prior established partnership between two actors Aggregator typically provides equal treatment to all aggregatees Aggregator independently provides the services and value to the users
Financial Domain	Financial Arrangements	Aggregator independently finance their business operation

Towards achieving the intended value, Aggregators employing *search engine model* utilize information crawler technology in their platform. They embed crawler technology such as RSS reader or AI bots in their platform to aggregate online services. Although able to automatically aggregate information from varying online sources, crawler technology possesses a limitation in collecting the information. Aggregators employing crawler technology can only pull information that is publicly available in the aggregatees' sites. In most cases, aggregatees have no role in pushing the information to the aggregators. Thus, the value delivery processes are established only through *service orchestration* or value delivery process that is conducted by only single entity.

Although having limitation, aggregators employing search engine model need no partnership with their aggregatees to aggregate service and deliver value to the service consumers. From our case study, it is also shown that aggregators are able to maintain an equal aggregation treatment to their aggregatees.

Aggregators employing *search engine model* emphasizes its core service offering through *service aggregation*. The value these aggregators provide to the consumers lies on the capabilities of the aggregators to give recommendation to the users. They compare various substituting services from various online sources and through several post-aggregation analysis they provide suggestion to select particular service.

The value delivery processes of search engine model are explained in below graph:

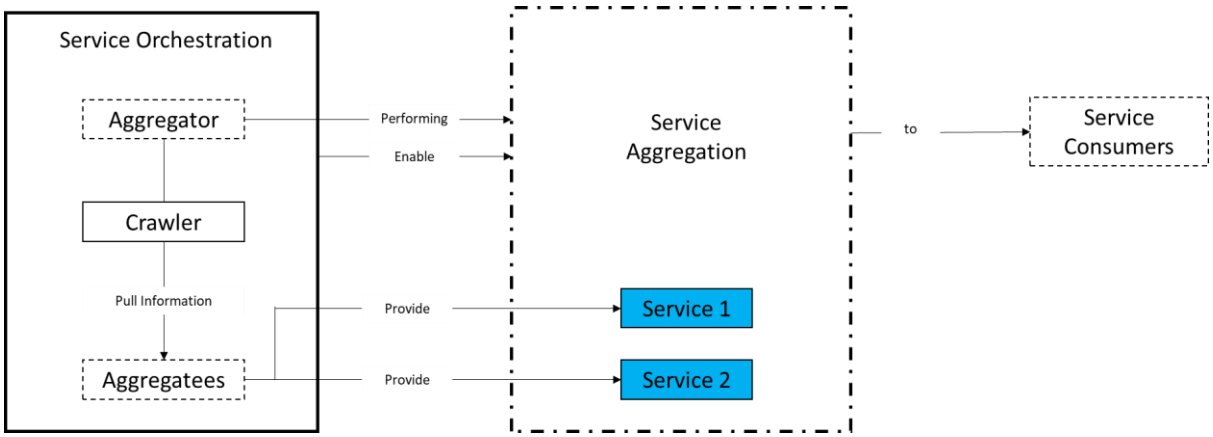

Figure 8: Value Delivery Process of Search Engine Aggregators

5.5.2 Business Model 2 – Advance Search Engine Aggregator

Table 6: Advance Search Engine Aggregator

Business Model Domain	Requirements	Business model components
Service Domain	Intended Value	Service consolidation and post-aggregation analysis under one location
	Delivered Value	Service Aggregation Service Composition
Technology Domain	Technical Architecture	Platform Crawler (AI Bots or RSS Reader)
	Technological Functionality	Service Orchestration
Organizational Domain	Actors	Aggregators and Aggregatees
	Value Network	Aggregation Without Partnership
	Organizational Arrangements	No partnership between aggregators and aggregatees
	Value Activities	Aggregators may extract information without aggregatees knowledge No prior established partnership between two actors Aggregator typically provides equal treatment to all aggregatees Aggregator independently provides the services and value to the users
Financial Domain	Financial Arrangements	Aggregator independently finance their business operation

Advanced search engine aggregators also utilize information crawler technology like RSS reader and AI bots to aggregate services from varying online sources. However, instead of only providing the service consumers with its core aggregation service, aggregators employing advance search engine model also adds complementary services in their platform, thus enabling *service composition* to consumers. Various complementary features can be added into the platform, for example payment features, content manager, and integration with other platform capabilities.

Although providing additional services, the utilization of crawler technology still limits the aggregators to singlehandedly providing the value to the users. *Service orchestration* is still emphasized by the aggregators within their technology domain. No information can be pushed to the aggregators by the aggregatees, therefore no partnership needs to be established. Due to the absent of partnership, most complementary services are still provided by aggregators.

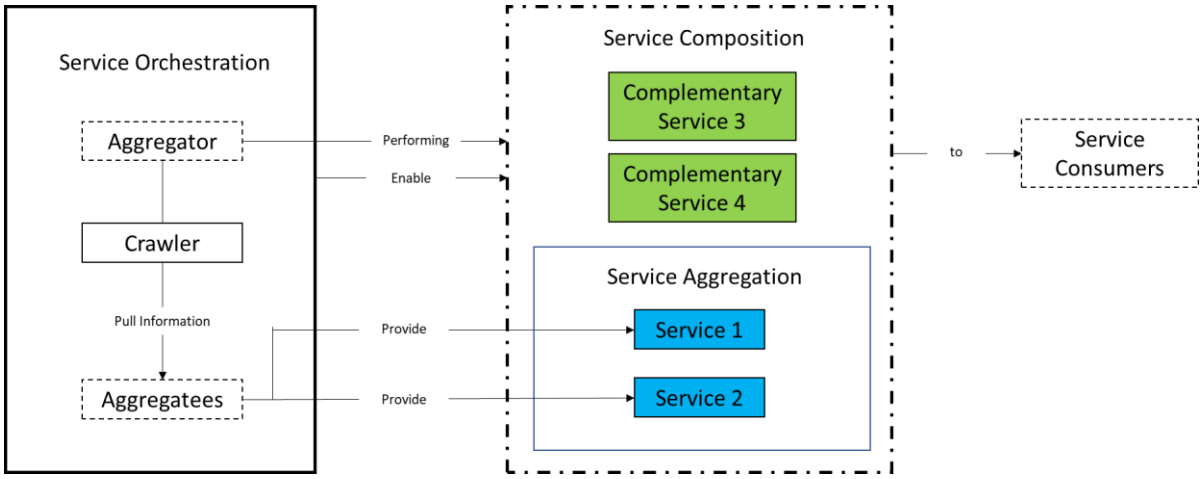

Figure 9: Value Delivery Process of Advance Search Engine Aggregator

5.5.3 Business Model 3 – Comparison Sites Aggregator

Table 7: Comparison Sites Aggregator

Business Model Domain	Requirements	Business model components
Service Domain	Intended Value	Service consolidation and post-aggregation analysis under one location
	Delivered Value	Service Aggregation
Technology Domain	Technical Architecture	Platform API Integration
	Technological Functionality	Service Choreography
Organizational Domain	Actors	Aggregators and Aggregatees
	Value Network	Aggregation With Partnership Aggregation With Ownership
	Organizational Arrangements	Partnership: Partial Collaboration, Alliance, Equal Collaboration Ownership: Owned by dominant aggregatee, owned by consortium of aggregatees.
	Value Activities	Aggregator establishes partnership with aggregatees Both actors involved in the information exchange and value delivery processes Treatment to aggregatees depends on the organizational arrangements

Financial Domain	Financial Arrangements	Partnership: Aggregator independently finance their business operation Ownership: Aggregator receive investment from aggregator or consortium

Aggregators with *comparison sites* model generally apply *service aggregation* towards providing the intended value to the service consumers. They typically operating as a platform that helps consumers compare several services and products, and the platform will help consumers to gather the required information to choose the service or product. The distinction with search engine aggregators portrayed on the implemented technology architecture. Comparison sites aggregators implement API integration. Implementing API in their platform facilitate both actors to exchange data and information. In our case study, it can be seen that some information regarding the services are not published publicly by the aggregatees (e.g, product availability), thus there is a necessities to let aggregatees provide information directly to aggregators.

Service choreography can be administrated through the API, thus aggregators can pull information from aggregatees and aggregatees can also push information to the aggregators.Towards the collaborative characteristics on the information exchange processes, some aggregators pursue independent route by establishing partnership with aggregatees. Through the partnership, various organizational collaborations are arranged. Equal collaboration can maintain neutrality as an advisor, partial collaboration can increase revenue through fees in exchange for a preferential treatment, and alliance can be formed to strengthen the network in the market share. Aggregators might also pursue dependent route through investment from dominating aggregatee or consortium of aggregatees.

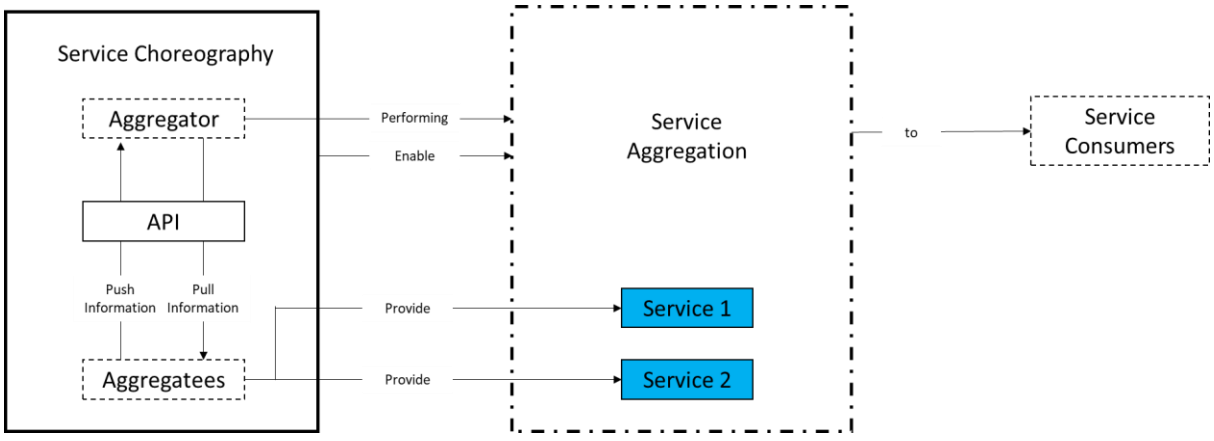

Figure 10: Value Delviery Process of Comparison Sites Aggregator

5.5.4 Business Model 4 – One-Stop-Shop Aggregator

Table 8: One-Stop-Shop Aggregator

Business Model Domain	Requirements	Business model components
Service Domain	Intended Value	Service consolidation and post-aggregation analysis under one location
	Delivered Value	Service Aggregation Service Composition
Technology Domain	Technical Architecture	Platform API Integration
	Technological Functionality	Service Choreography Service
Organizational Domain	Actors	Aggregators and Aggregatees
	Value Network	Aggregation With Partnership Aggregation With Ownership
	Organizational Arrangements	Partnership: Partial Collaboration, Alliance, Equal Collaboration Ownership: Owned by dominant aggregatee, owned by consortium of aggregatees.
	Value Activities	Aggregator establishes partnership with aggregatees Both actors involved in the information exchange and value delivery processes Treatment to aggregatees depends on the organizational arrangements
Financial Domain	Financial Arrangements	Partnership: Aggregator independently finance their business operation Ownership: Aggregator receive investment from aggregator or consortium

Aggregators exercising *one-stop-shop model* not only provide *service aggregation* but also provides *service composition* by adding various complementary services within their platforms. The service composition they added to the platform includes transaction services, in-platform service manager, value-adding services, re-sharing and integration with other platform capabilities. Most of these complementary services were embedded in the platform thus service consumers can enjoy various services without leaving the aggregator platform.

The one-stop-shop aggregator also utilize *API* in their platform. Similar with the comparison site model, the API enables aggregatees to push information and data to aggregator. In fact, our case study also shows that the API integration with aggregatees enables the aggregator to adds complementary features explained previously. Aggregatees can also engage in providing the complementary services.

Both *partnership* and *ownership* are also established between the aggregator and aggregatees. The API enables aggregator and aggregatees to conduct collaborative activities in delivering value to the users, thus the API facilitate the *service choreography* between aggregator and aggregatees. Similar like comparison site model, the partnership can be in the form of equal collaboration, partial collaboration, or forming an aliances. Through the ownership, major aggregatees or consortium of aggregatees can also invest and own the aggregator.

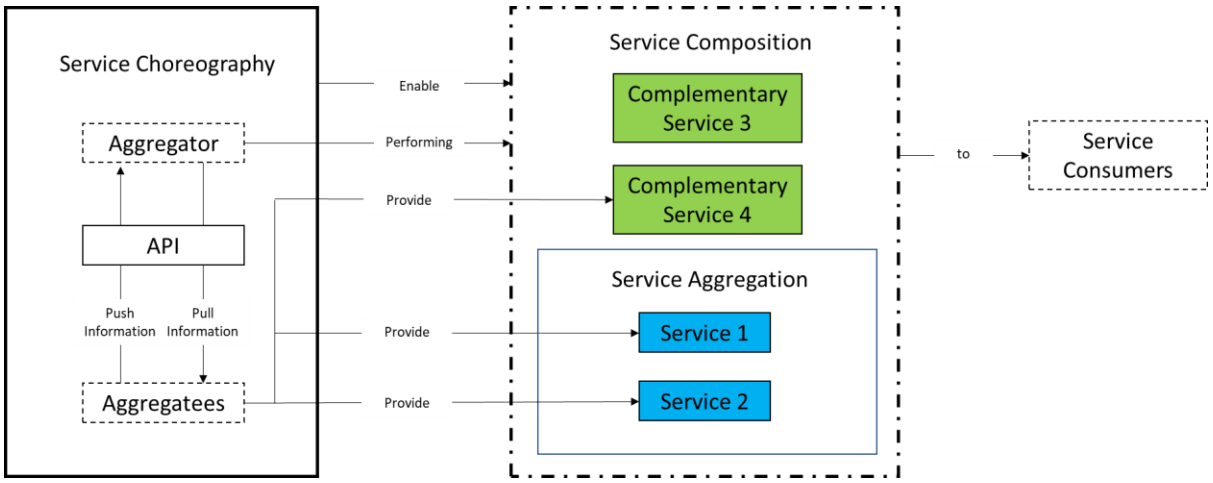

Figure 11: Value Delivery Process of One-Stop-Shop Aggregator

6

Chapter 6
Data Marketplace Aggregators

Previous chapter discussed business models of aggregators. We derived four Aggregator Business Models from our case study on existing aggregators: *search engine, advance search engine, comparison sites, and one-stop-shop.* The requirements along with their relationships were described in previous chapter.

In this chapter, we will focus our study towards demonstrating the Aggregator Business Models to the data marketplace domain. The aim of this chapter is to answer the third-sub research question "***How can the data marketplace operator translate the Aggregator Business Models into business activities?***". In the first part, we will present the discussion from the TRUSTS business model workshop. In the second part, the results from the workshop's discussion will be reflected to our Aggregator Business Model archetypes. In the last part, we conclude the chapter by describing the business model for data marketplace aggregator and adding the business activities as a form of demonstrating the data marketplace business models.

6.1 Demonstrating Aggregator Business Model

This chapter aim to demonstrate the Aggregator Business Models we derived from chapter 5. To demonstrate the business models, we would like to translate and interpret the business models into business activities. The business activities can be in the form of services offerings, platform features, embedded technologies, actor selections, etc.

6.1.1 About TRUSTS

To provide the demonstration with business activities, we will be using TRUSTS generic business model. TRUSTS is a data marketplace platform initiative from the European Commission. TRUSTS aims to create a data trading platform that is interoperable, safe, and secure. TRUSTS wants to become the platform federator to cover different organizations and jurisdictions. TRUSTS is addressed to solve varying technological differences of data marketplace in the EU by providing integration and interoperability of various platform.

Considering the envisioned goals of TRUSTS, we perceived that both this thesis research and TRUSTS share the same vision to navigate data trading transactions in a fragmented market. TRUSTS also aim to accommodate various organizations and be interoperable, which is also the aim of designing Aggregator Business Model in data marketplace. That being the case, we believe that it is reasonable to demonstrate our Aggregator Business Model by using TRUSTS generic business models because they share the same characteristics and vision.

6.1.2 TRUSTS business model workshop

To gain understanding regarding the business model of TRUSTS, we participated in the business model workshop hosted by TRUSTS. The workshop was conducted virtually on MS Teams on 20 January 2022. More than 20 participants joined the workshop. The participants include data marketplace experts, practitioners, and researchers in data market domain.

In the workshop, we discussed several potential business models that can be implemented by TRUSTS. The focal point of the discussion was centered around defining services and business activities that can be exercised by TRUSTS to realize the envisioned TRUSTS data marketplaces. The discussions were divided into three agenda. First, we discuss the Base TRUSTS Business Model. The base TRUSTS business model discusses the main essential services that TRUSTS needs to deliver. The second and third discussion talk about TRUSTS Value Added Services and TRUSTS Add-on Business Models. Both discussions talk the potential to add complementary services on top of the base business model. In all of the discussions, the moderator firstly presents the general idea of the business models along with the pre-defined services that can be realized by TRUSTS. The moderator presents the idea using Miro board. Upon presentation, the participants then were given time to put a note regarding the services on the Miro board and discuss the services within the business models.

The results of the discussion can be accessed on the appendix. In this thesis report, we will not explain the results of the discussion in detail. As a note, the workshop was conducted to discuss the generic business

model of TRUSTS but given the similarities of vision and characteristics of the business model, the summary of the TRUSTS generic business model can be used as sources of data and information to describe the business activities of aggregator data marketplace in our thesis.

In the next section, we will put the business activities discussed on the workshop into our four Aggregator Business Models.

6.2 STOF Model of Data Marketplace Business Model

From the discussion in the TRUSTS business model workshop (see Appendix), we can apply the presented business model services to our Aggregator Business Models design. The workshop classified the services into three categories: Base Model, Value-added Service, and Add-on Services. Although the categorization, we consider that the provided services in each of the category are to some degree still vaguely differentiated. For example, there is no clear distinction and criteria to settle which services are base services or value-added services. Additionally, all of the components in the discussion were classified as services, although based on our understanding, some of components can be classified as technology or organization. Thus, we would like to make our own classification of these services to present our idea of the business model.

We already gain understanding on the Aggregator Business Models from our study in previous chapter. To resolve the vague presentation, we will make reflection from our understanding of the Aggregator Business Model concept with the services presented from the business model workshop. Then we classify the components to the STOF model.

6.2.1 Service Domain – Data Marketplace Aggregator

From our study in previous chapters, we understand that aggregator generally deliver two values to the service consumers, comprises of *service aggregation* and *service composition*. Service aggregation focus on core services of comparing substituting services, while service composition adds complementary services on top of the core aggregation service.

Within the Base TRUSTS Business Model, several services components can be classified as service aggregation. *Asset catalogue and personalized search and recommendation* comprises the characteristics of service aggregation. Substitutable services in the form of data assets can be collected from various data marketplace. To help data buyers in choosing the asset, personalized search and recommendation can be added to refine the service aggregation process. This service could be the core service offerings of the data marketplace aggregator.

The workshop also present TRUSTS Value Added Services. By definition, these various value-added services should provide complementary services to the Base TRUSTS Business Model or in our definition service composition. However, we consider that several services within the TRUSTS Value Added Services still comprises the characteristics from the aggregation service. For example, *advanced search and personalization, data assets ranking mechanisms, and assets pricing benchmarks* also encompass

characteristics of data assets comparison and aggregation, thus we classify these services as service aggregation.

With regard to service composition, many of services from both the base model and value-added services contains service composition characteristics. For example, services such as *storage and computing power, data management services (cleansing, visualization, valuation, anonymization, quality check), training courses, AI training services, and Sandboxes features* can be introduced as complementary services supporting the core aggregation services. These services can also be independently provided by the data marketplace aggregator.

In addition to the above complementary services, some composition services can also be added if integration with the data marketplace aggregatees has been established. Transaction-focused services like *payment solution, transaction encryption, smart contracting, transaction log and compliance, and transaction dispute* require data assets suppliers to actively contribute in delivering the services. To realize these complementary services, more discussion will be presented in the technology domain and organization domain part.

6.2.2 Technology Domain – Data Marketplace Aggregator

Some services components like *interoperability layer to dataspaces*, *framework to integrate with external infrastructure,* and *federation frameworks library* can be closely related to the concept of service integration and service choreography, considering that it involves more than one entity to collaboratively delivering services.

To enable the collaborative activities in delivering the services, we understand from our previous study that aggregator typically utilize API. The API facilitates the data and information exchange between the collaborating actors. The workshop mentioned *framework to integrate with external infrastructure.* This service can also be closely defined to the concept of API, as the infrastructure to integrate with external infrastructures.

In previous section, we described several composition services that might only be enabled through collaborative value delivering activities. Payment and various transaction solutions in general can only be enabled if the payment accommodating actor (typically the aggregator) and payment receiving actors (typically the aggregatees) are involved in the entire transaction process (e.g., the payment is directed from the service consumers to aggregatees through the aggregator). That being the case, some service composition offerings can only be enabled through service choreography. Integration of the service choreography process can be facilitated by the API.

While other composition services can be enabled with service orchestration. *AI training services, storage and computing power, training courses, and sandbox features* can be provided singlehandedly by the data marketplace aggregator. These complementary services can be fully delivered to consumers as they essentially demand no resources from the aggregatees.

In the workshop, it is not described in detail on how the data assets were delivered from the data suppliers. However, we can draw upon our case study that aggregator can fulfil aggregation service through service

orchestration (crawler) and service choreography (API). If special information regarding the data assets is needed, then API can be developed in order to facilitate the partnerships.

6.2.3 Organization Domain – Data Marketplace Aggregator

The workshop discussed services that can be classified into the organization domain: *federation with external marketplaces.* In our concept, it can be regarded as *value network* If we bring the concept to the Aggregator Business Model, the value network consists of aggregation with partnership or aggregation with ownership. Depending on the *organizational arrangement*, varying degrees of collaboration can be established (see. Chapter 4).

Previous section discussed some composition services that can only be enabled if collaboration procedure with aggregatees were established. In this case, both data marketplace aggregator and data marketplace aggregatees needs to contribute in doing value activities.

For example, in previous section we describe how payment services may be enabled through collaborative value delivering activities. The data marketplace aggregatees supplying the data assets needs to provide the pricing information of the data being sold to data marketplace aggregator. The data marketplace aggregator responsible to accommodate the transaction and deliver the information to the data buyers. Smart contract procedure can also be introduced between data marketplace aggregatees and data buyers, facilitated by the aggregator. Assuming the deal and payment between data sellers and data buyers has been fixed, the data buyers has to deliver the data assets to the buyers, again, facilitated by the aggregator. Composition services can then be provided by aggregator to the data buyers e.g., data management and analysis services, data insurance, etc.

From the above value delivering process, it can be viewed that towards accommodating payment and transaction services within the platform, both data marketplace aggregator and aggregatees are responsible to collaboratively carry out value activities. In-platform payment cannot be realized without any involvement from the aggregatees (data sellers) side. In contrast, other composition services can be enabled without any involvement from the aggregatees' side. Complementary service like AI training service for example, can be independently provided to the consumers. Although to some extent, aggregatees may contribute in providing the training (e.g., providing training material), the value of the training services can be fully realized single-handedly by the aggregator itself.

Other than service composition, the core offering of aggregator lies on the service aggregation. Several aggregation services can be derived from the discussion: *Library of Federation Frameworks* and *the ability to show the federation assets in single catalogue.* These two services can be understood as aggregation service. The federation, consisting of data marketplaces, own their own data assets catalogue.

The data marketplace aggregator gathers and collect these federation data catalogue in a single library or location, thus providing aggregation service. In facilitating the aggregation service of data assets catalogue of the federation, we understand from other aggregator that API can be implemented to accommodate the collaboration. The API can aid the data assets delivery process between the federation and the aggregator. API can also aid data marketplace aggregator to obtain special information on the traded data assets.

Through API, data marketplace can also selectively choose which data marketplace to be included in the aggregation, thus enabling *collaboration of trusted circles* as envisioned in the workshop.

Despite our previous emphasizes towards API in enabling aggregation of federation, data marketplace aggregator can also conduct aggregation service with crawler. From our case study, we understand that crawler technology can also facilitate information aggregation, despite its limitation as the value activities were conducted by aggregator only.

6.2.4 Finance Domain – Data Marketplace Aggregator

Revenue generating processes were introduced in the business model workshop. These services can be regarded to the finance domain. There was discussion about *subscriptions model*. Other alternative form of revenue generating process are also discussed, for example *one-time payment* and *transaction-based revenue.*

6.3 Business Model Aggregator Data Marketplace

We previously reflected the discussion from TRUSTS business model workshop with our understanding on Aggregator Business Model. We classified several business services components from the workshop to the STOF model, and redefine the service components to the concept of aggregator. The four Aggregator Business Models will be presented by using the data marketplace services as the components. In this part, TRUSTS will be positioned as the data marketplace aggregator, aggregating data asset services from data market federation or online data marketplace. From this, we will answer the sub-research question "***How can the data marketplace operator translate the Aggregator Business Models into business activities?".*** To answer the question, we presented the data marketplace aggregators in the tables. In the table, we present the business model components.

6.3.1 Search Engine Aggregator – Data Marketplace

Data marketplace with search engine business model focus on aggregating vertical data assets catalogue from various online data marketplace. Service aggregation of data assets can be provided through several services offerings such as basic and advance search personalization for assets catalogue, assets catalogue comparison, assets ranking and pricing mechanisms.

The aggregation service is provided through platform infrastructure. The platform includes AI crawler technology to realize the aggregation of data assets catalogue. It needs no partnership with data marketplace aggreagtees, thus the assets catalogues aggregation should be conducted independently by the data marketplace aggregator.

The table below provide the components and implementation to design data marketplace search engine aggregator:

Table 9: Demonstration of Data Marketplace Search Engine Aggregator

Business Model Domain	Design Components	Business Activities
Service Domain		
Intended Value	Service consolidation and post-aggregation analysis under one location	Vertical data assets catalogue in a single location
Delivered Value	Service Aggregation	Asset catalogue, personalized search and recommendation Advanced search and personalization Data assets ranking mechanisms Assets pricing benchmarks
Technology Domain		
Technical Architecture	Platform Crawler (AI Bots or RSS Reader)	Platform as framework to facilitate integration with external infrastructure Crawler as framework to enable data asset library collection
Technological Functionality	Service Orchestration	Pulling information of data assets catalogue from online data marketplace
Organization Domain		
Actors	Aggregators and Aggregatees	TRUSTS (aggregators) Data suppliers, data marketplace (aggregatees)
Value Network	Aggregation Without Partnership	No prior established partnership between TRUSTS and its aggregatees
Organizational Arrangements	No partnership between aggregators and aggregatees	TRUSTS independently provide vertical data assets hosting without any partnership
Financial Domain		
Financial Arrangements	Aggregator independently finance their business operation	Subscription model, one time payment, fees from transaction

6.3.2 Advance Search Engine Aggregator – Data Marketplace

Most business model components for this type of business model are similar with search engine model. Data marketplace with advance search engine business model, however, can adds complementary services on top of aggregation services. Complementary services such as data management services, training courses, and sandbox feature are introduced in the platform. The usage of crawler technology limits the information exchange procedure, thus aggregatees play no role in the service delivery processes. That being the case, these complementary services are needed to be developed by the data marketplace aggregator itself.

The table below presents design components and implementation to realize advance search engine data marketplace.

Table 10: Demonstration of Advance Search Engine Data Marketplace

Business Model Domain	Design Components	Business Activities
Service Domain		
Intended Value	Service consolidation and post-aggregation analysis under one location	Vertical data assets catalogue in a single location Additional services and features to support data management
Delivered Value	Service Aggregation	Asset catalogue, personalized search and recommendation Advanced search and personalization Data assets ranking mechanisms Assets pricing benchmarks
	Service Composition	Storage and computing power Data management services (cleansing, visualization, valuation, anonymization, quality check) Data training courses AI training courses Sandboxes to experiment data
Technology Domain		
Technical Architecture	Platform Crawler (AI Bots or RSS Reader)	Platform as framework to facilitate integration with external infrastructure Crawler as framework to enable data asset library collection
Technological Functionality	Service Orchestration	Pulling information of data assets catalogue from online data marketplace

		Independently providing service composition offerings
Organization Domain		
Actors	Aggregators and Aggregatees	TRUSTS (aggregators) Data suppliers, data marketplace (aggregatees)
Value Network	Aggregation Without Partnership	No prior established partnership between TRUSTS and its aggregatees
Organizational Arrangements	No partnership between aggregators and aggregatees	TRUSTS independently provide vertical data assets marketplace hosting and operation
Financial Domain		
Financial Arrangements	Aggregator independently finance their business operation	Subscription model, one time payment, fees from transaction

6.3.3 Comparison Sites Aggregator – Data Marketplace

Data marketplace with comparison sites model also focuses on service aggregation of data assets, thus offering similar services like search engine model. The difference is that the data marketplace employs API in realizing the service aggregation process. As we already understand, API can facilitate information exchange process in a partnership. Instead of aggregating online data marketplace, the data marketplace aggregator focuses on integrating federation data assets catalogue.

Partnership can be organized in varying degrees. Vertical data marketplace integration can be set up to provide equal treatment and collaboration. The partnership can also organize private enterprise data ecosystem and closed group data marketplace to provide special services to the selected partners. Additionally, alliance with existing data marketplace, such as GAIA-X, can be established either through partnership or ownership.

The required design components and implementation to realize comparison sites aggregator data marketplace are presented as follow:

Table 11: Demonstration of Comparison Sites Aggregator Data Marketplace

Business Model Domain	Design Components	Business Activities
Service Domain		
Intended Value	Service consolidation and post-aggregation analysis under one location	Federation data assets catalogue in a single location
Delivered Value	Service Aggregation	Asset catalogue, personalized search and recommendation Advanced search and personalization Data assets ranking mechanisms Assets pricing benchmarks
Technology Domain		
Technical Architecture	Platform API	Platform as framework to facilitate integration with external infrastructure API as framework to enable data assets catalogue aggregation
Technological Functionality	Service Choreography	API enables TRUSTS to pull public and special information on data assets from aggregatees infrastructure API enables aggregatees to also push data assets catalogues to TRUSTS platform
Organization Domain		
Actors	Aggregators and Aggregatees	TRUSTS (aggregators) Data marketplace federation (aggregatees)
Value Network	Aggregation with partnership or ownership	TRUSTS can join or establish data marketplace consortium (partnership) Consortium of aggregatees can invest and own TRUSTS (ownership)
Organizational Arrangements	Partnership through partial collaboration, equal collaboration, or alliances Or	Vertical data marketplace hosting (partnership with equal collaboration) Large enterprise private data marketplace hosting – private data

	Ownership by consortium or major aggregatee	ecosystem (partnership with partial collaboration) Closed group data marketplace hosting (partnership with partial collaboration) On demand existing data marketplace to form federation with TRUSTS (alliance partnership or ownership by major aggregate)
Financial Domain		
Financial Arrangements	Aggregator independently finance their business operation	Subscription model, one time payment, fees from transaction

6.3.4 One-Stop-Shop Aggregator – Data Marketplace

One-stop-shop data marketplace incorporates complementary services on top of service aggregation. Similar like the comparison sites model, this data marketplace aggregator can utilize API to facilitate information exchange processes and partnerships. However, instead of only aggregating data assets catalogue, the API can also be utilized further to enhance the partnerships by collaboratively providing complementary services. With both API and partnership, many new different complementary services can be provided, like payment and transaction services. For example: data assets payment solution, data trade transaction encryption and smart contracting with data suppliers. Regarding the partnership, it can organize similar partnership establishment like comparison sites model.

To design one-stop-shop data marketplace, we present the required design components and implementation in below table:

Table 12: Demonstration of One-Stop-Shop Data Marketplace Aggregator

Business Model Domain	Design Components	Business Activities
Service Domain		
Intended Value	Service consolidation and post-aggregation analysis under one location	Federation data assets catalogue in a single location Additional services to enhance data transactions Additional services to enable in-platform data management and data analysis
Delivered Value	Service Aggregation	Asset catalogue, personalized search and recommendation Advanced search and personalization Data assets ranking mechanisms

		Assets pricing benchmarks
	Service Composition	Storage and computing power Data management services (cleansing, visualization, valuation, anonymization, quality check) Data and AI training courses Sandboxes to experiment data Payment solution Transaction encryption Smart contracting Transaction log, compliance, and dispute
Technology Domain		
Technical Architecture	Platform API	Platform as framework to facilitate integration with external infrastructure API as framework to enable data assets catalogue aggregation API to enable collaborative activities in delivering complementary services
Technological Functionality	Service Choreography	API enables TRUSTS to pull public and special information on data assets from aggregatees infrastructure API enables aggregatees to also push data assets catalogues to TRUSTS platform TRUSTS with data marketplace aggregatees can conduct collaborative value delivering activities to realize service composition
Organization Domain		
Actors	Aggregators and Aggregatees	TRUSTS (aggregators) Data marketplace federation (aggregatees)
Value Network	Aggregation with partnership or ownership	TRUSTS can join or establish data marketplace consortium (partnership) Consortium of aggregatees can invest and own TRUSTS (ownership)

Organizational Arrangements	Partnership through partial collaboration, equal collaboration, or alliances Or Ownership by consortium or major aggregatee	Vertical data marketplace hosting (partnership with equal collaboration) Large enterprise private data marketplace hosting – private data ecosystem (partnership with partial collaboration) Closed group data marketplace hosting (partnership with partial collaboration) On demand existing data marketplace to form federation with TRUSTS (alliance partnership or ownership by major aggregate)
Financial Domain		
Financial Arrangements	Aggregator independently finance their business operation	Subscription model, one time payment, fees from transaction

7

Chapter 7
Data Marketplace Aggregator Transformation

From the study in chapter 5, we understand that several aggregators were able to transform their Aggregator Business Model from one type to another. The study provided us insights that typically aggregator changed their business in two different paths, either by focusing on adding features or to establish integration with the services suppliers. In this chapter, our goal is to observe which transformation path to choose for the case of data marketplace aggregator. Thus, the aim of this chapter is to answer our fourth sub-research question "***Which Aggregator Business Model transformation can be exercised by the data marketplace operator?".*** In answering the sub-research question, we conduct surveys and semi-structured expert interviews.

7.1 Introduction

From chapter 5, it can be understood that typically, aggregator transform their business model in two different paths. In the first path, the aggregator focuses on adding more features, thus changing their business model from search engine aggregator to advance search engine aggregator. The second path involves establishing partnership with services suppliers. This partnership is typically accommodated by API developed by the aggregator. The API helps in accommodating the information exchange between aggregators and aggregatees (services suppliers).

As mentioned earlier, the main goal of this chapter is to select which business model transformation path to choose. We would like to see which transformation path would be more prominent for data marketplace aggregator.

7.2 Data Collection Approach

To help us select the transformation path, we conduct two different data collection methods. The first one, we conduct semi-structured expert interviews with data marketplace experts. The second one, we also conduct survey to ask data marketplace experts during a business model workshop conducted by TRUSTS. All of meetings and survey are conducted virtually through MS teams.

For the interview, we conducted semi-structured interview approach with the data marketplace experts. All data marketplace experts we interviewed were involved in data marketplace projects or consortium of data marketplaces. Considering our research purpose is to provide guidance for data marketplace operator, in addition to being experts in the domain, they can also be considered data marketplace operators due to their involvement in data marketplace projects. Thus, we believe that it is reasonable to interview them considering their expertise and their involvement as data marketplace operators.

7.2.1 Semi-Structured Interview

The interviews were conducted online. In order to gain reliable insights, we interviewed experts within the field as we perceived that the expert possess the knowledge, experiences, and expertise to answer the questions. In our case, the field of study are focused towards two topic: business model and data marketplace. Thus, we interviewed experts that possess knowledge in business model and data marketplace. On top of that, most of the experts were involved in data marketplace projects, thus they can also be considered data marketplace operators, thus align with our thesis purpose to provide guidance for data marketplace operator.

The following table describe the overview of the interviewees:

Table 13: Interview Participant for Business Model Transformation

Interviewee	Background / Expertise
Expert A	Academic researcher / Experience in conducting research in data marketplace, including the business model topic. Involved in various data marketplace projects.

Expert B	C-level executives and business consultant / Experience in digital business transformation. Involved in consortium of data marketplace
Expert C	C-level executives / Practitioners in data marketplace either as data buyer and data providers. Involved in consortium of data marketplace

The structure of the semi-structured interviews is as follows:

1. Conceptual understanding regarding the Aggregator Business Model transformation was concluded from the chapter 5. Interview questions were constructed based on this conceptual understanding.
2. We construct interview protocols as a guidance during the interview. The interview protocols can be found in the Appendix.
3. We select the criteria of the interviewees.
4. We sent invitation emails to the selected interviewees. Within the email, we also attached the study summary so that the interviewees can prepared in advance.
5. We conduct the interviews in the agreed schedule. During the interview, we also video recorded the interview.
6. We translate the interviews into transcripts.

The interview questions are as follows:

Based on our observation, some aggregators choose to shift to certain business model type. Comparison sites can be achieved by adding API integration and collaboration with data suppliers, while search engine 2.0 can be achieved by adding new features. Based on these two selections, which business model do you think is the better choice?

Probe:

1. Can you explain the reasoning behind your choice?
2. What is the trade-off of these two business models?

7.2.2 Surveys

On 20th January 2022, TRUSTS hosted business model workshop titled "All-hands Business Model Workshop". The workshop discussed the business model aspect of the visioned TRUSTS data marketplace. We got a chance to present our findings on Aggregator Business Model transformation. In the last session of our presentation, we ask the participants of the workshop to answer several questions. Nine people participated in the surveys during the presentations.

The questions were as follows:

1. Assuming we want to achieve the one-stop-shop federation, which business model paths do you prefer?
2. Can you explain the reasoning behind your choice?

7.2.3 Data Analysis

Upon the completion of each individual interview, we immediately started transcribing the interview. This means that we can start making transcriptions as soon as possible to ensure the clarity of the memory from the conversation and to avoid any missing interpretations from the interviews. To help us in making the transcripts, we recorded our online meetings and utilized automated transcriptions features from MS Teams. To ensure accurate transcriptions, we compared the automated transcripts with the video recording and made manual adjustments. We then finalize the transcripts by creating more structured documents to ease the process of making codes for analysis.

In this particular study, we intend to explore the reasoning behind the experts' choice in selecting particular business model path. The general concepts of the study have been explored, which are between adding new features or introducing platform integration with API. Therefore, deductive coding approach can be used. Deductive coding enables us to focus on our area of interest. In our cases, we already predetermined our codes. The codes are: features and integration.

After determining the initial codes, we started assigning transcripts to our codes. Although predetermined codes, we did not want to limit our findings from the predetermined codes, because it could provide bias and limit our results. Thus, we introduced new codes that are still relevant with our study. To ensure the relevancy between codes, we also observed the connection between codes, thus we group the codes or axial coding.

In grouping the codes, some codes constitute a hierarchical connection. For example, Expert A not only mention the importance of adding new features, but also provide examples of the features that can be added: user reviews and data quality information. From this, we introduce new code, data assessment features. The data assessment features can be regarded as the sub-codes of the features, thus providing a hierarchical connection.

Some codes also constitute a linear connection. For example, Expert A mentioned that the introduction of data assessment features could be difficult due to interoperability problems. The data assessment features are grouped to the sub-codes of features, while the interoperability is grouped to the sub-codes of integration. These two concepts are related with each other, thus providing a linear connection.

As a result of that, the whole process were iterative, because we kept grouping and re-grouping the transcripts with the codes. We also reassigned codes from the earlier process to fit with the new coding structures. We then finalize our analysis by presenting the results from the interview.

7.3 Interview Results

In this section, we present the discussion gathered from the interviews. The main point of the interview is to select between introducing new features or establishing integration with the data suppliers. Towards this, each expert argued different opinion with varying reasoning behind the selection.

Expert A provide the discussion from the basis of data buyers perspective. According to Expert A, users will typically be more interested to use the data marketplace platform if more features are available. This is

because the data marketplace aggregator may provide features that is not available on the aggregatees or data suppliers platform. Additionally, Expert A also state that typically API can be found on the aggregatees platform, thus providing little value to the users.

> *"As a as a user, I will personally be more interested in having first more features because I mean the API can be found on the original website anyway … the extra features can be a valid value because they may not be available on the original data marketplace." – Expert A*

Expert A also explains one examples of the additional features that can be added, which is a feature to help data buyer in assessing the data assets e.g., through user reviews and quality assessment features.

> *"So if there's a lot of different websites that have the data and then the additional feature could be to actually assessing its review ratings. Or it could be to add quality information …" – Expert A*

In realizing the quality assessment features in data marketplace, Expert A stated that in practice, it is still difficult to develop such features due to the interoperability issues that is still common in the data trading industry. Due to the interoperability issues, it may be complicated to assess and compare such different data assets.

> *"Again, it's the interoperability to a certain extent. So how do you assess that? How do you compare the different datasets across these additional features?" – Expert A*

Additionally, there is also a problem with trust. The data buyers need to firstly trust the data marketplace aggregator. For example, the data buyers need to know if the users is trusted and coming from real data buyer, not from the platform itself.

> *"Other challenges can be to gain the trust. For instance, if there are a lot of reviews, but I think they are being provided by the platform itself then I would not trust that" – Expert A*

Expert D also provided opinion based on the data buyers-perspective. According to Expert D, buyers in the data marketplace, especially in the aggregator domain, are different with buyers in other aggregators. Expert D argued that in other aggregators, buyers typically only buy the data and then use it only once, and this is different with the buyers in data marketplace. In data marketplace domain, data buyers may use the data continually and repetitively.

> *"Again, we have to start on the user perspective. Users of aggregator in data spaces are not the same users as the examples that you mentioned. Trivago and all these sites address individuals*

need. They buy a product, for instance a room … and they pay with credit cards … they use it once and they leave. The in using data. It's a total different story" – Expert C

"Very rarely datasets for specific projects are used only once. In operations that properly used again and again and again same or new versions or similar data." – Expert C

Thus, to accommodate the different characteristics of the data trades, Expert D presented that it needed feature to accommodate the transactions in collaborative manner. For example, the features can help data buyers and data suppliers to interact with each other, accommodated by some technical features within the platform architecture. This interaction can be accommodated systematically or non-systematic. This feature could accommodate repetitive collaboration.

"So, you need to have repetitive collaboration with the data space … certainly you need to interact and ask for more information in a systematic or non-systematic in a machine assisted way or, I don't know, via chat." – Expert C

In addition to the features to accommodate interactions, Expert D also argued that the value of data trading lies not only on the data being traded, but also on the services and applications that can be enabled from the data itself. For example, the features to provide visualization and data analysis with regards to the data being traded.

"You have to see how you transact with this and also, it's not only data, I think it limits the scope to refer only to data. We have to refer to data assets included applications and services because, I do have my own tools, my own applications, but ah, I would like to commend them or have a different tool and you have a different visualization of data or a different analysis." – Expert C

"The recommendation engine that compiles should be able to extend beyond the datasets to services and applications as well as a holistic view of the data space" – Expert C

While Expert B argued that the transformation path are dependent on the market segmentation of the aggregation. The additional features could be beneficial for the B2C markets, while the integration could be beneficial for the B2B markets.

"I would first differentiate between B2B and B2C … It's the right one (adding integration) for B2B, and for B2C … It's the left one (adding more features)" – Expert B

According to Expert B, in the B2C market, it needed experimentation on the features. Consumers may like the features or may not like the features, and most of the times, the consumers itself do not understand the reason they like the features.

"You can put in some more features because consumers also silly. I mean they even use TikTok You never would understand why. It's just a fact. So, the more features you give him, it's all experimentation" – Expert B

For the B2B sectors, integration is needed to gain control over the users in the data marketplace. Expert B argued that most established data marketplace are not actually a marketplace, but a data space, in which the data space tightly control the users. Additionally, common problem within the data spaces is typically the interoperability between the users, which can be conceptually solved by the integration.

"If I look at common data marketplaces, then look at the ones that really thrive, more often than not, (the thriving data marketplaces) not actually data marketplaces, but data spaces and are tightly controlled as to the users that are on there." – Expert B

"So, you carve out a stable context (by implementing API integration) and you have found a way to kill the problem of the long tail and hands (interoperability)." – Expert B

7.4 Survey Results

Out of 9 participants, 5 people choose to go with adding additional features, while the other 4 people choose to go with establishing integration with the current data marketplaces.

One participant that choose the additional features path argued that additional services can be the added-value compared to the other data platforms. The additional services could be the competitive advantages with the other data platform. This argumentation is similar with the Expert A, stating that the service can be the main differentiator with the other data marketplace, thus can be the reason for the data buyers to use the aggregator data marketplace.

Other participant also chose the additional features path because currently, not many data marketplaces are actually established. They may not even have their internal API. Thus, establishing API integration may not be feasible at the moment. Focusing on internal capabilities, in the form of features and services are preferable.

Other also argued that the integration route is considered to slow. This may lead to losing potential consumers. After focusing on the services and features, the integration could be introduced later as add-on.

However, another participant prefers the integration establishment path. He argued that integration could lead to better search results, thus also giving benefit to the users. Accurate search results are more important than multiple non-essential services.

Other participant of the same opinion also argued that the data marketplace should become a strong federated marketplace, thus a strong federated marketplace could lead to a coherent end-to-end ecosystem to provide advanced search capabilities. This strong federated mechanism could be enabled through the API integration.

7.5 Conclusion

In this chapter, we aim to discuss the aggregator business transformation path that can be exercised by the data marketplace aggregator. Two different paths can be exercised, the features addition path and the integration establishment path. From this, the sub-research question are asked "***Which Aggregator Business Model transformation can be exercised by the data marketplace operator?".*** To answer the above research question, we conduct semi-structured interview and survey. The answer from the interviews and surveys are as follows.

From the expert interviews, it can be understood that all experts prefer to focus on adding services and features rather than establishing API integration with data suppliers. Adding services can be a competitive advantage with the other data marketplace. The services that are available on the aggregator could be perceived by the users as an added value compared with the other data marketplaces. In addition to that, some services are important in accommodating the data trades transactions. Services like interaction features is essential to accommodate the transaction. The characteristics of data is different with the other services or products. It needed deeper information collections thus the interaction features could be beneficial for the users. Additionally, data trades should be seen beyond trading data, such as providing services and applications that can be enabled from the data itself.

Although important, adding services and features possess various challenges, such as the issues of trust and interoperability. For example, the aggregator should make sure that the information regarding the quality of data should be trusted and reliable. It should be coming from the data buyers and should not be coming from the data suppliers or the aggregators itself. This can be done by providing transparency with regards to the data quality assessment method conducted by the aggregator. Interoperability is also still an issue. At the moment, it is still difficult to compare different data services and assess different datasets. Thus, although transparently providing trusted data assessment procedure to the data buyers, it might not be equally comparable due to the interoperability issues.

Towards the surveys, there are mixed opinions between participants. For some participants, additional services could be the added value compared with the other data platform, because it helps the platform to gain wider user base, thus maintaining the platform existence in the market. While for some participants, it is more important to have a strong federation mechanism, so that the aggregator can provide an end-to-end ecosystem of data trades. Although others also argued that at the moment, there is not many established data marketplaces, thus establishing integration with data marketplace could not be the priority due to the absence of established data marketplace. Additionally, establishing integration is also too slow, and the aggregator might lose potential customers due to slow development.

8

Chapter 8
Business Model Evaluation

This chapter aims to evaluate the business model of the data marketplace aggregators. We will answer the fifth sub-research questions in this chapter**: "*To what extent each of the business model requirements can be exercised considering the current data market landscape?*".** To answer the sub-research questions, we conduct semi-structured expert interviews.

8.1 Introduction

This chapter involves performing evaluation of the artifact, which is the Aggregator Business Model. The main objective of this chapter is to observe the possibility to realize the business model requirements considering the current industry landscape.

The evaluations were done through expert interviews. Interviews are typically conducted in three types: structured interviews, semi-structured interviews, and unstructured interviews. Structured interviews asked a same fixed question to the expert. Thus, it is easy to compare answer from different experts. However, structured interviews lack a deeper understanding to gain detailed analysis due to the fact that the questions are fixed and no follow-up question can be asked. Unstructured interview on the other asked open-ended question. The interviewer asked different question to different experts. Although deeper understanding on certain topics can be reached, it could be difficult to compare answer from different experts. The semi-structured interviews provide a balance output. Semi structured interviews allow interviewers to ask fixed questions, while also ask follow-up question when detailed information is needed, thus giving more flexibility. With semi-structured interviews, we perceive that it helps us to gain deeper understanding on the topic, while able to compare different answers from the experts comparatively. Thus, we choose to conduct semi-structured interviews. The semi-structured interviews can provide us to conduct data collection for the evaluation of the data marketplace business model.

8.2 Interview Approach

We will explain the detailed structure of the interview in this section. The interviews were all conducted online. Online interviews allow us to reach people in different countries. Online interviews give us a cost-efficient approach without sacrificing the quality of the information that we can get.

8.2.1 Selection of the Interviewees

To get reliable and accurate insights, it is important to choose the right experts for the interview. Target group of experts in a specific domain is chosen to ensure that their expertise align with the topic being raised. Considering that our topics are related to data marketplace business model, we need to look for individuals that possess the expertise within the domain of data marketplace. To ensure diversity of the insights, we decided to ask experts from academia and industry.

The criteria of the interviewees are as follows:

- People involved in data marketplace development research. Research must be in the subject of business model to ensure that the researchers possess business model knowledge. For example: university professors and PhD researchers (academic perspective).

  Or

- People involved in the data marketplace project, specifically in the development of the business model. For example: Individuals from data marketplace consortiums or professional working in data marketplace company (industry perspective).

Considering the limitation of the networks that the thesis author has, only 10 people invited to the interviews. 4 people did not reply to the invitations. 6 people replied, with only 4 of them confirm the attendance, while the other 2 reject the invitation stating that the topic is beyond their reach. However, out of these 4 people, we believe that we already gather enough sample due to the fact that they are coming from a varying background from academia to industry.

The following table describe the overview of the interviewees:

Table 14: Interview Participants for Business Model Evaluation

Interviewee	Background / Expertise
Expert A	Academic researcher / Experience in conducting research in data marketplace, including the business model topic. Involved in various data marketplace projects.
Expert B	C-level executives and business consultant / Experience in digital business transformation. Involved in consortium of data marketplace
Expert C	C-level executives / Practitioners in data marketplace either as data buyer and data providers. Involved in consortium of data marketplace
Expert D	Business researcher / Experience in conducting research in data-driven business model, digital platform, and data discovery.

8.2.2 Interview structure and process

The process of conducting the semi-structured interviews is structured as follows:

1. From the business model components derived in previous chapter, we select the most important business model components in each business model domain.
2. Interview questions were constructed to assess if the business model components are possible to be realized in practice.
3. We construct interview protocols as a guidance during the interview. The interview protocols can be found in the Appendix.
4. The criteria of the interviewees are discussed and selected.
5. We sent invitation emails to the selected interviewees for confirmation. In the email, we also attach summary of the topic being raised. We also mentioned the time allocation for the interviews.
6. Finally, the interviews were conducted based on agreed schedule.
7. The interview is automatically converted into transcript and video recorded with prior consent.
8. The transcript is then edited to ensure it records accurate information.

8.2.2 Interviews questions

As stated earlier, the questions were framed to assess the viability in exercising the business model components and to discover the challenges in exercising the business model. The goal is to answer sub-

research question "***To what extent each of the business model requirements can be exercised considering the current data market landscape?"***

The questions are framed based on the service domain, technology domain, and organizational domain. The service domain focus on the value perceived by the platform users and we perceive that the main distinct characteristic of aggregator lies on its services, thus the questions are framed towards the attractiveness of the services, mainly the aggregation services. The technology is considered as tools to realize the services, thus we raised question on whether it is possible to develop such technical architecture, such as API integration. We also think that collaboration is important due to the nature of aggregator that consists of several business actors collaboratively delivering value to the services. Without the willingness of the actors to contribute in the ecosystem, the service delivery cannot be fully realized. Thus, the question were framed towards the willingness of the business actors to collaborate. The questions are as follows:

Interview Part 1: Service Domain

1. As I explained in the presentation, Aggregator Business Model offers aggregated sales which is to help buyer find seller from various different platform and vice versa. Do you think that this will give benefit to the data buyers and data sellers?

   Probe:

   - *[if beneficial]* Can you elaborate how the aggregated sales will benefit the data buyers and data suppliers?
   - *[if not beneficial]* Can you elaborate why the aggregated sales will not give any benefit?

2. What are the challenges of offering aggregated sales in the data marketplace industry?

Interview Part 2: Technology Domain

1. As I mentioned in the presentation, the collaboration between data suppliers, data buyers, and the platform can be enabled through API integration. Do you think it is possible to develop such technology?

   Probe: What are needed to develop API integration technologies? Are the needed elements already there in the current practice? (Required tech, required knowledge, cost to develop)

2. What are the challenges of developing or using API integration?

Interview Part 3: Organization Domain

1. How willing are data suppliers to collaborate or to sell their data through data marketplace operator?

   Probe: What incentives do the data suppliers want to collaborate or to sell their data through data marketplace operator?

2. What are the challenges to have collaboration between data marketplace operator and data suppliers?

8.3 Data Analysis

The analysis from the interviews was conducted immediately after finishing the interviews. This means that we still have the clarity from the interview process to ease the process of making the transcripts. We priorly requested consent from the interviewees to allow recording and transcribing the online interviews. Upon confirmation, we immediately video record the meeting and enable the auto transcriptions features. Both the recording and the automated transcriptions were done through MS Teams, in which the software is already complied with the university regulation to ensure the safety and privacy of the data. Upon the completion of the interview, we immediately compare the auto transcription documents from MS Teams with the video recording to ensure that the transcripts depict accurate transcriptions. We then made manual adjustment to the transcripts when necessary.

In this particular study, we would like to observe if the business model requirements can be exercised by considering the current industry landscape. The business mode requirements along with their components has been explored in previous chapters. Thus, in analyzing data from the transcripts, we firstly conducted deductive coding by already predetermined a set of codes according to the business model requirements. The codes that we already determined are: values, challenges to realize the values, technical feasibility, technical challenges, willingness to collaborate, and challenges in collaboration.

However, in the later phase of analyzing the transcripts, we decided to introduce new codes, thus inductive codes approach was introduced. We believe that adding new codes can provide us with deeper analysis from the transcripts and avoid us from limiting the analysis as a result of deductive coding. The introduction of new codes also allows us to observe the connection between codes.

Some new codes contain similar concepts with our predetermined codes. For example, from Expert B and Expert C, we introduce the codes “standardizations issues”. Standardizations issue can be seen as the sub-codes from the technical challenges code. Other code is API implementation, mentioned by Expert A, which also comprises a similar meaning with technical feasibility. These connections depict a hierarchical connection, because “standardizations issue” is one example of challenges in exercising the technology domain requirements, and “API implementation” is one way to exercise the technical requirements.

Other examples are the introduction of code “market knowledge”, that represent a different concept with our predetermined codes. Although deviating from our area of interest, this code provides us with a deeper understanding to our study. The code “market knowledge” provide us new insights, because the code represents a factor that makes data buyers see the value of aggregator differently.

Thus, the whole analysis was conducted iteratively, by combining both the deductive and inductive coding approach. After assigning each transcript with the predefined codes, we also introduced new codes. We then came back to previous transcript to reassign the codes and regroup the codes accordingly. After that, we then connect each code and group to find the connection and relation between the concepts.

8.4 Interview Results

In this section, we discuss the insights gained from the experts on data marketplace business models. As previously presented in earlier section, in evaluating the data marketplace business model, we differentiate our interview into three parts: service domain, technology domain, and organization domain. Each part contains questions to answer the two sub-research question, containing the viability to exercise the business model domain and the challenges in exercising the business model domain. In addition to that, some experts also add solution with regards to the challenge. We will present our discussion with the experts in the next section.

8.3.1 Service Domain Discussion

The main focal point of the discussion is to talk about the main service provided by Aggregator Business Model, which is the service aggregation. We framed several questions that correlates with topic such as service attractiveness, value to users, benefits and drawbacks, and challenges in implementing the service.

Value to the Users

Toward the services provided by the data marketplace aggregator, some experts agree that data marketplace aggregator offers value and benefit to the users. For instance, data marketplace aggregator can help users find out on where to find the data without visiting to all different marketplaces. It can also help users that have no time and knowledge to find data. This can be seen as the value from the perspective of data buyers.

"Very often the buyer probably has an idea of what type of data he or she is looking for, without knowing what platform to use or what data marketplace to use to find that type of data. So, then it's very useful to have some aggregator who can actually help you point at where you can actually find this data without the need for the for the buyer to go to all the different places" – Expert A

"There are some other data out there. Maybe you don't have the time or the knowledge or where to find that stuff. And this is certainly of a value" – Expert B

"There is definitely a market for aggregator. If you don't know, you would like probably just ask google, just like aggregator because here I can find everything. This is nice for data buyer, I don't know 10 different data suppliers, so if you have an aggregator, I have done only one. Let say a contact point to get everything that I need" – Expert D

Although providing value to the data buyers, for some type of data buyers, data marketplace aggregator might provide less value, especially if used by companies in a b2b applications.

"For industrial or B2B type applications, I think more often than not, you will end up that large company knows exactly what they need." – Expert B

"I think its dependent on the type of buyer. If it is an automotive company, first would be to look for data marketplace in which provides automotive data. So, if you are in a specific domain, you would probably look for specific data marketplace in your domain." – Expert D

But from this point of view, it can be seen that this company already possess the knowledge to find the required data. While an expert also stated that some industry might need to create new service or product beyond their domain, thus aggregator can be a solution.

"But if a company, let's say domain agnostic, so not from a specific domain like for example in IT, create data driven services, they would probably go to an aggregator" – Expert D

In addition to a domain agnostic company, aggregator could be beneficial for niche market, such as consulting company, as stated by another expert.

"The aggregator could be useful for consulting companies that they are not focused on a specific project domain, but they have multiple clients in various domains, but still this will be a one small percentage" – Expert C

Challenges in Realizing Services

In realizing the services, experts mentioned various concerns regarding the Aggregator Business Model. There are challenges regarding privacy and safety of the data trade as stated by expert.

"The problem is not that of data trading, but that of the regulation of what can happen with the data and having a secure and safe data space rather than a data market'' – Expert B

There are also challenges with regard to the nature of the data itself, which is different with service or product commonly traded in digital market. Common service or product regularly traded in traditional digital market possess well-defined characteristics. While for data, the value of the data itself can be perceived differently by different entities.

"The things are more complex because the goods that are sold in a data marketplace (are) different with the goods sold in the traditional digital marketplaces. Hotel Room is a well defined asset with a 2 bedroom bed, air condition, TV. Data? It's far more different. For instance, maybe a data set may be useful for someone that does analysis requiring data on a yearly basis but has lower value to someone who does analysis for in a semester." – Expert C

The competition with the other aggregator or other data marketplace are also concern presented by some experts. Trust and size of the marketplace are factors related to the competition. For instance, the data buyers need to trust the aggregator that the aggregator will provide them with the best results. Otherwise,

the data buyers will then search the data by themselves and repeat the process of moving to different data marketplaces.

> *"If you're looking for a particular type of data you would actually need to trust the aggregator in providing you with the best results. If you don't trust the aggregator then you might still want to do the search yourself, so, to go to different marketplaces yourself, and see if that's actually the best type of data set." – Expert A*

Other than the accurate results, the data marketplace also need to be big enough to provide every service and needs from the data buyers, or else, the data buyers will move to the other aggregator which is already providing more services.

> *"You need a specific size to be recognized as the platform which do have everything. If you don't provide specific needs of a data buyer, then I would go to the other aggregated marketplace…… which is already bigger than any other. You probably need to be the biggest in order to survive" – Expert D*

8.3.2 Technology Domain Discussion

In this part, the focus of discussion scoped around the possibility to implement the technology and to also see if there are ongoing project implementing or developing the same technology. Additionally, we also asked question to observe any technical challenge within the data marketplace aggregator.

Technical Feasibility

Experts mainly argue that the main point within the technology domain is about the interoperability. Several standards have been developed in order to reach the interoperability for data exchange procedures.

> *"(In federations) The aim is to make them interoperate…'" – Expert C*
>
> *"From what I've seen, from the potential I've seen in various projects, I do think this is possible…'" – Expert A*
>
> *"We are dealing with standardizations and we are in touch with the W3C…. other bodies had obviously had a high interest in standardization initiatives." – Expert B*
>
> *"There is a trend that a specific set of connectors will be used. IDSA connector, the data space connector, or other connectors may be used… so, there will be a certain set of connectors that will prevail." – Expert C*

Challenges in Implementing Standardizations

However, although the recent trends towards standardization as a mean for interoperability, the standardization itself generate another issue. At the moment, different entities develop different standards. Instead of creating a common procedure, this emerging different standard creates even more fragmentation that differentiate each procedure. One expert argue that the aggregator need to be the dominant player in the industry first, before the other entities are willing to accept the standards.

''Everybody fundamentally is taking three existing standards and comes up with three new standards.'' – Expert B

''You can never find, at least in the foreseeable future, a common way to interoperate with old data space and databases and data feeds that are out there. So, each one has individual leads and one has to use this connector because they are dominant. So, if you are not dominant you cannot create an API and be used by others till you get dominant.'' – Expert C

Challenges in the API Implementations

The role of the aggregator itself is more or less acting as intermediaries between data suppliers and data buyers. This intermediating role, in the technical point of view, could lead to a risk of misinterpretations of information in the data. The data could be presented differently with the actual data from the data suppliers.

"There's an extra step in between the data provider and data buyer, because of this aggregator role … there's an extra step of actually interpreting the data that is provided on existing data marketplaces, and it might be that the aggregator is presenting the information in such a way that it's actually not a completely adequate. There is another step in between which increases the risk of misinterpretation" – Expert A

The misinterpretation of data information could be due to the fact that the nature and characteristics of data itself is different with other services and products, as stated earlier by Expert D. Expert D also argues that a simple API is inadequate to make them interoperate. Regular service and product possess stable characteristics and is easily defined, while data contains more complex characteristics. IPR and usage protection are two example that provide complexity in the nature of data.

"it's not a matter of a simple API … In an API, it's to exchange databases of the products, are there images? their characteristics? their price? because they are stable, so it is a simple API … If I buy a car, I can sell. This is for granted. This is not for granted for data and in general for digital assets" – Expert C

"All we need for data is far more difficult. We have to understand a greater numbers of metadata in order to understand what data is. (For example) We have to understand the APR and do we have to protect the usage." – Expert C

8.3.3 Organization Domain Discussion

Regarding the organization domain, the focal point of the discussion revolves around the willingness of data suppliers and data marketplaces to collaborate with the data marketplace aggregators. We also observe the challenges towards the collaboration between data marketplace aggregator and the data suppliers.

Willingness to Collaborate

Experts argues that the data buyers, typically a company, its goal is more or less is always to gain profit. Profit could be translated from more sales, more customers, more channels. Thus, as long as the data marketplace aggregator could increase sales, customers, and profit to the data suppliers, then the company will collaborate with the data marketplace aggregators.

"If there would lead to more sales for the, uh, data suppliers. they would definitely be interested in working with the data marketplace aggregator." – Expert A

"If it enriches the customer base, I guess this is something which could be an incentive…… Maybe I can be found by some other potential customers, which usually would not find me. " – Expert C

"I want to sell it as much as I can. OK, this is the principle. The product should be sold to, uh, as many sales channels I have. I would consider it as yet another sales channel … The incentive is how much of your product has the potential to sell. At the end of the day, beyond this it's the euro that you will generate." – Expert C

Challenges toward Collaboration

In establishing collaboration with data suppliers and data marketplace, there are challenges with regards to the data trades. For example, it is going to be difficult to assess the data quality of the data suppliers. In addition to that, there are also concern regading the assurance of the data trades, like regulations compliance and inspection to the dataset being traded in the platform. Not to mention that assurance regarding the datasets is also expensive.

"If the aggregator is going to assess the different datasets from different suppliers, there's a challenge of how you're actually assessing those" – Expert A

"… but also the assurance that you will get from this profit. But if you do not have a lawful operation then this will impact reputation and probably the revenue … lawful operation, the

regulations compliant operations, the transparent operation, the inspection at any time of the operation, and these incur great costs" – Expert C

Security and trust is also a concern in data trades. For example, in addition to providing assurance and assessment on the dataset being traded, the data marketplace aggregator needs to provide the same level of security as the data suppliers.

"Security and trust is still in discussion … Let us say get your data from specific data marketplace, I don't know how the aggregator also provide the same level of security and trust as the specific data marketplace." – Expert D

Beyond that, one expert also add that providing your data sales to the other entities, including data marketplace aggregators possess risk. Revealing metadata can lead to other entities knowing specific information from the metadata owner.

"Data sets are all about risk. You can have just revealed metadata … You can pretty much pieced together like who's in a relationship with whom and then who is walking through all of this stuff like that … the analysis of the metadata is in itself are already like exposes me to external risks" – Expert B

8.5 Conclusions

The aim of this chapter is to evaluate the business model of the data marketplace aggregator. We evaluate the service domain, technology domain, and organization domain. The evaluation consists of two parts: to assess the feasibility to exercise the business model domain and to observe the challenges in exercising the business model domain.

The sub-research question "***To what extent each of the business model requirements can be exercised considering the current data market landscape?"*** can be answered by using the interview results.

First, the service of aggregator is considered attractive, especially for data buyers that possess limited knowledge in where to find the datasets. The value that the aggregator can provide to this data buyers is to provide an access point on finding datasets. Although according to some expert, this value might not be beneficial for company that already know where to find data. Company like this might prefer to directly buy data within their domain. However, expert also argued that company intended to expand and create new service beyond their domain might also go to aggregator in finding data.

Secondly, towards the technology domain, experts mentioned that several standardizations has been developed in various project. The standardization can be considered as a starting point to reach interoperability between platform, which is important towards the data exchange via the API.

Third, in the organization domain, data suppliers, mainly as a company, are willing to collaborate with data marketplace aggregator, as long as the aggregator could provide the data suppliers with more customers and more sales that leads to more profit for the data suppliers.

Despite the above feasibility towards realizing the business model domain, several concerns need to be addressed beforehand.

Firstly, although the service is perceived as attractive to some data buyers, there is concern with regards to the regulation to ensure safety of the data trades. The characteristics of data is also complex, and different with other commonly traded services and products, thus may create another issue especially in terms of valuing and assessing the data being trade. In addition to that, competition with the other data marketplace and the other data marketplace is also an issue. For example, the data marketplace aggregators need to provide the best accurate result in finding data. It also needs to provide every service that the data buyers need. Otherwise, data buyer might move to other data marketplaces or other aggregators.

Secondly, standardization might be in development, however, currently various entities develop their own standards, which led to another problem. At the moment, there is still no commonly accepted standard that could accommodate various data spaces and data marketplace, because each data marketplace has their own standard. The data marketplace aggregator needs to be the dominant player within the industry to be able to set the standard on its own.

Lastly, although collaboration with aggregatees is possible, and they are willing to collaborate, maintaining the collaboration itself is perceived to be difficult. Assessing each of dataset from the data suppliers is challenging. Providing assurance of the data trade between data suppliers and data buyers are also very expensive and exhausting. On top of that, one expert argue that some data suppliers are still uninterested to join the collaboration, due to the risk that the data suppliers might receive if some specific metadata can reveal some specific information.

9

Chapter 9
Conclusions and Discussions

This research was concerned to obtain insights to exercise Aggregator Business Model in the data trading industry. From the previous chapter, we already gathered insights on various topics, such as Aggregator Business Model characteristics, Aggregator Business Model archetypes, data marketplace Aggregator Business Models, Aggregator Business Model transformation, and evaluation towards data marketplace Aggregator Business Model. This chapter aims to conclude the results from the previous chapters and to answer our main research question "***How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?***".

9.1 Exercising Data Marketplace Aggregator

In the previous chapter, the studies are aimed towards answering the sub-research question. From our studies, we already answered all of the sub-research question. The answers from the previous sub-research questions were summarized in this chapter to answer the main research question:

"How can the data marketplace operator exercise the Aggregator Business Model in the data trading industry?"

In the next part, we will provide the answer to our main research question and it can be regarded as a guidance for data marketplace operator to design and exercise Aggregator Business Model. We will answer the main research question by providing the summary from previous chapter in this thesis. For data marketplace operator, it is best to use this summary as the first starting point before designing the business model, so that the general idea of the business model design can be first understood. Upon the completion of understanding the summary, we advise data marketplace operator to read through the answer from previous sub-research questions to provide a detailed explanation on the business model design. For example, we will not explain the business activities that can be exercised by data marketplace aggregator in this chapter, but we provide a detailed descriptions of the business activities in chapter 6.

To exercise Aggregator Business Model in the data marketplace platform, the data marketplace operator should first understand the business model components that distinguish and characterize Aggregator Business Model with the other business model. In chapter 4, we already conducted literature review study from various business management and information science domain to conclude our Aggregator Business Model characteristics. From chapter 4, we understand that Aggregator Business Model comprises of business model components as follows:

Service domain: Aggregation services, composition services

Technology domain: Service integration, service orchestration, and service choreography

Organization domain: Aggregation without partnership, aggregation with partnership, aggregation with ownership

Finance domain: Financially independent, financially dependent.

The data marketplace operator should incorporate the business model requirements presented above. These business model requirements are considered the essential business components that needed to be exercised by the data marketplace operator. The above descriptions of the requirements should be the general framework in starting Aggregator Business Model. The above conclusion explains the general idea that define the characteristics of Aggregator Business Model.

However, based on our study in chapter 5, we understand that although similarly possessing the business model components as explained in chapter 4, these aggregators exercise the business model components differently. Although possess the same goals of providing aggregation services, they behave differently. They deliver the services in a different way. In chapter 5, our study shows that there are four types of Aggregator Business Models. These four Aggregator Business Models are distinguished by the service they

offer to the users and the integration they established with service suppliers. The integration are also connected with the way they select the technology in their business.

Below are the four different Aggregator Business Models:

Table 15: Aggregator Business Model Archetypes

		Degree of Network (Enabling Technology)	
		Low (Information Crawler)	High (API)
Service Offerings	Multiple Services	**Advance Search Engine** (Feedly, Google)	**One-stop-shop** (Scopus, LinkedIn)
	Core Service	**Search Engine** (Yidio, Kimo)	**Comparison Sites** (PriceGrabber, Trivago, Discover Cars, Flipboard)

Each Aggregator Business Model comprises of different business model components. The main business model components are as follows:

Search engine: service aggregation and service orchestration. They only provide core offering by providing aggregation of services through crawler technology.

Advanced Search Engine: service aggregation, service composition, and service orchestration. They add multiple services to complement core aggregation.

Comparison Sites: service aggregation, service orchestration. They only provide core offering of aggregation services. The information of aggregation service is extracted through API integration with suppliers

One-Stop-Shop: service aggregation, service consolidation, service orchestration. They typically provide the most complete features and services. This is enabled by its API integration that enable them to offers more services.

From the above four Aggregator Business Model archetypes, data marketplace operator can implement the business model archetypes by translating the business model components into the data trading industry. In chapter 6, we already translated the business model components of aggregator to the data marketplace business model. This business model components are derived from the business model workshop, in which we discuss several concepts regarding the envisioned data marketplace business model.

In chapter 5, we also understand that aggregators were transformed from one type of aggregator to another type of aggregator. The aggregator could add more features and transform to advanced search aggregator or established integration with service suppliers to transform to comparison sites aggregator. Towards the data marketplace case, we conduct interviews with data marketplace experts to judge which business model transformation step to take.

We summarize our findings from the interviews in chapter 7 with our data marketplace business model components in chapter 6. Data marketplace operator can use the below guide to exercise Aggregator Business Model for their data marketplace operator. In brief, the data marketplace operator could start by exercising the search engine model. In later stage, the data marketplace operator could choose between adding features or providing integration with data marketplace platform by considering various consideration presented in chapter 7. Later, the goal is to become a one-stop-shop data marketplace. The brief explanation of prior explanation are as follows:

Start of the data marketplace:

From the pattern we see from the study in chapter 5, the pattern shows that aggregators tend to start as the search engine model. Thus, we derived the search engine data marketplace as the starting business model to be exercised by the data marketplace operator. The search engine model can be exercised as follows:

> **Search Engine Data Marketplace:** it can provide vertical data assets catalogue in a single location. Features to be implemented are: asset catalogue, data asset search, ranking mechanism, pricing and asset benchmarks. Platform is also established to accommodate transactions and trades. Crawlers are developed to collect data assets information from various data suppliers**.** With crawlers, data marketplace could independently provide data assets hosting and perform data assets aggregation without partnership with data suppliers.

Between adding services or establishing integration

Our study in chapter 5 also shows patterns in which aggregator introduced new services or establishing integration with suppliers. These business model transformations are then translated to the data marketplace context. We will use the interview from chapter 7 as a consideration towards changing the business model.

The data marketplace could introduce various services first. Experts perceived this step as the most preferable, due to the fact that services can be the competitive advantages of the platform, are the most attractive factor to provide added-value for data buyers, and are crucial components to accommodate data trades which characterized as different with other trades. Adding more complementary services transformed the data marketplace into advanced search engine data marketplace. The components are as follows:

> **Advanced Search Engine Data Marketplace:** The business model components of the data marketplace are more or less similar with the previous search engine model. However, various new complementary features are added. These features could be in the form of interaction accommodating features,data analysis and visualizations services, and data assessment.

The data marketplace could instead focus on creating a stronger federation of data host. They can establish partnership with various data marketplace. According to expert, many successful data marketplaces typically accommodate a tight control over its users, thus adding integration is necessary to realize the control procedure. Additionally, the stronger federation could lead to an end-to-end data ecosystem, which

can only be enabled through integration. Establishing partnership and integration transform the business model to the comparison sites model. The business model components are as follows:

> **Comparison Sites Data Marketplace:** The business model components of the data marketplace are more or less similar with the search engine model. However, instead of gathering data information with crawler, due to the established partnership with the federation, it needs API integration to accommodate the data assets exchange within the federation. The data marketplace could establish standardization as the first step before developing API integration.

Both transformation steps possess several challenges, as presented by experts. Towards the advanced search engine step, there are issues with regards to trusts. The main challenge is to gain trust from data buyers that the data marketplace aggregator provides a reliable information regarding the data. Regarding the comparison sites step, the challenges is that developing API and establishing partnership may slow down the development of the data marketplace. The data marketplace may lose potential customers.

The final model of data marketplace

The final business model is that the data marketplace could then introduce various new services enabled by the integration (if the comparison sites model is chosen) or establishing partnership with various data suppliers (if the search engine model is chosen). From our study in chapter, we see that most aggregators that thrive with established high user-base tends to already established various partnerships with its aggregatees and they also provided various complementary services on top of its core aggregation services. Having established partnership and offering various services transform the business model into one-stop-shop model. Thus, to translate the one-stop-shop model, we explain the components as follows:

> **One-Stop-Shop Data Marketplace:** The business provides a federation data assets catalogue in a single catalogue as its core service offering. Various complementary features are also added on top of the core service. These complementary features can also be added because API integration and partnership have been established by the data marketplace operator. Example of integration enabled features are: smart contracting, payment solution, transaction encryption, data sandbox, trade log and disputes.

Evaluation Towards the Aggregator Data Marketplace

The data marketplace aggregator can be considered as attractive for the data users. Data marketplace aggregator can help data buyers that possess limited knowledge in the data trade to find the required data assets. Data marketplace aggregator can be the access point to find data assets. Although, this value may not be beneficial for entities already possess the knowledge to find data. Typically, these entities prefer to find data within their vertical domain. Additionally, there are still many issues with regard to the data trade itself. Issues concerning trust and safety are still a common problem that exist in the industry.

Technology towards achieving integration is currently being developed by various projects. There are various projects intended to provide standardization as a starting point towards integration. However, this also creates another problem. At the moment, different parties develop different standards, which in turn make the it difficult to establish a common standard.

Regarding the partnership, collaboration with data suppliers is possible, because the data marketplace aggregator is perceived to help the data suppliers in gaining more sales and more profits. Although, the challenges itself is not on establishing partnership, but rather on maintaining the partnership. It will be difficult to provide assurance and safety with regards to the data being traded in the data marketplace. Additionally, the data marketplace should also consider the risk possessed by trading data.

9.2 Limitations

In this research, there are several issues and limitations that affected the validity of the results in these research studies.

First, regarding the data collection to observe the characteristics of Aggregator Business Model from various existing aggregators, we can only conduct analysis and derive conclusion based on the publicly available information. The information is gathered from the aggregator's website, and online news. In addition to that, the authors' perceptions of using the aggregators' platform are also considered. This collection method may provide subjective results. Many information is gathered from the corresponding aggregators' sites thus our information is limited to the information that the aggregator wants to show and publish. In addition to that, due to time and geographical concern, we could not gather primary data directly from the aggregators e.g., through interviewing employees of aggregators. This matter also further reduces the internal validity of the research, because we cannot really gain understanding regarding the actual reason behind the aggregator's decision e.g., to collaborate with aggregatees, to deploy API, or to change business model. Our conclusions are derived based on the theory from literatures and patterns from case studies. Thus, there could be other factors beyond theory and pattern that could also reflect the decision made by the business.

Nonetheless, the data collection method is also effective and efficient. Desk research method is less time-consuming and simpler method than interview. Although not able to gather deeper understanding (e.g., if conducted interview), we were able to gain understanding from many aggregators of varying domain in a short amount of time. Information from various business model can also be gathered more easily. Because of that, we could increase the generalizability of our findings. Considering that our aim of developing the aggregators business model archetype is to develop a framework that is applicable to different domains, we believe that making trade-off to internal validity without neglecting the generalizability is reasonable.

Secondly, we also intend to present the business models changes of some aggregators from one period of time to another period of time. We intend to observe the old business model and compare it with the current business model. Due to short time available in conducting the research, we could only be able to capture the old business model using limited information that is available publicly. We could not really grasp and experience the old business model as we did with the present business model.

Third, the evaluation of the business model is based on the subjective judgement by the experts, thus the outcomes of the evaluation are solely based on the perception and opinion of the experts. There might also be communication issues between the interviewer and the interviewees. Language barriers could be the

issues, because neither the interviewer nor the interviewees use English as their native language. These may lead to a different outcomes and interpretations regarding the discussion.

Nonetheless, the interview provides us to gain more in-depth knowledge regarding the subject being asked. We did not restrict the interviewees to share their opinion, thus help us to gain more understanding with regards to the topics. As a result of this, although the minimal internal validity, we still provide a deeper understanding of the topic from the interview.

9.3 Future Research

The Aggregator Business Model archetypes in this research were derived from observing eleven different aggregators that currently exist. The number of samples can be increased to get better insights. Most of the analysis are also derived using the information that are publicly available online. To get a better understanding regarding the business, interviews with professionals working on the corresponding aggregators may needed.

Many of the business model components that is implemented in the data marketplace Aggregator Business Model are based on the discussion from the business model workshops. The next research can be focused towards defining and translating the business model components in more details, either by interviewing data buyers, data suppliers, or data marketplace operators.

The evaluation of the business model is based on the results of the interviews. This is because the business model itself has not been really implemented in the industry. The next research can involves evaluating the business model in the practical settings, especially if the business model has been implemented in the industry.

9.4 Academic and Managerial Contributions

In the emerging data marketplace research, several business models studies have been developed, such as data marketplace business model taxonomies, data marketplace classification, and data marketplace business components. For example, taxonomies from Spiekermann (2019) and Fruhwirth et al., (2020) provide a conceptual model explaining the business model of various existing data marketplace. However, we deemed that many of these literatures are too conceptual and impractical. We contribute to the data economy domain by providing a business model studies that also incorporates practicalities towards the business model concepts. What we meant by practical is that we do not stop our study in classifying and describing the business model, but we further analyse the business model by also demonstrating the business model and evaluating the business model. We demonstrate the business model by translating the business model concepts into actionable business activities. Thus, practitioners such as data marketplace operators could also use this research as a guidance to design data marketplace. With the presented business activities, data marketplace operators could exercise the business activities in their business.

Additionally, we also contribute to a novel idea of Aggregator Business Model. We incorporate various concepts such as service ecosystem, aggregators and digital platform from different information technology and business domain to derive our concepts of aggregators. Academia could use this research as a

foundation to analyse aggregators in various industries. The concept of aggregator we derived could also be the starting point for practitioners to create and develop business that employ Aggregator Business Models.

9.5 MOT Curriculum Alignment

The program Master Management of Technology provide the students with the knowledge to explore how technology are connected with the business. The connection of the business and technology are intended to solve issues in the society and industry. Specifically, the thesis of MOT students should have a scientific-analytical study and utilize many technological concepts and management concepts.

In this thesis, we aims to develop business model of data marketplace that incorporates various technological and business management aspects. The business model is intended to solve societal problem that arise in the data trading industry. The thesis uses methodological research which are studied during the course of the program, from conducting literature reviews, performing analysis, and conducting interviews to draw conclusions. By combining the concept of technology and business, this thesis adheres to provide innovative methods to improve business.

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Appendix

Appendix A: Interview Protocols

Interview Protocol: Aggregator Business Model in the Data Marketplace

Interview Objectives:

A. **Session 1:**
   - To evaluate the viability of Aggregator Business Model in the data marketplace industry according to the industry expert.
     i. Service Domain: attractiveness of the service offerings
     ii. Technology Domain: possibility to develop such technology
     iii. Organization Domain: willingness of the data suppliers to collaborate
   - To discover the challenges of implementing Aggregator Business Model in the data marketplace industry according to the industry expert.

B. **Session 2**: To discover the reason to shift to the business model in the four types of Aggregator Business Model

Respondent Criteria:

A. People involved in data marketplace development research. Research must be in the subject of business model or management aspect of the data marketplace (academic perspective).

   OR

B. People involved in the data marketplace project, for example people that engaged in data marketplace consortiums or people working in data marketplace company (practitioners' perspective).

Script:

Introductory Session

Introduction

Firstly, thank you very much for your time. Before we start, I would like to inform you several things. To facilitate my notetaking, I would like to record our online video meeting today. For your information, only me and my thesis supervisors will have access to the recordings which will be removed after they are transcribed. If you have a concern with this, please kindly let me know. In addition, prior to this online meeting you were sent an introductory document and consent form. This interview will take approximately one hour and will follow a designed interview protocol which have been approved by the university. If you have any concern with these matters, please kindly let me know.

If there are no further questions, I will start the recording now.

Background

To start our session, let me introduce myself. I am Bisma, a student from the TU Delft. I am currently working on my master thesis project within the field of data marketplace. My research focuses on developing business model for data marketplace. I come up with the idea of Aggregator Business Model. So, without further do, let's jump to the presentation.

Presentation about the Aggregator Business Model

So as I mentioned earlier, I came up with the idea of Aggregator Business Model. As this discussion will revolve around that subject, I believe It would be great if present you about this idea.

[presentation start]

With regards to this idea, do you have some comment or questions you would like to ask?

If you have no question, then we can start moving to the discussion. So, the objective of this interview is that I would like to see whether this business model idea viable to be implemented in the data marketplace.

I see that you have quite a good experience with regards to this, so I would like to hear insights from you about this matter.

Interview Session 1: Evaluate the viability of the Aggregator Business Model

Interview Part 1: Service Domain

1. As I explained in the presentation, Aggregator Business Model offers aggregated sales which is to help buyer find seller from various different platform and vice versa. Do you think that this will give benefit to the data buyers and data sellers?

   Probe:

   - [if beneficial] Can you elaborate how the aggregated sales will benefit the data buyers and data suppliers?
   - [if not beneficial] Can you elaborate why the aggregated sales will not give any benefit?

2. What are the challenges of offering aggregated sales in the data marketplace industry?

Interview Part 2: Technology Domain

1. As I mentioned in the presentation, the collaboration between data suppliers, data buyers, and the platform can be enabled through API integration. Do you think it is possible to develop such technology?

   Probe: What are needed to develop API integration technologies? Are the needed elements already there in the current practice? (Required tech, Required knowledge, Cost to develop)

2. What are the challenges of developing or using API integration?

Interview Part 3: Organization Domain

1. How willing are data suppliers to collaborate or to sell their data through data marketplace operator?

   Probe: What incentives do the data suppliers want to collaborate or to sell their data through data marketplace operator?

2. What are the challenges to have collaboration between data marketplace operator and data suppliers?

Interview Session 2: Discover the reason and challenges shift to other business model type

Bilang dulu under the assumptions baru ke session 2

So, for now, I would like to proceed to the last session of the discussion. According to my research, I found out that there is a major trend with many aggregators. To give you some general idea, I will start presenting my findings.

[presentation start]

Do you have any comments or question about these findings?

Interview session 2:

1. Based on our observation, some aggregators choose to shift to certain business model type. Comparison sites can be achieved by adding API integration and collaboration with data suppliers, while search engine 2.0 can be achieved by adding new features. Based on these two selections, which business model do you think is the better choice?

   Probe:

   - Can you explain the reasoning behind your choice?
   - What is the trade-off of these two business models?

Appendix B: Base business model from TRUSTS workshop

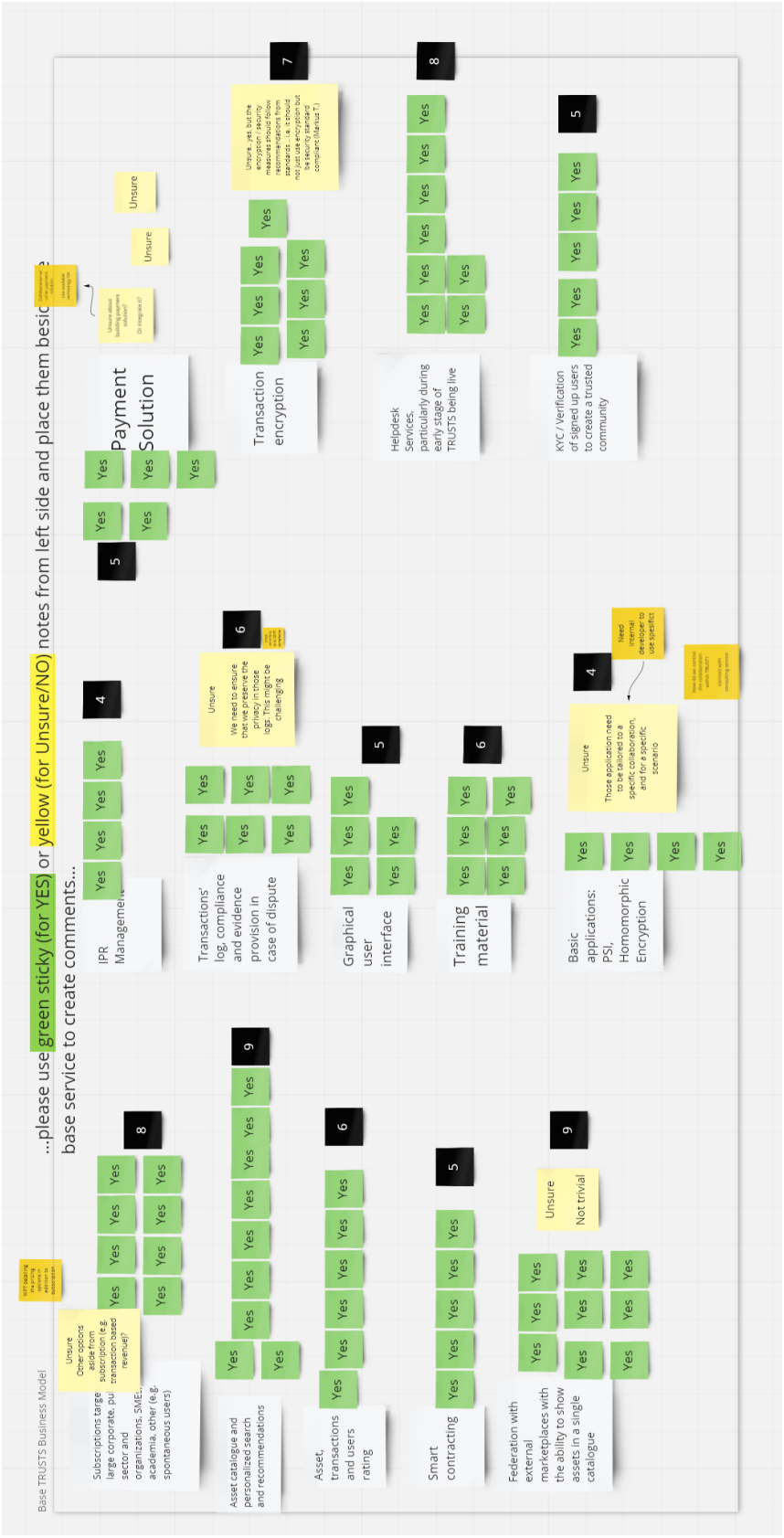

Figure 12: Generic TRUSTS Business Model - Base Model

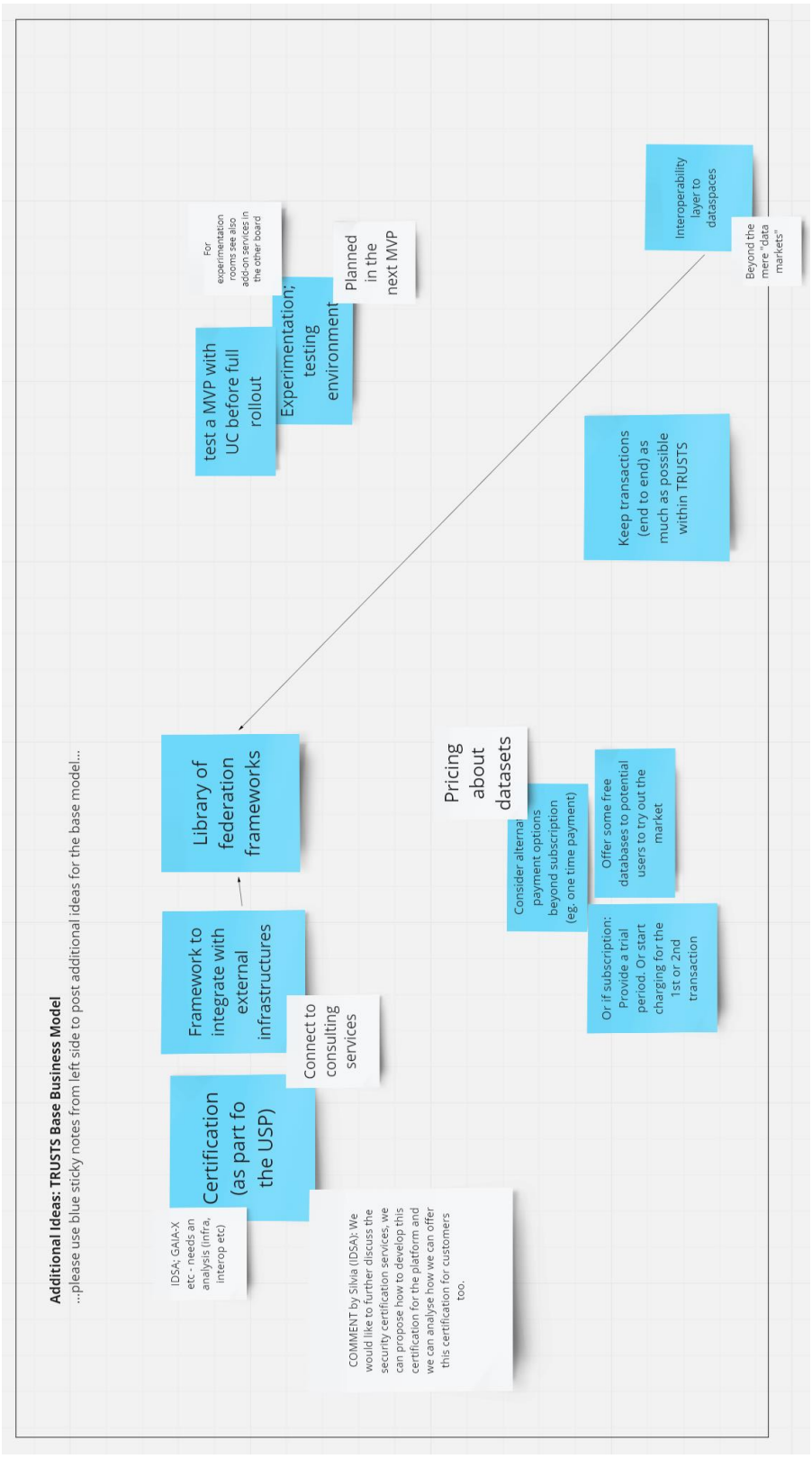

Figure 13: Additional Generic TRUSTS Business Model - Base Model

Appendix C: Value Added Services from TRUSTS workshop

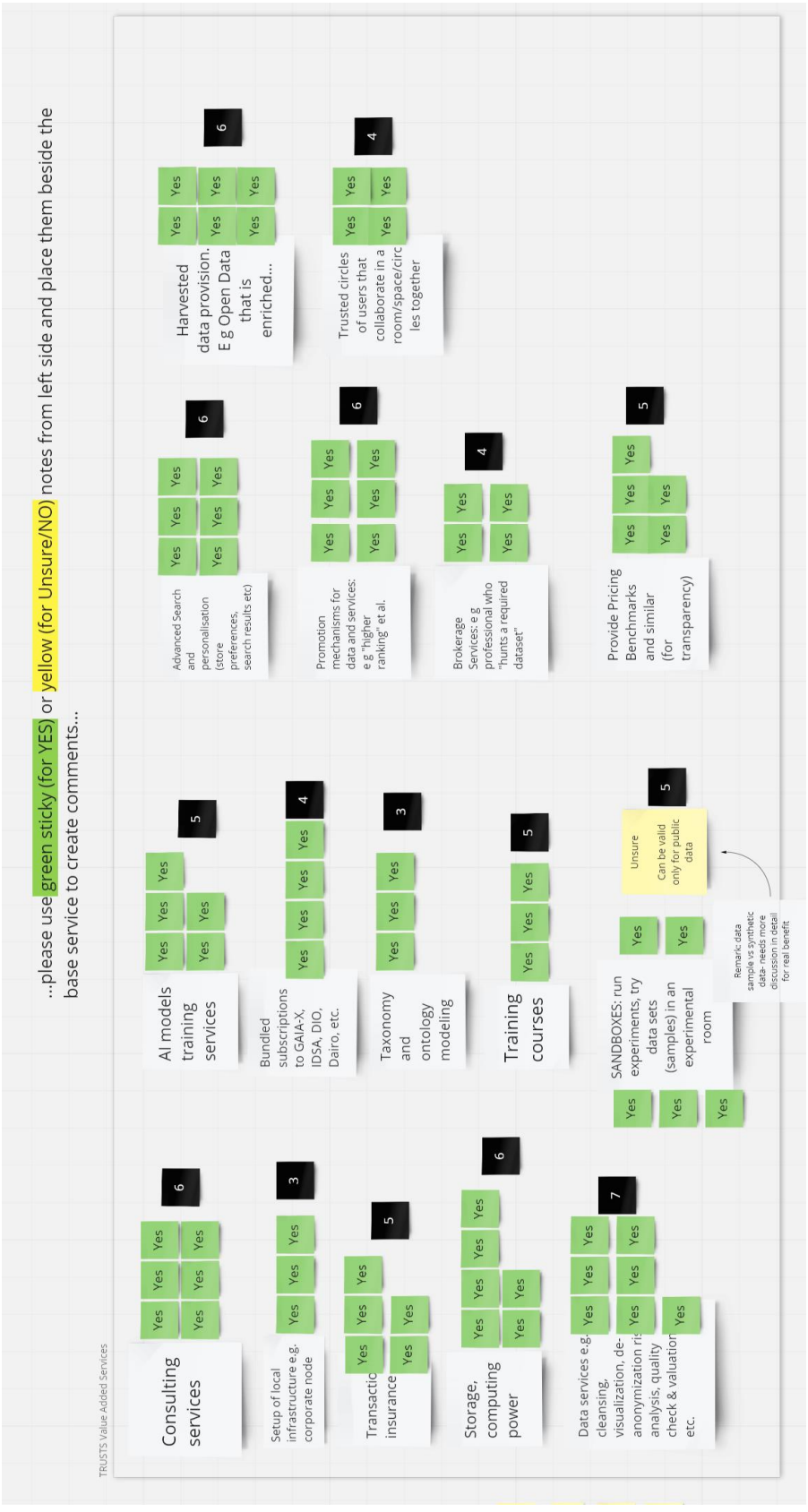

Figure 14: Generic TRUSTS Business Model - Value Added

Appendix D: Add-on Business Model from TRUSTS workshop

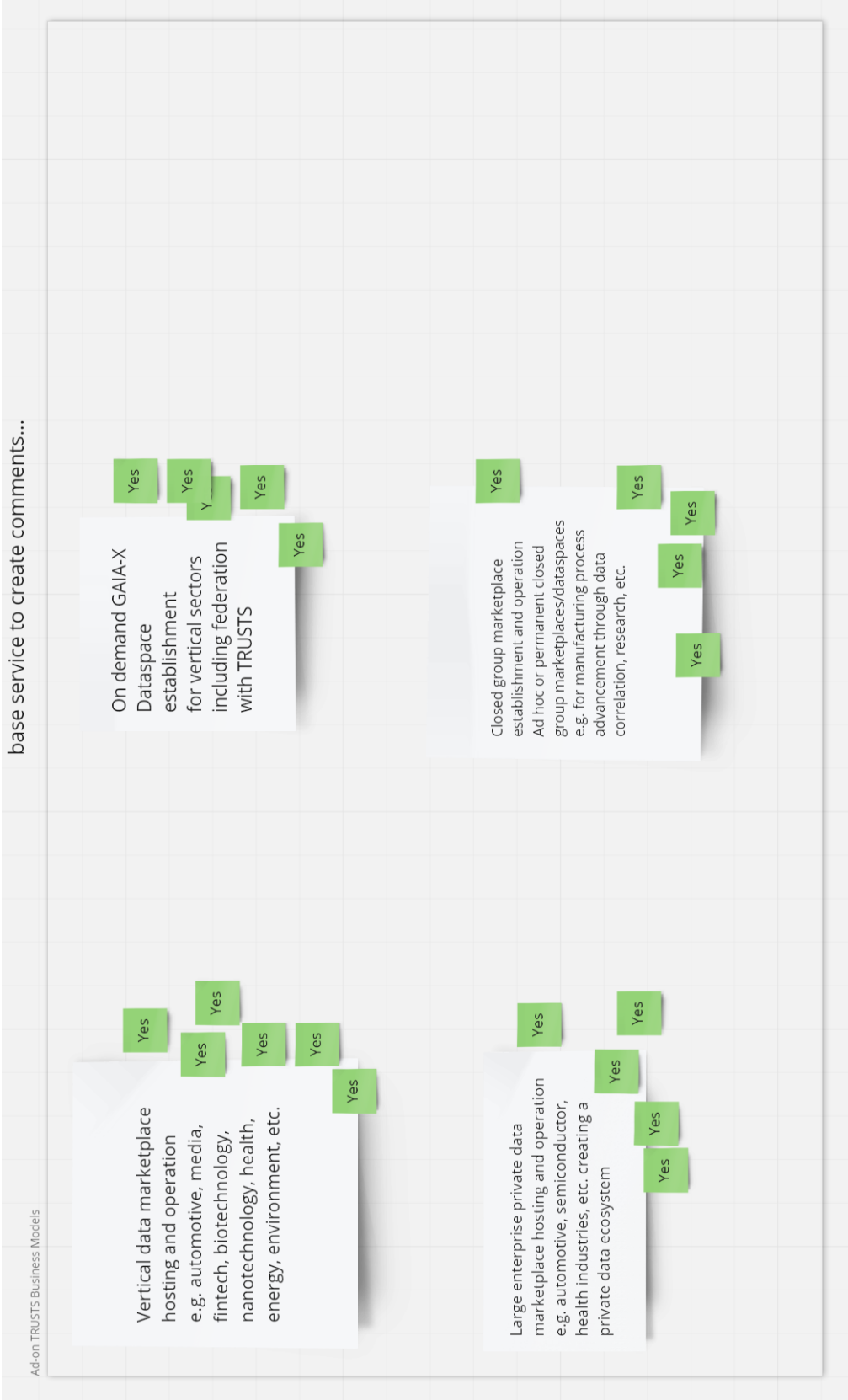

Figure 15: Generic TRUSTS Business Model - Add on

Appendix E: Aggregator Business Model with STOF Model

5.1.5 Kimo Business Model

Service Domain

Kimo is an online learning platform that gather various online learning materials and courses from various sites such as YouTube, Coursera, Udemy, and Medium articles. Currently, Kimo focuses on offering computer science related subjects such as AI, Blockchain, Cybersecurity and Cloud Computing. The users will select the desired topic based on prior subjects, and then the platform will help to refine the search results and find the most relevant courses. User then will be redirected to the website offering the selected courses. If the user decided to watch YouTube video course, Kimo allow users to watch YouTube platform within the platform. Kimo also offers the user a direction on where to start studying a particular subject, and recommend next study materials. In the case of Kimo, the core service of the business still lies only on gathering online learning materials, thus only providing *service aggregation*.

Technology Domain

In gathering the metadata of the courses from other online learning courses, Kimo crawl free online learning content from various sites (Kimo, 2021). As Kimo provide customized recommendation based on user behavior (AI Mentor), Kimo also uses AI to automate the process of finding the most relevant courses (Kimo. 2021). This process can be regarded as *service orchestration.*

Organization Domain

Considering that the company is still new, there is a limited information available that specifically mention the collaboration of Kimo with another platform owner. However, if we take a look from the technology domain where Kimo relying on its AI and crawler to aggregate online learning materials, it can be assumed that no partnership is established with Aggregatees. Most of the online learning materials Kimo collect are also publicly available online, thus no prior partnership is needed to collect these materials (*aggregation without partnership*)

Finance Domain

The platform is still in the early development. Users pay no fees to gain full features of the platform.

5.1.6 Flipboard Business Model

Service Domain

Flipboard is a news-publishing platform that gathers online news and articles from various news sources covering a wide range of content from technology, business, social issues, to travel and lifestyle (Flipboard, 2021). Flipboard's differentiation with others similar news platform is the platform UI/UX that mimic the experience of reading a magazine. As in magazine, Flipboard helps user to go through different articles and sources based on user's behaviour on using the platform, reducing the user time to find other articles in the same topic. Other feature includes articles re-sharing through social media. As the co-founder and CEO of

Flipboard, Mike McCue stated, he envisioned a one place to bring together user's favourite news source (Flipboard, 2021), thus Flipboard's offering is *service aggregation* for news and articles.

Technology Domain

Flipboard use Flipboard API to integrate between Flipboard platform with the publisher's platform. This API enables Flipboard to extract metadata and the RSS of the articles from the publishers to the Flipboard platform while at the same time enable publishers to manage their articles directly through Flipboard platform i.e., managing publication schedule and format (Flipboard, 2021). Unlike any other news portal, Flipboard only extract the RSS of submitted articles from its partners, while neglecting the unsubmitted articles, thus Flipboard partners play an active role in also delivering news and articles through Flipboard API. With this API, Flipboard enables *service choreography* and service integration with its publishers and partners.

Organization Domain

According to the Flipboard (2021), Flipboard only publishes and displays articles only if the articles were submitted by the corresponding publishing partners. Although if the publishers might publish an article through different platform and this article was not submitted to Flipboard, Flipboard will not publish the article. As stated in its QnA section, to become Flipboard partners, the publisher must firstly apply to Flipboard. There is a certain qualification to be met until Flipboard allows the publisher to submit its articles. Articles submitted by partners will also be checked upon publications. Albeit complicated publishing procedure, Flipboard maintain neutrality by providing no fees and charges to any publishers. Through this, Flipboard establishes *aggregation with partnership* with its aggregatees and maintaining *equal collaboration*.

Finance Domain

Flipboard users, both from the news readers to publisher side, can use all of Flipboard features for free. When using Flipboard, the platform will constantly display Ads within the platform. We believe that it is the way Flipboard to gather revenue and finance their operation. Additionally, Flipboard also offers a monthly membership to remove the Ads in the platform.

5.1.7 DiscoverCars Business Model

Service Domain

Discover Cars is a platform that helps users find and compare car-rental delas from various online car-rentals websites available in more than 145 countries (Discover Cars, 2021). Discover cars mainly provide *aggregation service* of car rental industry. The platform shows the availability of cars provided by online car rentals websites on specific region and recommends users with the lowest to highest price. Discover Cars provides information such as price, car type, pick-up location, provider's reviews, and insurance coverage. For transactions and payment matters, when user decided to book a car, the platform will provide a link to visit the respective provider's site, then proceed to payment in that site.

Technology Domain

Discover Cars develops its own API to exchange information related to the car rental procedure. The API integration allows Discover Cars to pull real-time information directly from the providers' site and enables the car providers to directly receives booking from the Discover Cars site. (Discover Cars, 2021; TravelPayouts, 2021). Information regarding the rented cars, for example related to car availability, is not typically published online by car rental aggregatees. While the car availability itself is a crucial information for the user. Thus, the API of DiscoverCars let car rental owners provide real-time information regarding the car availability.

Organization Domain

Discover Car Hire LTD is the company who owns and manage the platform. In providing car rentals to users, the company collaborates with many online car rentals providers through affiliate programs. The affiliates will get benefit such as free access to DiscoverCars API and integration with DiscoverCars API. Additionally, DiscoverCars also helps existing and future car rental owners to create and publish their own rental website.

Finance Domain

From using the platform until proceeding to payment, the renters pay no fees to the Discover Cars. The online car rental providers also pay no fees in using the service offered by Discover Cars (API, Affiliates features, Promotional Program, etc.). However, when a payment from user is finalized, the rental car providers will receive 30% commission from the transaction's profits, and the platform will receive 70% commission (Discover Cars, 2021).

5.1.8 Yidio Business Model

Service Domain

Yidio is a movie-streaming sites that recommend users with sites to watch movies, tv-series, cartoons, and tv-shows from various mainstream streaming sites like Hulu, Netflix, Apple TV and Amazon Prime. Yidio pull information from more than 180 content providers worldwide (Yidio, 2021). In the current movie industry, most movies are either showed in limited number of platforms or in many cases only showed in one platform. Yidio reduce the time needed for users in finding sites to watch movie by helping the users discover the site to watch the desired movies. Yidio will then redirect the user to the respective movie site. Additionally, Yidio also displays the price of subscriptions (if the movie is showed by subscription-only platform) and the price to rent/buy the movie from various movie streaming platform.

Technology Domain

Using its Bot, Yidio extensively monitor various mainstream streaming (information crawling) and provide an updated recommendation based on users' preferences and behaviour (watchlists, watch history, etc.). Yidio extensively pull content information from various streaming sites and put them in the cloud. Yidio will then push the information to the users (Yidio, 2021). To watch the selected movies, because there is

no API that enable users to watch movies within Yidio platform, users will be still be redirected to the respective site via a link provided by Yidio.

Organization Domain

Yidio has no affiliation with other mainstream streaming platforms. As Yidio relies only on the platform Bots and information crawling mechanisms, Yidio need no formal arrangement and collaboration with other streaming platforms to offers its services to users. However, there are collaboration between Yidio and several mainstream streaming platforms, although this collaboration is limited to let the platform place Ads or marketing campaigns via Yidio website (Yidio, 2021). Based on our observation, Yidio does not distinguish its results between Yidio marketing partners and non-partners i.e., putting the partner's movie on top of non-partner's movie, thus no special treatment with regard to the aggregation service towards its aggragtees. That being the case, Yidio keeps its neutrality towards its aggregatees and still maintain *no partnership* in terms of information collection and service aggregation.

Finance Domain

Users who access Yidio can gain full features of the platform by paying monthly membership fees. The content providers in which their content is showed in Yidio platform pay no fees. However, the content providers can opt to promote their sites through Yidio platform, and Yidio will receive this as an Ads fee (Yidio, 2021). At the moment, no investment was placed by any of Yidio aggregatees.

5.1.9 PriceGrabber Business Model

Service Domain

PriceGrabber mainly focuses on its *aggregation service* towards online retailers. PriceGrabber is a shopping website that compare prices of certain products from different sites. PriceGrabber let users type the desired product name from the search bar, and PriceGrabber will index the search results, and shows the results by sorting them from the lowest price to the highest price, thus reducing the time needed for users to visit different sites just to compare price. PriceGrabber shows a compilation of product from various sites and provides information such as price, availability, and a short brief about the product specification. Users that opt to buy the product can visit the respective site (aggregatees' site) through the provided link. Payment will also be done through the aggregatees website.

Technology Domain

PriceGrabber use API integration, called the Catalog API, with its site's affiliates, so that PriceGrabber can exchange real-time information to keep updated with price and availability of a certain product in certain sites (Connexity, 2021). The Catalog API also enables PriceGrabber affiliates to access and sent information related to the product. These could be in the form of accessing sales metrics from PriceGrabber and providing product availability information to PriceGrabber. Affiliates can also use this API as a basis to create their own shopping sites and integrate with the PriceGrabber website (Connexity, 2021).

Organization Domain

Connexity is the owner and platform administrator of PriceGrabber. To receive the benefit of product promotion and product reaches from PriceGrabber platform, merchant has to register as affiliates with Connexity. Connexity called this affiliation as Connexity Publishers Program, intended as a collaboration program to shopping sites owner, store owner, or companies who want to integrate their sites with Connexity. This program gives affiliates access to Connexity Catalog API to exchange information between affiliates, including PriceGrabber site (Connexity, 2021).

Finance Domain

Users pay zero fees in accessing the platform. Merchant can join Connexity Publishers Program without any fees, but Merchant may opt to pay fees in the form of Ads to increase their reaches in the search results. Connexity also get money from ads and promotion for company who want to put advertisement in the platform (Connexity, 2021).

5.1.10 LinkedIn Business Model

Service Domain

LinkedIn is a social-media platform that focuses on professional networking and job-searching. In this study, we would like take more focus on the job-searching services provided by LinkedIn. As a job-searching platform, LinkedIn provides users with a variety of job listings, published by various organizations through their job portal sites and also other job-seeking platform. Jobseekers can find relevant information regarding the position within the LinkedIn platform, without having to leave LinkedIn platform. For recruiters, the job applications process can be done both inside and outside LinkedIn depending on recruiters intended process.

Technology Domain

LinkedIn collects job-listings from other company's sites and platform through its API and collect the gathered data into LinkedIn database. This is enabled by LinkedIn APIs. Recruiters can post open position information while simultaneously promote the position's listing to LinkedIn though LinkedIn API. The API also enabled LinkedIn to show the same job listing information as showed in other company's sites or platform (LinkedIn, 2021). For the company who opt not to integrate their platform with LinkedIn platform, LinkedIn will provide a link so that the users will be redirected to the respective company's sites.

Organization Domain

The company (LinkedIn Corporation) is the business model developer and operator of the platform. Company who wants to put a job-listings through LinkedIn can partner with LinkedIn by registering the company in the LinkedIn and post the job listings to LinkedIn through the API. In addition to that, LinkedIn provide LinkedIn Developer Solutions. With this program, company who opt to integrate their platform

with LinkedIn can exchange information through LinkedIn API. This includes a feature that enable recruiters to conduct entire job application process through LinkedIn (LinkedIn, 2021).

Finance Domain

Ads and promotion fees are the main revenues of LinkedIn. LinkedIn also have three different premium membership, that also contribute to LinkedIn fees. These memberships targeted to three different market segments: job hunters, talent hunter, and business people for networking purpose (LinkedIn, 2021). Users can use LinkedIn without paying any fees, but there will be a features limitation.

5.1.11 Carvago Business Model

Service Domain

Carvago is a second-hand car sales aggregator. Carvago provide an all-in-one solution to buy second-hand car. Its core service is to aggregate second-hand sales from various second-hand car sites (*service aggregation*) while also adding complementary benefit such as car inspection facilities, 6-months post-purchase insurances, and car delivery across European region *(service composition)* Carvago acts as an advisor that represent the car buyers during the entire buying process with various car-sales owner.

Buyer will first choose a specified type of car through the platform. After a selection has been made, Carvago will recommend the buyer with various car sales sites and dealers that sell the selected car. Upon selecting the preferred dealers, Carvago will represent the buyer to visit the dealer, check the car condition, and deliver the car to the buyer if several condition criteria is met.

Technology Domain

Carvago collects over 7 million ads from various car dealers, but only publish nearly 10% for the purchase. Although not mentioned clearly in the plaform, it seems that Carvago use information crawler in gathering the car sales information. It is because information published between different dealers Ads is displayed differently and some information is also missing, although within the exact same car.

Organization Domain

Although Carvago specifically mentioned that Carvago only list cars from tried and tested dealers, no prior partnership was arranged between Carvago and car dealers. Listed car dealers also receive no special benefit from Carvago, especially towards the aggregation service of Carvago. As based on our observation, Carvago based its recommendation from price, year, and mileage. No ads from particular car dealers were also treated differently by Carvago. Thus, towards its aggregatees (car dealers), Carvago maintain neutrality.

Finance Domain

In searching for car in the platform, buyer can access the platform freely. However, payment will be made after the purchase. Additionally, Carvago provides various complementary offerings, such as insurance and car inspection in exchange for a fee. Carvago also receives no monetary benefit from the car dealers.

Appendix F: Survey Results from TRUSTS Workshop

Figure 16: Survey Results from TRUSTS Workshop

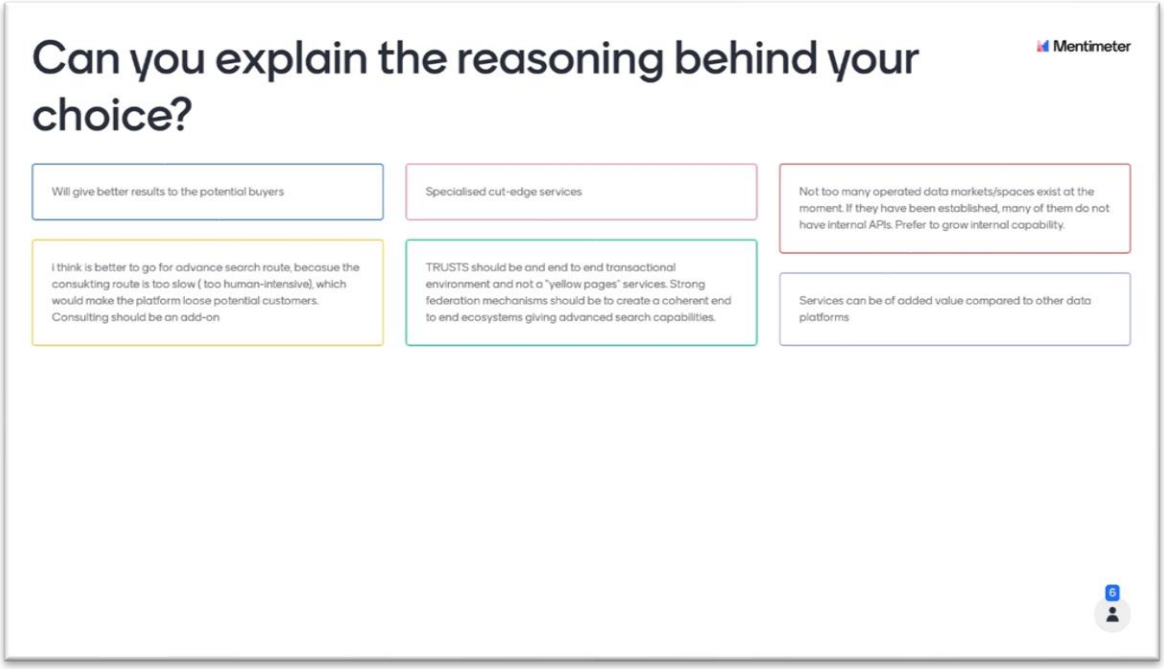

Figure 17: Reasoning Behind Survey Results from TRUSTS Workshop