國立政治大學資訊管理學系

碩士學位論文

API 驅動之企業轉型

API Enabled Business Transformation

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Abstract

In recent decades, digital transformation has gradually become a hot topic in various industries. API has also been used increasingly more widely in digital transformation. However, most of the literature on digital transformation is usually conducted from the perspective of Big Data or Artificial Intelligence. Moreover, relatively few studies have conducted more in-depth research from the perspective of APIs. In order to gain deeper perspective, this study regards APIs as a trigger driving digital transformation, summarizes value created by APIs and pattern of transformation driven by APIs through multiple case study.

Through conducting content analysis and cross-case table, this research analyzed the transformation brought about by APIs from the perspective of enterprises and industries. In sum up, this study scrutinizes how companies create business value through digital transformation, summarize different patterns of transformations driven by APIs, and provide some insights for API related applications in enterprises.

Key Words: Application Programming Interface (API), Digital Transformation, Business Value

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摘要

數位轉型在近幾年來逐漸成為許多產業中的熱門話題，而在眾多數位轉型中 API 的相關應用也越來越廣泛。然而大多數關於數位轉型的研究通常是以大數據和人工智能的角度進行分析，少有針對 API 所驅動的數位轉型進行了深入分析的研究。為了深入此議題，本研究將透過多個案例研究歸納出 API 所創造的價值及由 API 所驅動的各種轉型模式。

本研究透過質性研究和跨個案橫向分析，從企業和產業的角度進而分析 API 所帶來的變革。透過分析之結果了解企業如何通過數位轉型創造商業價值，並歸納出四種由 API 所驅動的數位轉型模式，期望能為 API 於企業的相關應用提供更多方向。

關鍵字： Application Programming Interface (API)，數位轉型，商業價值

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Table of Contents

DOI:10.6814/NCCU202101424

DOI:10.6814/NCCU202101424

Tables

DOI:10.6814/NCCU202101424

Chapter1: Introduction

1.1 Introduction

In recent years, digital transformation has gradually reshaped interactions between enterprises and customers (Taiminen and Karjaluoto 2015). The application of digital technology has become more diversified, while the advancement of digital technology has simultaneously fostered the development of digital transformations. With the emergence of new digital technologies, such as big data, artificial intelligence, application programming interface, and 4.0, machines are causing revolution changes across different industries (Yadav and Pavlou 2014).

Among these new digital technologies, the use of Application Programming Interface (API) has also recently received greater attention. A presentation by Joshua Bloch which explained clearly the history of APIs makes an important point: “most programs will make use of common operations, library subroutine would reduce amount of new code and error (Joshua Bloch, 2018).” Without understanding the details of the source code and the original programming language, an API enables developers to increase their productivity and avoid defects. Currently, we can observe rapid growth in the usage of APIs to connect web applications and services over the Internet. For instance, through the usage of the Google Maps API, users can accurately receive your travel time due to background high-performance platforms and precise geographical information (Socharoentum and Karimi 2014).

This study regards APIs as a trigger driving digital transformation, and understands the process of transformation and its impact by studying successful examples of domestic and foreign well-known company cases. We use a business model canvas to analyze the value proposition and the customer segments of the selected cases.

1.2 Motivation

Nowadays, more and more companies utilize digital transformation to enhance their competitiveness and increase their revenue (Vial 2019). Digital transformation refers to the way in which, “a firm employs digital technologies, to develop a new digital business model that helps to create and appropriate more value for the firm” (Verhoef, Broekhuizen et al. 2021). This kind of transformation will also affect the business

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model, business processes, operational routines, and organizational capabilities (Li, Su et al. 2017).

While many articles have discussed the application of APIs to different digital transformation cases, we currently lack a comprehensive understanding of this topic. Therefore, this study summarizes and analyzes enterprises from various industries, and tries to understand how organizations use APIs to achieve digital transformation and enhance their competitiveness.

1.3 Research Objective

Based on prior literature, the application of APIs is becoming more and more diversified. The objective of this research is to explore how Application Programming Interface (API) enables digital transformation, and analyze the business model for each selected case.

DOI:10.6814/NCCU202101424

Chapter2: Literature Review

2.1 Application Programming Interface

An Application Programming Interface (API) provides a programming interface that enables openness of data and service, and even enables programmers to reuse software components (Rauf, Troubitsyna et al. 2019).

According to the literature on the evolution history of APIs, the concept of an API appeared in the early 1960s (Collins and Sisk 2015). Subsequently, since 1980, the emergence of point-to-point interfaces, screen scraping, Request for Comments (RFCs), and Electronic Data Interchange (EDI) have enabled remote interaction on the network (Collins and Sisk 2015). During the period from 1990 to 2000, the emergence of new platforms allowed interfaces to gradually come to be defined as a concept of service. From 2000 onwards, companies began to utilize APIs to provide more convenient and innovative services for consumers, and to accelerate the development of new services. Moreover, some services extended by APIs even provided companies with new sources of income (Collins and Sisk 2015). In the future, API will not only be a tool for digital transformation, but it will also be one of the key points within the business strategy of leading companies.

2.2 Objectives of APIs

In this study, APIs will be classified according to their different uses. (I) In the first type of APIs, the purpose is to open up information to users. For instance, USA Today launched its Open API in 2010, providing nine types of APIs: articles, breaking news, bestselling books, book reviews, music reviews, movie reviews, snapshots (statistical graphics), sports salaries, and census data (Aitamurto and Lewis 2012). Thus, people have been able to browse over a million articles published since 1999. (II) The second type of APIs is those used to open and provide services to users. For example, Banco Bilbao Vizcaya Argentaria (BBVA) provides payment, fee verification, AML/KYC, and other services through Open API/Platform through Open API. (III) The third type of APIs is those used to allow programmers to reuse software components and provide source code to users. For instance, Salesforce offers hundreds of well-documented

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REST and SOAP APIs to the public. The openness of the source code can enhance ease of integration and development (Azpeitia, Iturrioz et al. 2020).

2.3 Business Transformation

At the time that the concept of digital transformation was first proposed, the definition of digital transformation tended to be, "the use of technology to radically improve performance or reach of enterprises." (Westerman, Calméjane et al. 2011). As long as digital technology was used, it could be summarized as a kind of digital transformation, and the definition of digitization was also vague. Additionally, if a company uses information technology to achieve automation, it would also be summarized as a kind of digital transformation (Matt, Hess et al. 2015). Furthermore, the level of automation has usually been used as a measure of digital transformation (Betz, Olagunju et al. 2016).

Recently, definitions of digital transformation have become more and more accurate, with digital transformation needed to enable major business improvements like enhancing customer experience, streamlining operations, or creating new business models (Singh and Hess 2017). With the advancement of technology, there are many examples of companies in various industries using emerging technologies to successfully achieve digital transformation. Therefore, the definition of digital transformation within literature has become more and more precise. Digital transformation should not just be considered as an automated process, it should also include changes in the internal and external situations of the organization and the transformation of business models (Jones, Hutcheson et al. 2021). The evolution of digital transformation is also shown in Table 2-1.

Table 2- 1 Definition of digital transformation

Definition	**Source**
The changes that digital technology causes or influences in all aspects of human life.	(Stolterman and Fors 2004)
The use of technology to radically improve the performance or reach of enterprises.	(Westerman, Calméjane et al. 2011)

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That which arises from the blending of personal and corporate IT environments, often referred to as the consumerization of IT.	(White 2012)
The use of new digital technologies (social media, mobile, analytics, or embedded devices) to enable major business improvements (such as enhancing customer experience, streamlining operations or creating new business models).	(Fitzgerald, Kruschwitz et al. 2014)
The increasing automation of business undertakings, practices, procedures, and models in response to the increasing influence and opportunities of information and computing technologies.	(Betz, Olagunju et al. 2016)
Digital transformation is concerned with the changes digital technologies can bring about in a company's business model, which result in changed products or organizational structures or in the automation of processes. These changes can be observed in the rising demand for Internet-based media, which has led to changes of entire business models.	(Hess, Matt et al. 2016)
The process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system).	(Ismail, Khater et al. 2017)
Customer-driven strategic business transformation that requires cross-cutting organizational change as well as the implementation of digital technologies. DT requires the organization to deal better with change overall, essentially	(Bloomberg 2018)

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making changes to core competencies as the enterprise becomes customer-driven end-to-end.	
A process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies.	(Jones, Hutcheson et al. 2021)

In summary, this study will adopt the extant definition of digital transformation from Ismail, Khater et al. in 2017 (Ismail, Khater et al. 2017):

The process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system).

The reason that we select this definition is because it is more comprehensive. Not only does it cover he internal and external changes of the organization, but it also considers the transformation of business models.

2.4 Business Model

The definition of a business model has many different interpretations (Zott, Amit et al. 2011). Prior literature has defined a business model as a framework that consists of the network structure, how transactions are made, how revenue models and incentives interact, and how capabilities are accessed (Wilkinson, Dainty et al. 2009).

Since the progress of digital technology, increasingly advanced technologies and concepts have been emerging. Therefore, this study will be based on comprehensiveness as its main consideration when choosing the definition of a business model. This study uses the definition of the business model proposed by Osterwalder and Pigneur (Osterwalder and Pigneur 2010):

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A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams.

Osterwalder and Pigneur (Osterwalder and Pigneur 2010) defined business model as a conceptual tool containing a set of elements and their relations to set goals, allowing to expose the business logic of the company. The Business Model Canvas invented by Osterwalder and Pigneur (Osterwalder and Pigneur 2010) is a practical tool for analysis. It comprises nine elements: demand-side resource, resource availability, flexibility mechanism, communication channel, flexibility product, service attributes, flexibility market segment, revenue model, and cost structure. It provides enterprises with a framework for deconstructing the development and evolution of new business models. This study will classify these nine elements into four major directions for analysis: value creation, customer segmentation changes, changes in services, and revenue stream. In terms of value creation, this research is mainly to understand whether API creates new value or changes old value, for example, making the company a paradigm in the industry, redefining the traditional operation mode of the industry, and providing customers with better services. Customer segmentation contains changes in channels caused by APIs, attracting new customer groups or redefining customer relationships. Meanwhile, in terms of service, the process, product, or service model created by APIs are created. Moreover, revenue stream refers to the source of income of the overall enterprise.

Therefore, this research uses these four directions to analyze the transformation of business models under the digital transformation. In this study, as long as four major directions have changed, it is deemed a change in the enterprise's business model.

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Chapter 3: Research Design

3.1 Research Method and Process

This research used qualitative content analysis to explore how APIs have affected the transformation of enterprises. A qualitative content analysis method is suitable for this study because it is a descriptive research and requires the researcher to select cases (M. Schreier, 2012). It is also a useful tool for disassembling complicated phenomena and clarifying the development of selected cases.

The research process of this study is shown in Table 3-1. This study chose six enterprises that used APIs to achieve business transformations, which changed each company's organizational culture and business model, and even became the best examples in the industry. To accomplish our objective, we determined current successful cases in the industry to illustrate and clarify the influence of using APIs for digital transformation. The first step of the analysis consists of reviewing prior research to study the definition of digital transformation, APIs, and business models. Subsequently, this study adopts the extant definitions among them as the basis for our case selection. Based on the result of the first step, we will select six enterprises to gain further insight into how APIs have enabled business transformations in the second step. Additionally, by studying the official website of the selected company, after understanding the types and functions of APIs used by the company, we choose one of the most influential APIs for the analysis. For the third step, this study analyzes the selected API's impact and changes on the enterprise through eight perspectives. The conclusion of this study is expected to provide more diverse insights and contribute to future generations.

Table 3-1 Description of the research process

Activities	Why	How	Results
Literature Review	To understand the definition of digital transformation from the past to the present	Collect and review relevant research literature	The definition of digital transformation is different from before
Multi-case	To observe how API has	This study selected some i	Raw findings of a

DOI:10.6814/NCCU202101424

Study and Cross-case Analysis	enabled digital transformations, then further determine the benefits created by APIs and summarize the patterns of digital transformation driven by APIs	influential cases in various industries for research	multi-case study and cross-case analysis
Conclusion	To organize findings and draw a conclusion	Analyze and summarize case study findings	The finalized conclusion and observations

3.2 Case Selection

Based on the selection criteria, this study selected eight companies from different industries. The selection of the cases is based on the following criteria:

1. The selected enterprise should use APIs to provide data, services, or permissions for users to develop.
2. During the transformation process, APIs should be the major trigger of the digital transformation and change the company's existing business model.
3. The result of digital transformation should be influential.

Based on the selection criteria, we have selected six representative companies (Table 3-2).

Table 3-2 List of selected cases

CompanyName	**Industry**	**Objectives of APIs**	**Name of Selected APIs (Year of Establishment)**
Amazon Alexa	PaaS	Provide service	Smart Home Skill APIs (2014)
Amadeus	Airline	Provide information	Amadeus APIs (2010)

DOI:10.6814/NCCU202101424

Revolut	Bank	Provide service	Revolut Business API (2015)
Facebook	Social Media	Provide source code	Facebook Graph APIs (2004)
Salesforce	SaaS	Provide source code	MuleSoft APIs (2018)
Shopify	E-commerce	Provide service	Shopify APIs (2009)
JB Financial Group	SaaS	Provide source code	JB Open Banking Platform (2015)
Fidor Bank	Bank	Provide service	Fidor OS Platform (2015)

3.3 Data Analysis

This study uses a business model canvas to analyze the digital transformation process of the selected companies. It also explains the role of APIs in the digital transformation through a business model canvas and further analyzes how companies can successfully use the characteristics of APIs to create value and become a model of innovation in the industry.

In the first stage, we clarify the objective of using APIs in the selected case, the main users of APIs, and services that APIs provide to users. In the second stage, through collecting secondary data, we first choose the most influential or most representative API among the numerous APIs used by the enterprise to analyze its impact. Then, we examine the process of digital transformation of enterprises and the methods of using APIs and whether changes occur due to APIs through four aspects: value creation, changes in customer segmentation, changes in services, and revenue stream. In the third, this study classifies the benefits created by APIs into different categories. Eventually, this research summarizes the different patterns of digital transformations driven by APIs.

DOI:10.6814/NCCU202101424

Chapter 4: Case Analysis

4.1 Analyzed Result

4.1.1 Amazon Alexa

In November 2014, Amazon announced the Echo smart speaker. Due to the internal Alexa artificial intelligence voice assistant, Echo can complete some basic voice interaction functions, such as setting alarms, playing music, and querying messages from the beginning. However, in the original official introduction video, Amazon did not emphasize the smart home attributes of Echo.

Shortly after, Amazon received feedback from some Echo internal beta users, who requested Amazon to add the function of controlling the Amazon Echo switch. Therefore, Amazon decided to be involved with smart homes; in April 2015, Amazon upgraded Alexa; not only did they add new controls for Belkin Wemo wireless switches, but they also add control to Philips Hue lamps. The realization of this smart home function can be seen as a prelude to Amazon's opening of Alexa (Amazon 2010).

Subsequently, after the opening of Alexa, Amazon launched an API called Smart Home Skill specifically for smart homes. Based on Alexa Smart Home skill API, whenever a customer speaks to Alexa, the Smart Home Skill API interprets the received voice content and then gives feedback based on the interpreted content, such as verbal responses or device actions (Amazon 2010). The power of this API is not only in the voice interpretation for customers. Amazon uses Alexa Smart Home skill API as a platform to introduce third-party service providers, allowing these people to build their own services on the platform, making the services on the platform become increasingly comprehensive. For example, functions, such as inquiring about weather, financial services, ordering food, and calling a car, can all be met through API. Over time, with the accumulation of consumer data and the increase in the number of third-party partners, the functions on Alexa are getting increasingly closer to the daily lives of consumers.

To discuss the changes caused by Smart Home Skill API to Amazon Alexa, this study divides the following discussion into four main sections: value creation, changes in customer segmentation, changes in services, and revenue stream.

DOI:10.6814/NCCU202101424

- The Value Creation of Smart Home Skill API for Amazon

Smart Home Skill API enables a small device to have tens of millions of functions for customers to use; moreover, it plays a key role in Amazon's smart home implementation because it can convert user commands into instructions and pass them to smart home skill. It prompted the birth of a new voice-driven platform, which is rich in many business opportunities.

- Changes in Customer Segmentation

When Alexa was first launched, Amazon's initial purpose was to sell more of its own products and only to lock the customer base on the most terminal consumers. However, after receiving the feedback, Amazon realized that this API could bring more business opportunities than originally envisioned. The customer segmentation has also been expanded to the enterprise side, attracting more and more third-party service providers to enter this platform, enriching the functions of this small device.

- Services Provided by APIs

On the part of the end-user, when the customer starts to enable the smart home function, the Smart Home Skill API will first link the customer's account to the device cloud and enable Alexa to search for devices associated with the customer's account (Amazon 2021). Subsequently, when the customer gives any verbal request to the device or wants to modify the device settings in the Alexa application, the Smart Home Skill API will translate these requests into programming directives that the system can process and understand. The directives include capability message, endpoint identifier, and customer's authentication information. Next, Amazon Web Services (AWS) Lambda will receive, parse the directives, and validate customer's authentication information. Then, AWS Lambda will communicate with the device cloud and use the customers-defined communication channels, so that the device can respond to the customer (Amazon 2021). On behalf of platform service providers, they can set the sentence patterns and corresponding responses that users might ask on the Alexa background.

Through the above process, Alexa can use this cross-industry alliance to expand various kinds of new services to consumers on its platform.

DOI:10.6814/NCCU202101424

- The Revenue Stream of Amazon Alexa

Through the description in the previous paragraph, we have learned that Amazon Alexa has become an intermediary for matching end users and the third-party platform service providers through APIs, and then charge platform service fees as a source of profit. According to the "Price ranges for in-skill products" table on the Alexa Developer Documentation website, Amazon charges 30% of the revenue of Amazon Alexa Skill, whereas developers or third-party service providers receive the remaining 70% (Amazon 2021). Additionally, service providers are not allowed to charge customers for enabling Alexa skills; they can only charge for additional content that further enhances the skill experience. Moreover, the pricing of each Alexa Skill listed on Amazon also has maximum and minimum restrictions. For instance, all in-skill products cannot be charged less than 0.99 USD, and the subscription fee cannot be higher than 9.99 USD a month (Amazon 2021).

Meanwhile, through this API-based platform, the services provided by Amazon Alexa are growing rapidly every year. If we take the United States, as an example, as of January 2021, the number of skills provided to users by Amazon Alexa has increased to 80,111, which is a staggering number (Statista 2021).

4.1.2 Amadeus

Amadeus was jointly established by four airlines, namely, Air France, Iberia, Lufthansa, and Scandinavian Airlines System Aktiebolag (SAS) in 1987. Amadeus was just a pure global distribution system (GDS) at the beginning of the system development, which was mainly used for airline reservation. Furthermore, the system also used Passenger Name Record (PNR) as the data center.

Amadeus's APIs are divided into two categories according to the customer needs: Self-Service APIs and Enterprise APIs (Amadeus 2021). These two categories are composed of many different APIs. Enterprise APIs can be subdivided into ten types of APIs according to the functional area, namely, Air APIs, Booking Management APIs, Car and Transfers APIs, Cruise APIs, Customer Profile APIs, Hotel APIs, Insurance APIs, Payment APIs, Queue Management APIs, and Rail APIs (Amadeus 2021). Through Enterprise APIs, users can have their pricing scheme to satisfy their

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requirements. Alternatively, Self-Service APIs can also be subdivided into four types of APIs according to the functional area: Air APIs, Hotel APIs, Destination Content APIs, and Trip APIs (Amadeus 2021). Self-Service APIs are free for testing and prototype design; thus, users will have a free monthly request quota. Therefore, most of the users of Self-Service APIs are individual developers or small and medium enterprises (Amadeus 2021). Furthermore, several APIs user manuals and blog pages are dedicated to Amadeus API developers to refer to the Amadeus official platform. In this way, developers can share development experiences and create a space for the joint discussion. All in all, the combination of Enterprise APIs and Self-Service APIs meets the diverse needs of customers and provides open resources for developers to use. Some APIs in Enterprise APIs and Self-Service APIs are duplicated; moreover, some API functions are relatively trivial, which is difficult to select a representative API. Therefore, this research adopts the overall Amadeus APIs in the analysis.

Similarly, to discuss the changes caused by Amadeus APIs to Amadeus, this study divides the following discussion into four main sections: value creation, changes in customer segmentation, changes in services, and revenue stream.

- The Value Creation of Amadeus APIs for Amadeus

With the help of APIs, Amadeus has grown from a simple airline reservation system to today's leader in the tourism industry throughout the development of its history. Amadeus APIs have contributed a great deal to the function creation of enterprise and allowed Amadeus to step into the tourism industry to form a cross-industry alliance. Amadeus's annual report also has a pivotal position in the industry. Due to the massive data and analysis results accumulated by Amadeus APIs, the annual analysis report released by Amadeus can provide unique insights into the industry.

- Changes in Customer Segmentation

In the early days when Amadeus was an airline online reservation system, its customer base was mainly people who ordered air tickets. Nowadays, Amadeus has a rich customer base. This study divides its current customer segmentation into five categories and summarizes them in the following table.

DOI:10.6814/NCCU202101424

Table 4-1 Current Customer Segmentation of Amadeus

Category	Description
Travel provider airlines	Network airlines, regional airlines, and low-cost carriers
Hotels	Hotel chains, representation companies, and independent hotel companies
Ground/Maritime Related	Car rental companies, railway companies, ferry lines, cruise lines and insurance companies
Tour operators	Mass-market tour operators and vertically-integrated tour operators
Travel sellers and agencies	Travel management companies, business and leisure agencies, online travel agencies and consolidators

- Services Provided by APIs

Amadeus APIs enable people to advance their travel or even build a better journey. For instance, Air APIs provide flight booking and searching services (Amadeus 2021). Meanwhile, Trip APIs provide services like trip-arranging functionalities for users. These APIs allow Amadeus to integrate travel needs on one platform horizontally, so that customers can be satisfied on their platform from planning the itinerary before departure, booking tickets to purchasing goods. Thus, the services provided by Amadeus cover the entire travel lifecycle.

- The Revenue Stream of Amadeus

Amadeus mainly obtains income through two business lines: GDS and IT Solution. The main income of Amadeus comes from the GDS platform, and it earns transaction and service fees by charging each service provided on the platform (e.g., hostel reservation, flight booking, and purchasing of tickets) (Statista 2021). The proportion of fees charged by each transaction is different. For example, according to the data disclosed on the official Amadeus website, the transaction fee for ticket booking is between 2% and 4%, whereas the hotel booking is about 20%. Although the official website does not display the exact percentage of fees charged by each transaction, it can be reasonably estimated from the number of air bookings on the "Amadeus Result"

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published by Amadeus each year that these transaction fees can bring huge benefits to it. The impact of COVID 19 from 2020 to the present has significantly reduced bookings for flights and travel-related projects; therefore, this study adopted the data released by Amadeus Result in 2019 for the estimation (Amadeus 2020). In the results announced in 2019, the number of tickets and non-ticket bookings alone reached 646.6 million (Amadeus 2020).

4.1.3 Revolut

Revolut is a fintech company from London. It was founded in 2015 and mainly provided digital bank accounts and various other financial services. The original concept of Revolut is to solve the problem of high exchange fees. It is a simple platform dedicated to providing users with multiple currency transactions. When people go abroad, they usually must pay high currency conversion fees, handling fees, and exchange rate differences when exchanging foreign currencies. The banking settlement and clearing system generate these costs, but the customers bear these costs.

The main goal of Revolut is to meet the needs of customers and provide global multi-currency consumer services and international remittance transfer services without hidden costs. To achieve this goal, Revolut divides its APIs into three categories: Merchant API, Business API, and Open Banking API (Revolut 2020). According to the API usage introduction on Revolut's official website, Revolut enterprise-level users could use the Merchant API to accept online payments via debit or credit cards, and they can also manage orders (Revolut 2020). Alternatively, Business API and Open Banking API are mainly responsible for supporting various financial-related services (Revolut 2020). For instance, Revolut Business API includes seven APIs: Account API, Counterparties API, Transfers API, Payments API, Payment Drafts API, Exchange API, and Webhooks API.

Revolut has also launched many services, such as deposits, travel insurance, and personal butlers, effectively replacing the daily business of many traditional banks, which is more attractive to young people who are keen on embracing advanced technologies. On the enterprise side, Revolut also provides convenient financial services (e.g., budget management and salary payment) for small enterprises and self-employed individuals, which improves the efficiency and saves employers' foreign

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exchange costs. Nowadays, Revolut has gradually become a virtual bank. It has even developed a new kind of revenue model, allowing customers to subscribe to their selective functions through subscription, which is an innovative revenue model in the industry. Without the help of Revolut APIs, the above-mentioned reforms and developments will not be realized.

To discuss the changes caused by Revolut APIs to Revolut, the following discussion is divided into four main sections: value creation, changes in customer segmentation, changes in services, and revenue stream.

- The Value Creation of Revolut APIs for Revolut

The application of Revolut Business API breaks the traditional thinking in the industry that only banks can provide financial-related services. Moreover, it also contributed to the birth of a new revenue model, that is, subscription, allowing customers to subscribe and pay for the functions they need. It enables Revolut to show its prominence in the industry and blaze a trail in a competitive market.

- Changes in Customer Segmentation

Revolut has targeted youth as their main audience from the very beginning; thus, it does not have the obvious change in customer segmentation from the past to the present like in other cases. In addition to targeting younger generations familiar with digital tools, Revolut also locks channels on digital channels, such as apps, as their main platform.

- Services Provided by APIs

As a Revolut customer, they can automate business processes through these APIs (e.g., checking accounts, currency exchange, and payment). The whole process does not need to be completed manually, which reduces errors and makes Revolut a bank alternative. Moreover, Revolut provides its customers with a monthly free transfer quota to overseas. Alternatively, in May 2021, Revolut announced that it will increase service items through cross-industry alliances in the future (Revolut 2021). Through cooperation with the entertainment, tourism, and catering industries, consumers can

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enjoy discounts as long as they use Revolut cards to pay for consumption at selected partners and reach certain standards (Revolut 2021).

- The Revenue Stream of Revolut

Revolut makes profits by charging monthly subscription fees for users of different levels (Revolut 2021). The general standard account does not have to pay a monthly fee; Plus account needs to pay 2.99 euros monthly; Premium account needs to pay 7.99 euros monthly; and the Metal account needs to pay 13.99 euros monthly. Furthermore, Revolut and MasterCard can gain interchange fees from every successful physical card transaction, but Revolut does not show the exact payment method of interchange fees on its website. Also, Revolut customers can enjoy free monthly transfers overseas; once they exceed £5,000, they will be charged a 0.5% transaction fee.

4.1.4 Facebook

Facebook is a platform created by Mark Zuckerberg and his roommates when he was in college. It has now developed into the most widely used social media platform globally and has more than 700 million users worldwide.

Many APIs are provided by Facebook to enable third-party applications to offer richer functions. For example, the third-party authentication provided by Facebook simplifies the authentication and authorization process on many applications; thus, third-party operators do not have to spend a tremendous amount of time storing and keeping user data (Facebook 2021). Facebook has also specially established an API platform, a dedicated platform established for developers, allowing developers to obtain various APIs quickly, including artificial intelligence, augmented reality, business tools, and games (Facebook 2021). Additionally, developers can find information collected from social media on the platform, such as related instructions and test files. Facebook hopes that through the provision of APIs, more developers can stimulate creativity to use the API to propose more creative applications to consumers.

Among the many APIs provided by Facebook, the most representative one is Facebook Graph API, which is the main method for reading and writing Facebook social relationship graphs. In other words, the Facebook Graph API is the primary way

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to obtain data into and out of the Facebook platform. Through the Facebook Graph API, applications are allowed to programmatically query data, publish new stories, manage advertisements, and perform various other tasks.

To discuss the changes caused by Facebook Graph API to Facebook, the following discussion is divided into four main sections: value creation, changes in customer segmentation, changes in services, and changes in revenue stream.

- The Value Creation of Facebook Graph API for Facebook

The Facebook Graph API allows Facebook to create different functions for users to share and record their lives when providing free social media (Facebook 2021). Moreover, it is based on HTTP (HyperText Transfer Protocol), and thus, it can be used with any language that has an HTTP library. Therefore, many APIs are extensions of Facebook Graph API. For example, the third-party authentication function provided by Facebook is a function that is often used today. Facebook Graph API will be used in function practice, and it has an indispensable role during the process. Overall, it becomes the basis of many functions of this social media platform and enriches the platform's functions.

- Changes in Customer Segmentation

Facebook Graph API enables the company to expand more different channels, such as websites of third-party partners, mobile apps, and developer tools. In terms of customer segmentation, the accumulated performance of the field data volume in the Facebook Graph API will also attract advertisers to place advertisements on the platform, so that the customer segmentation can be divided into users, developers, and advertisers.

- Services Provided by APIs

Some basic functions in Facebook are accomplished through the Facebook Graph API. For example, users can create and publish new albums, and publish photos or videos through the Facebook Graph API (Facebook 2021). Nowadays, an increasing number of APIs are extensions of Facebook Graph API. Developers can obtain different

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APIs in the API platform that established by Facebook and combine them to create new services or functions.

- The Revenue Stream of Facebook

Facebook will not directly charge end consumers for usage fees, its main source of income is advertising fees, which is obtained by placing ads on Facebook, Instagram, Messenger and third-party online websites or mobile applications to increase exposure. Furthermore, according to Facebook Reports First Quarter 2021 Results, Facebook can also charge developers for the use of their payments infrastructure, such as Portal device and other resources, in addition to advertising fees (Facebook 2021).

4.1.5 Salesforce

Salesforce is a company famous for its customer relationship management in the world. The cloud-based CRM applications they provide can be used for various purposes (e.g., sales, marketing, and services). Through Salesforce's customer management system, you can actively track and manage customer information without having to create a web page and backend from scratch, effectively simplifying repetitive tasks, providing real-time insights and suggestions, and expanding functions according to the company's own needs.

Many different types of APIs exist in Salesforce, and each type of API can assist different functions. In addition, some APIs will include other APIs that support this function (Salesforce 2021). The Salesforce Data API is a representative example. The Salesforce Data API is composed of four APIs: REST API, SOAP API, Bulk API, and Streaming API. The combination of these APIs allows users to manipulate their own Salesforce data (Salesforce 2021). It is widely used across the spectrum of core Salesforce data-related function development and can also be combined with other APIs to create different new tools.

In 2018, Salesforce enhanced its application of API through the acquisition of MuleSoft. MuleSoft is a software company and has been selected as a leader in two reports published by Gartner, namely, the Magic Quadrant for Enterprise Integration Platform as a Service (IPaaS) (Gartner 2020) and the Magic Quadrant for Full Lifecycle

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(Gartner 2020) published in 2020 API Management. The MuleSoft Anypoint Platform designed by MuleSoft can concentrate the API's four life cycle management mechanisms on one platform solution, including Design, Simulate, Feedback, and Validate (Mulesoft 2021). Hundreds of existing connectors and templates on MuleSoft Anypoint Platform, including connectors commonly used by enterprises, such as SAP and Oracle, can help developers quickly connect with traditional large-scale IBM mainframes, 'SAP's enterprise resource planning system (ERP system), or Salesforce's cloud applications.

After mergers and acquisitions, because of the seamless integration of MuleSoft Anypoint Platform and Salesforce CRM, companies that have or will become Salesforce customers can quickly break through the barriers between CRM data and other systems.

No matter companies want to connect their existing CRM to ERP System or Order Management System (OMS), during each stage of the sales process (e.g., business opportunity management, sales opportunity, quotations, orders, and renewal purchase processes, through MuleSoft API, all the information of the front-end and back-end merchandise, inventory, orders, and logistics) can be simultaneously presented on the interface of Salesforce, so that the order process and the statement process are fully automated. MuleSoft API is mainly composed of three types of APIs, namely, System APIs, Process APIs, and Experience APIs. Each API has different functions. System APIs can unlock data from the record in critical system, such as ERP System, customer, and billing system. Meanwhile, process APIs provide an approach to combine data and orchestrate multiple System APIs for different business purposes, such as creating a 360-degree view of the customer or displaying shipment status. Moreover, experience APIs can provide a business context for the data unlocked by System APIs and the process built by Process APIs. Combining these three types of API functions can implement the integration of MuleSoft Anypoint Platform and Salesforce CRM (Mulesoft 2021).

To discuss the changes caused by MuleSoft API to Salesforce, the following discussion is divided into four main sections: value creation, changes in customer segmentation, changes in services, and changes in revenue stream.

DOI:10.6814/NCCU202101424

- The Value Creation of MuleSoft API for Salesforce

MuleSoft API can effectively organize customer-related data scattered in different systems and then uniformly present these data on the Salesforce CRM interface. This function is equivalent to connecting marketing, business, and customer service on the same platform. In the past, because various old-fashioned systems were not interoperable, IT departments often took time and effort to process and collect consumer data.

- Changes of Customer Segmentation

The integration of different systems can effectively improve the continuity of the Salesforce CRM experience. In addition to saving tremendous time on collecting data, more importantly, companies can better grasp consumer trends and information and thus have a deeper understanding of consumers' consumption characteristics.

- Services Provided by APIs

When MuleSoft API connects Salesforce CRM with other systems, the customer data of the system will be transferred to Salesforce before the data connection is performed. After the connection is completed, if OMS data change, the data on Salesforce side will also change accordingly (Mulesoft 2021).

- The Revenue Stream of Salesforce

Salesforce's main source of revenue is subscription-based cloud service, and the remaining revenue is to provide professional services. Salesforce provides many cloud services and CRM types according to different usage requirements, such as Sales Cloud, Marketing Cloud, Commerce Cloud, Salesforce Platform. According to Salesforce's 2019 financial report, CRM-related revenue accounted for 92% of overall revenue, and more than 150,000 customers purchase and use its CRM system, showing the importance of CRM to Salesforce (Salesforce 2019).

The function of MuleSoft API also enriches Salesforce's CRM and makes it more comprehensive, and it can also increase the willingness of enterprises to purchase Salesforce's CRM. The pricing of the CRM is based on different levels, for instance,

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Sales Essentials Edition level should pay 25 USD monthly, and Professional Edition level should pay 75 USD monthly. Meanwhile, Enterprise Edition and Unlimited Edition levels needs to pay 150 and 300 USD monthly (Salesforce 2021).

4.1.6 Shopify

Shopify is an e-commerce company established in 2006 in Canada. It is currently one of the world's largest e-commerce website platform service providers. Its service scope covers 175 countries, and 1,700,000 merchants use their Self-built e-commerce website service (Shopify 2020).

Dissatisfied with the existing e-commerce products on the market, Tobias Lütke, one of the founders of Shopify, decided to build an e-commerce platform that could meet all needs. In June 2009, Shopify launched an application programming interface (API) platform, which allows developers to create applications for the Shopify online store and then sell them on the Shopify application store (Shopify 2021).

Shopify provides many small and medium-sized merchants with a back-end engine for e-commerce websites, helping them solve all the services required by e-commerce websites in one stop. In 2016, more than 100 million consumers spent on Shopify-supported websites. Big brands (e.g., Tesla, Red Bull, and Los Angeles Lakers) are also Shopify customers. Additionally, Shopify has partnerships with companies, such as Ebay, Amazon, Facebook, and even Uber. Shopify provides a complete set of services for online retailers, including payment, marketing, shipping, and customer engagement tools to simplify the process of opening an online store for small merchants. Among the numerous kinds of APIs provided by Shopify, the Shopify API plays a major role in the process of building e-commerce websites for customers.

With the Shopify API, merchants don't need to build their e-commerce platform from scratch by themselves. This customized tool not only allows users to create their own fully-custom storefront, but it also allows Shopify to be a fully featured e-commerce platform that provides users various kinds of sales channels to sell products. Besides, the Shopify API can also greatly extend users' shopping experience in Shopify to the webpage, mobile phones, and even gaming environments. Meanwhile, some of the API

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functions are relatively trivial, which is difficult to directly select a representative API. Therefore, this research will adopt the overall Shopify API for the analysis.

To discuss the changes caused by Shopify API to Shopify, the following discussion is divided into four main sections: value creation, changes in customer segmentation, changes in services, and revenue stream.

- The Value Creation of Shopify API for Shopify

Through the usage of the Shopify API, Shopify is no longer a pure online shopping platform, it satisfies all the e-commerce needs of users. Furthermore, through the analysis of consumer data on the backend of the website, Shopify can also regularly advise sellers on consumer trends, such as fashion trends in different quarters, and inform sellers of recent hot items to strengthen their promotion for these items. Consequently, Shopify has successfully combined the functions that sellers should use from the initial storefront establishment to the subsequent maintenance on the platform.

- Changes in Customer Segmentation

According to a press release issued by Shopify in 2020, they claim that as of 2020, they claim that as of 2020, Shopify powers over 1.7 million businesses in more than 175 countries (Shopify 2020). Behind such an astonishing number, we can observe Shopify's growth history and discover that its customer base was mainly small- and medium-sized enterprises (SMEs) in the early days of its establishment. However, as Shopify used the Shopify API to improve the seller's user experience and customer stickiness on the platform, the number of merchants and online shoppers attracted by Shopify also increased substantially. After it gradually became the industry leader in the later period, Shopify's merchant customer base has also expanded to large enterprises. We can find this phenomenon in the types of its partners recently.

- Services Provided by APIs

In addition to providing tens of thousands of themes for merchants who want to create an e-commerce platform, Shopify API authorizes third-party developers to create apps, themes, channels, and other integrations that build on Shopify's platform. Once a

DOI:10.6814/NCCU202101424

merchant establishes an online store in Shopify, customers can choose from thousands of themes. After the merchants select the theme, they can also use Shopify API to access Shopify's built-in capabilities and add new features they want. Additionally, merchants can also obtain records of consumers who have previously purchased in the store through the Shopify API, and further help merchants group consumers into four groups: loyal, promising, dormant, and at risk. Then, merchants can use automated mailing function in the platform to retain consumers. In sum, these functions can provide merchants automating full-scale campaigns and create personalized buyer journeys.

- The Revenue Stream of Shopify

The two main revenue streams of Shopify are subscription and merchant solution. Subscription fees are an important source of income for Shopify. Users can pay monthly subscription fees according to the functions they must use (Shopify 2021). Since 2013, Shopify has established an additional source of income for the company through a merchant solution.

Alternatively, Shopify owns a huge number of themes and merchants. The data from their official website show that more than one million merchants use Shopify's platform, and more than half a million of them are "Active" stores. Furthermore, Shopify provides additional value to the core experience of their merchants through the extended suite of merchant solutions, such as transaction fees, transportation fees, and financing services, which are all potential fees that can be charged.

4.1.7 JB Financial Group

JB Financial Group Co., Ltd. Is a company established in South Korea in 1969. Its subsidiaries are divided into three departments: Banking, Credit-Specialized Financial Services, and Collective Investment. Moreover, the services provided by each department are all different. The Banking department mainly provides private and corporate banking and loan services; the Credit-Specialized Financial Services department provides installment payments, equipment leasing, and advanced technical business-financing services; the services provided by the Collective Investment department include discretionary investment and asset management.

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Compared with other banks in South Korea, JBFG is much smaller in scale; however, it has strong information technology capabilities as its competitive advantage. JBFG recognized the potential of open banking at an early stage; therefore, it established its own digital platform, named JB Open Bank Platform (JBOBP), allowing the creation design and development of new fintech service or products by third-party partners and banks. Furthermore, a layer of API Management Platform exists in JBOBP, which is used to provide Open Banking related functions (Group 2021). It can monitor the stability and efficiency of each API in the platform, and control API traffic to confirm security and risk control. JBOBP provides third parties with access to APIs through the portal in the platform. Thus, third parties can develop and publish their services through the portal after obtaining the permission from JBFG.

To discuss the changes caused by APIs to JBFG, the following discussion is divided into four main sections: value creation, changes in customer segmentation, changes in services, and changes in revenue stream.

- The Value Creation of JBOBP for the JB Financial Group

JBOBP enables the JB Financial Group to become the paradigm in financial industry, which conquers the obstacles encountered by the traditional financial industry in innovation such as financial regulatory and compliance. Unlike other banks, they usually add an extra layer of API Management platform under the existing system architecture, JBFG directly provides customers with a complete open banking solution in its established platform. Thus, JBOBP enables JBFG to gain new customers while earning commissions to increase a source of income.

- Changes in Customer Segmentation

JBFG is a local banking group in South Korea; therefore, its service scope is mainly concentrated in South Korea. When the company was first established, it mainly targeted ultimate consumer of financial services as their target customer group. After the establishment of JBOBP, it is equivalent to expanding the target customer base to third-party suppliers, and attracting them to purchase platform solutions by providing

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platform services. Moreover, JBFG can also gain new customers from the third-party digital channels.

- Services Provided by APIs

Customers can log in to the JBOBP system interface after purchasing the license of the system user. After entering the platform, they are authorized to use all the functions provided on the platform, such as developing and optimizing financial tool modules. For instance, after completing the development of the credit investigation module, customers can optimize the process steps of the review mechanism according to their own needs to achieve a customized effect. Moreover, third-party vendors who purchase the JBOBP solution do not have the authority to change the back-end architecture of the product, they are allowed to combine and develop financial products in accordance with the types of APIs provided by the JBOBP.

- The Revenue Stream of the JB Financial Group

The profit model of JB Open Banking Platform mainly includes three sources of income, which are transaction fees, platform maintenance fees, consulting fees, and platform registration fees. The consulting fee is to help customers who purchase JBOBP for the first time. Through education and training, customers can quickly familiarize themselves with the various functions and service applications on this platform. The registration fee refers to the account permission license for this platform. Customers must purchase the license for the system user to log in to the JBOBP system interface and operate various functions.

4.1.8 Fidor Bank

Fidor Bank is the first digital bank founded by Matthias Kroner in Germany in 2009. Fidor Bank is affiliated to the Fidor Holding Group, and it holds two other entities, namely, Fidor Solutions and Fidor Factory. Fidor Solution focuses more on the development of financial service applications related to Open API and provides Fidor's B2B partners to import financial services and build customized products quickly. Fidor Factory focuses on the design of customer marketing experience, providing users to

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have better agile and convenient financial services. In 2015, Fidor hopes to master customer engagement while providing technology and banking services; however, it couldn't find a suitable platform to use. Thus, Fidor decided to build a platform by itself, which is Fidor OS. Fidor has used Fidor OS as the core and provided their B2B partners with financial-related services through Open API to efficiently receive and access financial service information provided by Fidor Bank in a short time. Fidor OS greatly improves Fidor's agility and flexibility in customer experience. The types and numbers of APIs included in Fidor OS are large; therefore, if only a single-function API is chosen for the analysis, it will be too limited (Fidor 2021). Therefore, in the next analysis, this research will analyze the impact of all APIs in Fidor OS on Fidor Bank.

To discuss the changes caused by APIs to Fidor Bank, the following discussion will be divided into four main sections: value creation, changes in customer segmentation, changes in services, and changes in revenue stream.

- The Value Creation of APIs for Fidor Bank

The successful application of Fidor on API enables it to redefine traditional banking and narrows the distance between banks, users, and developers. Fidor Bank overcame the obstacles that traditional banks might encounter in providing innovative services. It also reinvents the business content of traditional banks. It uses two major principles to achieve innovation in financial services, namely openness and community, and leverages APIs to create product differentiation.

- Changes in Customer Segmentation

In the early days, Fidor directly targeted the younger ethnic group as the target customer group. After 2015, due to the establishment of Fidor OS, Fidor has expanded greatly through cooperation with different third-party vendors. Therefore, customer segmentation has increased the number of third-party vendors and customers attracted through the channels of third-party vendors.

- Services Provided by APIs

Through the openness of APIs, Fidor's third-party partners can provide Fidor customers with their services. According to the content of the official website of Fidor

DOI:10.6814/NCCU202101424

Bank, the financial API service module of Fidor OS can be divided into 10 types, including Core Banking, Payment, Card, Investment, API Crypto, etc (Fidor 2021). Take API Crypto for example, this module is used for cryptocurrency services. Although Fidor Bank does not provide services for trading bitcoin, through cooperation with bitcoin exchange company, Bitcoin.de, Fidor Bank customers can still trade bitcoin directly through Fidor Pay. Through this service, we can also find that the emergence of APIs has greatly enriched the services provided by Fidor through cross-industry cooperation.

- The Revenue Stream of Fidor Bank

Fidor has several different sources of income, which also include the revenue generated by partnerships with its API (e.g., revenue sharing based on the number of accounts and subscription fees). According to the data published by Fidor on its official website, it has accumulated almost 1 million users in 2020. Furthermore, Fidor can also charge transaction fees for every transaction concluded through Fidor. For example, in a cryptocurrency collaboration scenario, Fidor can get a 0.1% transaction fee for each transaction.

Table 4-2 Summary of the impacts of APIs in selected cases

Company	Value Creation	Customer Segment	Service	Revenue Stream
Amazon Alexa	• Enable Amazon to realize the key role of smart home • Promote the birth of a voice-driven platform	• Before Ultimate consumer • After Ultimate consumer and the third- party platform service providers	• Become the intermediary for matching end users and third-party platform service providers through APIs	• Platform service fee, transaction fee, subscription
Amadeus	• From an airline reservation system to leader in the tourism industry	• Before Passengers who ordered air tickets online	• Horizontally integrate travel needs on one platform • The services provided	• Transaction fee, booking fee, IT Solution revenue

DOI:10.6814/NCCU202101424

	• A large number of cross-industry alliances	• After Travel providers airlines, hotels, ground/maritime related companies, tour operators, travel sellers and travel agencies	by Amadeus cover the entire travel lifecycle • Enable people advance their travel or even build a better journey	
Revolut	• Breaks the traditional thinking in the industry to provide financial-related services	• Youth • Digital channels	• Provide financial-related services without branches	• Interchange fee, subscription, registration fee, transaction fee (from international money transfers), service fee
Facebook	• Allow Facebook to create different functions for users	• Enable company to expand more different channels • Advertisers, users, developers	• It is a primary way to obtain data into and out of the platform • Developers can obtain open resources from the API platform	• Advertising fee, payment fee (from developer)
Salesforce	• Provide a platform that enables Salesforce to organize customer information •	• SMEs, large enterprises, institutions	• Connect various platforms through APIs to enable unified collection of customer data	• Service fee, subscription
Shopify	• From a pure tool to a platform	• Before SMEs • After SMEs, large e-commerce stores	• Vertically integrate all functions that online shoppers will need to use • Expand market space	• Merchant solution fee, subscription

DOI:10.6814/NCCU202101424

JBFG	• Conquers traditional obstacles in financial industry in innovation	• Before Ultimate consumer • After Ultimate consumer and the third- party partners	• Provide development platform, financial and process service module, and developer discussion space	• Transaction fees, consulting fees, platform maintenance fees, and platform registration fees
Fidor Bank	• Overcome obstacles traditional banks might encounter in providing innovative services • Lower operating expenses • Create product differentiation	• Before Ultimate consumer • After Ultimate consumer, third- party partners, and customers attracted through third-party partner channels	• Fidor OS provides service through ten financial API service module	• Subscription fees, transaction fees, revenue sharing

4.2 Cross-case Analysis - Benefits created by APIs

From the case-analyzed result of the previous section, we determine how enterprises use APIs to drive business value. Subsequently, we further compare these cases and divide the benefits created by APIs into four categories for analysis: functional benefits, transactional benefits, strategic benefits, and economic benefits. Lastly, this study sorts out these main points through the cross-case table.

4.2.1 Functional Benefits

- Vertical Integration of Functions

For decades, the industry trends are mostly horizontal integration. Companies must reach their end consumers through additional layers in the value chain; however, APIs break this established rule and enable companies to gradually integrate their sales, marketing, and customer support functions. APIs enable companies to integrate functions in the value chain vertically, and through the integration, they can also bring customers a better consumer experience. For instance, Shopify has vertically integrated functions from initial storefront establishment to subsequent maintenance and

DOI:10.6814/NCCU202101424

marketing on their platform through APIs.

- Creation of New Features

Through the previous description and discussion in Chapter 4-1, we can find that APIs are extensible, which can develop new functions through permutations and combinations with different APIs. For example, in the early days of Facebook's establishment, it provided users with many social media functions by using Graph API, laying a solid foundation for Facebook to become a leader in social media in the future. Moreover, after the creation of Facebook API platform, Graph API is also used in many emerging functions. All in all, the characteristic of APIs drives the portfolio expansion of function, which can also bring innovative services or functions.

- Improve the Efficiency of Data Integration

In the past, to achieve data integration, programmers always must spend a tremendous amount of time manually converting data fields between different systems and redefining unified system rules. However, with the emergence of APIs in 2000, the past situation has begun taking a turn for the better. It was led by Salesforce, which uses many APIs to enable customers to share and integrate data between different business applications. Thus, the IT department of the enterprise can effectively reduce time costs and increase efficiency during back-end data integration.

4.2.2 Transactional Benefits

- Enable Companies to Achieve Cross-Industry Alliances

APIs allow different business partners to develop or use and share data on the same platform, which gives companies more possibilities for development in cross-industry alliances. Amadeus is a representative case of growth through cross-industry alliances. It uses APIs to concentrate services from different industries on its own platform to give consumers more choices and experiences. Paying huge IT infrastructure costs is not necessary to connect different systems and simplify the original cumbersome process. APIs allow companies from different industries to come to the same platform to provide

DOI:10.6814/NCCU202101424

services to consumers, successfully reducing the threshold for cross-industry alliances.

- Horizontal Integration of Marketspace

In addition to enabling enterprises to vertically integrate some functions in the value chain, APIs play a key role in the horizontal integration of the enterprise marketspace. For instance, some companies have gradually expanded from small to large-scale through APIs; therefore, their marketspace has also expanded in the development process (e.g., Amadeus and Shopify). Then, large companies realize the importance of entering the platform, they will also enter this platform to open stores.

- Lower the Cost

As mentioned in the previous section, APIs can effectively help companies save costs in different aspects. Instead of spending huge costs on purchasing IT infrastructure and cultivating professional IT departments, enterprises can spend much more time and energy on their products. Without paying a tremendous amount of money on Information Technology, small- and medium-sized enterprises can have more opportunities to be seen in the market. Consequently, APIs can be used as intermediaries to bring different companies, developers, and consumers to the same platform at a much lower cost than before.

4.2.3 Strategic Benefits

- Expand Customer Segmentation

From the analysis results in each case, we can observe that APIs help expand customer segmentation. From the analysis results in each selected case, we can observe that APIs are helpful in expanding customer segmentation, we can also discover this phenomenon from the development of Amadeus, Amazon Alexa, and Shopify. The product they originally launched may be just a tool or skill, but these products can gradually have the capital to become a platform through APIs. During the process, the original customer segmentation of the company can also be expanded from SMEs to large-scale enterprises; moreover, we can find this change from the scale and type of

DOI:10.6814/NCCU202101424

the company's cooperation partners recently.

- Enable Companies to Provide Better Services or Products and Stimulate Business Innovation

APIs can contribute to the birth of new products or services to a certain extent, which we can also observe from case studies in the previous section. For instance, Fidor Bank uses its APIs to offer new services and business innovation. Its platform enables partner to connect and interact with each other, without using a tremendous number of individual connections.

- Boost Competitiveness

After analyzing these cases, we can easily observe that APIs do sharpen the competitive edge of the enterprises. In this advanced age, as APIs can reduce the cost for integration and raise competition simultaneously, it has gradually become one of the critical weapons in the industry. While helping companies improve their competitiveness, the APIs-based platform also prepares companies for future expansion. As an increasing number of partnerships join in its ecosystem, it can create a more global value for the enterprise.

4.2.4 Economic Benefits

- Ultimate Customer

Most companies that use APIs can benefit from ultimate customer from different fees, such as subscription fees, transaction fees, and service fees. Except for some industry-specific companies, such as Facebook. Facebook provides products related to social media, and the main source of income is advertising costs. Thus, it will not charge ultimate customer for the usage of their products.

- The Third-Party Service Provider

In the selected cases, some companies use APIs to become intermediaries between third-party service providers and consumers, and some companies also charge third-

DOI:10.6814/NCCU202101424

party service providers through cross-industry alliances (e.g., Amazon Alexa, Amadeus, Shopify, and Fidor).

- Individual Developer

Most companies are unlikely to profit from individual developers. The interaction between companies and individual developers is usually by opening production lines or resources so that individual developers can join production together or provide more ideas to stimulate innovation of products. In these cases, only Facebook will charge developers for some portal devices.

- Enterprise Side

Some companies profit from the enterprise side by charging advertising fees, selling API-based products and IT solutions, such as Amadeus, Salesforce, Facebook, Shopify.

Table 4-3 Summary of Benefits Created by APIs

(O – Significant; V – Very Significant)

	Amazon Alexa	**Amadeus**	**Revolut**	**Facebook**	**Salesforce**	**Shopify**	**JBFG**	**Fidor Bank**
Functional Benefits								
Vertical Integration of Functions	V	V			O	V	O	O
Creation of New Features	O	O	V	V	O	V	O	O
Improve the Efficiency of Data Integration			O		V	O	V	O
Transactional Benefits								
Enable Companies to Achieve Cross-Industry Alliances	O	V				V	V	V
Horizontal	O	O				V		

DOI:10.6814/NCCU202101424

Integration of Marketspace								
Lower the Cost					V			V
Strategic Benefits								
Expand Customer Segmentation	O	V		O	O	V	V	V
Enable Companies to Provide Better Services or Products and Stimulate Business Innovation	O	O	V	O	O	V	V	V
Boost Competitiveness	O	O	V	O	O	V	V	V
Economic Benefits								
Ultimate Customer	V	V	V		V	V	V	V
The Third-Party Service Provider	V	V	V			V	V	V
Enterprise Side	V	V	V	V	V	V	V	V
Individual Developer				V				

Taking everything into consideration, we can observe from this cross-case table that APIs do bring various types of benefits to enterprises and industries; therefore, this study hopes to summarize further the types of different digital transformations in the next section.

4.3 Cross-case Analysis – Four Patterns of Digital Transformation Driven by APIs

After completing the cross-case analysis table, this study will further summarize the four patterns of digital transformation driven by APIs in the selected cases. Furthermore,

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we can also observe during the induction process that a case can belong to more than one type of digital transformation simultaneously.

- Accelerate the Expansion of Existing Business

In the analysis results of these cases, we can conclude the first digital transformation pattern (e.g., Amadeus, Facebook, and Shopify) can all be classified as this pattern of digital transformation. Through APIs, Amadeus has developed its existing airline reservation system into a leader in the tourism industry, formed cross-industry alliances with many companies, and concentrated business partners, users, and developers from different industries on its own platform. Facebook promoted the existing social media functions through APIs to a platform that can connect different users, and finally created its own API platform to facilitate more business expansion and development. Shopify originally only provides tools to make it easy for users to open a store online. However, APIs allow Shopify's user to create their fully-custom storefront and successfully combined functions that sellers might need from the initial storefront establishment to the subsequent maintenance on their platform.

- Open Production Line and Resources to the Public

In the past, the production lines of enterprises were usually closed to the outside world. However, APIs allowed the production lines to be opened and provided other people for production or development. Among selected cases, Salesforce is classified as a digital transformation of this pattern. Under this pattern, enterprises can reduce some development costs by opening their own production lines and resources. Furthermore, they can also make more breakthroughs in innovation due to the wisdom of everyone.

- Overturn the Traditional Operation of the Industry

APIs also allow companies to overturn the traditional mode of operation in different industries and brought the revolution. In the selected cases, Revolut and Amadeus are classic in this pattern. Take Revolut as an explanation, it transformed the business mode of providing financial services in financial services industry, and brought fintech revolution. Through APIs, Revolut has redefined the way it provides customers with

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financial services, so that third-party providers can have more opportunities to enter into the market and furnish different services. In this case, APIs eliminate barriers to entry in the financial market and accelerate industry disruption.

- Enable Ecosystem to Integrate Extensions from the Early Stage

From the case analysis results of Amazon Alexa, JBFG, Amadeus, and Shopify, we can find that APIs play a key role in establishing an enterprise's ecosystem. Moreover, it can lay a foundation for ecosystem expansion in the early days. Take Alexa, for example. Numerous physical devices have built-in Alexa support, which can be voice controlled or bundled with Alexa, thereby increasing sales of related products and forming the ecosystem integrated physical extensions. Nowadays, Amazon Alexa not only occupies a place in smart homes but also enters different industries. For example, Amazon launched Amazon Prime to allow users to use their voice to control music streaming and play videos in the entertainment industry.

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Chapter 5: Conclusion

5.1 Summary

In recent decades, API has been used increasingly more widely in digital transformation. It breaks the barriers between enterprises and consumers in the past, and reshaped their interactive mode. However, most of the literature on digital transformation is usually conducted from the perspective of Big Data or Artificial Intelligence. Moreover, relatively few studies have conducted more in-depth research from the perspective of APIs. In order to gain deeper perspective, this study regards APIs as a trigger driving digital transformation, summarizes value created by APIs and pattern of transformation driven by APIs through multiple case study. Subsequently, through the result of content analysis and cross-case table, this research analyzed the transformation brought about by APIs from the perspective of enterprises and industries. The result of the study show that APIs can bring four different benefits to enterprises, namely functional benefits, transactional benefits, strategic benefits, and economic benefits. Through these four categories of benefit creation, the impact of APIs can be roughly analyzed. On the functional side, APIs can contribute to the integration of data, and can also promote the production of some innovative functions. On the transaction side, APIs not only increase the opportunities for companies to form alliances in different industries, but also reduce costs. In terms of strategy, APIs help companies enhance their competitiveness and expand customer segmentation. In terms of economics, APIs allow companies to charge for four different roles, namely ultimate customer, individual developer, enterprise side, and the third-parties service provider. Although charging for each role may not be possible, at least one of them can charge more. Although companies may not be able to profit from every role, at least they can charge more from more than two roles. Furthermore, the digital transformation driven by APIs also be summarized into four patterns.

Take everything into consideration, the benefits and digital transformation patterns summarized in this study prove that API has indeed brought changes to the market, enterprises and consumers. On the industry side, APIs eliminate barriers to entry in the different markets and accelerate industry disruption. On the enterprise side, APIs break the barriers between enterprises and consumers and reshaped their interactive mode. Moreover, APIs bring more and different sources of income to enterprises and enable

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the ecosystem to integrate extensions from the early stage. On the consumer side, consumers can enjoy more diverse services or services than before, and no longer passively accept products. Due to the change in the interaction mode between enterprises and consumers, enterprises can more directly receive consumer needs and feedback, and then develop more customized products and services.

This study scrutinizes how companies change their business models and create business value due to digital transformation, summarize different types of transformations driven by APIs, and provide some suggestions for companies that would like to utilize APIs to stand out in the industry in the future.

5.2 Contribution

This study enriches the digital transformation literature for APIs. Although many studies have been conducted on digital transformation, less literature has focused on the digital transformation driven by APIs. In addition, through systematic review of relevant literature and cross-case analysis, this study also specifically demonstrated the impact of these APIs on enterprises and industries, and also summarized four patterns of four transformations driven by APIs.

For practical contributions, this study proved the benefits of APIs in value creation for companies in different industries, and further summarizes the impact of these benefits on companies or industries. On the other hand, for companies that would like to incorporate APIs as part of their strategic development in the future, this study can provide an analysis of successful cases, allowing them to understand more specifically how other companies have successfully used APIs to grow their companies. Through the understanding of successful cases, reduce the risk of failure in investing in APIs.

5.3 Limitation and Future Research

In order to figure out the impacts that APIs have brought to digital transformation, this study provides numerous different perspectives on the benefits of APIs and the digital transformation driven by APIs. However, this study still has some limitations because of case selection. First of all, the multiple case research only includes eight enterprises; moreover, the difference size of the selected enterprise may cause some

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biases. Therefore, we cannot guarantee that the results of this research can be applied to all enterprises from different industries. Secondly, this study is unable to obtain the actual APIs usage data, company financial report and other information of the selected cases; therefore, this study cannot actually calculate the APIs usage and the company's profit. Lastly, the cases selected in this research are from various industries, so it cannot generalize the company’s preference for using APIs to drive digital transformation according to the industries.

The study provides a general observation of the benefits creation and the digital transformation pattern driven by APIs. Future research can consider relevant analysis for specific industries.

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