

Article

Dynamic Capability in Business Ecosystems as a Sustainable Industrial Strategy: How to Accelerate Transformation Momentum

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Abstract: From a sustainable development perspective, continuous industrial growth is an important issue. In recent years, it has become difficult for companies to survive in an increasingly competitive and rapidly changing business environment. To align with these changes, companies must not only rapidly transform their own organizations but also their current business domains. However, it is difficult for a leading company alone to transform existing business domains. While it is known that the transformation of a business area requires cooperation with partners, the mechanism of sustainable growth in existing business ecosystems is unclear. To solve this problem, this paper aims to unveil the role of transformation momentum in the business ecosystem in the IT (information technology) industry, which is rapidly changing from traditional IT services to cloud-based services. This study has selected Amazon Web Services (AWS) and Microsoft Azure as IoT case studies, as these cases have successfully transitioned from their original business domains to new ones. Based on these cases, we established a Sustainable Business Ecosystem Transformation (SBET) model for transforming industries using the business ecosystem's dynamic capabilities. The SBET model demonstrates how transformation momentum can be created using business ecosystems in four phases (Exploration, Creation, Formation, and Mutation). The SBET model contributes to expanding the business ecosystem concept by adopting sustainable growth and accelerating transformations to enhance global IT business ecosystems. Using the model in this study, companies can achieve continuous growth not only in their own organizations but also in their partners in the wider business domain.

Keywords: business ecosystem; sustainable development; dynamic capability



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1. Introduction

Sustainable development is an important problem for our society. Sustainable development is not only an environmental problem but also an issue of human rights, world peace, and industrial development. For example, the United Nations (UN) defined the Sustainable Development Goals (SDGs) to achieve a better and more sustainable future for all [1]. From an industrial development perspective, Goal 9 [2] focuses on promoting sustainable industrialization and fostering innovation targets. To reach these targets, management research can enhance strategies in business ecosystems. Moore describes business ecosystems as the way in which “companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations” [3]. Moore also notes that competition among business ecosystems, not individual companies, fuels modern industrial transformation [3]. After establishing Moore's business ecosystem strategy, recent business ecosystem research focuses on what business ecosystems are, how they operate, and the timing of new ecosystems emerging and the reasons why [4].

In order to survive competition with practical businesses, it is important for new businesses to understand the business ecosystem's mechanisms based on current research. Focus should be placed on not only existing stable business ecosystems but also dynamic business ecosystems. The business ecosystem strategy is the perspective that each company in a business ecosystem survives to complement the other in a competitive environment. However, this research area focuses not only on survival strategies but also on sustainable industrialization strategies. For example, Awano and Tsujimoto discuss sustainable business ecosystem mechanisms in the server backup market [5]. It is certainly better to recognize that a large-scale transformation of such a business ecosystem has a greater impact on an industry's development than each individual company undergoing transformation. However, the following research questions remain unanswered: (1) how do the leading companies in a business ecosystem achieve transformation from an existing business ecosystem to a new one, and (2) how do individual companies follow the business ecosystem's transformation momentum?

In order to implement the business ecosystem strategy to ensure sustainable industrial growth, we choose the case of cloud services in the information technology (IT) business domain. The traditional IT business domain has formed a business ecosystem. IT systems were built so that customers could buy IT hardware and software and integrate these resources locally. In contrast, cloud services provide IT resources over the Internet as a utility service, which started in 2006. The IT business domain and the business ecosystem are currently undergoing dynamic changes. Therefore, this movement is a good one to take as a case to answer the above research questions. This study aims to unveil how to transform the business domain using business ecosystem momentum. In particular, we focus on the leading company's efforts to transform their business ecosystems and look at the business ecosystem time series. From these perspectives, this study expands the field of business ecosystem research as a sustainable industrial strategy and provides a reference for how companies in existing industries can transform into new ones using business ecosystem mechanisms.

Following this section, Section 2 presents a literature review related to the research questions. Section 3 explains the research method. Section 4 describes two case studies from Amazon Web Services (AWS) and Microsoft Azure in the IoT industry. Section 5 summarizes the case studies and explains our new findings. Section 6 discusses the implications and limitations of this study and future work.

2. Literature Review

2.1. Business Ecosystems

Moore defined business ecosystems in [3]. He also unveiled the four stages of a business ecosystem [6] and explained how to expand business ecosystems. The stages are good descriptors to help understand the process from a business ecosystem's birth to its death. However, a description of the mass transformation momentum of business ecosystems is needed based on Moore's concept. To consider business ecosystem transformations, the platform concept is also important for answering the research questions. Gawer and Cusumano describe the characteristics of modern high-tech platforms: "an evolving system made of interdependent pieces that can each be innovated upon" [7]. Cusumano et al. define two types of basic platforms [8]. The first type of platform is an "innovation platform", which serves as a technological foundation upon which other firms develop complementary innovations. The second type of platform is a "transaction platform", which serves as an intermediary for direct exchange or transactions, subject to network effects. Although we also consider achieving sustainable industrial transformations from the innovation platform perspective in this research, we mainly focus on how to transform existing industries into new ones in phases to build sustainable strategies. Iansiti and Levien argue the importance of the keystone in business ecosystems to enhance the productivity of their ecosystems [9]. They also mention the importance of the dynamics in business ecosystems in sustaining business strategies. Although this study discusses keystones as sustainability strategies to

sustain business ecosystems, this research also focuses on transformation mechanisms in business ecosystems [10].

Oghazi et al. delineate four phases of ecosystem transformation [11]. The phases are (1) ecosystem transformational forces, (2) ecosystem opportunity identification, (3) ecosystem value alignment, and (4) ecosystem revitalization. Although the authors prove the importance of ecosystem transformation, they also notice that who takes the orchestrating role in an ecosystem and how they ensure alignment of values between diverse actors is a direction for future research. Our research questions aim to obtain relevant responses to this research direction. Kolagar et al. review recent ecosystem transformation research and advocate for a framework for ecosystem transformation in digital servitization [12]. They also mention the limitation of their study, which is that their results are more general, favoring breadth over depth in their analysis. In response to this, our research dives deeper into the cloud service business domain to unveil business ecosystem transformation as a sustainable strategy. Henningsson and Hedman developed the digital ecosystem technology transformation (DETT) framework to explain the technology-based transformation of digital ecosystems by integrating theories of business and technology ecosystem [13]. This research also indicates the importance of business ecosystem transformation cases from the perspective of payments. Although our research also analyzes cases from the cloud service business domain, we adopt business ecosystem transformation to implement a sustainable business approach. Moreover, Korpela et al. focus on the use of cloud integration to transform business ecosystems [14]. Their research approach focuses on high-level business executives and managers in the business ecosystem. Although we also recognize the importance of cloud service business ecosystems, we focus on how to coordinate the business ecosystems between leading companies and partners, not individual people. Floereche et al. analyzed stakeholders in the cloud service business ecosystem using the Passau cloud computing ecosystem model (PaCE model) [15]. Their research illustrates that the cloud service business ecosystem consists of vendors, clients, hybrid roles, and support roles. Our research uses terms such as vendor role and hybrid role based on the aforementioned research.

2.2. Dynamic Capability

Dynamic capability is a kind of transformation capability. Teece et al. define the dynamic capabilities approach, which endeavors to analyze the source of firms' wealth creation and capture [16]. The term 'dynamic' refers to the capacity to renew competencies so as to achieve congruence with the changing business environment. The term 'capabilities' emphasizes the key role of strategic management in appropriately adapting, integrating, and reconfiguring internal and external organizational skills, resources, and functional competencies to match the requirements of a changing environment. Teece et al. also explain dynamic capabilities in digital platform lifecycles (birth, expansion, leadership, and self-renewal) [17]. Although these studies do not emphasize business ecosystems, they do mention the importance of changing internal and external organizational capabilities to survive in competitive environments. O'Reilly and Tushman describe the modes of organization evolution as ambidextrous (exploit and explore) [18]. O'Reilly and Tushman focus on maintaining a balance between enhancing existing business capabilities and finding new capabilities in each firm. This approach may enhance our investigation into how to transform not only a firm but also industry-wide business ecosystems as a sustainable strategy. Some studies try to establish dynamic capabilities in business ecosystems. For example, Linde et al. define dynamic capabilities for ecosystem innovations in six sub-themes, which are (1) opportunity screening, (2) partnership scouting, (3) value proposition development, (4) ecosystem formation, (5) adaptive value creation, and (6) ecosystem resilience [19]. Helfat and Raubitschek explain dynamic capabilities and their importance for designing and transforming business models in digital-platform-based ecosystems. In particular, the findings showed the importance of scanning/sensing capabilities in digital-platform-based ecosystems from a platform leader perspective [20]. Faridian and Neubaum

argue for ambidexterity in open-source ecosystems [21]. This study unveiled the asset positions between exploration-oriented ties and exploitation-oriented ties. From what is stated above, the dynamic capabilities approach is expanding to obtain new capabilities in business ecosystems, and we believe this research trend will be able to enhance strategic sustainable approaches in business ecosystems.

2.3. Dynamic Capabilities in Business Ecosystems

From a dynamic capabilities in business ecosystems perspective, Espina-Romero et al. indicate that the impact of dynamic capabilities on the performance of a business ecosystem is one of the future research directions enabling good commercial results [22]. To survive in continuously changing environments, Banka and Uchihira discuss the importance of dynamic capability in business ecosystems based on the Microsoft Azure IoT case and how to transform an existing business ecosystem into a new one [23]. The Microsoft Azure IoT case is one of the best cases to help understand transforming business ecosystems based on dynamic capability. However, the literature lacks research on how to build a new business domain from scratch based on business ecosystems. Analyses of the birth of new business domain cases are also needed to help better understand sustainable industrial strategies. To address these research gaps, we argue for not only transforming existing business ecosystems to new ones, such as in the Microsoft Azure IoT case, but also creating a new business domain case through a leading company. From these cases, we are able to understand the ways in which the momentum of the business ecosystem helps transform existing industries into new ones as a sustainable industrial strategy based on the business ecosystem theory.

2.4. Sustainable Development Strategy in Cloud Services

Mavuri et al. indicate that sustainable development encompasses not only environmental perspectives but also information and communication technology (ICT), which, based on SDG 9, is one of the keys to achieving continuous development in the era of digitization [24]. The United Nations defines SDG 9 as “Build resilient infrastructure, promote sustainable industrialization and foster innovation” [2]. In this paper, we define “sustainable development” as the “acceleration of sustainable industrialization and fostering innovation in digital business ecosystems”. Cloud services represent important research areas from the perspective of sustainable development. Tim and Rana mention that cloud services are able to achieve sustainable development by not only being cost-effective for businesses but also by adopting a multi-client approach [25]. Cloud services have the potential to engage each stakeholder. However, Tim and Rana also argue that current research does not explain how cloud services can contribute to sustainable development due to a lack of expertise in cloud services. Bajdor indicates that one of the benefits of cloud services in a sustainable development context is that cloud services accelerate cooperation with customers and partners from a social perspective [26]. Yenugula et al. also argue the importance of cloud services for sustainable development from the perspective of social benefits [27]. Cloud services can contribute to sustainable strategies not only by educating employees and customers but also by collaborating with partners. Zhang and Chen unveil how platform-based ecosystems can contribute to sustainable development by looking at the JD group case study [28]. Li et al. explore the intersection of platform ecosystems and sustainable business models through a survey of the existing literature [29]. This study indicates that digital platform ecosystems such as cloud services contribute not only to digital transformation but also to sustainable transformation, including through value propositions and value creation in digital platform ecosystems. Kumar and Kumar posit that one interface between sustainability and technology is cloud computing and state the importance of multi-scale sustainability, including partnerships in business ecosystems [30]. In addition, they also argue that business ecosystems can achieve sustainable competitiveness within a business domain.

The literature described above indicates that business ecosystems in cloud services have the ability to accelerate cooperation with customers and partners and also provide social benefits in business ecosystems, contributing to sustainable development. The literature provides directions for future research to clarify the mechanisms through which business ecosystems such as cloud services can contribute to social benefits and sustainable development. Therefore, this study tries to unveil how cloud services can contribute to the transformation of business ecosystems in an entire business domain as a sustainable development strategy.

3. Research Approach

The research questions in this paper are as follows: (1) “How do the leading companies in a business ecosystem succeed in transforming from an existing business ecosystem to a new one?” and (2) “How do individual companies align with the momentum of business ecosystem transformation momentums?” These questions cannot be easily answered through numerous analyses because few business ecosystems are able to form global-scale business ecosystems and thus are unable to influence individual companies to transform a business domain. It is also difficult for researchers to directly influence the transformation of leading companies, partners, and customers in a global-scale business ecosystem. To answer these research questions, this paper focuses on contemporary dynamic events. Yin introduced five social science research strategies, namely experiment, survey, archival analysis, history, and case study [31]. To select the best research strategy, Yin also mentions three conditions, which are (a) the form of the research question, (b) requires control of behavioral events, and (c) focuses on contemporary events. For condition (a) (form of the research question), this paper’s research questions are “how”-based research questions. For condition (b) (requires control of behavioral events), it is difficult to control thousands of stakeholders in the studied business ecosystems as behavioral events through academic research. For condition (c) (contemporary events), this paper observes current business ecosystem transformation events. Based on what is stated above, Yin posits that the case study method is best able to answer “how” research questions, uncontrollable actual events, and contemporary events [31]. Therefore, this study tries to answer the research questions using the case study method as a form of qualitative research. This paper chooses dynamic business ecosystems as case studies. Floereche et al. mention that cloud service ecosystems represent typical dynamics of business ecosystems [15]. Therefore, this study focuses on global cloud service providers as case studies.

To select case studies, this paper considers the market impact. The Canalys report shows that Amazon Web Services (AWS) and Microsoft Azure represented over 50% of the cloud spending share in Q1 2023 [32]. Synergy research group reported on the cloud service provider market share trends from Q4 2017 to Q4 2022 [33] and found that AWS kept a market share of around 30–35% and Microsoft Azure’s market share rose around 10% to 20%. On the other hand, other cloud service providers are not experiencing efficient growth like AWS and Microsoft Azure. It is meaningful to understand how AWS and Microsoft Azure ecosystems were created and transformed. From another point of view, this paper aims to comprehensively answer the research questions by analyzing two types of cases: (a) transforming from an existing business ecosystem to a new one without any business relationships and (b) transforming from an existing business ecosystem to a new one with business relationships. When Amazon established AWS in 2006, they did not have cloud service experience. However, AWS has maintained a leading company position in the cloud infrastructure and platform services domain since 2006 [34]. Therefore, studying the AWS case will unveil how to be a leading company in a new business ecosystem and foster and attract new partners without any business relationships between existing business ecosystems and the new one. On the other hand, Microsoft already had IT product assets such as Windows Embedded and security expertise, and they recognized the importance of cloud services as a turning point in the IT business domain. They have since transformed from software business to cloud-based services. Microsoft has also tried to transform its

existing partners. Based on the above, the AWS and Microsoft Azure cases will be studied to comprehensively unveil how to create a new business ecosystem and transform existing business ecosystems as a leading company, as well as the effect of transformation momentum using business ecosystems. Google Cloud [35], Oracle Cloud [36], IBM Cloud [37], and Alibaba Cloud [38] are also trying to establish or transform into cloud service business ecosystems. However, these cloud service providers are not significant cases due to their smaller market shares, their lack of successful business ecosystem transformation from their existing business domains to new ones, and their similarity to AWS's and Microsoft's established partnership strategies in cloud services. Therefore, this paper only focuses on the AWS and Microsoft cases based on public information.

4. Case Studies

To address the research questions, we have selected case studies from AWS and Microsoft Azure IoT. In the case of AWS, Amazon is a pioneer in new digital business domains through cloud services. Additionally, AWS plays a significant role within its business ecosystem, collaborating with many partner companies. In the case of Microsoft Azure IoT, Microsoft is trying to transform its existing embedded device business ecosystem into the new Azure IoT business ecosystem. Microsoft developed Microsoft Azure from scratch to compete with AWS. However, Microsoft Azure IoT, which is one of the categories within Microsoft Azure, utilizes existing Microsoft business ecosystems. This case study provides valuable insights into how to transform an existing business ecosystem into a new one. We investigate each case in the following subsections.

4.1. Amazon Web Services (AWS)

4.1.1. Establishing a New Business Domain

Amazon Web Services (AWS) is one of Amazon's subsidiary companies and provides cloud services to customers. AWS released Amazon Simple Storage Services (S3) as its first cloud service in 2006. After pioneering the cloud service business, AWS continually expanded its services and geographical reach. For example, AWS has released over 200 cloud services and provides these cloud services in 33 regions [39]. As a result of these efforts, AWS is still the largest cloud service provider [40]. AWS contributes over USD 80 billion in net sales and over USD 22 billion in operating income to Amazon's total revenue [41]. Gartner recently named AWS a Cloud Infrastructure and Platform Services (CIPS) Leader for the 12th consecutive year [42]. AWS is not only providing services to customers but also to AWS partners and regional communities. For example, AWS built the Amazon Partner Network (APN), which is a global community of partners (100,000 partner companies from over 150 countries) [43]. AWS also invests in each region in which it operates. In the case of Japan, AWS has invested JPY 1351 billion to AWS in the Tokyo and Osaka regions in Japan since 2011 and has contributed about JPY 1306 billion to the Japanese Gross Domestic Product (GDP) between 2011 and 2022, supporting over 20,300 full-time jobs at third-party vendors in Japan, and has contributed to a nearly 80% reduction in energy and carbon emissions by migration to cloud data centers [44]. Based on the above, AWS is not only leading the new digital business domain but is also supporting the development of partner companies, society, and people. In this case study, we delve deeply into the APN and AWS partners.

4.1.2. Definition of Partner Network Policy

AWS established the APN to support AWS partners in 2012 [45,46]. To establish a new business ecosystem on AWS, AWS first defined its partner network rules. AWS focused on two partner categories, which are technology-based partners (including ISVs, SaaS, tool providers, platform providers, and others) and consulting-based partners (including system integrators, agencies, consultancies, managed service providers, and others). AWS is also defined as three tiers: Select, Advanced, and Premier. AWS provides numerous supports to partners based on the different partner types (technology-based partners and consulting-

based partners) and tiers (Advanced, Standard, and Registered). For example, Standard- and Premier-tier partners can receive AWS Service and Premium Support credits [45], allowing customers to recognize partner competencies through the partner types. After defining the partner network rules, AWS prepared new training programs for each partner type [47]. Partners were also able to learn new cloud technologies based on the different partner types and tiers. After launching the APN, AWS helps AWS partners obtain new opportunities by connecting AWS partners and customers based on customer feedback. For example, AWS launched the AWS Managed Service Provider (MSP) program, which helped customers migrate from existing customer environments to AWS cloud [48]. Also, AWS launched the AWS SaaS partner program, which supported AWS partners in developing Software as a Service (SaaS) on the AWS cloud [48]. To provide new value to customers, the program had three stages, which are Collaborate, Build, and Grow. In the Collaborate stage, the program supports customers through communication, collaboration, and sharing of best practices with other partners and AWS technical experts. In the Build stage, the program supports the development environment through funding and discounted training and providing specific technical content to build new solutions as a form of SaaS. In the Grow stage, the program supports eligible APN SaaS partners through marketing funds and lead-generation campaigns. AWS also aims to connect APN partners and customers through new channels. AWS launched the APN Blog [49], AWS Partner Solutions Finder [50], AWS Device Qualification program [51], AWS Service Ready Program [52], and AWS marketplace [53] to support customers in finding APN partners offering them value. Through these channels, customers can find partner solutions and devices to build customer IT systems on the AWS cloud. As a result of the above efforts, AWS partners have been growing alongside AWS. For example, the Canalys report unveiled that the AWS partner ecosystem can achieve a USD 6.40 multiplier for every USD 1 AWS in sales [54].

4.1.3. Fostering Partners in the APN

Through these efforts, partners have succeeded in the APN. For example, Nasstar has been one of AWS's premier-tier service partners since 2012 [55]. Nasstar understood AWS was the most mature and reliable hyper-scale cloud services provider and understood that becoming an AWS partner was essential to maintain competitive capabilities in the cloud-based future. Over the last decade, customers have shifted from relying on local computing resources to cloud services. To adapt to this change, Nasstar built the Cloud Center of Excellence (CCoE) and started documenting processes and procedures. In addition, Nasstar joined the AWS MSP program to enhance its practices. Through the use of AWS's partner support mechanisms and +200 services, Nasstar was able to grow in the cloud service business domain for over a decade. As another example, Temenos is one of the largest banking-based independent software vendors (ISVs) in the world, serving more than 40 of the top 50 global banks while also consistently devoting 20% of their annual revenue to research and development [56].

4.1.4. Creating New Values through Partners in the APN

Temenos launched the Temenos high-water benchmark, which calculates the value of a given investment fund, through AWS in 2019. After releasing the benchmark software, Temenos had to double its throughput. However, it was difficult to satisfy both Temenos's goal and banking customers' requirements. Then, Temenos combined their software with another AWS partner solution called Yugabyte, an AWS partner that offers a cloud-native relational database for business-critical workloads. This product is called YugabyteDB and has been released on AWS Marketplace. AWS, Yugabyte, and Temenos fine-tuned the software and AWS infrastructure and transitioned from monolithic to distributed Structured Query Language (SQL) to achieve their goals and build new value. After this collaboration, the companies had not only achieved their goal but also combined their knowledge and resources through the partner network, creating new value in the database business domain. Also, AWS users can access the new YugabyteDB from AWS Marketplace.

In another case, Cyber Security Cloud, one of the top Web Application Firewall (WAF) partners on AWS [57], provides a WAF solution known as “Shadankun”. Shadankun has become the most used product in the Japanese cloud-based WAF market in terms of market share and the number of companies using it [58]. Although AWS already provides a WAF service, known as AWS WAF, Cyber Security Cloud also provides managed rules to AWS WAF on AWS Marketplace. The managed rules are managed services that detect and reduce vulnerabilities or other unwanted traffic on AWS WAF. Cyber Security Cloud is one of seven companies in the world that can provide these managed rules. In 2013, Cyber Security Cloud started its web security business, and the company released Shadankun [59]. Over 20,000 sites use Shadankun, and the customer persistency rate is over 99%. Cyber Security Cloud has also released new services since Shadankun, such as the WafCharm AWS version and various managed rules. Cyber Security Cloud was listed in the Tokyo Stock Exchange Mothers market in 2020, and WafCharm was launched on Microsoft Azure and Google Cloud. In addition, their business domains are also expanding beyond Japan to other countries such as the US. As a result of the above efforts, Cyber Security Cloud’s reached its highest sales, operating income, and ordinary income in FY19-22, based on publicly available information [60].

4.1.5. Summary

To summarize the AWS partner case studies, three key points can be identified. First, AWS partners can grow their capabilities and businesses using AWS partner services. For example, Nasttar uses the AWS MSP program, and Yugabyte and Cyber Security Cloud released their products on AWS Marketplace. Second, AWS partners can collaborate to achieve their goals and create new value based on each partner’s knowledge and strengths. Third, AWS partners can provide their services even though AWS also releases similar services, such as a WAF service. AWS does not interfere in its partners’ businesses, providing diverse value propositions to its customers.

4.2. Microsoft Azure IoT

4.2.1. Finding a New Business Area

Since the 1980s, Microsoft has been a software company providing software such as operating systems (OSs) and office software. Now, Microsoft is changing its business portfolio from a software licensing business to cloud computing services. Microsoft Azure focuses on enterprise cloud services, and Microsoft Azure IoT (Internet of Things) provides connectivity from the edge to the Microsoft Azure cloud [61]. To expand this business, Microsoft invested USD 5 billion in IoT development [62]. Although AWS is still the leader in the cloud service domain, Microsoft was named a leader in the global industrial IoT platform domain by Gartner [63]. Microsoft has not only made significant investments in this area but also utilizes its existing assets.

4.2.2. Creating New Core Value Based on Existing Value

To achieve success, Microsoft endeavored to transform its business ecosystems based on its existing products and knowledge, such as Xbox and Windows Embedded, to create the new Azure IoT business ecosystem. The IoT is a complex field of technology because many devices are allocated in fields such as factories, the automotive industry, and hospitals to collect field data. To ensure the health of IoT systems, administrators must protect IoT devices from attacks and establish connections between various edge devices and the cloud. To address these challenges, Microsoft has provided Azure Sphere [64] and Azure IoT Plug and Play [65].

4.2.3. Azure Sphere

Microsoft realized that non-secured IoT devices are vulnerable to malware attacks via the internet [66]. Azure Sphere consists of a secure microcontroller unit (MCU), an OS, and cloud services to ensure an edge device’s security. In order to provide an IoT

security product quickly, Azure Sphere was not developed from scratch. To accelerate Azure Sphere's development, Microsoft used its knowledge of Xbox console chipsets to develop the Azure Sphere MCU [67,68]. Microsoft already understood the seven properties of protecting device security from its Xbox development experiences [69,70] and used these experiences to design the Azure Sphere MCU. On the other hand, Microsoft did not use Windows as the Azure Sphere OS because Microsoft understood that Windows needed computing resources such as CPU, memory, and disk capacities through its experience developing personal computers (PCs). However, IoT devices in the 2010s did not have sufficient computing resources because of technical issues. Thus, Microsoft chose a Linux-based OS to run on resource-limited IoT devices. Microsoft was also trying to transfer its Windows Embedded partners to its Azure Sphere service. To accomplish this, Microsoft adopted the existing business ecosystem to the Azure Sphere platform. For example, although Avnet was a Windows Embedded business partner [71], Avnet became one of the suppliers of Azure Sphere development kits and modules [72]. In particular, Avnet provided the MT3620 starter kit, which supported highly secure, end-to-end IoT implementations based on Azure Sphere. Furthermore, Advantech had also been working with Microsoft as an important Windows Embedded partner since the Windows Embedded era, even being recognized as a gold-level Microsoft Windows Embedded partner in 2002 [73]. Advantech also provides an industrial WiFi I/O module for Azure Sphere [74]. Based on the above, it is clear that Microsoft did not create a new Azure IoT platform ecosystem from scratch. Microsoft overlapped existing business ecosystems (i.e., Xbox and Windows Embedded), transformed existing partners, and created a new Azure Sphere business ecosystem.

4.2.4. Azure IoT Plug and Play

Azure IoT Plug and Play is one of Microsoft's solutions to solving the complexity of IoT, stemming from the many different types of IoT devices. IoT developers must understand each device's specifications and implement each device's proper configurations to connect to Microsoft Azure. Microsoft realized this pain and adopted an existing concept from its PCs: Plug and Play. PCs are also diverse devices, and Microsoft solved this issue in the 1990s by using device metadata. Windows configures device settings based on the device's metadata automatically. Therefore, PC users do not need to configure their device settings by themselves. Microsoft thus brought over this concept to the IoT area in the form of Azure IoT Plug and Play. To implement this approach in the IoT area, Microsoft developed the Digital Twins Definition Language (DTDL) [75]. The DTDL can describe models and interfaces for IoT digital twins. In addition, the DTDL can describe device capabilities such as its properties, telemetry, and commands. Microsoft did not develop the DTDL independently. Microsoft not only formed an open-source community but also contributed to the digital twin consortium as a founder [76]. To expand on this concept, Microsoft also launched the IoT Plug and Play device certification program to increase the number of certified IoT Plug and Play devices [77]. Microsoft also provides an Azure Certified Device catalog to help customers find +2200 certified devices developed by both customers and partners [78]. Microsoft thus established its IoT Plug and Play platform based on its existing business ecosystems. For example, Seeed is not only one of Azure Sphere's device partners [79] but also an IoT Plug and Play device partner [80]. ST Microelectronics is also an Azure Real-Time OS (RTOS) hardware partner [81] and an IoT Plug and Play partner [82]. Finally, Tokyo Electron Device was one of the biggest Windows Embedded partners for decades [83], and the company started providing IoT Plug and Play certified devices in 2021 [84].

4.2.5. Summary

Based on the above, it is clear that Microsoft's business ecosystem strategies are (1) create a new core competence such as IoT Plug and Play, which was based on the Plug and Play technology on PC, and (2) transform existing Microsoft partners to accelerate the expansion of the business ecosystem.

5. New Findings

This section summarizes the AWS and Microsoft Azure IoT cases and describes new findings to answer our research questions. As explained by Yin [31], this paper aims to perform a time-series analysis for each case to unveil how to transform existing business ecosystems into new ones and to find commonalities between the AWS and Microsoft Azure IoT cases. First, Table 1 summarizes the AWS and Microsoft Azure IoT cases from their beginnings to the establishment of each business's ecosystem. The AWS and Microsoft Azure IoT cases are not identical situations. Amazon created AWS as a new business domain. On the other hand, Microsoft Azure IoT was adjacent to existing business ecosystems such as Xbox, Windows Embedded, and Plug and Play. However, the case studies indicate business ecosystems may rely on momentum to transform from existing industries to new ones, whether new business ecosystems are being created or not. In addition, we found a common denominator among these cases. The common denominator indicates that the transformation process has four phases: (1) exploring a new business domain, (2) developing new core values, (3) fostering partners in the new business ecosystem, and (4) mutations by each partner. (1) The exploring a new business domain phase happens when a leading company tries to create new core values based on existing business environments. For example, Amazon realized that its IT services for e-commerce could also benefit other customers. Microsoft also understood the benefit of developing new IoT services based on market trends and feedback from existing embedded customers and partners. (2) In the developing new core values phase, the leading company establishes new core values to attract new partners to the new business ecosystem. For example, AWS developed +200 unprecedented cloud services for its customers. As a result, AWS was also able to attract partner companies. Moreover, Microsoft created new core values using existing assets such as Xbox, Windows Embedded, and Plug and Play, allowing Microsoft to suggest that existing partners join its new business ecosystem. (3) In the fostering partners in the new business ecosystem phase, the leading company fosters partner businesses based on core values. AWS defined a partner policy and supported partners in gaining new cloud service competencies. Microsoft led embedded partners from its Windows business ecosystem to the new Microsoft Azure IoT business ecosystem after creating new core values. (4) In the mutations by each partner phase, the creation of new value is accelerated by each partner. AWS collaborates with partners to create new value, and partners develop their own value with each other. Moreover, Microsoft Azure IoT partners provide a diverse range of devices using Azure IoT.

Table 1. Summary of case studies.

Business Ecosystem Transformation Phase	AWS (Creating a New Business Domain)	Microsoft Azure IoT (Transforming a Business Domain)
1. Exploring a new business domain Leading companies try to find a new business domain based on existing business environments	AWS: Amazon realized the need for utility IT services based on customer needs. Microsoft: Microsoft realized IoT problems based on existing embedded businesses.	
2. Creating new core values Leading companies develop new core values in a new business domain	AWS has developed +200 services based on customer needs since 2006 and provides services in 33 regions.	Microsoft developed new core values such as Azure Sphere's security design and IoT Plug and Play based on Xbox and PnP experiences.
3. Forming a new business ecosystem to support partners Leading companies combine each partners' competencies and partners form a business ecosystem	AWS defined a partner fostering mechanism through the APN. Existing companies joined the APN as AWS partners and formed a business ecosystem (e.g., Nasstar).	Microsoft commissioned existing Windows Embedded partners to manufacture certified Azure Sphere and IoT Plug and Play devices.
4. Mutations by each partner Partners create new value in the new business ecosystem by themselves using the core values.	AWS collaborated with partners to create new value, and partners developed their own value (e.g., Temenos and Yugabyte, Cyber Security Cloud).	Partners provide +2200 Azure Certified devices (Azure Sphere and IoT Plug and Play devices).

As a result of the common denominator, this study summarizes these phases into a Sustainable Business Ecosystem Transformation (SBET) model for using business ecosystem transformation momentum to achieve sustainable development (Figure 1). The SBET model developed based on the common denominator from Table 1 is shown in Figure 1. The diagram shows each phase in the transformation of one existing business ecosystem into a new one. The SBET model also aligns with Moore's business ecosystem life cycle [3], and the Most Relevant Dynamic Capabilities [17] are listed for each phase. In the exploration phase, the leading company in the existing business ecosystem is trying to find a new core value to establish a new business domain, such as in the case of AWS, or in an adjacent business domain, such as in the case of Microsoft Azure. This phase is also similar to the birth life cycle in business ecosystem theory and generative sensing in dynamic capabilities. However, the SBET model focuses specifically on how to create a new business ecosystem from an existing business ecosystem. In the creation phase, a leading company in the existing business ecosystem harnesses momentum from the existing business ecosystem to create a new one by creating core value in the new business domain. This phase is similar to the expansion life cycle stage in business ecosystem theory and transformation (execution) in dynamic capabilities theory. In particular, this study emphasizes the motivation of partners' transformations from the existing business ecosystem to the new one. In the formation phase, the leading company establishes a new business ecosystem and fosters and accelerates the partner transformation by creating new value. In addition, partners create new value by themselves using the leading company's new core values. This phase is similar to the leadership life cycle stage in business ecosystem theory and transformation (minor) in dynamic capabilities theory. This study emphasizes the role of the leading company's support in leading partners to create new value to solidify the new business ecosystem. In the mutation phase, the new business ecosystem facilitates the creation of various forms of new value through collaboration between each partner and the leading company within the new business ecosystem. This phase is similar to the self-renewal life cycle phase in business ecosystem theory and transformation (major) in dynamic capabilities theory.

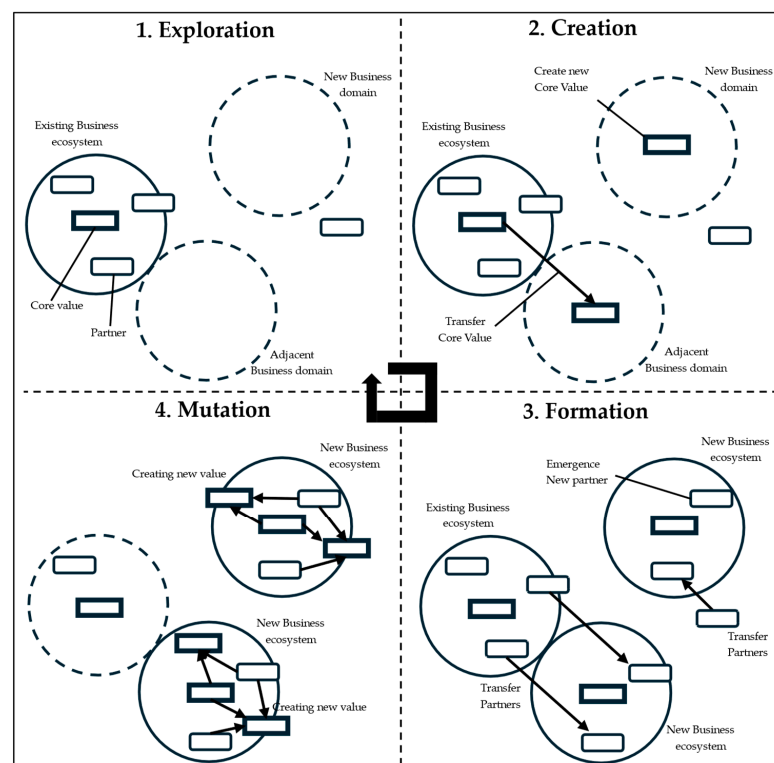


Figure 1. Sustainable Business Ecosystem Transformation (SBET) model.

This study also investigates the reasons why new core values in the new business ecosystem attract other partners. As mentioned above, the SBET model is based on existing research, such as the life cycle of business ecosystem theory and dynamic capabilities (Table 2). However, our SBET model focuses on the business ecosystem's transformation momentum generated by the leading company's efforts and strategies and its effect on motivating partners using the business ecosystem theory. Moreover, the SBET model also shows how to sustain stakeholders in the existing and new business ecosystems.

Table 2. Relationship between the SBET model, business ecosystem lifecycle, and dynamic capabilities theory.

SBET Model		Business Ecosystem Lifecycle [3]	Most Relevant Dynamic Capabilities [17]
1.	Exploration	Birth	Generative Sensing; Business Model Selection; Asset Orchestration
2.	Creation	Expansion	Seizing; Learning; Transformation (execution)
3.	Formation	Leadership	Sensing for threats; Transformation (minor)
4.	Mutation	Self-Renewal	Generative Sensing; Ambidexterity; Transformation (major)

This study had two research questions: (1) how do leading companies in a business ecosystem achieve transformation from an existing business ecosystem to a new one, and (2) how do individual companies follow the business ecosystem transformation's momentum? To answer the first question using the SBET model, the leading companies create new core values first to establish a new business ecosystem. After, the leading companies transfer existing partners to the new business ecosystem and support the creation of new value for each partner, expanding the new business ecosystem. To answer the second question, the existing partner companies gradually recognize the leading company's creation of new core values. If partners identify the core values and want to transform their business portfolios, they can collaborate with leading companies and transform their businesses rapidly and reduce the risk of transformation.

Because the leading companies also want to transform the existing business, the leading companies therefore help partners to transition from the existing business ecosystem to the new one.

6. Conclusions

6.1. Summary

To achieve sustainable development, firms have to develop new capabilities not only by themselves but also through collaboration with other stakeholders. Although business ecosystem theory is one of the solutions to solving this problem, we can expand the theory from the co-creation of value in business ecosystems to transforming existing business ecosystems to new ones in a business domain on a larger scale. Existing business ecosystem theories are sufficient to understand the stable relations between firms, positioning, and value creation in business ecosystems. However, few studies have tried to unveil the mechanisms of how transforming existing business ecosystems into new ones can sustain industries. To contribute to this approach, this study focuses on cloud service business ecosystems because the information technology (IT) business domain is rapidly changing from local business models to cloud services. This study analyzed AWS as a case study of a company creating a new business ecosystem based on an existing business and transforming existing IT firms and Microsoft Azure IoT as a case study of a company transforming

existing embedded business ecosystems into a cloud-native IoT business ecosystem. As a result of analyzing these cases, this research established the Sustainable Business Ecosystem Transformation (SBET) model for developing new industries. Amazon created AWS to contribute to the e-commerce sector using their own original IT technologies; then, AWS created new business ecosystems, attracted external firms, and is now contributing to Amazon's profits. Microsoft realized the market trend changing from a licensing business model to a subscription model, such as subscriptions to cloud services. To adapt to this change, Microsoft created a new capability in the form of Azure IoT and transitioned its existing embedded partners to its new Azure IoT business ecosystem. Based on these cases, the SBET model illustrates how to transform an existing business ecosystem into a new one. This model has four phases: First, the leading company in the existing business ecosystem identifies a new business domain using existing values or experiences (exploration phase). Second, a new business ecosystem is established based on new core values (Creation phase). Third, the leading company creates policies and support to facilitate partners' transitions from existing business ecosystems to new ones (Formation phase). Fourth, the leading company ignites the creation of diverse value propositions in the new business ecosystems (Mutation phase). Based on these cases, the SBET model can be adapted to transform global IT business ecosystems, providing numerous services via the Internet and creating new value using these services for partners and customers. Using this model, firms are able to realize their transformation from existing industries to new ones. Moreover, leading companies and partners can more easily consider sustainable development strategies using this model.

6.2. Theoretical and Practical Contributions

This study provides several theoretical contributions. First, based on Moore's definition of a business ecosystem and business ecosystem life cycle [3], this study expands on the mechanism of how to transform businesses from existing business ecosystems to new ones. As a result, the business ecosystem theory is expanded to not only be a survival strategy but also a sustainable development strategy for rapidly transforming existing industries. Moreover, this study also focuses on achieving business ecosystem transformation based on Teece et al.'s explanation of platform lifecycles from the dynamic capabilities perspective [17]. In addition, this study also aimed to unveil how to transform existing business ecosystem capabilities into new ones to sustain in the business domain on a wider scale. Moreover, whereas Banka and Uchihiro described the dynamic capabilities in business ecosystems based on one case of business ecosystem transformation only [23], this study analyzes the case of an existing business ecosystem's transformation in the IT business domain (Microsoft Azure IoT) as well as the case of new business ecosystems being created from another business domain (Amazon and AWS). From the analysis of multiple cases, this study contributes to the development of concrete business ecosystem transformation theories to achieve a sustainable development model.

This study also has several practical contributions. First, leading companies in existing industries can build new transforming strategies not only by themselves but also by collaborating with partner companies in business ecosystems. Using the SBET model, leading companies can reduce the risk of failure during transformation by involving partner relationships. Although it is not easy to build business ecosystems from scratch as leading companies, these companies can incorporate their partners in existing business ecosystems in the new ones using this research approach. Moreover, using the SBET model, leading companies can easily understand how to transform their business ecosystems to build sustainable strategies and easily establish influence over the new business ecosystems. Second, partner companies can also use the proposed model to transform their own core competencies in the transition to new business ecosystems. This study helps partner companies to recognize business transformations, adopt new innovations created by leading companies, and provide new value to stakeholders by transitioning to new business ecosystems and building sustainable business strategies. Partner companies can

also realize their transformation using the SBET model in collaboration with the leading companies from the same perspective. The SBET model helps us to better understand the directions to be taken to achieve the same goals and relationships between the transforming leading companies and their partners.

6.3. Limitations and Future Work

This study unveils transforming business ecosystems as a sustainable development strategy. However, further prospective analyses are needed to establish a sustainable strategy using business ecosystems. As a first limitation, this study does not focus in-depth on partner companies involved in the transformation of business ecosystems. Although we posit that partner companies create new value using leading companies' innovations and supporting policies in transforming business ecosystems, this study mainly focuses on the activities of the leading companies in the business ecosystems. To accelerate transformations from existing business ecosystems to new ones, we also need to unveil partners' motivations for aligning with leading companies in the transformation of business ecosystems. Second, we are not able to explain how strategic changes between leading companies and partner companies should be adjusted. In transforming business ecosystems, leading companies are seeking new business opportunities through trial and error, and the leading companies have to influence these strategic changes with partners in transforming business ecosystems immediately. To establish methods for finding new business areas to transform business ecosystems productively, we must analyze cases with dynamic and changing strategic directions to build a new theory. Third, the SBET model can only be adapted to the global IT business ecosystem so far. To expand this model, we would like to analyze cases in other business areas in the future. Fourth, we also need to clarify the merits of transforming business ecosystems through quantitative evaluations. We hope that future work will unveil data such as revenue, growth rate, market share, and company lifespan. Fourth, we focused on successful cases such as AWS and Microsoft Azure IoT in this article. To determine the correct approach based on this study, future research can also investigate cases of failure. Finally, future research needs to analyze not only IT industries but also other industries to validate the SBET model.

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