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Digital Transformation Research of Taiwan's Traditional Manufacturing Industry based on the Ecosystem Perspectives

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ABSTRACT

Taiwan's traditional manufacturing has great impact for the economic take-off, and is an important force for stabilizing the domestic social economy and livelihood. However, with the rapid development of liberalization and globalization, high-tech industries have emerging and replaced it. With recent domestic and international economic situations such as the US-China trade war, the low-price competition from emerging countries and the continued spread of the COVID-19 epidemic have made the traditional export-oriented manufacturing industry face more severe challenges. On the other hand, Taiwan's traditional manufacturing industry uses industrial clusters as the main operating mode, but emerging technology has brought disruptive innovations. So, many businesses look to develop new business models based on data. Due to cluster mode, this has driven many cross-industry and cross-field innovation ecosystems in Taiwan traditional manufacturing market and cascading to global industrial chains. The objective of this paper is to find out the paths for the digital transformation of Taiwan's traditional manufacturing industry. This study will use Jacobides, Cennamo, and Gawer's "Towards a theory of ecosystems" as the analysis framework to investigate the specific innovation or new value proposition of traditional manufacturers in Taiwan, as well as identify possible complementary support group relations and proposed a transition mode and from concept to enterprise management implications practice.

Keywords: Digital transformation, ecosystem, traditional manufacturing industry, strategy development

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INTRODUCTION

Definition and Scope of Traditional Manufacturing Industries

There is no consistent classification definition statement for the traditional manufacturing agreed by the government and academic institutions in Taiwan. The definitions are mostly based on the purpose of data usage purpose and the difficulty of obtaining. According to the 2014 "Promotion Plan for Value-added Transformation of Traditional Industries" compiled by the Ministry of Economic Affairs, academic research advocates adopting "market-side" or "technical-side" as categories.

The basic "market-side" view is that the industry was once the economy with a contribution rate of at least 15-20% or more, but today's market position has declined to 5% or even below 1%, and should be classified as traditional industries. Therefore, traditional industries should belong to the "mature" period in the product life cycle. Those market shares will no longer increase or even have begun to decline (Cai, 2000). So, these industries are in the mature period and declining period. Scholars also have proposed that traditional industries must have two characteristics. First is the output value and profits of the industry show long-term decline; second, the cause of the decline or recession has no related to the business cycle. (Wang, 2001) There are also scholars who define any industries that are closely related to people's livelihood such as food, clothing, housing, construction, and automobiles, including upstream and downstream industries such as steel, petrochemical, mold, machinery, plastics, and building materials have categorized into traditional industry. (Xu & Liao, 2000)

The aspect of "technical side" view is to define high-tech industries first, which means to classify industries the electronics industry, finance and insurance industry, electrical machinery industry and construction industry, the rest of industries are categorized into traditional industries. The common categorization indicator is the ratio of research and development (R&D) expenses to the total sales output value, and the proportion of scientific and technical personnel in total employees. However, the government statistical department usually defines the scope of traditional industry based on the convenience of data collection and comparison. For instances, in the statistical data department of the General Accounting Office of the Executive Yuan, the following industries are mainly classified as the traditional manufacturing industry: (1). "Agriculture industry" - agriculture, forestry, fishery, animal husbandry, (2). "Manufacturing Industry" - mining, manufacturing, water, electricity and gas industry, construction industry, and (3). "Service industry". These three industries are generally known as primary, secondary and tertiary industries. In

2010, the Ministry of Economic Affairs formulated the "Plan for Improving the Competitiveness of Traditional Industries", which defined traditional industries as "industries other than strategically important emerging industries". The strategically important emerging industries which are selected and defined by the Ministry of Economic Affairs according to 2009 "Regulations on of Promoting Industrial Upgrading" as "the emerging important strategic industries that have significant benefits for economic development, high risks and urgently need to be supported". Any other not in such categories belong to traditional industries. So, accordingly, the 2012 "Research on Traditional Industry Renovation Strategies" proposed by the Economic Development Committee of the Executive Yuan has defined the traditional industries as the following table.

Table 1: Traditional industry listing in Taiwan

Categories	Classification.	Items
Manufacturing	Traditional manufacturing	Food industry, beverage industry, tobacco industry, textile industry, clothing and apparel products industry, leather, fur and its products industry, wood and bamboo products industry, pulp, paper and paper products industry, printing and data storage media reproduction industry, petroleum and media Product industry, chemical material industry, chemical product industry, pharmaceutical industry, rubber product industry, plastic product industry, non-metallic mineral product industry, basic metal industry, metal product industry, machinery and equipment industry, automobile and its parts industry, other transportation tools industry , Furniture industry, other manufacturing and industrial machinery and equipment maintenance and installation industry.
	Non-traditional manufacturing	Electronic components, computer electronic products and optical products, power equipment manufacturing
Services.	Non-knowledge-intensive services (traditional industries).	Wholesale and retail industry, transportation and storage industry, accommodation and catering industry, real estate industry, art, entertainment and leisure service industry.
	Knowledge-intensive services	Commodity brokerage, postal, telecommunications, computer system design services, portal operations, data processing, website hosting and related businesses, finance and insurance, professional scientific and technical services (excluding veterinary serv.
Agriculture	All belong to traditional industries	agriculture, forestry, fishery, animal husbandry

Source: The Council for Economic Planning and Development of the Executive Yuan, R.O.C. (Taiwan), 2012.

Due to the various definitions of traditional industries by academia and government agencies, the economic impact by industry types and company scales are also different. Therefore, the author summarizes the above-mentioned definitions to conclude the characteristics of traditional industries include: (1). the contribution of the economy to the economy has declined significantly under long-term observation, (2). the production technology has matured, and (3). R&D and equipment inputs do not account for a high proportion of output. To ensure that the research objects consistent with industry attributes, this study will use the industry categories proposed by the Economic Development Council in 2012.

The Realization of Ecosystem Innovation Viewpoints

"Ecosystem" has become an important term for industrial innovation, as well as a new way to describe the competitive environment. Despite there are different translations for "ecosystem" in Chinese, the main view of ecosystem means to break away from the traditional supply chain and value chain thinking, leading manufacturers to re-define the value proposition and pattern of corporate innovation. In the early stage of ecosystem planning, it needs to emphasize the innovative viewpoints of integrating overall service process and structure in order benefiting and connecting multiple stakeholders including customers in a high-level perspective. Effectively inlaid together to form a positive circulation and cooperation atmosphere with a suitable supply and demand (Chen & Chang, 2015). Ecosystem not only entered technology companies' mindset, but also entered mature industries such as financial services. (Deloitte, 2015)

Beside the popular business media reports, ecosystems have also been eagerly adopted by strategic areas. Teece (2014) proposed that "the concept of ecosystems can now replace industry analysis." Although ecosystems have been considered in our research field for a while, there has been a boom in the academic research area in recent years. (Dhanaraj & Parkhe, 2006; Iansiti & Levien, 2004; Moore, 1993) Searching for the keyword ecosystem in the titles or abstracts of top strategic journals shows that its frequency has increased sevenfold in the past five years. Jacobides, Cennamo and Gawer (2018) believe that modularity of ecosystem can promote the emergence of ecosystems research which prompting the organization to coordinate newly completely planning for interdependent ordinance. In other words, the value of the ecosystem created by the leading manufacturer can coordinate its dependence on multilateralism through a series of similar roles, thereby avoiding the need to sign a customized contract agreement with each partner. Based on previous research output, this research will according to the ecosystem model proposed by Jacobides *et al.* (2018), discuss how to use the ecosystem to optimize the digital transformation of traditional manufacturing industry by rearrange or integrate the supply chain vertically, and to develop grouping relationships that may be recognized and complementary to support, to establish an ecosystem with strategical purpose.

PROBLEM STATEMENT

Despite the economic output, the number of traditional manufacturing company accounts for more than 90% of Taiwan enterprises that play an important role and position in economic and trade development which lead to an important force for stabilizing the social economy and people's livelihood. Since the 1970s, Taiwan's traditional manufacturing industries have adopted industrial clusters as the main operating mode. They exist in cities and towns geographically, but connected and allied to produce various in heterogeneous ways. The government vigorously promoted this operation mode over years. By participating in overseas exhibitions of public associations and jointly seeking OEM orders jointly shipped through capacity sharing, forming a unique development model for Taiwan's industrial exports, creating a world-famous economic miracle, and letting Taiwan Become a veritable manufacturing kingdom. According to the Swiss World Economic Forum (WEF) 2019's "The Global Competitiveness Report", Taiwan ranked 4th position and continues to rank among the top four innovative countries, Taiwan also ranked 3rd position in "the degree of universality of development". This ranking is mainly due to the "complete industrial clusters operation mode to create an innovation ecosystem for leading advantage". Taiwan's traditional industry that is urban innovation ecosystem foundation affects the overall Taiwan economic innovation momentum. However, according to the Taiwan Economic Research Institute in November 2019, and observed that the last five-year export growth has stagnated for some traditional manufacturing industries, while China's export value has grown from 13.27 billion to 22.27 billion (+67.82%). It is obvious that Taiwan has the hidden concern of insufficient export momentum, possibly due to the degree of this innovation ecosystem.

The diversified and low-cost competition and rise of emerging countries were the challenges both in domestic and foreign economic conditions. Due to the production lines of some traditional industries were mostly moved to China or other Southeast Asian countries. The demographic advantage is gradually reduced, the human location no longer has advantages, and the Internet The rise and increase of owners are more likely to find competitors or alternatives in the same industry, causing companies to start cutting prices and competing for orders and are forced to sacrifice profits. Coupled with the recent continuous spread of the COVID-19 epidemic, it is not easy for outside factories to recruit (return) workers and relocate (expand) factories, raw material prices and production costs have increased significantly, and manufacturers' profitability and production efficiency are difficult to recover in the short term. The domestic environment is faced with high turnover rate, lack of professional managers, most unique knowledge is only passed on within the family, product improvement research and development momentum are limited, the industry lacks cross-field talents for cross-industry integration and design integration, and second-generation succession There are many problems to be overcome, such as innovative intentions or ideas but difficult to put into practice.

Under the influence of the global economy and the trend of digital transformation, more countries need to face the market competition, not limited to the technology, talents, and markets, but also the allocation of own resources and integration with other ecosystems need to be considered. The digital transformation process is highly risky, challenging, and staged, especially in facing unknown markets, cross-industry competitors, different thinking required in cross-fields, and even difficulties in obtaining information in the evaluation process, which will cause interpretation and difficulties in decision-making. Therefore, to help break through the challenged industrial survival dilemma, this research will focus on exploring the core roles established by traditional manufacturing industry knowledge, and use the ecosystem model to integrate and collaborate across business fields, and propose innovations in multi-fields. The development strategy recommendations for product domain services are expected to serve as a reference basis for the digital transformation model of the traditional industry.

RESEARCH METHODS

Recently, in many research strategies and practices, people's interest in "ecosystems" has surged, mainly focusing on what is an ecosystem and how it operates. According to a literature review conducted by Jacobides, Cennamo & Gawer (2018), the study supplements these documents by considering when, why and why the ecosystem is different from other forms of governance, and

incorporates them into the ecosystem. It is different from other business systems, including markets, alliances or hierarchical management of supply chains.

Therefore, this study uses the above three ecosystems with different value chain structures, including: (1) Business Ecosystem, centered on the company and the surrounding environment. (2) Innovation Ecosystem, around a specific innovation or new value proposition, and a specific group that agrees with its business values. (3) Platform Ecosystem, based on how participants develop around the platform, and on this basis, this research hopes to help Taiwan's traditional manufacturing industry to further understand the development of different ecosystem strategies.

Business Ecosystem

Business ecosystem research mainly focuses on a single company or a new enterprise, which is an economic community of mutual influence participants. This kind of ecosystem influences each other through the activities of their respective enterprises, and even affects all relevant participants outside the scope of a single industry. The business ecosystem represents the environment that enterprises must monitor and respond to, which affects the dynamic capabilities of the enterprise itself and whether it is the ability to build sustainable competitive advantage (Teece, 2007). Despite the emphasis on corporate capabilities to work together, authors such as Iansiti and Levien (2004) emphasized ecosystem-led enterprises as a functional role to providing cooperation between members, but how do leading enterprises make knowledge flow, innovation proprietary and belonging, and how members adapt to maintain the stability of the network. Overall, there is a lack of supporting evidence from scholars and market experience in related literature studies.

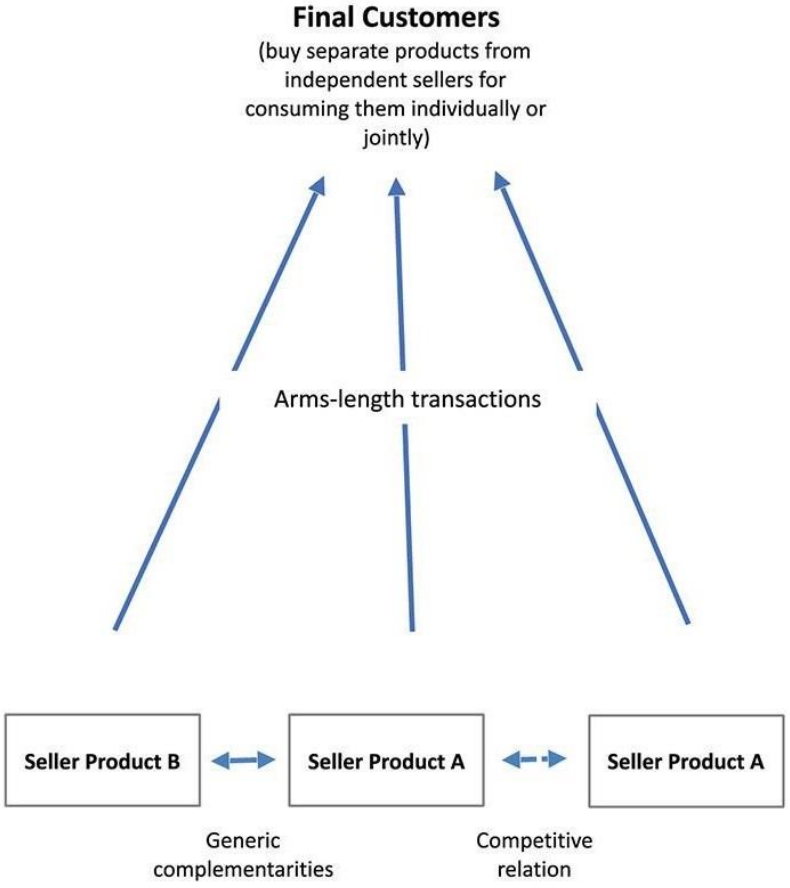
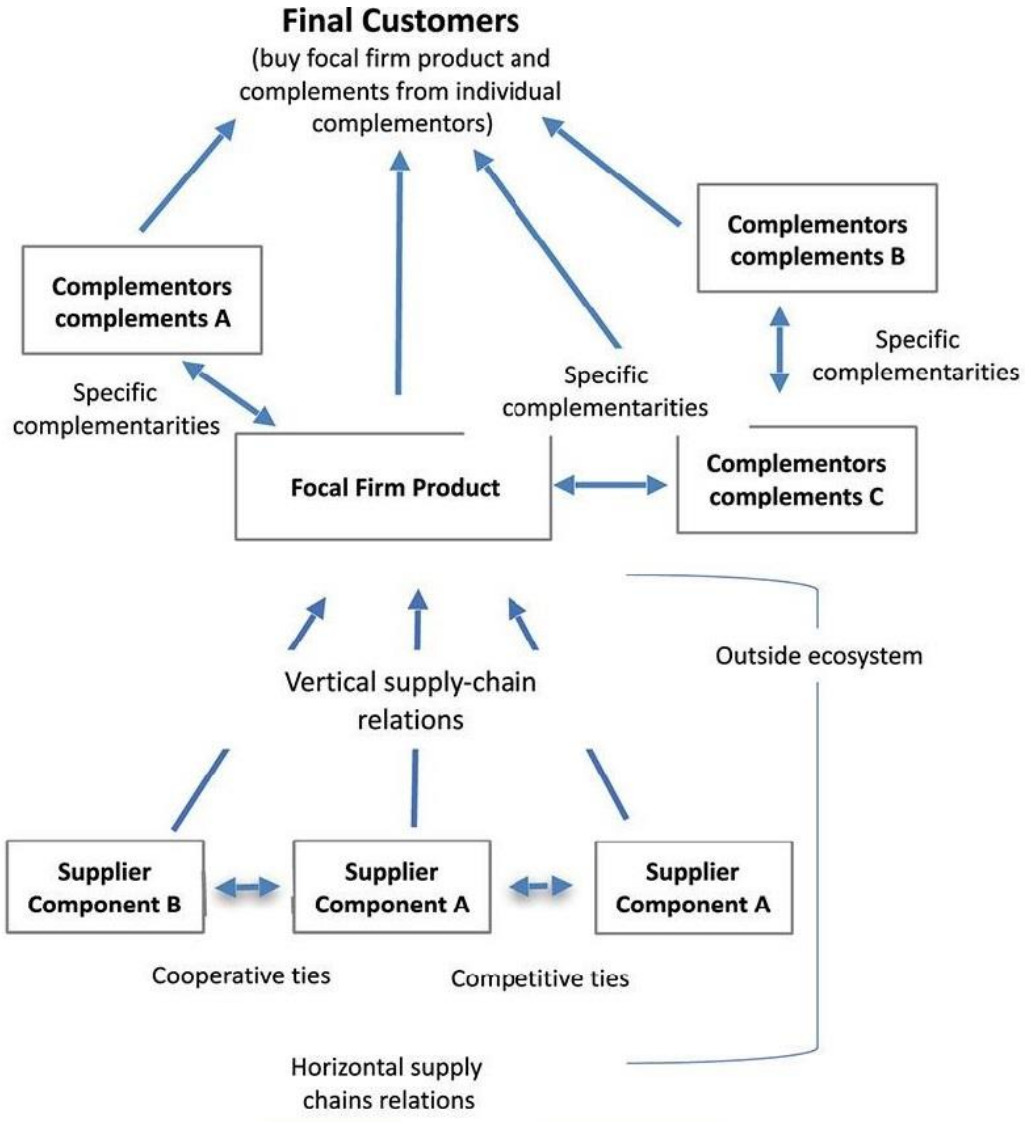


Figure from: https://www.researchgate.net/publication/323916602_Towards_a_Theory_of_Ecosystems
Figure 1: Market-based value systems

Innovation Ecosystem

Innovation ecosystem focuses on key innovations and supports upstream entities that support innovation to supplement downstream entities. The entities, companies or government agencies, collaborate to produce value-added product and propose solutions to customers (Adner, 2006). The focus of innovation ecosystem is to understand how interdependent participants interact

with each other to create and commercialize to benefit end customers, and keep the coordination within the ecosystem for sustainability purpose. (Adner & Kapoor, 2010; Adner, 2012; Kapoor & Lee, 2013) Ecosystem development lies in establishing the relationship between co-created products and their components or complementary products or services to jointly add value to customers; the extent to which companies participating in the ecosystem adjust through different arrangements will affect their ability to ultimately create value for customers (Adner, 2017). The ecosystem can form a virtual network (Iyer *et al.*, 2006) to provide focused and complementary innovations. How to share knowledge will affect the strength of the relationship between enterprises, thereby affecting the strategy development of enterprises. (Alexy *et al.*, 2013; Brusoni & Prencipe, 2013; Frankort, 2013) How knowledge sharing within ecosystem affects the strength of the relationship between enterprises, and thus affects the development and status of ecosystem as whole. (Leten *et al.*, 2013; West & Wood, 2013).

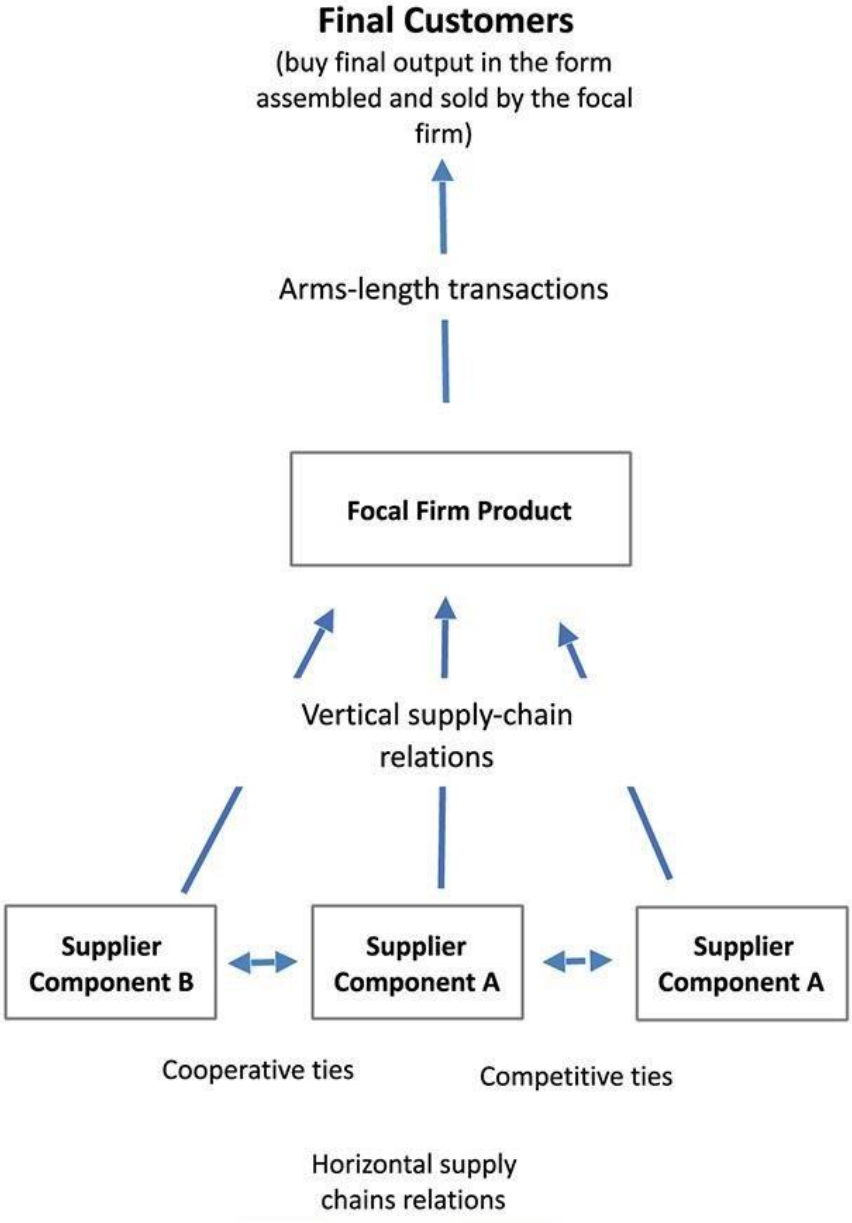


Source: https://www.researchgate.net/publication/323916602_Towards_a_Theory_of_Ecosystems
Figure 2: Ecosystem-based value systems

Platform Ecosystem

Platform Ecosystem research focuses on specific types of platform technologies, and the interdependence between platform sponsors and their complements. Based on this point of view, the ecosystem includes platform sponsors and all supplementary suppliers who make the platform more valuable to consumers (Ceccagnoli *et al.*, 2012). In essence, the platform ecosystem tends

to be radial. In the form of development, various companies connect to the platform through shared or open source technologies and technical standards. Supplementary programs can not only generate complementary innovations, but also directly or indirectly gain access to platform customers. Therefore, the platform ecosystem is seen as a "semi-regulated market" (Wareham, Fox & Cano Giner, 2014) that promotes corporate actions under the coordination and guidance of platform sponsors, or as a realization between different user groups the "multilateral market" of transactions (Cennamo & Santaló, 2013).



Source: https://www.researchgate.net/publication/323916602_Towards_a_Theory_of_Ecosystems
Figure 2: Hierarchy-based value systems

RESULTS AND DISCUSSION

The objective of this research is to assist Taiwan's traditional manufacturing industry in understanding the ecosystem, and to explore how to form an interdependent yet independent network by sorting out the complementarity and key issues of different types of ecosystems. In fact, the digital transformation of traditional industries or enterprises has considerable risks and challenges, especially in the face of unknown markets or cross-industry different thinking. It is difficult to obtain information in the evaluation process of digital transformation especially in ecosystem type strategy. So, it is relatively difficult to interpret and make decisions for the strategy forming. Based on the consideration of the past development and current situation of Taiwan's traditional manufacturing industry, strategic thinking should be more inclusive, rather than hope that a single element or component can be promoted. Based on this, this study suggests that Taiwan's traditional manufacturing industry at this stage should develop the "innovative ecosystem" strategic model.

According to the Brookings Institution (2017) the innovation study of North American regions pointed out that only a cluster of industries with an active innovation ecosystem can promote the sustainable development of sub regional towns. The key successful factors to the active innovation ecosystem are the three type of assets: physical assets, economic assets and network assets which interact with each other. Although this research discusses the digital transformation strategy of Taiwan's traditional manufacturing ecosystem, it is also important to point out a single company or enterprise needs to continuously invest in R&D and strengthen core capabilities to ensure irreplaceability in the ecosystem, or cross-domain to other the mobility of ecosystem cooperation.

CONCLUTION

At present, ecosystem research has not developed in the mainstream literature. No matter which type of ecosystem is, complementary innovation providers, products or services are required to emphasize that the output of the ecosystem must be unique or novel place. It is also the result based on this study show that the digital transformation for Taiwan's traditional manufacturing industry must shift from the import ecological view to ecosystem view. This strategy will lead enterprises to expand and promote the inclusion of different industries to cooperate, and not limited in traditional supply chain relationship. Moreover, important interdependence can still be established. However, due to the relatively complex sub-sectors of Taiwan's traditional manufacturing industry, issues such as core technology, digital application capabilities, leader behavior and intentions are needed to define by the coordination of a collection of multilateral partners interact to achieve the value propositions. Effectively balancing control of ecosystem governance and achieving the collective results have become key issues and challenges for follow-up research on ecosystem cooperation. Therefore, it is recommended that follow-up research can target specific companies as a hub, which can further deepen the network density and collaboration mode of the ecosystem. Discussing the companies increasingly participate in and respond to the growth of the ecosystem, the research results they provide will enrich the research on ecosystem types and enhance the value of mainstream strategy research for corporate transformation.

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