

Article

Establishing the Digital Transformation Strategies for the Med-Tech Enterprises Based on the AIA-NRM Approach

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Abstract: The medical technology (Med-Tech) industry turnover has reached a record high, attracting a great deal of capital investment, while mergers and acquisitions continually increase. In order to move to a higher value-added segment, traditional Med-Tech manufacturers have to transform into digital smart manufacturers. This development trend promotes industrial operators of Med-Tech to consider how to strengthen professional competence, expand their market, and determine the future direction. This study proposed the value-driving forces of Med-Tech enterprise, based on five aspects: Professional competence (PC), operation management (OM), critical resources (CR), regulatory system (RS), and market expansion (ME). Then, the acquisition and importance analysis (AIA) and the network relation map (NRM) approaches were proposed and implemented to find an optimal pathway for a Med-Tech enterprise to implement digital transformation. Our findings suggest that Med-Tech enterprises should treat RS as the priority in transformation. Finally, based on small- and medium-sized Med-Tech enterprise scenarios, we propose four development strategies (direct acquisition, strategic alliance, maintenance status, and in-house development) should be decided in the digital transformation process.

Keywords: Usage intention medical technology (Med-Tech) enterprise; small- and medium size enterprise (SME); digital transformation; acquisition and importance analysis (AIA); network relation map (NRM)

1. Introduction

With the development of modern medicine, the scale of the medical technology industry is huge and growing. The value of the global medical technology market continues to grow from 2018 to 2025. The estimated growth percentage is around 5.4%. The total annual value in 2018 is as high as 425.5 billion US dollars. It is expected to reach 612.7 billion U.S. dollars in 2025 [1]. According to SelectUSA [2], the United States is the world's largest medical device consumer market. The total consumption in 2017 reached 156 billion US dollars. It accounts for 40% of the global medical equipment market consumption. By 2023, it is expected to grow to US\$208 billion. The medical technology industry provides 2 million jobs in the United States.

The industrial structure of medical technology is dominated by large manufacturers. In the United States, pure medical technology manufacturers account for 90% of medical technology revenue

and 86% of the total market value. They make up 16% of all listed companies in the United States. In addition, European medical technology revenue (89%) and market value (90%) also come from 18 European business leaders. The net income of these European manufacturers increased by 10% [3]. American medical technology companies are in a leading position in the world with their innovative and high-tech products. The nature of the industry is that R&D expenditures account for a large part of company expenditures, accounting for an average of 7% of revenue. However, in the United States, more than 80% of medical device companies have fewer than 50 employees [2].

In 2013, Taiwan's medical technology market had sales of approximately US\$4.3 billion. Between 2008 and 2013, the compound annual growth rate was 7.9%. Moreover, there are more than 700 medical device companies in Taiwan. Most of them produce mid/low-end medical equipment. 90% of companies are engaged in the manufacture of artificial limbs for the disabled [4]. Taiwan's medical technology industry is dominated by small manufacturers. Although the manufacturer is small, the products are sold all over the world. In a globalized market environment, Med-Tech manufacturers are facing global competition with lower prices and better quality. It is necessary to find a strategy for enterprise transformation to have better competitive advantages.

In recent years, digital transformation (DT) has declared that companies must participate in these new information technologies by formulating "strategies that embrace the implications of digital transformation and drive better operational performance" [5]. Digital transformation has the analytics capability of big data and brings a lot of opportunities to traditional enterprises. Researchers have been contributing studies of enterprising digital transformation in all sorts of perspectives. For example, Rahayu et al. [6] discussed the application of marketing 4.0 in the pharmaceutical industry. Marketing 4.0 proposes a new concept to enhance the relationship between brands and customers, including brand identity, brand image, brand integrity, and brand interaction to meet customer needs. It is not only used on the Internet and social media, but also in aggressive sales activities. Another hot research topic of digital transformation is industry 4.0. Pech, Martin, and Vrchota [7] proposed a classified method for small- and medium-sized enterprises for their level of implementation industry 4.0. The research results show that large enterprises have greater chances to have successful digital transformation. Moreover, Redondo, Corchado, and Sedano [8] developed an exploratory visualization technique for the automotive industry as an implementation tool for industry 4.0. These visual data analytics assisted a multinational company in an intuitive and informative way to monitor machines in order to anticipate failures. Furthermore, based on AUDI's three steps of developing the analysis of big data, Dremel, Wulf, Herterich, Waizmann, and Brenner [9] proposed a way to establish the analysis of big data successfully in traditional manufacturers, and a technique to control the related organization's transformations. In addition, Schalock, Verdugo, and van Loon [10] studied the pattern of organizational transformation, including transformation pillars, transformation strategies, organization ability, and organization outputs and results in the human service industry. By a case of the pattern's application, expounding on the useful and learned experience accumulated was presented. Then, Schimanski, Monizza, Marcher, and Matt [11] armed on the construction industry and proposed a Building Information Modeling to representing a key driver for digital transformation. By applying a design method, the study developed artefacts for the business processes automation. Moreover, Chen, Lin, and Wu [12] evaluated organization-driven barriers for big data healthcare information system implementations. They applied an analytic network process approach to suggest an appropriate transformation strategy for the organization.

Among sorts of consideration, scholars proposed evaluation models to analyze their importance, relationships, or priorities. For example, Lin, C. [13] proposed an innovation opportunity analysis-Network Relation Map (IOA-NRM) approach to assist enterprises in analyzing their value-driving forces for digital transformation for the appropriate tourism transformation strategy decision. Moreover, Wang, Lin, Chia, Chung, and Lee [14] developed a satisfied importance analysis (SIA) to evaluate the performance of each division and the decision making trial and evaluation laboratory technique (DEMATEL) to capture the causal relationships among divisions and generate an

influence–relationship map. Moreover, Wang, Lin, Wang, Liu, and Lee [15] processed an importance–satisfaction analysis (ISA) model to evaluate the performance of each delay factor and an influence–relations map (IRM) capture the relationship among factors.

As most Med-Tech enterprises are small- and medium-sized traditional manufacturers, digital transformation is a great opportunity for them to gain competitive advantages and move to the next stage. The enterprises have to evaluate the current enterprise situation by different aspects, criteria, forces, or factors before setting up the right transformation strategy. However, there is no digital transformation study focusing on Med-Tech enterprises. The present study evaluates Med-Tech enterprises from driving forces to suggest the appropriate path to implement digital transformation by proposing five different aspects and developing a new factor evaluation approach. The five aspects include professional competence (PC), operation management (OM), critical resources (CR), regulatory system (RS), and market expansion (ME) that should be considered while conducting digital transformation for a Med-Tech enterprise. Then, the study proposes new acquisition-importance analysis (AIA) approach to determine the acquisition and importance of various aspects. Moreover, the influence relation structure of aspects can be evaluated by network relations map (NRM) approach. Therefore, the AIA-NRM approach can aid decision-makers in identifying any gaps in the evaluating aspects, finding the best path, and determining strategies for the Med-Tech enterprise. The study includes five sections. Section 2 reviews the related literature of the critical driving factors of the digital transformation for the Med-Tech industry. Section 3 develops operational definition of five driving forces and introduces the AIA-NRM approach. Section 4 provides an empirical case of digital transformation of the Med-Tech industry and determines the best-suited implementation paths through the AIA-NRM approach. Section 5 is the conclusions and recommendations for the digital transformation of the Med-Tech industry.

2. Literature Review

2.1. Driving Forces of Enterprise Transformation

Since Porter [16] established the driving forces of the manufacturing enterprise to transform into the next stage of business operation. There have been sorts of the list of factors considered by different researchers. Porter first proposed the famous five driving forces, including high qualified employees and suppliers, access to specialized information, complementary relationships, access to institutions and public goods, and better motivation and performance measurements. Then, Porter [17] provided further studies about factors for enterprise transformation. First, the enterprise has to review the factors (input) conditions. It might be natural resources, human resources, capital resources, the physical infrastructure, the information infrastructure, the scientific and technological infrastructure. Secondly, the demand conditions may include the local demand, the future expected local demand, the maturity of local customers, and the local demand that could be globalized. The third aspect is firm strategies and challenges, including a local situation that encourages appropriate arrangements of investment and sustained advancement and vital competition among locally-based challengers. The last aspect is about the correlated and supporting industries, including the existing competence, local suppliers, and the existing industrial competition.

Based on Porter's studies, Furman et al. [18] considered four driving forces, including input, demand, steady strategy and competition, and related and supporting industries for information transformation. They developed second-order forces of each aspect. There are four sub-factors of input, including human resources, basic research infrastructure, information infrastructure, and sufficient supply of risk capital. Then, they developed two considerations of demand, the demand of local clients and the future predictable local demand. The third situation for steady strategy and competition contains two sub-factors. One is the innovative activity and the other one is the competition among locally-based rivals. Finally, related and supporting industries also have two sub-factors,

namely the capabilities of local suppliers and related companies and the existence of clusters rather than isolated industries.

Furthermore, Lin et al. [19] developed four factors for information computer technology enterprise transformation: Human resources, technology, money, and market. Also, Lin and Tzeng [20] proposed four driving forces based on the perspectives of information computer technology enterprises, including human resources, technological resources, investment environment, and market development. Moreover, for the same industry, Pique, Berbegal-Mirabent, and Etzkowitz, [21] presented five driving forces of the industrial innovation ecosystem, including the rise of accelerator programs, an early arrangement of corporations with startups, the geographical extension of Silicon Valley, an growing commitment of universities with investment funds, and the rise of micro-multinationals because of faculty shortage and fierce competition in the area.

In short, driving forces provide the aspects of enterprise transformation considerations. Different features of the industry would lead to different contexts of consideration. This present study focuses on Med-Tech enterprise, as the small- and medium-sized enterprise scenario. Therefore, the factors of digital transformation for Med-Tech enterprises would be different from the manufacturing industry, information computer technology, or service industry.

2.2. Professional Competence (PC)

Many 1990s research has been interested in analyzing the “core competence” of an organization as a key resource to define competitive advantage [22–24]. Hamel and Prahalad [25] proposed the definition of core competence as mutual learning in the organization in order to coordinate varied production skills and join in multiple streams of technologies. Based on the resource-based theory, sustained competitive advantage is developed from a firm’s internal resources for product or service value-adding. These resources are unique or rare, difficult for competitors to emulate, and non-substitutable [26,27]. The core competence would focus on the importance of learning and path dependency in the transformation. Moreover, it can recognize the multifaceted interaction of people, skills, and technologies that drives firm performance [28].

SME has an advantage about reaction of investment at new technologies or products [29]. However, SME needs to enhance the professional ability to involve effectively in opportunity recognition and evaluation [30]. Man et al. [31] investigated 255 successful SMEs about enterprise competence which was represented by strategic, conceptual, opportunity, relationship and technical skills. Enterprise competence increases organizational abilities in developing new products, services, or processes. Moreover, Abdul Mohsin et al. [32] focused on how innovative behavior would be affected by strategic and conceptual competencies. Letonja et al. [33] emphasized that the entrepreneurial competences have strong relationship with their innovative abilities. This would make greater competitiveness of family SMEs. In short, enterprise professional competences should be considered as one of the key factors of evaluating driving forces of enterprise digital transformation.

2.3. Operation Management (OM)

Slack (2001) defined operation management as “the set of activities that create goods and services through the transformation of inputs into outputs”. According to OperationsAcademis.org [34], operations management can be defined as the management of business practices to generate the most efficient procedure as possible in an organization. It is mainly concerned with planning, organizing, and supervising in the frameworks of production, manufacturing, or the delivery of services. Chase, Jacobs, and Aquilano [35] described operation is one of the three major functions, marketing, finance, and operations of any business. For a manufacturer, operation management is specific pointed to an organization’s productive resources or its production system.

2.4. Critical Resources (CR)

Wernerfelt (1989) defined critical resources as the unique resources that can differentiate from competitors [36]. On the other hand, scholars studying on project management identify critical activities and critical paths by certain resource constraints to arrange project schedule [37–40]. Badiru [41] proposed critical resource diagram (CRD) as a diagram tool to manage resources. Moreover, Cui, Qin, Cao, Yue, and Yin [42] treated time as a critical resource when discussing the project makespan. They developed an algorithm to decrease idle resources and increase project efficiency by utilizing critical resources in certain intervals.

2.5. Regulatory System (RS)

According to WHO Global Model Regulatory Framework for Medical Devices, there are over 2 million kinds of medical devices on the market today. The Global Medical Device Nomenclature Agency has classified more than 22,000 basic device groups for medical devices (Source: GMDN Agency). However, many countries are lack of regulatory systems for medical devices. WHO decided to provide guidance for WHO Member States to progress their regulatory system of medical devices and continue to develop their regulatory frameworks to ensure the quality and safety in their countries [43]. Med-Tech SMEs have to follow the particular regulatory system in order to produce their products.

2.6. Market Expansion (ME)

Market penetration refers to the successful selling of a product or service in a specific market. An effective market penetration strategy can definitely increase customer base and the quantity of products sold for a company [44]. Some scholars concerned about market trends and strategy in different industries. For example, Ko [45] conducted research from the perspective of external environment and internal resources to observe the trends of the construction market. The key successful factors includes corporate brand, target market, location selection, product positioning, design and planning, building materials equipment, financial stability, and the handling of land. Moreover, Richard and Mark [46] developed an organic products demand model to explore the relationship between product assortment and the market share. They used a structural model of demand to test the market stealing and market expanding effects of new product introductions in the organic coffee segment. They found that the market expansion effect dominates the market stealing effect for almost all participants. The largest market share gains for organic products are not to be had among the strongest organic families, but rather among the moderately keen organic households. Indeed, market expansion would be one of the important considerations of Med-Tech SME managers.

3. Research Model

3.1. The Research Structure

This section proposes the model of digital transformation strategies based on the AIA-NRM for the Med-Tech enterprises. This study defines the critical decision problem of digital transformation for the Med-Tech enterprise, and then identifies the aspects/criteria that influence the driving factor of digital transformation by the expert interviews and literature review. In the second stage, the study measures the acquisition and importance for each aspect/criterion based, on the AIA (acquisition–importance analysis) approach. We also determined the influence relation structure of the digital transformation through the NRM (network relation map) approach. Then, the study integrated the AIA (acquisition–importance analysis) approach and NRM approach to propose the AIA-NRM (acquisition–importance analysis and network relation map) approach for digital transformation of the Med-Tech industry.

The AIA-NRM approach also offers the best-suited development path approach based on the aspects/criteria rank of acquisition and importance level. The analytical process of AIA-NRM includes six stages: (1) Defining the critical decision problems, (2) establishing the aspects/criteria for an

evaluation model of digital transformation, (3) measuring the aspects/criteria status based on the AIA approach, (4) measuring and establishing the influence relation structure using the NRM approach, (5) integrating the AIA (acquisition–importance analysis) approach and the NRM approach to establish the digital transformation strategies based on the AIA-NRM approach, and (6) establishing the suited development paths through the aspects/criteria rank of acquisition and importance level, as shown in Figure 1.

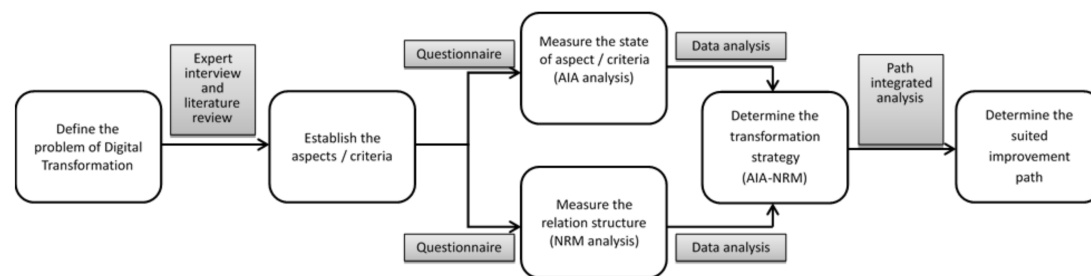


Figure 1. Research structure.

3.2. The Aspects/Criteria Design

Digital transformation offers unprecedented opportunities for small- and medium-sized enterprises (SMEs). However, many entrepreneurial SMEs lack the capabilities to perform digitalization. Thus, based on the literature reviews, the present study establishes five aspects of Med-Tech enterprises to evaluate their digital transformation determination. Then, we conducted expert interviews to have the following sub-order driving forces. There were 18 experts involved in this study, including five Med-Tech international enterprise owners, three government agencies or Med-Tech association managers, two experienced professors who involved practical projects, two Med-Tech vice presidents with R&D specialty, two Med-Tech vice presidents with sales and marketing specialty, and four doctors and pharmacists. They are all experienced experts in Taiwan. Based on the results of the literature collection and analysis, multiple possible aspects can be selected. Then use the results as the main interview question. After many interviews with experts, its content was organized into draft verbatim records. Then merge similar results to become the source of questionnaire design as the following definitions.

With regard to PC for small- and medium-sized enterprises of Med-Tech industry, this present study defines four driving forces, including product innovation capability (PC1), R&D and manufacturing capability (PC2), marketing capability (PC3), and branding capability (PC4). The PC1 (product innovation capability) means that Med-Tech manufacturer can enhance the company's operating margin and can effectively, through product innovation capability and reducing and price competition with homogenization of products. The PC2 (R&D and manufacturing capability) means medical material manufacturers can increase the products' differentiation with competitors by improving research and development capabilities and control manufacturing costs through manufacturing capabilities. The PC3 (marketing capability) shows that medical material manufacturers can improve their revenue forecasting capabilities by understanding market demand changes and industrial development trends and can deploy organizational resources effectively. The PC4 (branding capability) means medical material manufacturers can get rid of the low-margin OEM problem by establishing their brands and thereby increase their business benefits by their brand.

In the OM aspect, this study defines four driving forces of digital transformation, including OM1 (stable cash flow), OM2 (motivate all team members to transform), OM3 (mergers and acquisitions), and OM4 (international operation experience). OM1 (stable cash flow) means that medical material manufacturers must consider whether conflicts with existing brand manufacturers require moving to their own brands and need to assess the impact of reduced OEM income; OM2 (motivate all team members to transform) implies that company leaders must assess the impact of transformation and let members

have unity of purpose to help reduce the transformation impact. OM3 (mergers and acquisitions) means that the company must overcome their own lack of resources through mergers and acquisitions in the process of transformation and improve the company's competitiveness through complementary resources. OM4 (international operation experience) implies that the company improves market sales and operation by understanding various countries' customs and user habits in international markets.

This study induces four driving forces of digital transformation in the CR, which include CR1 (fundraising), CR2 (obtaining key resources), CR3 (Obtaining market information), and CR4 (training multifunctioning team members). The CR1 (fundraising) means that medical material manufacturers want to promote their own branded products to the market by obtaining sufficient resources for brand promotion, channel preparation, and related matters. The CR2 (obtain key resources) means that the medical material manufacturer can successfully sell their products to the market by determining the availability of sufficient sources of critical components or raw materials for the production process. The CR3 (obtain market information) means the medical material manufacturer can successfully put their products into the channel of commerce by understanding the different kinds of market information, including local culture and habits of consumers in the country of sale. The CR4 means that the medical material manufacturers can transform from OEM to OBM by developing relevant professional sale and marketing, channel establishing, IP and regulatory, and technology integration, as shown in Table 1.

Table 1. The descriptions of aspects/criteria for the digital transformation of Med-Tech enterprises.

Aspects/Criteria	Descriptions
Professional Competence (PC)	
Product innovation capability (PC1)	Medical material manufacturers can enhance the company's operating margin and can effectively through product innovation capability reduce and price competition with a homogenization product.
R&D and manufacturing capability (PC2)	Medical material manufacturers can increase the products' differentiation with competitors by improving research and development capabilities and control manufacturing costs through manufacturing capabilities.
Marketing capability (PC3)	Medical material manufacturers improve their revenue forecasting capabilities by understanding market demand changes and industrial development trends and can deploy organizational resources effectively.
Branding capability (PC4)	Medical material manufacturers can get rid of the low-margin OEM problem by establishing their brands and increasing their business benefits by their brand.
Operation Management (OM)	
Stable cash flow (OM1)	Medical material manufacturers must consider conflicts with existing brand manufacturers when moving in their own brands and need to assess the impact of reduced OEM income.
Motivate all team to transform (OM2)	Company leaders must assess the impact of transformation and let members have unity of purpose to help reduce the transformation impact.
Merge and acquisition (OM3)	The company must obtain their own lack of resources through mergers and acquisitions in the process of transformation and improve the company's competitiveness through complementary resources.
International operation experience (OM4)	The company improves market sales and operations by understanding various countries' customs and user habits in international markets.

Table 1. Cont.

Aspects/Criteria	Descriptions
Critical Resources (CR)	
Fundraising (CR1)	Medical material manufacturers want to promote their own branded products to the market by obtaining sufficient resources for brand promotion, channel preparation, and related matters.
Obtain key recourse (CR2)	The medical material manufacturer can successfully sell their products to the market by determining the availability and sources of critical components or raw materials for the production process.
Obtain market information (CR3)	The medical material manufacturer can successfully put their products into the channel by understanding the different market information, including local culture and habits of consumers in the country of sale.
Train multifunction team member (CR4)	The medical material manufacturer from OEM to OBM medical material manufacturer by developing relevant professional sale and marketing, channel establishing, IP and regulatory, and technology integration.
Regulatory System (RS)	
Approve by international certification (RS1)	The medical material manufacturer who wants to manufacture and sell medical-related products must plan to obtain FDA/CE/GMP and other international medical equipment certification.
Approve by local sales certification(RS2)	The medical material manufacturers sell medical products in the different countries and regions by obtaining the inspection of the competent local authority and get a local sales permit.
Approve by health insurance (RS3)	The medical material manufacturer sells medical products in the different countries and regions by understanding the payment system and insurance system for medical certification in the country.
Apply intellectual property (RS4)	The medical material manufacturer produces medical-related products by carrying out intellectual property rights distribution and obtaining relevant intellectual property protections, such as local patents/trademarks in the country of sale.
Market Expansion (ME)	
Build up reputation (ME1)	The medical material manufacturer enters the market initially with lack of popularity; they need to spend more time and resources to obtain the approval of the channel and gain consumers' favor.
Connect channels (ME2)	The medical material manufacturer enters the market initially; they can speed up product sales by learning more about local consumers' needs and finding the channel trusted by the locals.
Influence by National image (ME3)	The medical material manufacturer enters the market initially; they are affected by the image of their country of production, therefore have to assess for themselves the image of the state of the producing countries.
Understand different culture (ME4)	Because of the differences in culture and habits in different markets, the medical material manufacturer needs to understand the cultural differences of local countries when entering the market.

This study induces four driving forces of digital transformation in the RS, which include RS1 (approved by international certification), RS2 (approved by local sales certification), RS3 (approve by health insurance), and RS4 (apply intellectual property). The RS1 (approved by international certification) means the medical material manufacturer who wants to manufacture and sell medical-related products must plan to obtain Food and Drug Administration (FDA)/Conformity with European (CE)/Good Manufacturing Practice (GMP) and other international medical equipment certifications. RS2 (approved by local sales certification) implies the medical material manufacturers sell medical products in the different countries and regions by obtaining inspection by the competent local authority and get a local sales permit. RS3 (approved by health insurance)

means that the medical material manufacturer sells medical products in the different countries and regions by understanding the payment system and insurance system for medical certification in each country. RS4 (apply intellectual property) means that the medical material manufacturer produces medical-related products by carrying out intellectual property rights distribution and obtaining relevant intellectual property protections, such as local patents/trademarks in the country of sale, as shown in Table 1.

This study induces four driving forces of digital transformation in the ME, which include ME1 (building up reputation), ME2 (connecting channels), ME3 (influence by national image) and ME4 (understand different cultures). The ME1 (building up reputation) implies the medical material manufacturer enters the market initially with a lack of popularity; they need to spend more time and resources to obtain the approval of the channel and gain consumers' favor. ME2 (connect channels) mean that the medical material manufacturer enters the market initially; they can speed up product sales by learning more about local consumers' needs and finding the channel most trusted by the locals. ME3 (influence by national image) means that when the medical material manufacturer enters the market initially. they are affected by the image of their country of production, therefore needing to assess for themselves the image of the state of the producing countries. ME4 (understand different culture) implies that because of the differences in culture and habits in different markets, the medical material manufacturer needs to understand the cultural differences of local countries when entering the market, as shown in Table 1.

3.3. The Research Design and the Reliability Analysis

This study aggregates the stakeholders' interview results and generalizes five aspects (professional competence, operation management, critical resources, regulatory system, and market expansion) and 25 criteria. The aspects/criteria can be generalized based on the interview result of stakeholders (vender, distribution and end users) of the Med-Tech industry. This study also checks the aspect/criteria by the stakeholders by having them finish the 30-question preparatory test. The data collection methods included the paper questionnaire and the online questionnaire. A total of 108 questionnaires were collected, and 80 of them were valid samples. This study adopts the indicator of Cronbach's Alpha (Cronbach α) to evaluate the reliability of acquisition and importance for each aspect/criterion. The Cronbach's Alpha of the Acquisition index (AI) was 0.920, and then the Cronbach α of the AD was higher than the suggested level of 0.7 (Cronbach $\alpha > 0.7$), the Cronbach's Alpha of the Importance index (II) was 0.949, and the Cronbach's Alpha of the ID was also higher than the suggested level of 0.7 (Cronbach $\alpha > 0.7$). So, the reliability of the acquisition index and importance index were highly consistent. In addition, the Cronbach's Alpha of the aspect of evaluation system was 0.922, and the Cronbach α was higher than 0.7 (Cronbach) $\alpha > 0.7$ as shown in Table 2.

Table 2. The analysis of reliability (Cronbach α).

Aspects/Criteria	Alpha	Result
Acquisition index (AI)	0.920	High
Importance index (II)	0.949	High
Aspects of evaluation system	0.922	High

Note: Cronbach suggest Alpha α -value: $\alpha \leq 0.35$ are low reliability, $0.35 < \alpha < 0.70$ Middle reliability, $\alpha \geq 0.7$ is high reliability.

4. Empirical Analysis

4.1. The Analysis of the AIA (Acquisition–Importance Analysis) Approach

The axes on the competency position map include the AI and the II. The AI evaluates the acquisition level from the Med-Tech business viewpoint, while the II shows the importance level for

the Med-Tech business. As shown in Figure 2, the x -axis is the Acquisition Dimension (AD), and the y -axis is the Importance Dimension (ID). In this study, the digital transformation strategies for the Med-Tech industry include five aspects, PC, OM, CR, RS, and ME.

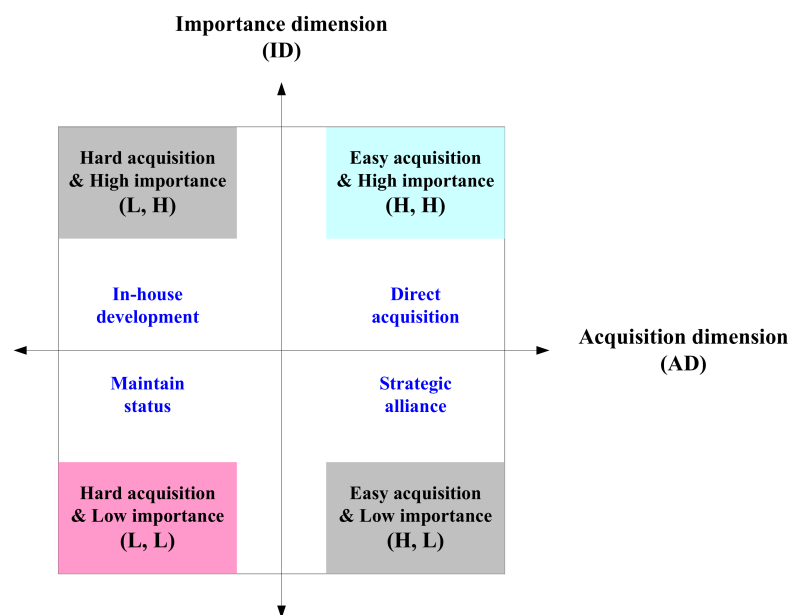


Figure 2. The concept map of AIA (acquisition–importance analysis).

The position map of the digital transformation strategies for the Med-Tech industry is divided into four quadrants. The first quadrant (H, H) represents a high AD and high II (importance index). The aspects in the first quadrant mean that the Med-Tech businesses consider the segment as an acquisition and deserving of importance. Thus, the aspects in the first quadrant are called “easy acquisition and high importance (H, H)”. The second quadrant (L, H) represents a low AI but a high II (importance index). The aspect in the second quadrant means that the Med-Tech businesses do not consider the segment as a hard acquisition, but they still think these aspects/criteria are important and critical. Thus, the segment in the second quadrant is called “hard acquisition and high importance (L, H)”. The third quadrant (L, L) represents a low AI and a low II. The aspects in the third quadrant mean that the Med-Tech businesses consider the segment as a hard acquisition, and they also do not think their aspects/criteria are important. The segment in the third quadrant is called “hard acquisition and low importance (L, L)”. Last, the fourth quadrant (H, L) represents a high AD and low ID. The aspects in the fourth quadrant mean that, although the Med-Tech businesses consider the segment is an easy acquisition, they do not believe these aspects/criteria are important and critical. Consequently, the segment in the fourth quadrant is called “easy acquisition and low importance (H, L)”.

The aspect of RS and PC was located in the second quadrant (L, H), indicating that the aspect of RS and PC were characterized by low AI and high II. Hence, the Med-Tech businesses consider that the aspect of RS and PC are hard acquisitions and of high importance for the digital transformation. Although the Med-Tech businesses do not consider the acquisition as easy, the RS aspect and PC aspect, but the aspects of RS and PC are the critical and important aspects, the Med-Tech businesses should consider developing the professional competence and establish the regulatory system through in-house development. Therefore, the development strategy of in-house development should be applied in the second quadrant. The aspects of CR and ME were located in the third quadrant (L, L), indicating that the aspects of CR and ME were characterized by a low AI and a low II. Hence, the Med-Tech businesses consider that the aspects of CR and ME are hard acquisition and of low importance for the digital transformation. Although the Med-Tech enterprises consider critical resources and market expansion ability are hard to acquire, but the CR aspect and ME aspect still

do not involve the critical and important aspects, and the Med-Tech enterprises can maintain the current status. Therefore, the development strategy of maintaining the status quo can be applied in the third quadrant.

The OM aspect located in the fourth quadrant (H, L), indicating that the aspect of OM was characterized by high AI and low II. Hence, the Med-Tech enterprises consider that the OM aspect is an easy acquisition but of low importance for the digital transformation. Although the Med-Tech enterprises consider the ability and resource of operation management as easy to acquire, the OM aspect is not a critical and important aspect; the Med-Tech enterprises can form alliances with other support chain partners. Therefore, the development strategy of strategic alliance can be applied in the fourth quadrant, as shown in Table 3 and Figure 3.

Table 3. The AIA analysis of digital transformation.

	Acquisition (AI)		Importance (II)		(AI, II)
	MA	SA	MI	SI	
Professional competence (PC)	2.103	−0.934	8.584	0.858	(L, H)
Operation management (OM)	2.519	1.687	7.775	−1.569	(H, L)
Critical resources (CR)	2.231	−0.126	8.263	−0.107	(L, L)
Regulatory system (RS)	2.231	−0.126	8.594	0.887	(L, H)
Market expansion (ME)	2.172	−0.501	8.275	−0.069	(L, L)
Average	2.251	0.000	8.298	0.000	
Standard deviation	0.159	1.000	0.333	1.000	
Maximum	2.519	1.687	8.594	0.887	
Minimum	2.103	−0.934	7.775	−1.569	

Note 1: (H, H) is the criteria of easy acquisition and high importance, (L, H) is the criteria of hard acquisition and low importance; (L, L) is the criteria of hard acquisition and low importance and (H, L) is the criteria of easy acquisition and low importance. Note 2: MA, SA, MI, and SI stand for acquisition value, standardized acquisition value, importance value, and standardized importance value, respectively.

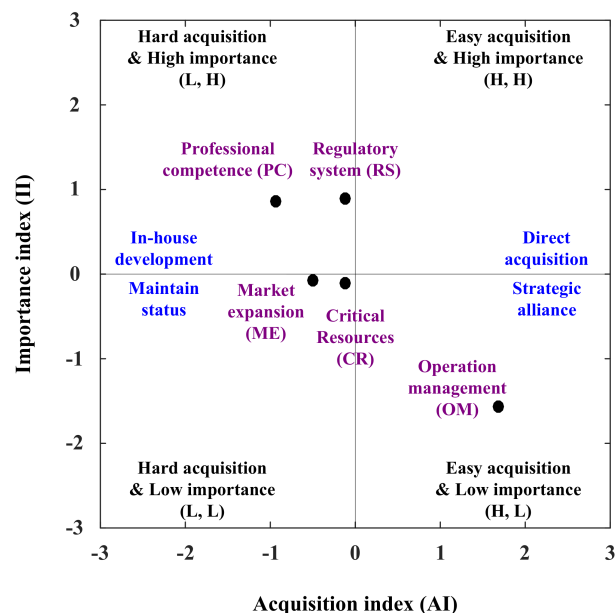


Figure 3. The AIA (acquisition–importance analysis) analysis.

4.2. The NRM Analysis Based on the DEMATEL Technique

The DEMATEL technique was adopted to construct the structure of the network relationships map (NRM) for the digital transformation of the Med-Tech industry. When users are making decisions about the digital transformation of the Med-Tech industry, there are many criteria they may consider. The most common problem they face is how these aspects impact each other. Therefore, before making development decisions, it is necessary to know the essential aspects and then make useful improvements to enhance the overall capability of digital transformation. When a decision-maker needs to develop many aspects, the best way to handle this is to determine the aspects that most impact others and improve them.

Recent studies have used the DEMATEL techniques for solving complex problems, such as the analysis of user interface [47], failure sorting evaluation system [48], the innovation policy portfolios of Taiwan's SIP Mall industry [49], the evaluation system of e-learning programs [50], the evaluation system of knowledge management strategy [51], the value-created systems of science (technology) parks [20], and the key success factors of block-chain for sustainable supply chain [52], the selection of R&D projects for energy sector based on the fuzzy based approach [53]. This study divides DEMATEL into five steps: (1) Calculate the original average matrix, (2) calculate the direct influence matrix, (3) calculate the indirect influence matrix, (4) calculate the full influence matrix, and (5) analyze the NRM (network relation map).

(1) Calculate the original average matrix

Respondents were asked to indicate the influence that they believed each aspect exerts on each of the others according to a scoring scale ranging from 0 to 4. "0" means no influence, whereas "4" means "extreme influence" between aspect/criterion. "1", "2", and "3" mean "low influence", "medium influence" and "high influence" respectively [54]. As shown in Table 4, the influence that "PC" has on "CR" is 2.688, which means "medium influence." The influence that "RS" has on "PC" is 2.713, which also means "medium influence" as shown in Table 4.

Table 4. The original average influence matrix (A).

Aspects	PC	OM	CR	RS	ME	
Professional competence (PC)	0.000	2.700	2.688	2.663	2.850	10.900
Operation management (OM)	2.813	0.000	2.938	2.575	2.788	11.113
Critical resources (CR)	2.963	2.975	0.000	2.588	2.713	11.238
Regulatory system (RS)	2.713	2.638	2.575	0.000	2.863	10.788
Market expansion (ME)	2.575	2.825	2.638	2.563	0.000	10.600
Total	11.063	11.138	10.838	10.388	11.213	-

(2) Calculate direct influence matrix

From Table 4, we processed the "Original average influence matrix" (A) by Equations (1) and (2) and got the "Direct influence matrix" (D). As shown in Table 4, the diagonal items of D are all 0, and the sum of a row is at most 1. Then we got Table 5 by adding up rows and columns. In Table 6, the sum of row and column for "Operation management (OM)" is 1.980, which is the most important influence aspect. On the other hand, the sum of row and column for "Regulatory system (RS)" is 1.884, which is the least essential influence aspect.

$$D = sA, s > 0 \quad (1)$$

where

$$s = \min_{i,j} [1 / \max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}, 1 / \max_{1 \leq j \leq n} \sum_{i=1}^n a_{ij}], s = \min_{i,j} [1 / \max_{1 \leq i \leq n} \sum_{j=1}^n a_{ij}, 1 / \max_{1 \leq j \leq n} \sum_{i=1}^n a_{ij}], i, j = 1, 2, \dots, n \quad (2)$$

Table 5. The direct influence matrix (D).

Aspects	PC	OM	CR	RS	ME	Total
Professional competence (PC)	0.000	0.240	0.239	0.237	0.254	0.970
Operation management (OM)	0.250	0.000	0.261	0.229	0.248	0.989
Critical resources (CR)	0.264	0.265	0.000	0.230	0.241	1.000
Regulatory system (RS)	0.241	0.235	0.229	0.000	0.255	0.960
Market expansion (ME)	0.229	0.251	0.235	0.228	0.000	0.943
Total	0.984	0.991	0.964	0.924	0.998	-

Table 6. The degree of direct influence.

	Sum of Row	Sum of Column	Sum of Row and Column	Importance of Influence
Professional competence (PC)	0.970	0.984	1.954	3
Operation management (OM)	0.989	0.991	1.980	1
Critical resources (CR)	1.000	0.964	1.964	2
Regulatory system (RS)	0.960	0.924	1.884	5
Market expansion (ME)	0.943	0.998	1.941	4

And $\lim_{m \rightarrow \infty} D^m = [0]_{n \times n}$, where $D = [x_{ij}]_{n \times n}$, when $0 < \sum_{j=1}^n x_{ij} \leq 1$ or $0 < \sum_{i=1}^n x_{ij} \leq 1$, and at least one $\sum_{j=1}^n x_{ij}$ or $\sum_{i=1}^n x_{ij}$ equals one, but not all. So, we can guarantee $\lim_{m \rightarrow \infty} D^m = [0]_{n \times n}$.

(3) Calculate indirect influence matrix

The indirect influence matrix can derive from Equation (3), as shown in Table 7.

$$ID = \sum_{i=2}^{\infty} D^i = D^2(I - D)^{-1} \quad (3)$$

Table 7. The indirect influence matrix (ID).

Aspects	PC	OM	CR	RS	ME	Total
Professional competence (PC)	6.885	6.882	6.731	6.500	6.913	33.911
Operation management (OM)	6.943	7.036	6.829	6.604	7.023	34.435
Critical resources (CR)	7.006	7.049	6.951	6.669	7.095	34.770
Regulatory system (RS)	6.779	6.824	6.676	6.489	6.853	33.621
Market expansion (ME)	6.691	6.725	6.584	6.359	6.811	33.169
Total	34.305	34.516	33.771	32.621	34.694	-

(4) Calculate the full influence matrix

The full influence matrix T can be derived from Equation (4) or (5); Table 8 is the calculated full influence matrix. As shown in Table 8, the full influence matrix [11] consists of multiple elements, as indicated in Equation (6). The sum vector of row value is [53], and the sum vector of column value is [53]; the sum vector of row value plus column value is $\{d_i + r_i\}$, which describes the full influence of matrix T . As the sum of row value plus column value $\{d_i + r_i\}$ is higher, the correlation of the dimension or criterion is stronger. The sum of row value minus column value is $\{d_i - r_i\}$, which describes the net influence relationship. If $d_i - r_i > 0$, it means the degree of influencing others is stronger than the degree of being influenced. As shown in Table 9, the OM has the highest degree of full influence ($d_3 + r_3 = 70.930$). The aspects of CR and RS are the highest net influence ($d_4 - r_4 = 1.036$). The order of other net influences is listed as follows: OM ($d_3 - r_3 = -0.084$), PC ($d_2 - r_2 = -0.408$), and last, the ME ($d_1 - r_1 = -1.580$).

$$T = D + ID = \sum_{i=1}^{\infty} D^i \quad (4)$$

$$T = \sum_{i=1}^{\infty} D^i = D(I - D)^{-1} \quad (5)$$

$$T = [t_{ij}], \quad i, j \in \{1, 2, \dots, n\} \quad (6)$$

$$d = d_{n \times 1} = \left[\sum_{j=1}^n t_{ij} \right]_{n \times 1} = (d_1, \dots, d_i, \dots, d_n) \quad (7)$$

$$r = r_{n \times 1} = \left[\sum_{i=1}^n t_{ij} \right]'_{1 \times n} = (r_1, \dots, r_j, \dots, r_n) \quad (8)$$

Table 8. The full influence matrix (T).

Aspects	PC	OM	CR	RS	ME	d
Professional competence (PC)	6.885	7.122	6.970	6.737	7.167	34.881
Operation management (OM)	7.193	7.036	7.090	6.833	7.271	35.423
Critical resources (CR)	7.270	7.314	6.951	6.899	7.336	35.770
Regulatory system (RS)	7.020	7.059	6.905	6.489	7.108	34.581
Market expansion (ME)	6.920	6.976	6.819	6.587	6.811	34.112
r	35.289	35.507	34.735	33.545	35.692	-

Table 9. The degree of full influence.

Aspects	[53]	[53]	{d + r}	{d - r}
Professional competence (PC)	34.881	35.289	70.170	-0.408
Operation management (OM)	35.423	35.507	70.930	-0.084
Critical resources (CR)	35.770	34.735	70.505	1.036
Regulatory system (RS)	34.581	33.545	68.126	1.036
Market expansion (ME)	34.112	35.692	69.805	-1.580

(5) Analyze the NRM (Network relation map)

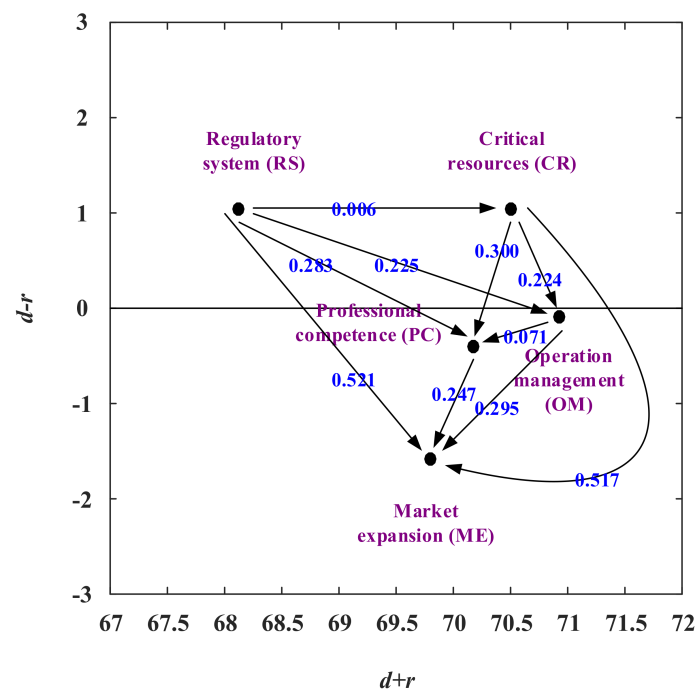
Experts were invited to discuss the relationships and influence levels of criteria under the same aspects/criteria defined in Table 1 and to score the involvement and influence among criteria based on the DEMATEL technique. Aspects/criteria are divided into different types, so the experts could answer the questionnaire in areas/fields with which they were familiar. The net full influence matrix, C_{net} , is determined by Equation (9).

$$C_{net} = [t_{ij} - t_{ji}], \quad i, j \in \{1, 2, \dots, n\} \quad (9)$$

The diagonal items of the matrix are all 0. In other words, the matrix contains a strictly upper triangular matrix and a strictly lower triangular matrix. Moreover, while values of the strictly upper and strictly lower triangular matrix are the same, their symbols are opposite. This property helps us; we only have to choose one of the strictly triangular matrices. Table 8 shows the full influence matrix, and Equation (9) can produce the net influence matrix shown in Table 10. Using the values of $(d + r)$ and $(d - r)$ in Table 9 as X and Y values, respectively, the NRM (Network relation map) approach can be drawn as shown in Figure 4 [55]. Figure 4 shows that RS (regulatory system) and CR (critical resources) aspects are the primary aspect with net influence, while ME (market expansion) aspect is the primary aspect being influenced. The OM (operation management) aspect is the aspect with the highest full influence, while the RS (regulatory system) is the one with the smallest full influence aspect.

Table 10. The net influence matrix.

Aspects	PC	OM	CR	RS	ME
Professional competence (PC)	-				
Operation management (OM)	0.071	-			
Critical resources (CR)	0.300	0.224	-		
Regulatory system (RS)	0.283	0.225	0.006	-	
Market expansion (ME)	−0.247	−0.295	−0.517	−0.521	-

**Figure 4.** The network relation map (NRM) of digital transformation for Med-Tech industry.

4.3. The Analysis of the AIA-NRM Approach

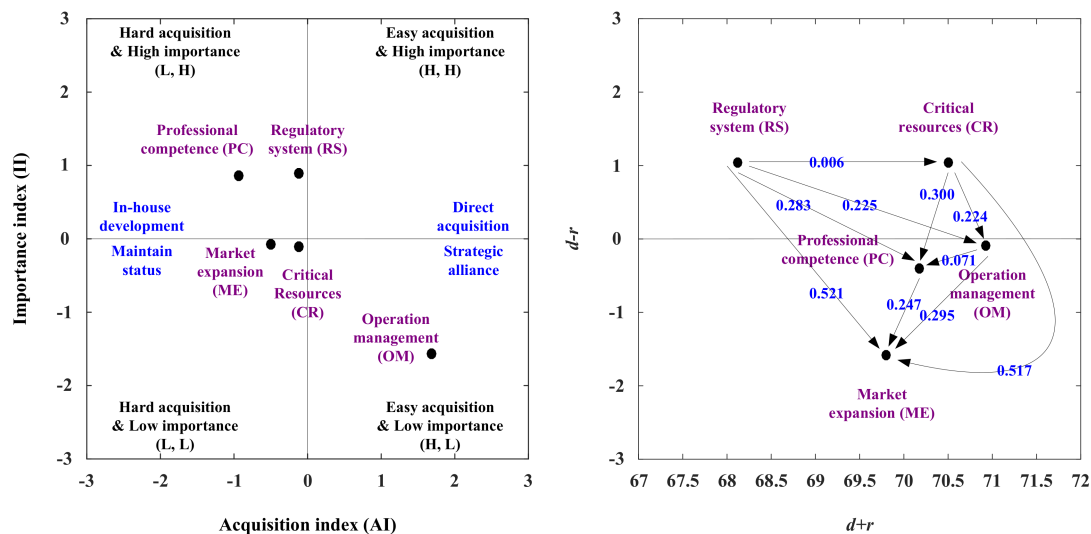
The analysis process of AIA-NRM includes two stages. The first stage is the AIA approach and the second stage is the analysis of the NRM approach. The AIA approach determines the acquisition and importance level of aspects/criteria for digital transformation; the AIA (acquisition–importance analysis) approach can help decision makers identify aspects that should be developed when the standard importance level is more than the average importance level. There are four development strategies presented in Table 11. Development strategy B (immediate improvement) can apply to the aspects of PC and RS (regulatory system), development strategy C (maintain status) can apply to the aspects of CR (critical resources) and ME, and development strategy D (status monitoring) can apply to the OM (operation management) aspect.

The AIA-NRM approach determines the criteria that should be developed based on the AIA approach and the development path using the NRM (network relation map). We can determine that the aspects of PC and RS should be developed, and the aspects of RS are the aspect that is the primary aspect with net influence. So, we can develop the PC aspect by addressing the aspect of RS. The ME aspect is the primary aspect being influenced; therefore, the ME aspect can be influenced by the aspects of RS, CR, OM, and PC, as shown in Table 11 and Figure 5.

Table 11. The improvement strategy for digital transformation.

Aspects	IIA			NRM			Strategy
	AI	II	(AI, II)	d + r	d − r	(R, D)	
Professional competence (PC)	−0.934	0.858	(L, H)	70.170	−0.408	ID (+,−)	B
Operation management (OM)	1.687	−1.569	(H, L)	70.930	−0.084	ID (+,−)	D
Critical resources (CR)	−0.126	−0.107	(L, L)	70.505	1.036	D (+,+)	C
Regulatory system (RS)	−0.126	0.887	(L, H)	68.126	1.036	D (+,+)	B
Market expansion (ME)	−0.501	−0.069	(L, L)	69.805	−1.580	ID (+,−)	C

Notes: The development strategies include four types: Development strategy A (Direct acquisition), development strategy B (In-house development), development strategy C (Maintain status) and development strategy D (Strategic alliance).

**Figure 5.** The AIA-NRM analysis for digital transformation.

4.4. Discussion

The ranking of the AI is $OM > CR = RS > ME > PC$ and the ranking of the II is $RS > PC > ME > CR > OM$ based on the AIA approach as illustrated in Table 12. There are eight development paths ($RS \rightarrow ME$; $RS \rightarrow PC \rightarrow ME$; $RS \rightarrow OM \rightarrow ME$; $RS \rightarrow CR \rightarrow ME$; $RS \rightarrow OM \rightarrow PC \rightarrow ME$; $RS \rightarrow CR \rightarrow PC \rightarrow ME$; $RS \rightarrow CR \rightarrow OM \rightarrow ME$; $RS \rightarrow CR \rightarrow OM \rightarrow PC \rightarrow ME$) in the evaluation system, based on the NRM approach. Further, we can improve the disadvantage aspects/criteria through the advantage aspects/criteria based on the aspects/criteria rank of AI and II. The ranking of the AI is $OM > CR = RS > ME > PC$, and the ME aspect can be improved through RS aspect based on the first development path ($RS[2] \rightarrow ME[3]$). The PC aspect can be improved through the aspect of RS based on the second development path ($RS[2] \rightarrow PC[5] \rightarrow ME[4]$), and then the ME can be improved by OM aspect based on the third development path ($RS[2] \rightarrow OM[1] \rightarrow ME[4]$) as illustrated in Table 12. The ME aspect can be improved through the CR based on the fourth development path ($RS[2] \rightarrow CR[2] \rightarrow ME[4]$). The PC aspect can be improved through the OM aspect based on the fifth development path ($RS[2] \rightarrow OM[1] \rightarrow PC[5] \rightarrow ME[4]$). The PC aspect can be improved through the CR, and the CR aspect can be improved through RS aspect based on the sixth development path ($RS[2] \rightarrow CR[2] \rightarrow PC[5] \rightarrow ME[4]$). The ME aspect can be improved through the OM, based on the seventh development path ($RS[2] \rightarrow CR[2] \rightarrow OM[1] \rightarrow ME[4]$). The PC aspect can be improved through the OM, based on the eighth development path ($RS[2] \rightarrow CR[2] \rightarrow OM[1] \rightarrow PC[5] \rightarrow ME[4]$), as illustrated in Table 12.

Table 12. The suited improvement paths of digital transformation.

Rank	Acquisition Index (AI)	Importance Index (II)
	OM[1] > CR[2] = RS[2] > ME[4] > PC[5]	RS[1] > PC[2] > ME[3] > CR[4] > OM[5]
Improvement paths	1. RS[2]→ME[3] {Y} 2. RS[2]→PC[5]→ME[4] {Y} 3. RS[2]→OM[1]→ME[4] {Y} 4. RS[2]→CR[2]→ME[4] {Y} 5. RS[2]→OM[1]→PC[5]→ME[4] {Y} 6. RS[2]→CR[2]→PC[5]→ME[4] {Y} 7. RS[2]→CR[2]→OM[1]→ME[4] {Y} 8. RS[2]→CR[2]→OM[1]→PC[5]→ME[4] {Y}	1. RS[1]→ME[3] {Y} 2. RS[1]→PC[2]→ME[3] {Y} 3. RS[1]→OM[5]→ME[3] {Y} 4. RS[1]→CR[4]→ME[3] {Y} 5. RS[1]→OM[5]→PC[2]→ME[3] {Y} 6. RS[1]→CR[4]→PC[2]→ME[3] {Y} 7. RS[1]→CR[4]→OM[5]→ME[3] {Y} 8. RS[1]→CR[4]→OM[5]→PC[2]→ME[3] {Y}
Suited Improvement paths	1. RS→ME 2. RS→PC→ME 3. RS→OM→ME 4. RS→CR→ME 5. RS→OM→PC→ME 6. RS→CR→PC→ME 7. RS→CR→OM→ME 8. RS→CR→OM→PC→ME	

The ranking of the II (importance index) is RS > PC > ME > CR > OM, and the aspect of ME aspect can be improved by the RS aspect, based on the first development path (RS[1]→ME[3]) and the aspect of ME can be improved through the PC and PC can be improved by the RS aspect based on the second development path (RS[1]→PC[2]→ME[3]), as illustrated in Table 12. The aspect of OM can be improved by the RS aspect based on the third development path (RS[1]→OM[5]→ME[3]). In addition, the aspect of CR can be improved by the RS aspect based on the fourth development path (RS[1]→CR[4]→ME[3]), as illustrated in Table 12.

The aspect of OM can be improved by the RS aspect and ME (market expansion) aspect can be improved by the PC aspect, based on the fifth development path (RS[1]→OM[5]→PC[2]→ME[3]), as illustrated in Table 12. Further, the aspect of CR can be improved by the RS aspect and ME aspect can be improved by the PC, based on the sixth development path (RS[1]→CR[4]→PC[2]→ME[3]), as illustrated in Table 12. The aspect of CR (critical resources) can be improved by the RS based on the seventh development path (RS[1]→CR[4]→OM[5]→ME[3]), as illustrated in Table 12. In addition, the aspect of CR can be improved by the aspect of RS and ME aspect can be improved by the PC, based on the eighth development path (RS[1]→CR[4]→OM[5]→PC[2]→ME[3]), as illustrated in Table 12.

Therefore, the AIA-NRM approach integrates the AI development paths and the II development paths; the best-suited development paths are illustrated in Table 12. Because the AI development paths and II development paths are the same in the empirical result, the best-suited development paths include the eight development paths (RS→ME; RS→PC→ME; RS→OM→ME; RS→CR→ME; RS→OM→PC→ME; RS→CR→PC→ME; RS→CR→OM→ME; RS→CR→OM→PC→ME), as illustrated in Table 12.

5. Conclusions

The Med-Tech industry is a prosperous industry in Taiwan with mainly small- and medium-sized enterprises. Med-Tech enterprise faces competition with international enterprises in transforming. In the study, we first interviewed executives from five major Med-Tech businesses in Taiwan who have experience of digital transformation implementation, to confirm the five aspects and 20 factors that relate to the success of the transforming. Then, we surveyed more than 100 Med-Tech enterprises based on the 20 criteria and determined the five critical aspects. After that, this study proposed the AIA-NRM approach, which includes the two processes of AIA and NRM.

The research results come from AIA-NRM approach. AIA method can help Med-Tech enterprises in understanding their value proposition and evaluate their competitive strategies based on their acquisition and importance. The research results are as the follows:

- (1) RS and PC are located in the second quadrant (L, H). That means RS and PC are low acquisition and high importance. Therefore, the development strategy B (in-house development) can apply to the aspect of RS and PC. Regarding the net influence effect, the RS influences the CR, OM, PC, and ME. The RS aspect is the most dominant of all aspects. The regulatory system in the Med-Tech industry is not only the most critical challenge but also very difficult to overcome. Med-Tech enterprises consider the regulatory system as their first priority of digital transformation and develop it by themselves.
- (2) The CR and ME located in the third quadrant (L, L). They both difficult to attain but less important. That means the development strategy C (maintain status) can apply to the aspect of CR and ME. ME in the Med-Tech industry does not dominate any other aspect. It fails to show any specific pathway to follow. The med-Tech industry is different than in other industries. ME has to be conservative. The strategy is suggested as maintain status.
- (3) The OM is located in the fourth quadrant (H, L). Unexpectedly, the accessibility of OM is high. The development strategy D (strategic alliance) can apply to the aspect of OM. Med-Tech enterprise should consider strategic alliance with other suppliers.

Moreover, the NRM approach can help the enterprise to find the pathway of digital transformation. This study finds out that there are eight suited paths for Med-Tech enterprises to select as the priority to consider enhancement, including RS→ME, RS→PC→ME, RS→OM→ME, RS→CR→ME, RS→OM→PC→ME, RS→CR→PC→ME, RS→CR→OM→ME, and RS→CR→OM→PC→ME. The regulatory system is in the first place of all these eight paths. The importance of the regulatory system makes the Med-Tech industry different than other industries. Med-Tech enterprises have to attend certain regulations in order to produce particular products. Among all kinds of competitive improved transformation, Med-Tech enterprise will gain the most benefit by transforming for gaining the certificate from the regulatory system. The regulatory system plays as a threshold of qualification. Once a Med-Tech enterprise obtains certain certification, the sales orders would be full and company value would increase dramatically overnight. The improvement path RS→ME can explain this situation.

As a reference company with a successful digital transformation experience, BEGO GmbH, and SME, an automated clinical survey for the EU Medical Device Regulation (MDR) was conducted to gather data about their product's performance and safety in the market [56]. Med-Tech industry is different from other industries. The regulatory system is a key factor in checking when Med-Tech companies intend to implement digital transformation. The research result is the same as BEGO's implementation of digital transformation to meet certification requirements. It verified this present research's practical contribution.

Nevertheless, there are three classifications of Med-Tech products, which are class I, II, and III with different levels of technology requirement. Most Med-Tech enterprises would produce a certain class of products. Because of the research limitation, the present study does not consider this particular factor. However, digital transformation driving forces could be closely related to the level of technical requirement of producing. In future research, the technology level could be considered as one of the driving forces. Furthermore, stakeholders of Med-Tech industry, including end-users, sales channels, and venders, have different driving forces when implementing digital transformation.

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