The analysis of sustainable development strategies for industrial tourism based on IOA-NRM approach

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A B S T R A C T

Taiwan's economic development has gradually shifted from the manufacturing industry to the service industry. The manufacturing industry faces cheap competition from neighboring countries (such as China and Southeast Asian countries). As industrial enterprises relocate their production facilities to China and Southeast Asian nations, they must think about how to restructure the industry. Industrial tourism has been adopted as a form of industrial transformation. In recent years, an increasing number of conventional industrial enterprises have begun to transform production-oriented manufacturing and production plants into tourism facilities. This trend not only promotes industrial transformation but also helps industrial operators rethink how to create corporate value through service innovation as well as to determine future development directions for the manufacturing industry. Thus, this study attempts to identify the driving force of service facilities based on industrial tourism views. This study can help industrial operators review their value-driving forces while also helping them to understand the critical success factors for industrial transformation and determine the appropriate tourism transformation strategy. Additionally, this study explores tourists' need for industrial tourism and integrates the tourists' preference for service innovation and service demands for industrial tourism. This study proposes the IOA-NRM (innovation opportunity analysis-Network Relation Map) approach, which combines the IOA technique and NRM technique. The service/function of EH (educational heritage) not only increases the product/service knowledge for customers but also strengthens their enterprise identification with educational heritage consciousness. Therefore, the service providers of industrial tourism can identify the service innovation strategies and conventional industrial enterprises to find new market value via the IOA-NRM approach.

1. Introduction

A country's economic growth is often associated with industry changes. In the early stages, Taiwan's economic development relied on conventional manufacturing but has gradually shifted to a service-based economy pattern. Traditional production plants face cheap labor competition from neighboring countries; thus, the relocation of production bases is just an expedient temporary solution. The fundamental approach to building industrial tourism is industrial transformation and upgrading. As the Taiwan industry felt the effect of globalization and the rise of the Chinese market, the global competitiveness of traditional industries faced a severe challenge. The traditional industries had faced the market pressure of industrial relocation along with industrial transformation and

upgrading. Therefore, the Taiwanese government encouraged traditional plants, allowing local industries and conventional factories to carry out industrial transformation and modernization. Using the service process redesign approach, these traditional plants can be transformed gradually from traditional manufacturing plants to various tourism factories with service experience, education & heritage, local culture, and tourism & recreation. The Taiwanese Industrial Development Bureau of Ministry of Economic Affairs proposed the project and has guided and supported the transformation of these conventional plants from their original industrial manufacturing foundations to industrial tourism sites through the establishment of new tourism and recreation elements (factory tours, site interpretation, and implementation experience).

To continue to assist the transformation of the conventional industry, the Executive Yuan further proposed the Creative Life Industry Development project to address structural unemployment

by assisting the transformation of traditional industries and proposing the concept of industrial tourism. The traditional industries combined the leisure and tourism industry with cultural and creative industries and installed new elements of cultural, creative, and service experience in traditional manufacturing/production plants in line with the industrial tourism style. They enhanced the benefit of conventional industries and expanded their domestic market. The traditional industries face industry environmental changes; hence, industrial transformation and upgrading are necessary. However, the conventional factories need to escape the traditional manufacturing-oriented management style and use service innovation to import new industrial development elements, let industrial tourism create the diverse pattern of cultural and creative industries, and bring the social value of education and heritage. Therefore, this study attempts to discuss the service value of industrial tourism and explores destination attractiveness and service-driving force. This study not only helps industrial tourism operators re-examine their service value-driving force, but also allows traditional industry operators to understand the critical success factors of conventional industry transformation and develop appropriate transformation strategies for industrial tourism based on their competitive advantages.

In recent years, an increasing number of researchers have paid attention to the industrial tourism issue, but to our knowledge, no related empirical study on industrial tourism in Taiwan has been conducted. In Europe, early industrial tourism studies focused on the reuse issue of abandoned mining areas. That study tried to find the new development opportunities for these abandoned mining areas by analyzing industrial tourism of industrial ruins. They found that scenic spots of abandoned mining areas should be included in the generalized industrial tourism. As abandoned mining areas are not popular tourism scenic spots, these industrial ruins get less attention. The study examined the tourists' perceptions and tourism development of mines and quarries for industrial tourism, as well as the development and expansion of mines and quarries in the past few decades. It also discussed the transformation of industrial ruins and used cases in Wales and Spain to present their vision for development by industrial transformation (Edwards and Cotes, 1996). With a gradual increase in industrial cities, tourism development is important to urban renewal and economic development. Therefore, an increasing number of researchers began to consider the reuse issue of industrialized districts through preservation of industrial ruins and installing the new driving forces for industrial heritage through industrial tourism. Hence, this study summarized six critical attributes of industrial heritage tourism by reviewing the existing literature, interviewing experts, and using the American National Historic Jeep Museum as a case to explain how to apply these six critical attributes help to develop the industrial heritage tourism (Xie, 2006). Other industrial tourism development strategies can be seen in the German Ruhrgebiet, which pointed out that German Ruhrgebiet was once the largest industrial area in Western Europe. The region pursued some re-industrialization policies after the coal and steel manufacturing crisis, but these policies did not help the German Ruhrgebiet region change its condition. The authorities gradually executed new regional innovation policies to solve the region's lock-in problem. The re-orientated Ruhrgebiet adopted innovation strategies for environmental technology, energy, and industrial tourism industries, and obtained better results compared to earlier re-industrialization policies. The success of the German Ruhrgebiet case offered some new insights to assist with the renewal of other old industrial areas in Europe (Hospers, 2010).

This study explores the customers' needs and preferences for industrial tourism and induces the value-driving force of tourist factory. This study also introduces the IOA (Innovation-Opportunity Analysis) approach, which integrates the service innovation (innovative degree) and market opportunities (need degree) to evaluate these critical value-driving forces. In addition, this study discusses how enterprises respond to new market opportunities by using new strategies of service innovations and creating manufacturing-oriented plants to upgrade to new market segmentation. Moreover, this study uses the NRM (Network Relation Map, NRM) approach to analyze the value-driving force of service systems and uses the influence relation structure of value-driving force to identify effective service innovation strategies for industrial transformation and upgrades. Service-driving forces of industrial tourism include four aspects according to literature reviews and expert interviews, and the four service-driving forces include the aspects of PS (product show), MP (marketing promotion), SE (service experience), and EH (educational heritage) and 16 evaluation criteria. The current study uses the questionnaire to understand the service innovations and market opportunities of value-driving forces based on the IOA (Innovation-Opportunity Analysis, IOA) approach. Finally, this study uses the IOA-NRM approach to determine service innovation strategies.

The remainder of this paper is organized as follows: Section 2 presents the service value-driving forces of industrial tourism. This study introduces the IOA-NRM approach, which integrates the IOA (Innovation-Opportunity Analysis) and NRM (Network Relation Map) technique for product innovation and value-added services in Section 3. Section 4 presents the empirical analysis of industrial tourism. Section 5, the conclusion, uses the empirical results to propose the service innovation strategy of industrial transformation and upgrades for conventional manufacturing plants.

2. The discussion of sustainable development of industrial tourism

In this section, the four service-driving forces of industrial tourism, including the aspects of product show (PS), marketing promotion (MP), service experience (SE), and educational heritage (EH), as well as 16 evaluation criteria identified based on literature reviews and expert interviews are shown.

2.1. The aspect of PS (product show)

The PPCM (Product-Process Change Matrix) can help enterprises move from the state of mass production to mass customization. The process of essential customization includes three stages: mass production stage, continuous improvement stage, and mass customization. In the first stage, the enterprises of mass production often have a bureaucratic and hierarchical organization. Staff regularly engages in repetitive work under close supervision. So, the mass production stage yields low-cost, standardized products and services. In the second stage, the staff gradually faces functional limitations and work hard to continuously improve the processes while the manager often enhances the results through coaching and continuous staff communication. Hence, low-cost, high-quality standardized products and services are produced in the constant improvement stage. In the third stage, mass customization enterprises have the capacity for flexibility and rapid response. In the continually changing environment, people, processes, units, and technology are reassembled to achieve the products and service that customer desire. The manager's role is to be an independent coordinator and serve as an efficient organizational link system (Pine et al., 1993). The reuse of abandoned factories and production fields has become a new research issue for industrial tourism and there have been more and more successful cases of transforming abandoned factories into industrial tourism. The oldest oil field, which located in the Polish Carpathian

Mountains, had ended its production activity and the former mines and distilleries have become industrial heritage sites. Industrial tourism brings new opportunities by rescuing industrial heritage and protecting the natural environment. The research focused on the traditions of mining and oil industry and analyzed the tourist attraction for the region's heritage in the Polish Carpathian Mountains. They evaluated the possibilities of Carpathian oil route for industrial tourism by the SWOT analysis and revitalized the industrial heritage sites and ensured sustainable development for the region. The planned oil routes will be registered in the EIHR (European Industrial Heritage Routes) system, and the creation of tourist routes can bring benefits for the natural environment and local communities (Kruczek and Kruczek, 2016). Tourism serves as the agent of social and cultural change and enables the cultural enrichment and rejuvenation of territories. The museums and interpretation centers are established in abandoned factories, and these old factories have created new attractions for those tourists who understand more industrial history. Industrial tourism plays crucial role in geographic content because industrial tourism recovers the cultural, social, and economic values of the old industrial landscape. The abandoned factories have been converted into tourist products and create the new value of industrial development and social and cultural preservation (Forga and Valiente, 2017). Energy tourism is a new niche of modern travel. A study of energy tourism analyzed the forms, locales, and possible societal impacts for energy tourism, and surveyed visitors and operators of the three energy tourism attractions that include Coal Safari, a nuclear plant and wind farm in the Czech Republic. This survey of energy tourism explored the motivations and perceived benefits of energy tourism for organizations and analyzed the motives and experiences of visitors as well as their attitude change (Frantál and Urbánková, 2017).

The product show (PS) aspect includes four criteria (material verification, PS1; manufacturing process show, PS2; product display, PS3; and derivative applications, PS4), as shown in Table 1. Material verification (PS1) means that industrial tourism can increase customer trust in products/services through disclosing raw material and through customer verification. The manufacturing process show (PS2) implies that industrial tourism can enhance customer trust in products/services by increasing their understanding of the manufacturing process. Product display (PS3) means that the industrial tourism can make customers familiar with corporate products/services through product demonstration, and derivative applications (PS4) suggests that the industrial tourism can create new derivative applications of products/services to satisfy different customers' needs, as shown in Table 1.

2.2. The aspect of marketing promotion (MP)

Environmentally friendly tourism and green tourism are newly developing trends for industrial tourism, so the concept of green credits can create opportunities for industrial tourism service providers. Distilleries promote the concept of green credits and create opportunities by enhancing their environmental reputations. The visitor centers of Scottish malt whiskey distilleries is an essential case of industrial tourism attraction. It claims environmental credibility and capitalizes on the tourists' sentiment for the green tourism market. The research findings point out that the strategy of the green image can assist enterprises in entering the process of self-examination and self-directed improvements for environmental accreditation schemes, and let tourist be seen as an agent for environmental betterment (McBoyle, 1996). Industrial tourism plays an essential role in the autonomous region of the Shendong coal sea travels area. Because people don't seem to be aware of the characteristics of industrial tourism, the development

of industrial tourism is slow. The study of the coal sea travels area evaluated the industrial tourism resources in the area using descriptive and statistical methods. The research found that the significant industrial tourism resources (the green and modern coal industrial landscape, and the excellent business enterprise culture) are attractive to tourists and the industrial tourism developed with support of industrial tourism resources in that area was stronger (Wu et al., 2008). German Ruhrgebiet was once the largest industrial area in Western Europe. The region pursued some re-industrialization policies after the coal and steel manufacturing crisis, but these policies did not help the German Ruhrgebiet region move in a good direction. The authorities gradually executed new regional innovation strategies to solve the region's lock-in problem. The re-oriented Ruhrgebiet adopted innovative strategies for environmental technology, energy, and industrial tourism and obtained results compared to earlier re-industrialization policies. The success of the German Ruhrgebiet case also offers new insight for other old industrial area renewal in Europe (Hospers, 2010). Recently, mining tourism has become a niche form of industrial tourism and brought some new development opportunities for industrial tourism. Attention can be drawn to various aspects of industrial tourism in different regions. A study of mining tourism analyzed how tourists perceive visiting mines and other geological objects, and analyzed their travel behavior for mining tourism. The empirical study collected 120 student samples from two Polish universities (University of Science and Technology in Cracow and the University of Physical Education in Cracow) via a self-administered questionnaire. The research findings provide some important implications regarding tourism marketing for local governments, and aid private enterprises developing new tourism products that can satisfy their customers' needs (Rozycki and Dryglas, 2017).

The marketing promotion (MP) aspect includes four criteria (product description, MP1; experience sharing, MP2; product extensions, MP3; and brands deepening, MP4) as shown in Table 1. Product description (MP1) means that industrial tourism can help customers understand product/service functions through the product description and function explanation. The experience sharing (MP2) aspect implies that industrial tourism helps customers understand product/service functions more through experience sharing. The product extensions (MP3) aspect suggests that industrial tourism allows corporate products to free themselves of existent product limitations and explore customers' potential needs. Finally, brands deepening (MP4) means that industrial tourism can deepen customer product image through the brand product display and user experience, as shown in Table 1.

2.3. The aspect of service experience (SE)

Although experience is a new value source and still cannot be identified widely, an increasing number of researchers have discussed the issue of experience value in the service industry. At present, most consumers still consider experience as a part of the service industry, such as merchandise sales, equipment maintenance, and catering services. Consumers can get integrated services based on their needs during the service consuming period. In the experience-consuming period, consumers enjoy immersion in unforgettable events offered by service providers. Sir Colin Marshall, the former British Airways' chairman, mentioned the commodity mindset of the airline industry. If the enterprises only have a single function, the function of the airline industry is to transport passengers from location A to location B on time and at the lowest cost. However, British Airways considers the journey as a promotion platform of experienced marketing. The enterprise should strive to overcome inherent limitations and create the competitive

Table 1
The description of service experience system for industrial tourism.

Aspects/Criteria	Descriptions
1. Product show (PS)	
Material verification (PS1)	The industrial tourism can increase customer trust for products/services by disclosing raw materials and customer verification.
Manufacturing process show (PS2)	The industrial tourism can increase customer trust in products/services by understanding the manufacturing process.
Product display (PS3)	The industrial tourism can make customers familiar with corporate products/services through product demonstration.
Derivative applications (PS4)	The industrial tourism can create a new derivative form of products/services to satisfy different customers' needs.
2. Marketing promotion (MP)	
Product description (MP1)	The industrial tourism can help customers understand product/service functions through product description and function explanation.
Experience sharing (MP2)	The industrial tourism can help customers understand product/service functions through users sharing the experience.
Product extensions (MP3)	The industrial tourism can help corporate products break the existing product limitations and explore customers' potential needs.
Brands deepening (MP4)	The industrial tourism can improve customer product image through the demonstration of the brand product and user experiences.
3. Service experience (SE)	
Feelings of perception (SE1)	The industrial tourism allows customers to contact new products/services and experience various services.
Handmade participation (SE2)	The industrial tourism allows customers to become involved with the product manufacturing process and create their merchandise.
Field experience (SE3)	The industrial tourism allows customers to observe the production process at the production site.
Ideation conveys (SE4)	The industrial tourism helps customers understand the enterprise's persistence in the promotion and sustainable development of traditional skills.
4. Educational heritage (EH)	
Knowledge transmission (EH1)	The industrial tourism communicates the evolution and development of traditional crafts and helps customers understand the knowledge skills.
Artistry heritage (EH2)	The industrial tourism keeps sustainable development of artistry technology by promoting the craft and inheritance among the next generation.
Local endorsing (EH3)	Industrial tourism creates and preserves the users' common memory and contributes to local identification through knowledge preservation and product promotion.
Cultural communications (EH4)	The industrial tourism accelerates the cultural diffusion of traditional craft and artistic skill through the conventional process of technology preservation and handmade experience.

advantage of a niche market by providing a wonderful travel experience and allowing customers to relieve their tension and anxiety from the journey and to enjoy the airline's unique services (Prokesch, 1995). Pine (1996) proposed that the experience should define a new unique economic product (Pine, 1996). The service experience can enhance customers' impression of the service process and can attract customers to use the service again. The Taiwanese hot springs tourism study used factor analysis to extract four aspects (empathy and assurance, responsibility, tangibility, and reliability). Empathy and assurance includes nine factors (convenient opening hours, ease of obtaining staff attention and help, convenience of the use of facilities and equipment, personalized and friendly service, provision of safe environment and equipment, courtesy and friendliness of staff, best interests of customers at heart, knowing to respond to customer requests, understanding the specific needs of customers). Responsibility includes four factors (never give any excuse for not responding to customer requests, personal attention from staff, willingness to help customers, and prompt response to tourist questions). Tangibility includes four criteria (visually appealing physical facilities; comprehensive hot spring facilities; hygiene and cleanness of hot spring facilities; and availability of adequate fire, first aid facilities, and instructions). Reliability includes four criteria (reasonable prices, providing accurate information, reliability in handling customer service problems, and giving prompt service to the tourist at the promised time) (Deng, 2007). To reduce the negative environmental impacts and reshape the sustainable development of tourism destinations, governments and the tourism industry have promoted the concept of slow travel since 2010. Slower modes of transportation helped establish some industrial tourism. The study of slow travel proposed a research model that includes three core elements (the style of slow travel, tourism experience, and environmental consciousness) used to analyze the tourists' travel motivation for slow travel. The research found that industrial tourists need destinations accessible by car so that these locations will become the new hotspots for industrial tourism. The service quality and tourism experience of the transportation modes were

the key factors that influenced tourists' motivation for slow travel, and slow travel will become a new form of sustainable tourism (Lin, 2017).

Service experience (SE) aspect include four criteria (feelings of perception, SE1; handmade participation, SE2; field experience, SE3; and ideation conveys, SE4), as shown in Table 1. Feeling of perception (SE1) means that industrial tourism allows customers to contact new products/services extensively and experience diverse services. Handmade participation (SE2) means that industrial tourism allows customers to become personally involved in the product manufacturing process and create their own merchandise. Field experience (SE3) suggests that industrial tourism allows customers to observe the production process at the production site. Ideation conveys (SE4) means that industrial tourism allows customers to understand the enterprise's persistence in the promotion and sustainable development of traditional skills as shown in Table 1.

2.4. The aspect of educational heritage (EH)

Industrial museums and industrial tourism can create new opportunities for industrial heritage tourism, and these industrial museums and industrial tourism also help tourists to know the technical development track and help abandoned factories to find new development directions. The industrial tourism study of the National Historic Jeep Museum in the city of Toledo, Ohio, pointed out that even though the preservation and interpretation of the museum have a high value for industrial tourism, conflicting views still exist among various stakeholders. The main problems are poor community perceptions and the lack of strong support for the Jeep industry, as well as the controversial reuse of existing facilities, ill-informed economic benefits, and authenticity issues. So, this study also provided some suggestions for improving industry heritage tourism (Xie, 2006). The tourist characteristics and choice preference for modern travel have been discussed in recent years. The previous study found a relationship between the effect of social identities and the role of the symbolic community. The proposed

research also explains the relationship between personality and tourism and emphasizes the impact of community identities on industrial tourism. This study also analyzed the effects of community identities on the heritage tourism industry in four Southern Spain mining areas (Ruiz Ballesteros and Hernandez Ramirez, 2007). Renewable energy can create potential tourism attractiveness through renewable energy sources. The industrial tourism of renewable energy can increase the number of visitors for their modern design, proportions, eco-image, and area uniqueness. The interactions of renewable energy and travel can be classified into four categories (lowest, middle, higher, and highest). The lowest level of interaction means that the renewable energy sources (RES) are the tourist attraction in the area, but there is no other tourism infrastructure, and the middle level of interaction indicated simple information points and natural educational hiking trails that are built near renewable energy sources. The higher level of interaction means pure visitor centers constructed close to renewable energy sources, and the highest level means that renewable energy sources directly linked to the educational centers. Based on the research results, the tourists reached the visitor centers, and then visited geothermal power plants and wind parks. The unique visual aspects can attract these tourists (Beer et al., 2017). The efficient conservation and use of the geological heritage are essential for science, education, and tourism. The Kurkur Dungul area has identified seven unique geological features including stratigraphical, sedimentary, palaeogeographical, mineralogical, structural, geomorphological, and economical. The sedimentary is determined by their wide distribution of paleospring tufa deposits, and the geomorphological type is established by their high relative abundance and natural diversity. The geological heritage of the Kurkur Dungul area can diversify the tourist destination, and the geopark can also better exploit the geological heritage of the Kurkur Dungul area (Sallam et al., 2018).

The aspect of educational heritage (EH) includes four criteria (knowledge transmission, EH1; artistry heritage, EH2; local endorsing, EH3; and cultural communications, EH4), as shown in Table 1. Knowledge transmission (EH1) means that industrial tourism enables individuals to communicate the evolution and development of traditional skills and allows them to gain knowledge and skills. Artistry heritage (EH2) implies that industrial tourism facilitates sustainable development of artistry technology through artistry promotion and heritage among the next generation of descendants. Local endorsing (EH3) means that industrial tourism helps individuals to create and preserve the users' common memory and contributes to forming local identification through the knowledge preservation and product promotion. Cultural communications (EH4) means that industrial tourism accelerates the cultural diffusion of traditional artistry and artistic skill through the conventional process technology preservation and handmade experience, as shown in Table 1.

3. Research method and analytical process

3.1. The research concept and analytic process

The IPA (Important-Performance Analysis, IPA) is a simple and efficacious analytical technique, and it can help decision-makers evaluate and improve specific services/products (Hansen and Bush, 1999). Some researchers tried to use the revised IPA (Important-Performance Analysis) to construct service improvement strategies. The IPA approach is a simple and effective assessment method used to assist practitioners in evaluating the importance and performance of customers' attribution to enhance service quality and increase customer satisfaction. This research explains and demonstrates the revised IPA model through a Taiwan hot spring tourism case, and shows how the revised IPA model can help business managers find the appropriate improvement direction effectively and maintain enterprises' competitive advantage (Deng, 2007). Because the IPA technique adopts the unstandardized value to evaluate the importance and performance state, which the decision-maker could not easily analyze. So this study proposes the modified model using the standardized value to modify the IPA technique. The proposed model also adopts the NRM (Network Relation Map) technique to improve the aspects/criteria that are low satisfaction (Lin and Tzeng, 2009). However, this proposed model still exhibits some restrictions in the NRM (Network Relation Map) technique as follows: Because the proposed model determines the improvement path based on the threshold approach, some two-way improvement paths exist in the Network Relation Map and the decision-maker could not determine their suited improvement strategies. To overcome this problem, the SIA-NRM technique was proposed to improve the restrictions of two-way improvement path so that the modified Network Relation Map exists only as a one-way improvement path. The SIA-NRM technique provides the proposed model that integrates the SIA (Satisfaction Importance Analysis) technique and NRM (Network Relation Map) technique and the SIA-NRM technique to determine the improvement path based on the net relation matrix approach (Wang et al., 2014; Wang et al., 2012b).

Because the industrial environment changes continuously and the product life cycles shorten unceasingly, it is essential to maintain the high quality of products and services and reduce the time to market for products and services. Therefore, researchers have proposed PPCM (Product-Process Change Matrix) to illustrate the innovation process of product and service. PPCM (Product-Process Change Matrix) comprises two dimensions of "process change" and "product change" and four segments (invention, dynamic stability, mass production, and developmental). "Invention" is located in the first quadrant and represents the revolutionary change for the process change and product change. "Dynamic stability" is located in the second quadrant and represents the evolutionary process change and the revolutionary product change. "Mass Production" is located in the third quadrant and represents the evolutionary process change and product change. "Developmental" is located in the fourth quadrant and represents the revolutionary process change and evolutionary product change (Boynton and Victor, 1991).

Therefore, the SIA-NRM technique solved the restrictions of two-way improvement path, but the SIA-NRM technique still has some restrictions in determining the suited improvement paths. Because the decision-makers may not be able to use the disadvantage aspects/criteria to improve the advantage aspects/criteria, some improvement paths may not work in the Network Relation Map. Therefore, the modified IOA-NRM technique provides a modified model to solve the restrictions of improvement path based on the aspects/criteria rank. The modified IOA-NRM technique proposes a suitable improvement path analysis to evaluate the improvement paths for the SII (Service Innovation Index) and MOI (Market Opportunity Index). First, the study analyzes the rank of aspects/criteria rank for the SII and MOI axes and evaluates the related improvement paths. The study determines the same improvement paths for SII and MOI axis and proposes the suited improvement paths based on the IOA-NRM technique.

This study uses the IOA (Innovation Opportunity Analysis, IOA) technique based on the IOA technique. The horizontal axis is the SII (Service Innovation Index, SII), which indicates the degree of service innovation that operators offer to customers. The high degree of SII means that the service operator offers diverse services to customers with varied needs utilizing novel thinking and great operation style; whereas the low degree of SII means that the

service operator offers the same or similar services to customers with varied needs using outdated thinking and inappropriate operation style. The vertical axis is the MOI (Market Opportunity Index, MOI) identifies market opportunities that exist as some customers' needs were not satisfied and current technology serviceability that can solve the customers' problems and satisfy customers' needs.

This section introduces the service improvement model based on the IOA-NRM of industrial tourism. To accomplish this, we need to define the critical decision problem of the service system of industrial tourism. We then identify the aspects/criteria that influence the driving factor of the service system of industrial tourism through a literature review and expert interviews. In the third stage, we point out the gap aspects/criteria that still exist because of low service innovation and high market opportunity. These gap aspects/criteria decrease service innovation and increase market opportunity, according to the IOA analysis. This study determines the relationship structure of the service system of industrial tourism and identifies the dominant aspects/criteria in the service system of industrial tourism based on the NRM analysis (the fourth stage). Finally, we integrate the results of IOA analysis and NRM analysis to establish the suited market position and determine the effective service innovation strategy for the service system of industrial tourism. The analytical process includes five stages: (1) clearly defining the critical decision problems of the service system, (2) establishing the aspects/criteria of the service system, (3) measuring the state of the aspects/criteria based on an IOA analysis, (4) measuring the relationship structure using NRM, (5) integrating the results of the IOA analysis and NRM analysis to determine the service innovation strategy of the service system, and (6) determining the suited improvement paths based on the aspects/criteria rank. The analytic process uses the analytic technique (e.g., IOA analysis, NRM analysis, and IOA-NRM analysis) and five analytic stages, as shown in Fig. 1.

The axes on the market position map include the SII (Service Innovation Index, SII) and the MOI (Market Opportunity Index, MOI). The SII consists of the aspects that increase the service innovation level and the MOI (Market Opportunity Index, MOI) consists of the aspects that increase market opportunity level. As shown in Fig. 2., the x-axis is the SII (Service Innovation Index, SII) and the y-axis is the MOI (Market Opportunity Index, MOI). In this study, the service system of industrial tourism includes four aspects, PS (product show), MP (marketing promotion), SE (service experience), and EH (educational heritage). The market position map is divided into four sections or market segmentation.

The first quadrant (H, H) represents high SII (Service Innovation Index, SII) and high MOI (Market Opportunity Index, MOI). The product/service in the first quadrant means that this service is novel, and it can attract customers and stimulate continued demand. The product/service in the first quadrant is characterized by straddling competition. The second quadrant (L, H) represents low SII (Service Innovation Index, SII) and high MOI (Market

Opportunity Index, MOI). The product/service in the second quadrant means that the primary service demand rises continually, so the service providers do not need to have high service innovation. The service providers only satisfy the customers' basic needs, and the customers just choose the same or similar product/service in this quadrant. Besides, customers have fewer alternatives for advanced products/services and are more likely to accept the current product quality and service level in the quadrant. Market segmentation of market expansion characterizes the product/service in the second quadrant. The service providers can maintain stable growth of their enterprises continually by finding the new market demand; hence, the service providers allocate resources for product/service innovation.

The third quadrant (L, L) represents low SII (Service Innovation Index, SII) and low MOI (Market Opportunity Index, MOI). The product/service in the third quadrant means that service providers offer only the essential service to customers using the traditional operation style and that current service providers not only lack service innovation but cannot also excite customers to increase their service demands. Accordingly, the service providers keep, although reluctantly, only the current market condition. State maintenance characterizes the product/service in the third quadrant. If customers change their service needs or service providers adopt new service innovation strategies, the existing service market size will become smaller and smaller. Therefore, the service providers in the third quadrant should break the status quo and find the new market opportunities and improve their ability to innovate their service.

Comparatively, the fourth quadrant (H, L) represents a high SII (Service Innovation Index, SII) and low MOI (Market Opportunity Index, MOI). The product/service in the fourth quadrant means that the customer needs of product/service exist continually and that customers have the ability to evaluate the benefits of product/service. Although customer demand apparently does not change, the customers can choose service providers with continued innovative capacity, so the service providers need to increase their service innovation to deepen their services and satisfy customers' changing preferences. The product/service under the fourth quadrant is characterized by market segmentation of service deepening; with the new service style replaces traditional service style. Because market demand does not increase, service providers can deepen their product/service through service quality and service innovation, and service providers with service innovation ability will obtain the market competitive advantage.

Also, the study developed four service improvement strategies for four innovation opportunity states. In the first quadrant (H, H), the innovation opportunity state of straddling competition was represented the high SII and high MOI, so the study suggests maintaining the current condition, and adopt the "maintain strategy" to keep the state of "straddling competition" by maintaining the ability of service innovation and keeping the market advantage continuously. In the second quadrant (L, H), the innovation
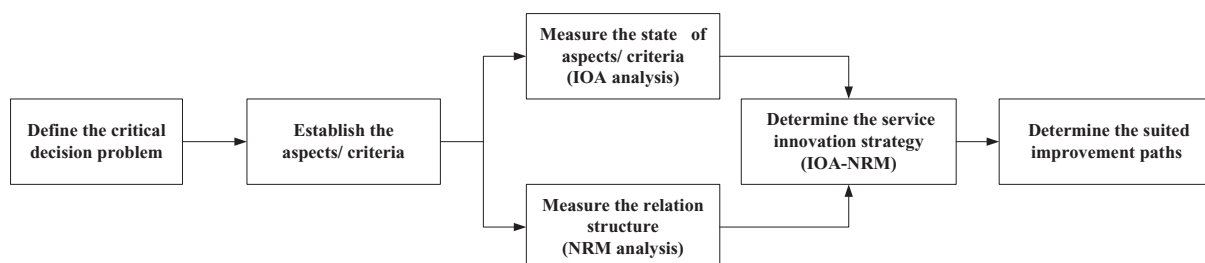

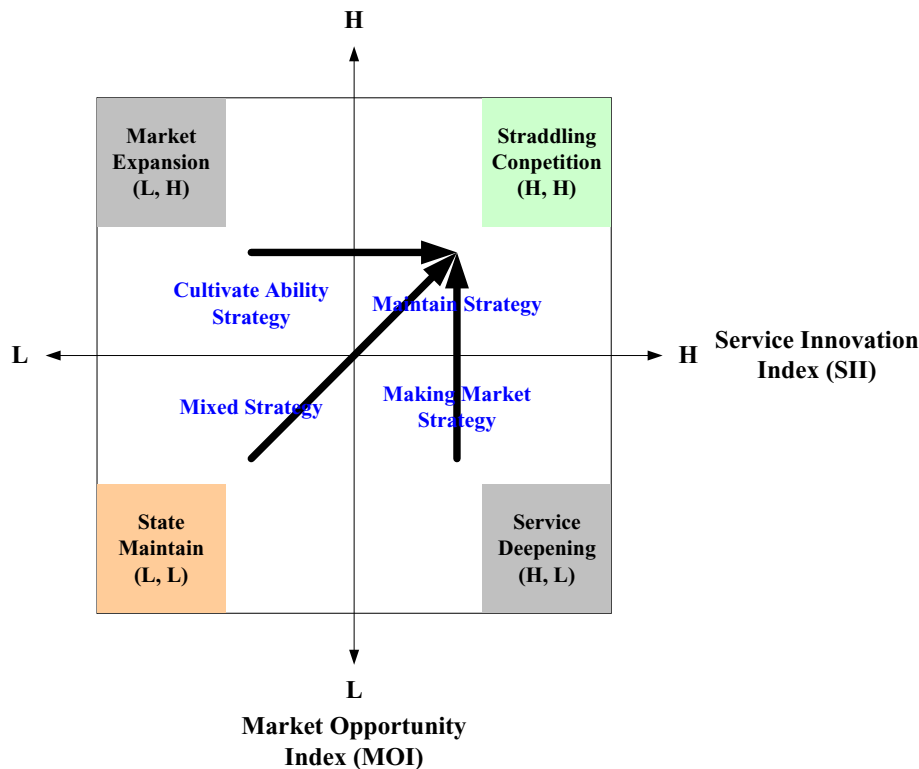**Fig. 1.** The analysis process of IOA-NRM approach.

Fig. 2. The concept of IOA (Innovation Opportunity Analysis) approach.

opportunity state of market expansion represented the low SII and high MOI, so service providers can maintain stable growth by finding the new customer needs and market demand. Therefore, this study also suggests adopting the "cultivate ability strategy" to improve the state of "market expansion" by strengthening the ability of service innovation. In the third quadrant (L, L), the innovation opportunity state of "state maintain" was represented the low SII and low MOI, so service providers can break the current status quo by determining the new market opportunity and improve service innovation ability. This study suggests adopting the "mixed strategy" to improve the state of "state maintain" by strengthening the ability of service innovation and creating the new market opportunity continuously. In the fourth quadrant (H, L), the innovation opportunity state of service deepening was represented the high SII and low MOI, so the service provider can deepen its product/service by service innovation and adopt the "making market strategy" to improve the state of "service deepening" by creating the new market opportunity as shown in Fig. 2.

3.2. The analysis of IOA (Innovation opportunity analysis, IOA)

The following step involved the analysis of the degree of SII (Service Innovation Index, SII) and MOI (Market Opportunity Index, MOI) criteria. The surveyed data was normalized into equal measuring scales. According to the results of the studied data, the criteria were divided into four categories, as follows: The first category reflects a high degree of SII (Service Innovation Index, SII) with a high degree of MOI (Market Opportunity Index, MOI), as illustrated by the symbol (H, H). The second category represents a low degree of SII (Service Innovation Index, SII) with a high degree of MOI (Market Opportunity Index, MOI), as shown by the symbol (L, H). The third category is a low degree of SII (Service Innovation Index, SII) with a low degree of MOI (Market Opportunity Index,

MOI), as illustrated by the symbol (L, L). The fourth category reflects a high degree of SII (Service Innovation Index, SII) with a low degree of MOI (Market Opportunity Index, MOI), as shown by the symbol (H, L).

In this study, the IOA was analyzed as follows: The aspects of SE (service experience) and EH (educational heritage) were located in the first quadrant, indicating that the SE aspect and the EH aspect are characterized by high SII (Service Innovation Index, SII) and high MOI (Market Opportunity Index, MOI). Hence, in industrial tourism, customers have high demands for the service values of service experience and educational heritage. Accordingly, the aspects of SE and EH are essential and indispensable for tourism factories. Therefore, the tourism factories should foster innovative service thinking to satisfy continued growth in customers' demands regarding the service value of service experience and educational heritage. The aspect of MP (marketing promotion) is located in the second quadrant, meaning that the MP aspect has low SII (Service Innovation Index, SII) and high MOI (Market Opportunity Index, MOI). Thus, tourists have high demands for the service value of marketing promotion, although the current tourism factories' service innovation of marketing promotion still does not reach customers' expectations, and the current tourism factories adopt only the traditional service styles in response to the tourists' needs. Therefore, the tourism factories should strengthen their service innovation ability to create the service value of marketing promotion and adopt the new service styles to satisfy tourists' service needs. The aspects of PS (product show) are located in the third quadrant, meaning that the PS aspect has low SII (Service Innovation Index, SII) and low MOI (Market Opportunity Index, MOI). Thus, tourists have low demands for the service value of product show, and the existing tourism factories' service innovation of product show also does not satisfy customers' needs. Hence, tourism factories should consider how to increase their

service innovation ability to address the present dilemma and identify the tourists' preferences and potential customers' needs (Fig. 3, Table 2).

3.3. The analysis of NRM (Network Relation Map, NRM)

DEMATEL was used to construct the structure of the NRM of the evaluation systems. When users are making decisions about using evaluation systems, they should consider several criteria. The most common problem they face is that those criteria influence one another. Therefore, before improving the criteria, it is necessary to understand the basic criteria and then make effective improvements to enhance their overall satisfaction. If a decision-maker needs to improve too many criteria, the best way to handle this is to determine and improve the criteria that influence others the most. DEMATEL has been used to address complicated issues, and in the early stages, it was used with user interfaces of monitoring systems (Hori and Shimizu, 1999), failure sorting and system failure analysis (Seyed-Hosseini et al., 2006). In recent years, DEMATEL has drawn much attention from the decision and management domains. Some recent studies considered the DEMATEL technique for solving complex studies, such as developing global managers' competencies (Wu and Lee, 2007), evaluating performance in e-learning programs (Tzeng et al., 2007), the measurement system of airline safety (Liou et al., 2007), developing innovation policy portfolios for Taiwan's SIP mall industry (Huang et al., 2007), choosing knowledge management strategy (Wu, 2008), evaluating safety management system of airlines (Liou et al., 2008), selecting management systems of SMEs (Tsai and Chou, 2009), examining value-created system of science (technology) parks (Lin and Tzeng, 2009), identifying a threshold value for the DEMATEL method (Li and Tzeng, 2009), determining hotel service quality system (Tsai et al., 2010), the system evaluation model of the vehicle telematics system (Lin et al., 2010), the integrated evaluation system of outsourcing providers (Liou et al., 2011), the organization performance improvement strategies for matrix organization (Wang et al., 2012a), the carbon management model of supplier

selection for green supply chain management (Hsu et al., 2013), the assessment model of innovative restaurants for physical dining environment design (Horng et al., 2013), the drivers of corporate social responsibility for mining industry based on multi-criteria approach (Govindan et al., 2014), the service system position model for VTS (vehicle telematics system) under consideration of dependence and feedback (Lin, 2015), project portfolio selection of national research institutes (Jeng and Huang, 2015), the framework of environment sustainable product design based on QFD (quality function deployment) (Younesi and Roghanian, 2015), the service selection model of digital music service platforms (Lin et al., 2016), the CSFs (critical success factors) of sustainable development for bio-fuel industry (Liang et al., 2016), the design alternative evaluation model based on data-driven performance prediction (Zhang et al., 2017), the evaluation model of critical risk factors of sustainable supply chain management (Song et al., 2017), the implementation path of green information technology systems for the mining industry (Bai et al., 2017), the green supplier selection model based on the integrated QFD-MCDM approach (Yazdani et al., 2017), and the influential indicators of sustainable supply chain for the auto components manufacturing sector (Li and Mathiyazhagan, 2018). This study divides DEMATEL into five steps: (1) calculating the original average matrix; (2) calculating the direct influence matrix; (3) calculating the indirect influence matrix; (4) calculating the full influence matrix; and (5) analyzing the structure of the NRM.

(1) Calculating the original average matrix

Respondents were asked to indicate the influence that they believe each aspect exerts on the others on a scale from 0 to 4. "0" implies no influence, whereas "4" means powerful influence between aspect/criterion. "1," "2," and "3" indicates "low influence," "medium influence," and "high influence," respectively. As the data in Table 3 shows, the influence of "product show (PS)" on "marketing promotion (MP)" is **2.781**, which means "medium influence." On the other hand, the influence of "marketing promotion (MP)" on "product show (PS)" is **2.810**, also indicating "medium influence." From Table 3, we processed the "original average matrix" (**A**) using Equations (1) and (2) and obtained 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 1 in most cases. We then developed Table 5 by adding up rows and columns. In Table 5, the sum of row and column for "marketing promotion (MP)" is **1.989**, which is the most important influence aspect. On the other hand, the sum of row and column for "educational heritage (EH)" is **1.906**, which is the least
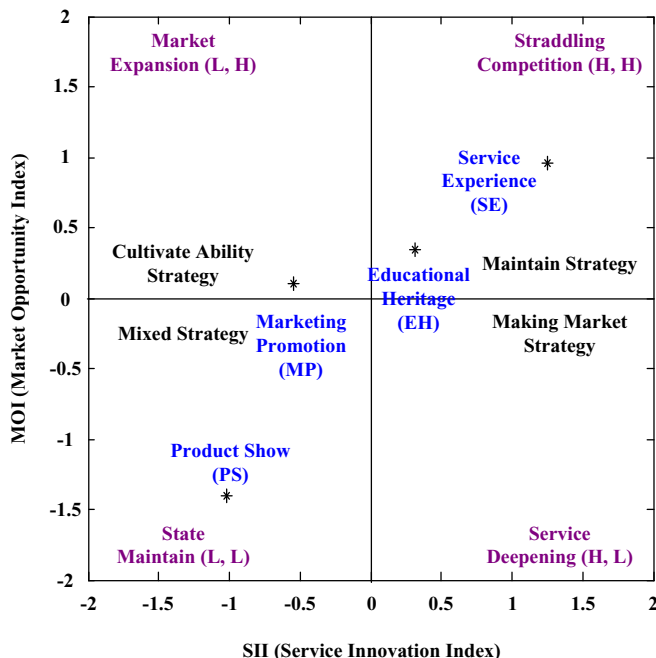
Table 2
The analytic table of IOA (Innovation Opportunity Analysis) approach.

Aspects	SII		MOI		(SII, MOI)
	RSII	SII	RMOI	MOI	
Product show (PS)	6.952	−1.017	6.790	−1.398	(L, L)
Marketing promotion (MP)	6.981	−0.548	7.026	0.098	(L, H)
Service experience (SE)	7.090	1.252	7.162	0.960	(H, H)
Educational heritage (EH)	7.033	0.313	7.064	0.340	(H, H)
Average	7.014	0.000	7.011	0.000	
Standard deviation	0.061	1.000	0.158	1.000	
Maximum	7.090	1.252	7.162	0.960	
Minimum	6.952	−1.017	6.790	−1.398	

Note 1: (H, H) = a **high** degree of SII and a **high** degree of MOI; (H, L) = a **high** degree of SII but a **low** degree of MOI; (L, L) = a **low** degree of SII and a **low** degree of MOI; (L, H) = a **low** degree of SII but a **high** degree of MOI.
Note 2: RSII, SII, RMOI, and MOI stand for the raw data of service innovation index (SII) value, standardized of SII value, raw data of market opportunity index (MOI) value, and standardized of MOI value, respectively.

Fig. 3. The analytic map of IOA (Innovation Opportunity Analysis) approach.

important influence aspect.

$$D = sA, \quad s > 0 \tag{1}$$

where

$$s = \min_{i,j} \left[1 \Big/ \max_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}, \, 1 \Big/ \max_{1 \le j \le n} \sum_{i=1}^{n} a_{ij} \right], \quad i, j = 1, 2, ..., n \tag{2}$$

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

The indirect influence matrix can be derived from Equation (3), as shown in Table 6.

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

Full influence matrix T can be derived from Equation (4) or (5). Table 7 shows the full influence matrix T consisting of multiple elements, as indicated in Equation (6). The sum vector of row value is $\{d\}$ and the sum vector of column value is $\{r\}$; then, the sum vector of row value plus column value is $\{d_i + r_i\}$, which indicates the full influence of the matrix T. As the sum of row value plus column value $\{d_i + r_i\}$ increases, the correlation of the dimension or criterion is stronger. The sum of the row value minus column value is $\{d_i - r_i\}$, which indicates the net influence relationship. If $d_i - r_i > 0$, the degree of influence exerted on others is stronger compared to influence from others.

As shown in Table 8, the MP (marketing promotion) aspect has the highest degree of full influence $(d_2 + r_2) =$ **111.157**, and the EH (educational heritage) aspect has the lowest degree of full influence $(d_4 + r_4) =$ **107.642.** The EH (educational heritage) aspect has the highest degree of net influence $(d_4 - r_4) =$ **1.108**, followed by the MP (marketing promotion) aspect $(d_1 - r_1 = 0.237)$, the SE (service experience) aspect $(d_3 - r_3 = -0.632)$, and the last one, the product show (PS) aspect $(d_1 - r_1 = -0.713)$. The degree of influence of EH (educational heritage) aspect and MP (marketing promotion) aspect exerted on others is stronger compared to influence from others; hence, the aspects of EH (educational heritage) and MP (marketing promotion) should improve preferentially.

$$T = D + ID = \sum_{i=1}^{\infty} D^i \tag{4}$$

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

$$T = [t_{ij}], \quad i, j = 1, 2, ..., n \tag{6}$$

Table 3
Original average matrix.
(2) Calculating the direct influence matrix

Aspects	PS	MP	SE	EH	Total
Product show (PS)	0.000	**2.781**	2.657	2.495	7.933
Marketing promotion (MP)	**2.810**	0.000	2.790	2.495	8.095
Service experience (SE)	2.657	2.705	0.000	2.638	8.000
Educational heritage (EH)	2.610	2.562	2.667	0.000	7.838
Total	8.076	8.048	8.114	7.629	–

Table 4
The direct influence matrix.(D)

Aspects	PS	MP	SE	EH	Total
Product show (PS)	0.000	0.343	0.327	0.308	0.978
Marketing promotion (MP)	0.346	0.000	0.344	0.308	0.998
Service experience (SE)	0.327	0.333	0.000	0.325	0.986
Educational heritage (EH)	0.322	0.316	0.329	0.000	0.966
Total	0.995	0.992	1.000	0.940	–

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

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

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

According to the aspects/criteria defined in Table 1, some experts were invited to discuss the relationships and influence levels of criteria under the aspects/criteria as shown in Table 1 and to score the relationship and influence among criteria based on the DEMATEL technique. Different aspects/criteria were divided into different types, allowing experts to respond to the questionnaire that assessed the areas/fields with which they were familiar. The net full influence matrix C_{net} was determined using Equation (10).

$$C_{net} = [t_{ij} - t_{ji}], \quad i, j \in \{1, 2, ..., n\} \tag{10}$$

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, the values of a strictly upper triangular matrix and strictly lower triangular matrix are the same while their symbols are the opposite. This property allows us to choose only one strictly triangular matrix. Table 9 shows the net influence matrix, and Equation (10) can produce the net influence matrix, as shown in Table 9. Using the values of $(d + r)$ and $(d - r)$ in Table 8 as the X value and Y value, respectively, the NRM can be drawn as shown in Fig. 4. Data in Table 9 can be used to illustrate the NRM, as shown in Fig. 4. Fig. 4 shows that the EH (educational heritage) aspect is the primary aspect of a net influence while the product show (PS) aspect is the primary aspect that is being influenced. The MP (marketing promotion) aspect is the aspect with the most significant full influence and the EH (educational heritage) aspect is the one with the smallest full influence.

3.4. The analysis of IOA-NRM

In the analysis of IOA, as shown in Table 10 and Fig. 5., the aspect of SE (service experience) and the aspect of EH (educational heritage) are located in the first quadrant (H, H) representing high degree of SII (Service Innovation Index, SII) with a high degree of MOI (Market Opportunity Index, MOI), which suggests improvement Strategy A (maintain strategy) should be adopted. The aspect of MP (marketing promotion) located in the second quadrant (L, H) represents the low degree of SII (Service Innovation Index, SII) with a high degree of MOI (Market Opportunity Index, MOI); thus, the improvement Strategy B (cultivate ability strategy) should be adopted. The PS (product show) aspect located in the third quadrant (L, L) reflects the low degree of SII (Service Innovation Index, SII) with a low degree of MOI (Market Opportunity Index, MOI). Accordingly, the strategy of improvement Strategy C (mixed

Table 5
The degree of direct influence.
　(3) Calculating the indirect influence matrix

Aspects	Sum of rows	Sum of columns	Sum of rows and columns	Importance of influence
Product show (PS)	0.978	0.995	1.973	3
Marketing promotion (MP)	0.998	0.992	**1.989**	1
Service experience (SE)	0.986	1.000	1.986	2
Educational heritage (EH)	0.966	0.940	**1.906**	4

Table 6
The indirect influence matrix.
　(4) Calculating the full influence matrix

Aspects	PS	MP	SE	EH	Total
Product show (PS)	13.668	13.552	13.637	13.027	53.884
Marketing promotion (MP)	13.787	13.847	13.838	13.227	54.699
Service experience (SE)	13.657	13.626	13.788	13.088	54.159
Educational heritage (EH)	13.468	13.442	13.514	12.984	53.408
Total	54.580	54.468	54.776	52.326	–

Table 7
The full influence matrix (T).

Aspects	PS	MP	SE	EH	d
Product show (PS)	13.668	13.895	13.964	13.335	54.862
Marketing promotion (MP)	14.133	13.847	14.182	13.535	55.697
Service experience (SE)	13.984	13.959	13.788	13.413	55.144
Educational heritage (EH)	13.790	13.758	13.843	12.984	54.375
r	55.575	55.460	55.776	53.267	–

Table 8
The degree of full influence.
　(5) Analyzing the structure of the NRM (Network Relation Map, NRM)

Aspects	{d}	{r}	{$d + r$}	{d-r}
Product show (PS)	54.862	55.575	110.436	−0.713
Marketing promotion (MP)	55.697	55.460	**111.157**	**0.237**
Service experience (SE)	55.144	55.776	110.920	−0.632
Educational heritage (EH)	54.375	53.267	**107.642**	**1.108**

Table 9
The net influence matrix of industrial tourism.

Aspects	PS	MP	SE	EH
Product show (PS)	–			
Marketing promotion (MP)	0.238	–		
Service experience (SE)	0.021	−0.223	–	
Educational heritage (EH)	0.454	0.223	0.430	–

Fig. 4. The NRM (Network relation map) of industrial tourism.

strategy) should be adopted. Therefore, if the manufacturer/production plants offer only the service/function of product show, their industrial tourism can maintain the present operating state. Nevertheless, the manufacturer/production plants can provide the service/function of marketing promotion. At the same time, their industrial tourism can expand their primary sales channels, increase market reputation, and expand market breadth. If manufacture/production plants offer the service/function of educational heritage in their industrial tourism, the manufacturer/production plants could achieve genuinely industrial transformation from manufacturer industry upgrade to experience economy industry (Table 10 and Fig. 5).

In the analysis of NRM (Network Relation Map), as shown in Table 10 and Fig. 5, EH (educational heritage) is the primary aspect with a net influence value-driving force and PS (product show) is
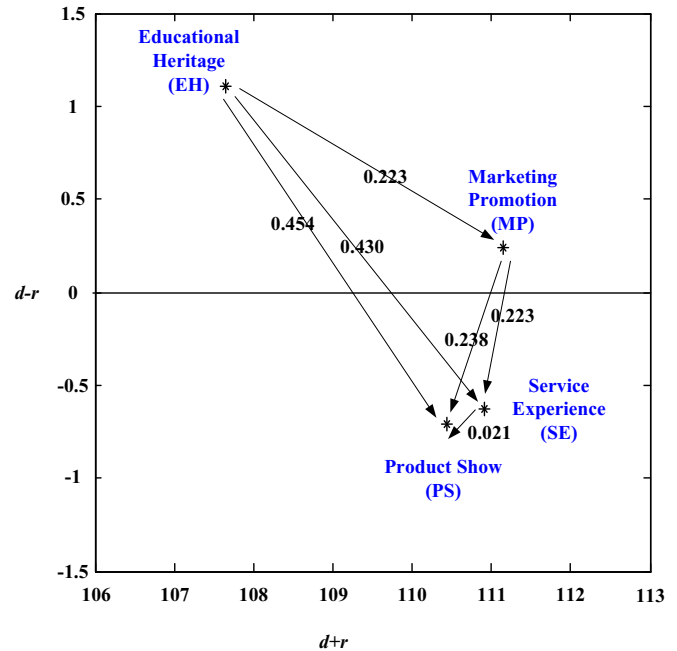
the fundamental aspect being influenced. MP (marketing promotion) is the aspect of the most significant full influence whereas EH (educational heritage) is the one with the smallest full influence. Thus, industrial tourism operators want to improve the entire outcome effectively. The EH (educational heritage) aspect should be developed first, followed by MP (marketing promotion), SE (service experience), and finally PS (product show). Therefore, the operators of industrial tourism can increase the improvement effect by improving EH (educational heritage) and focusing on the EH (educational heritage) value proposition. Operators of industrial tourism should also pay attention to the MP (marketing promotion) and the SE (service experience) value propositions. Besides, the NRM analysis also showed that the aspect of EH (educational heritage) is the most significant value-driving force in the service system of industrial tourism. The EH (educational heritage) aspect not only allows the conventional manufacturing plants to upgrade the service experience enterprise, but also dominates the MP, SE, and PS aspects. The educational heritage function is the value-driving force of the industrial tourism; it facilitates the formation of the commodity trading upgrade through the relationship between customers and manufacturers to promote local industry, product knowledge transfer, and unique skill heritage (Table 10 and Fig. 5).

3.5. Determine the suited improvement paths based on the aspects/ criteria rank

In the suited improvement path analysis, the ranking of the SII

Table 10
The service innovation strategies integrate table of industrial tourism.

Aspects	IOA			NRM			Strategy
	SII	MOI	(SII, MOI)	$d + r$	$d-r$	(R, D)	
Product show (PS)	−1.017	−1.398	(L, L)	110.436	−0.713	ID (+,-)	C-
Marketing promotion (MP)	−0.548	0.098	(L, H)	111.157	0.237	D (+,+)	B+
Service experience (SE)	1.252	0.960	(H, H)	110.920	−0.632	ID (+,-)	A-
Educational heritage (EH)	0.313	0.340	(H, H)	107.642	1.108	D (+,+)	A+

Notes1: Improvement strategies include three types: Improvement Strategy A (maintain strategy), Improvement Strategy B (cultivate ability strategy), Improvement Strategy C (mixed strategy), and Improvement Strategy D (making market strategy).
Notes2: "+" means the direct improvement and "-" mean the indirect improvement.
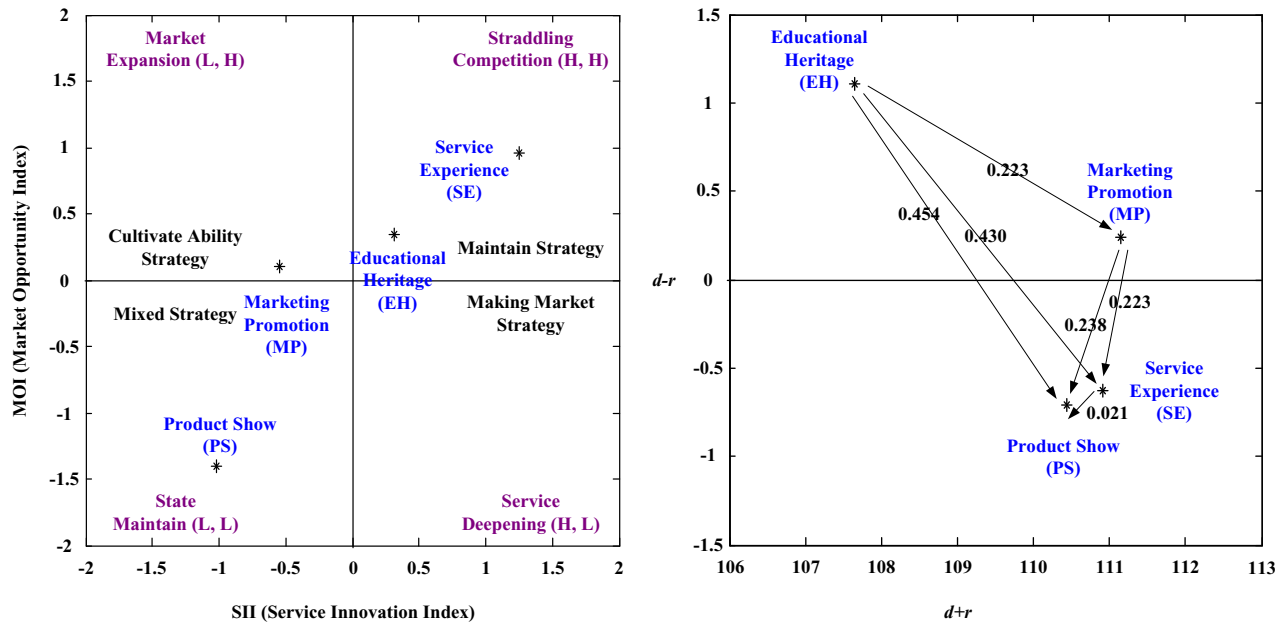

Fig. 5. The IOA-NRM map of industrial tourism.

(Service Innovation Index, SII) is SE⊃EH⊃MP⊃PS and the ranking of the MOI (Market Opportunity Index, MOI) is SE⊃ EH⊃ MP⊃ PS as shown in Table 11. The four improvement paths (EH→PS; EH→SE →PS; EH→MP→PS; EH→MP→SE→PS) could be determined by NRM analysis, and then advantage aspects/criteria can improve the disadvantage aspects/criteria. So the EH (educational heritage) aspect can improve the PS (product show) aspect by the first improvement path (EH [2]→PS [4]) as shown in Table 11. The SE (service experience) aspect can improve the PS aspect in the second improvement path (EH [2]→ SE [1]→PS [4]), and then the MP (marketing promotion) aspect can improve the PS aspect in the third improvement path (EH [2]→MP [3]→PS [4]). The EH aspect can improve the MP aspect, and the SE aspect can improve the PS aspect in the fourth improvement path (EH [2]→MP [3]→SE [1]→ PS [4]) as shown in Table 11. The ranking of the MOI (Market Opportunity Index, MOI) is SE⊃EH⊃MP⊃PS, and the aspect of EH can improve the aspect of PS by the first improvement path (EH [2]→PS [4]) and the aspect of SE can improve the PS aspect in the second improvement path (EH [2]→ SE [1]→PS [4]) as shown in Table 11. The aspect of MP can improve the aspect of PS in the third improvement path (EH [2]→MP [3]→PS [4]). Besides, the aspect of EH can improve the aspect of MP, and the aspect of SE can improve the aspect of PS in the fourth improvement path (EH [2]→MP [3]→ SE [1]→PS [4]) as shown in Table 11. Therefore the IOA-NRM technique combines the result of the SII improvement paths and MOI improvement paths, the suited improvement paths can be determined as shown in Table 11. Because the SII (Service Innovation Index) improvement paths and MOI (Market Opportunity Index) improvement paths are the same in the empirical case of industrial tourism, so the suited improvement paths include the four improvement paths (EH→PS; EH→SE→PS; EH→MP →PS; EH→MP→SE→PS) as shown in Table 11.

4. The IOA-NRM analysis of industrial tourism

This empirical study uses the service business of industrial tourism to present the IOA-NRM technique and investigates the degree of service innovation and market opportunity via questionnaires. This study determines the criteria that should be moved upon based on an IOA (Innovation Opportunity Analysis) and identifies suitable improvement paths using the NRM (Network Relation Map). The IOA and NRM technique is integrated to determine the improvement strategy and an appropriate improvement path for the service business of industrial tourism.

The aspects and criteria used to construct the questionnaires are based on the results of interviews for stakeholders (operators and tourists). Then, the stakeholders' questionnaires were designed accordingly. We then asked these stakeholders for answers to the questionnaires. This study also checks the aspect/criteria by the stakeholders (operators and tourists) and finishes the questionnaires preparatory test. The data collection methods included the paper questionnaire and the online questionnaire. This study takes

Table 11
The suited improvement paths of industrial tourism.

	SII	MOI
Rank	SE [1] >EH [2] >MP [3] >PS [4]	SE [1] >EH [2] >MP [3] >PS [4]
Improvement paths	1. EH [2]→PS [4]	1. EH [2]→PS [4]
	2. EH [2]→SE [1]→PS [4]	2. EH [2]→SE [1]→PS [4]
	3. EH [2]→MP [3]→PS [4]	3. EH [2]→MP [3]→PS [4]
	4. EH [2]→MP [3]→SE [1]→PS [4]	4. EH [2]→MP [3]→SE [1]→PS [4]
Suited improvement paths	1. EH→PS	
	2. EH→SE→PS	
	3. EH→MP→PS	
	4. EH→MP→SE→PS	

the heterogeneous of the stakeholders' sample (operators and tourists). A total of 120 questionnaires were collected, and 105 of them were valid samples. Cronbach's Alpha was applied to evaluate the questionnaires' reliability. The results indicated that the reliability of the SII and MOI aspect were 0.984 and 0.979, higher than the standard Cronbach level suggested, 0.7, which means the questionnaires were highly consistent. The results indicated that the reliability of the aspect was 0.935, i.e., higher than the standard level that Cronbach suggested, 0.7, which means the questionnaires were highly consistent. The reliability of the PS (product show) criterion was 0.946, and the reliability of the MP (marketing promotion) criterion was 0.958. And then the reliability of the SE (service experience) criterion was 0.965, and the reliability of the EH (educational heritage) criterion was 0.964, higher than the standard level that Cronbach suggested, 0.7, which means the questionnaires were highly consistent (Table 12).

4.1. Product show (PS)

With the PS (product show) aspect, the IOA-NRM integrated analysis is illustrated in Table 13 and Fig. 6. The net influence matrix of the PS aspect is presented in Table 13 and Fig. 6. In the analysis of the IOA, the criteria of the PS1 (material verification) and PS3 (product display) are the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, these two criteria located in the third quadrant, and then these two criteria should improve the degree of SII and MOI by adopting the mixed strategy as shown in Table 13 and Fig. 6. The criteria of the PS2 (manufacturing process show) and PS4 (derivative applications) are the degree of service innovation (SII) more than the average service innovation degree (SII> 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, these two criteria were located in the fourth quadrant, and these two criteria should be improved via degree of MOI by adopting the making market strategy as shown in Table 13 and Fig. 6.

In the analysis of NRM, the criteria of the PS1 (material

Table 12
The reliability analysis (Cronbach α).

Items	Aspects/Criteria	Alpha	Result
Service Innovation Index (SII)	–	0.984	High
Market Opportunity Index (MOI)	–	0.979	High
Aspects of Evaluation System		0.935	High
Criteria of aspects	Product show (PS)	0.946	High
	Marketing promotion (MP)	0.958	High
	Service experience (SE)	0.965	High
	Educational heritage (EH)	0.964	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.

verification), PS4 (derivative applications), and PS2 (manufacturing process show) are found to have a positive net influence effect $(d - r > 0)$. They can improve the PS aspect from the criteria of the PS1, PS4, and PS2, as shown in Fig. 6. The two improvement strategies are presented in Table 13. Improvement Strategy C (mixed strategy) can be applied to the criteria of the PS1 and PS3 (SII<0 and MOI<0). Improvement strategy D (making market strategy) can be applied to the criteria of the PS2 and PS4. As illustrated in Table 13 and Fig. 6, the criteria of the PS3 and PS1 were located in the third quadrant [(SII, MOI)=(L, L)], so these two criteria need improvement. The criteria of the PS3 can be improved upon by the criterion of the PS1, PS4, and PS2, and the criterion PS1 should be improved upon by itself. The criteria of the PS2 and PS4 were located in the fourth quadrant [(SII, MOI)=(H, L)], so these two criteria need improvement. The criteria of the PS2 can then be improved upon by the criteria of PS1 and PS4 and the criterion PS4 should be developed upon by PS1, as shown in Fig. 6.

In the suited improvement path analysis, the ranking of the SII (Service Innovation Index, SII) is PS4⊃PS2⊃PS1⊃PS3and the ranking of the MOI (Market Opportunity Index, MOI) is PS4⊃PS2⊃PS3⊃PS1as shown in Table 14. The four improvement paths (PS1→PS3; PS1→PS4→PS3; PS1→PS2→PS3; PS1→PS4→PS2→PS3) could be determined by NRM analysis, and then the advantage aspects/criteria can improve the disadvantage aspects/criteria. So the criterion of PS1 (material verification) can improve the criterion of PS3 (product display) by the first improvement path (PS1 [3]→ PS3 [4]) as shown in Table 14. The criterion of PS4 (derivative applications) can improve the criterion of PS3 in the second improvement path (PS1 [3]→ PS4 [1]→ PS3 [4]), and then the criterion of PS2 (manufacturing process show) can improve the criterion of PS3 in the third improvement path (PS1 [3]→ PS2 [2]→PS3 [4]). The criterion of PS4 can improve the criterion of PS2, and the PS2 criterion can improve the criterion of PS3 in the fourth improvement path (PS1 [3]→ PS4 [1]→PS2 [2]→ PS3 [4]) as shown in Table 14. The ranking of the MOI (Market Opportunity Index, MOI) is PS4⊃PS2⊃PS3⊃PS1, and the disadvantage criterion of PS1 (material verification) cannot improve the advantage criterion of PS3 (product display) by the first improvement path (PS1 [4]→ PS3 [3] {X}), and the criterion of PS4 (derivative applications) can improve the criterion of PS3 in the second improvement path (PS1 [4]→ PS4 [1]→PS3 [3]) as shown in Table 14. The criterion of PS2 can improve the aspect of PS3 in the third improvement path (PS1 [4]→ PS2 [2]→PS3 [3]).

Besides, the criterion of PS4 can improve the criterion of PS2, and the criterion of PS2 can improve the criterion of PS3 in the fourth improvement path (PS1 [4]→ PS4 [1]→PS2 [2]→PS3 [3]) as shown in Table 14. Therefore the IOA-NRM technique combines the result of the SII improvement paths and MOI improvement paths, and the suited improvement paths can be determined as shown in Table 14. Because the SII (Service Innovation Index) improvement paths and MOI (Market Opportunity Index) improvement paths are

Table 13
The improvement strategy of the PS (product show) aspect.

Criteria	IOA			NRM			Strategy
	SII	MOI	(SII, MOI)	$d + r$	$d-r$	(R, D)	
Material verification (PS1)	−1.282	−2.226	(L, L)	116.032	0.674	D (+,+)	C+
Manufacturing process show (PS2)	0.221	−0.860	(H, L)	117.208	0.093	D (+,+)	D+
Product display (PS3)	−2.078	−1.543	(L, L)	114.896	−1.338	ID (+,-)	C-
Derivative applications (PS4)	0.840	−0.633	(H, L)	115.028	0.571	D (+,+)	D+

Notes1: Improvement strategies include three types: Improvement Strategy A (maintain strategy), Improvement Strategy B (cultivate ability strategy), Improvement Strategy C (mixed strategy), and Improvement Strategy D (making market strategy).
Notes2: "+" means the direct improvement and "-" mean the indirect improvement.
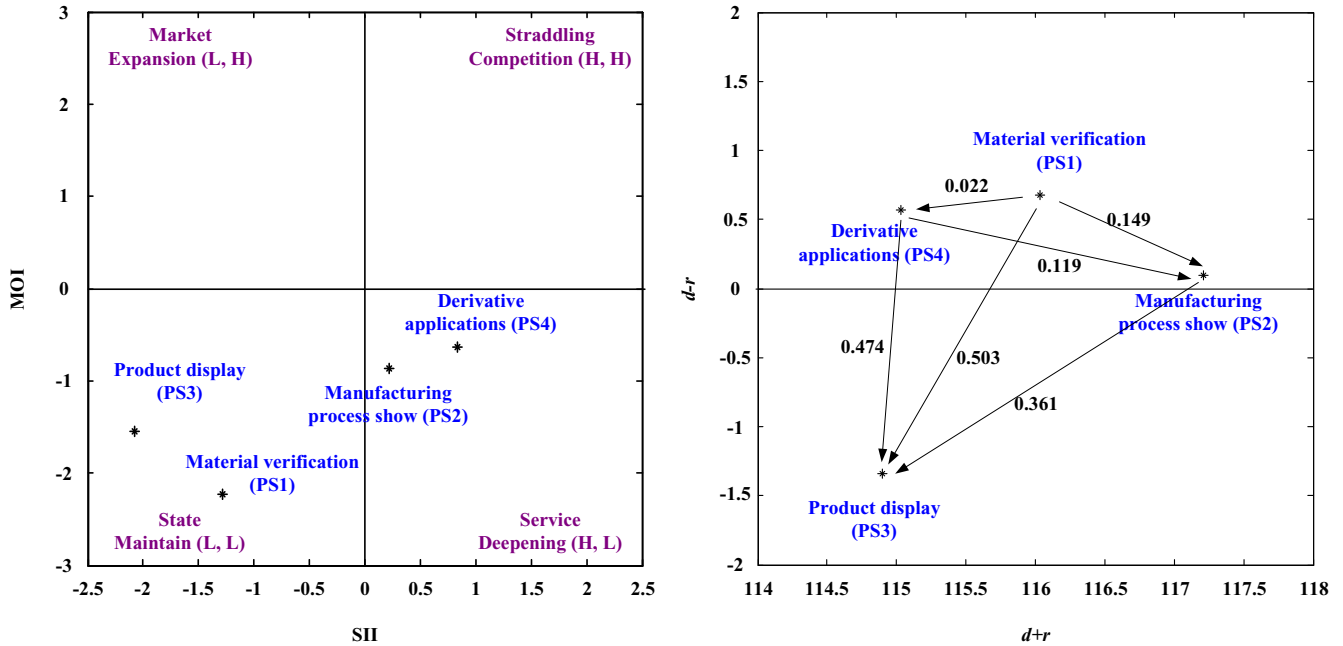

Fig. 6. The IOA-NRM analysis for the PS (product show) aspect.

Table 14
The suited improvement paths of the PS (product show) aspect.

	SII	MOI
Rank	PS4 [1] >PS2 [2] > PS1 [3]> PS3 [4]	PS4 [1]> PS2 [2]> PS3 [3]>PS1[4]
Improvement paths	1. PS1 [3]→ PS3 [4]	**1. PS1 [4]→ PS3 [3] {X}**
	2. PS1 [3]→ PS4 [1]→PS3 [4]	2. PS1 [4]→ PS4 [1]→PS3 [3]
	3. PS1 [3]→ PS2 [2]→PS3 [4]	3. PS1 [4]→ PS2 [2]→PS3 [3]
	4. PS1 [3]→ PS4 [1]→PS2 [2]→PS3 [4]	4. PS1 [4]→ PS4 [1]→PS2 [2]→PS3 [3]
Suited improvement paths	2. PS1 → PS4 →PS3	
	3. PS1 → PS2 →PS3	
	4. PS1 → PS4 →PS2 →PS3	

different for the PS (product show) aspect, so the suited improvement paths include the three improvement paths (PS1→ PS4→PS3; PS1→PS2→PS3; PS1→PS4→PS2→PS3) as shown in Table 14.

4.2. Marketing promotion (MP)

With the MP (marketing promotion) aspect, the IOA-NRM integrated analysis is illustrated in Table 15 and Fig. 7. The net influence matrix of the MP aspect is presented in Table 15 and Fig. 7. In the analysis of the IOA, the criteria of the MP2 (experience sharing) and MP4 (brands deepening) aspect are the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) more than the average market opportunity degree (MOI> 0). Therefore, the criterion was located in the second quadrant, and the criterion should be improved the degree of SII by adopting the cultivate ability strategy as shown in Table 15 and Fig. 7. The criterion of the MP1 (product description) aspect is the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, this criterion was located in the third quadrant, and it should be improved the degree of SII and MOI by adopting the mixed strategy as shown in Table 15 and Fig. 7. The criteria of the MP3 (product extensions) aspect is the degree of service innovation (SII) more than the average service

innovation degree (SII> 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, the criterion was located in the fourth quadrant, and then the criterion should be improved the degree of MOI by adopting the making market strategy as shown in Table 15 and Fig. 7.

In the analysis of NRM, the criteria of the MP1 (product description) and MP2 (experience sharing) are found to have a positive net influence effect ($d - r > 0$). They can improve the MP (marketing promotion) aspect from the criteria of the MP2 and MP1, as shown in Fig. 7. The three improvement strategies are presented in Table 15. Improvement strategy B (mixed strategy) can be applied to the criteria of the MP2 and MP4 (SII<0 and MOI>0), and then Improvement Strategy C (mixed strategy) can be applied to the criterion of the MP1 (SII<0 and MOI<0). Improvement strategy D (making market strategy) can be used as the criterion of the MP3 (SII>0 and MOI<0). As illustrated in Table 15 and Fig. 7, the criteria of the MP4 and MP2 were located in the second quadrant [(SII, MOI)=(L, H)], so these two criteria need improvement. The criteria of the MP4 can then be improved upon by the criterion of the MP2, MP1, and MP3, and the criterion MP2 should be developed upon by itself. The criterion of the MP1 was located in the third quadrant [(SII, MOI)=(L, L)], so the criterion needs improvement. The criteria of the MP1 can then be improved upon by the criterion of the MP2. The criterion of MP3 was located in the fourth quadrant [(SII, MOI)=(H, L)], so the criterion needs improvement. The criteria of the MP3 can then be improved upon by the criteria of the MP2 and MP1 as shown in Fig. 7.

In the suited improvement path analysis, the ranking of the SII (Service Innovation Index, SII) is MP3⊃MP1⊃MP4⊃MP2 and the ranking of the MOI (Market Opportunity Index, MOI) is MP4⊃MP2⊃MP1⊃MP3 as shown in Table 16. The four improvement paths (MP2→MP4; MP2→MP3→MP4; MP2→MP1→MP4; MP2→MP1→MP3→MP4) could be determined by NRM analysis, and then advantage aspects/criteria can improve the disadvantage aspects/criteria. So the disadvantage criterion of MP2 (experience sharing) cannot improve the advantage criterion of MP4 (brands deepening) by the first improvement path (MP2 [4] →MP4 [3] {X}) as shown in Table 16. The criterion of MP3 (product extensions) can improve the criterion of MP4 (brands deepening) in the second improvement path (MP2 [4]→MP3 [1]→MP4 [3]), and then the criterion of MP1 (product description) can improve the criterion of MP4 (brands deepening) in the third improvement path (MP2 [4]→MP1 [2]→MP4 [3]). The criterion of MP3 (product extensions) can improve the criterion of MP4 in the fourth improvement path (MP2 [4]→MP1 [2]→MP3 [1]→MP4 [3]) as shown in Table 16. The ranking of the MOI (Market Opportunity Index, MOI) is MP4⊃MP2⊃MP1⊃MP3, and the disadvantage criterion of MP2 (experience sharing) cannot improve the advantage criterion of MP4 (brands deepening) by the first improvement path (MP2 [2]→MP4 [1] {X}), and the criterion of MP2 (experience sharing) can improve the criterion of MP3 (product extensions) in the second

improvement path (MP2 [2]→MP3 [4]→MP4 [1]) as shown in Table 16. The criterion of MP2 can improve the criterion of MP1 (product description) in the third improvement path (MP2 [2]→MP1 [3]→MP4 [1]). Besides, the criterion of MP2 can improve the criterion of MP1, and the criterion of MP1 can improve the criterion of MP3 in the fourth improvement path (MP2 [2]→MP1 [3]→MP3 [4]→MP4 [1]) as shown in Table 16. Therefore the IOA-NRM technique combines the result of the SII improvement paths and MOI improvement paths, and the suited improvement paths can be determined as shown in Table 16. The SII (Service Innovation Index) improvement paths and MOI (Market Opportunity Index) improvement paths are same for the MP (marketing promotion) aspect, so the suited improvement paths include the three improvement paths (MP2→MP3→MP4; MP2→MP1→MP4; MP2→MP1→MP3→MP4) as shown in Table 16.

4.3. Service experience (SE)

With the SE (service experience) aspect, the IOA-NRM integrated analysis is illustrated in Table 17 and Fig. 8, and the net influence matrix of the SE aspect is presented in Table 17 and Fig. 8. In the analysis of the IOA, the criteria of the SE4 (ideation conveys) aspect is the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) more than the average market opportunity degree (MOI> 0). Therefore, the criterion was located in the second quadrant, and it should be improved the degree of SII by adopting the cultivate ability strategy as shown in Table 17 and Fig. 8. The criteria of the SE1 (feelings of perception) is the degree of service innovation (SII) more than the average service innovation degree (SII> 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, the criterion was located in the fourth quadrant, and the criterion should be improved the degree of MOI by adopting the making market strategy as shown in Table 17 and Fig. 8. The criteria of the SE2 (handmade participation), and SE3 (field experience) are the degree of service innovation (SII) more than the average service innovation degree (SII> 0) and the degree of market opportunity (MOI) more than the average market opportunity degree (MOI> 0). Therefore, these two criteria were located in the first quadrant, and then the criteria should only keep the degree of SII and MOI by adopting the maintain strategy as shown in Table 17 and Fig. 8.

In the analysis of NRM, the criteria of the SE3 (field experience) and SE4 (ideation conveys) are found to have a positive net influence effect ($d - r > 0$). They can improve the SE (service experience) aspect from the criteria of the SE3 and SE4, as shown in Fig. 8. The three improvement strategies are presented in Table 17, improvement strategy B (mixed strategy) can be applied to the criteria of the SE4 (ideation conveys) (SII<0 and MOI>0), and then improvement strategy D (making market strategy) can be applied to the criterion of the SE1 (SII>0 and MOI<0). Improvement strategy A (maintain strategy) can be used to the criteria of the SE2 and SE3

Table 15
The improvement strategy of the MP (marketing promotion) aspect.

Criteria	IOA			NRM			Strategy
	SII	MOI	(SII, MOI)	$d + r$	$d-r$	(R, D)	
Product description (MP1)	−0.044	−0.121	(L, L)	140.573	0.107	D (+,+)	C+
Experience sharing (MP2)	−1.459	0.277	(L, H)	139.869	1.244	D (+,+)	B+
Product extensions (MP3)	0.486	−0.292	(H, L)	140.745	−0.603	ID (+,-)	D-
Brands deepening (MP4)	−0.221	0.505	(L, H)	141.528	−0.748	ID (+,-)	B-

Notes1: Improvement strategies include three types: Improvement Strategy A (maintain strategy), Improvement Strategy B (cultivate ability strategy), Improvement Strategy C (mixed strategy), and Improvement Strategy D (making market strategy).
Notes2: "+" means the direct improvement and "-" mean the indirect improvement.
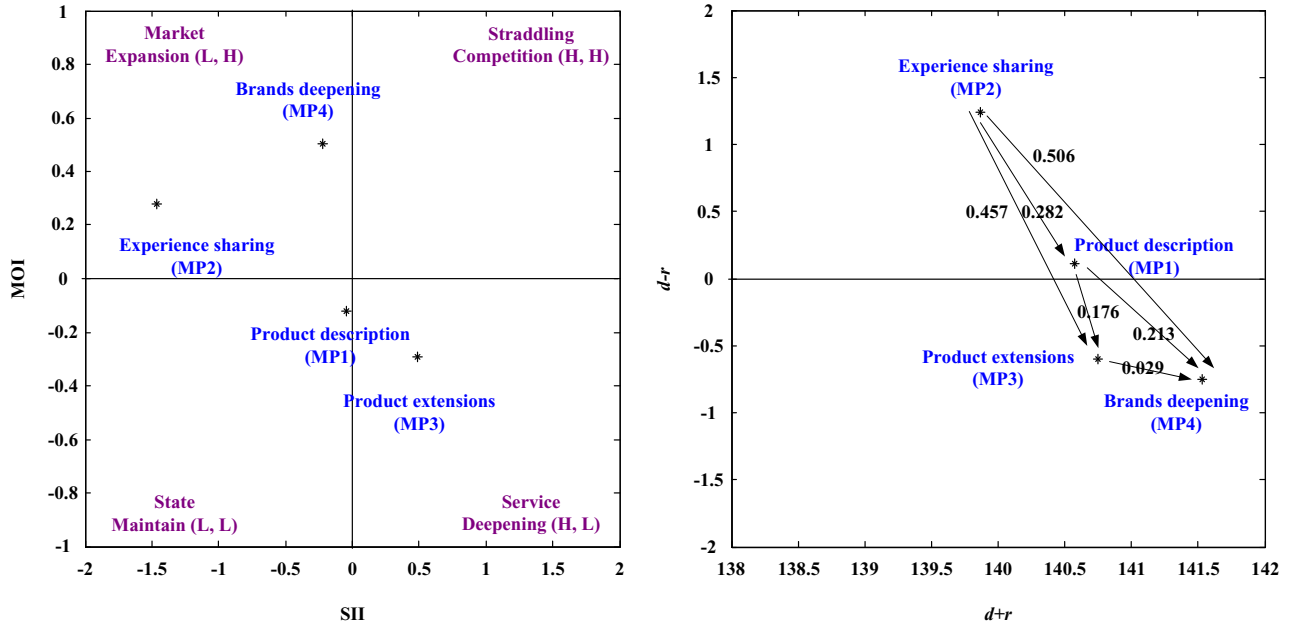
Fig. 7. The IOA-NRM analysis for the MP (marketing promotion) aspect.

Table 16
The suited improvement paths of the MP (marketing promotion) aspect.

Rank	SII	MOI
	MP3 [1]> MP1 [2]> MP4 [3] >MP2 [4]	MP4 [1]> MP2 [2]> MP1 [3] >MP3 [4]
Improvement paths	1. MP2 [4]→MP4 [3] {X}	1. MP2 [2]→MP4 [1] {X}
	2. MP2 [4]→MP3 [1]→MP4 [3]	2. MP2 [2]→MP3 [4]→MP4 [1]
	3. MP2 [4]→MP1 [2]→MP4 [3]	3. MP2 [2]→MP1 [3]→MP4 [1]
	4. MP2 [4]→MP1 [2]→MP3 [1]→MP4 [3]	4. MP2 [2]→MP1 [3]→MP3 [4]→MP4 [1]
Suited improvement paths	2. MP2 →MP3 →MP4	
	3. MP2 →MP1 →MP4	
	4. MP2 →MP1 →MP3 →MP4	

Table 17
The improvement strategy of the SE (service experience) aspect.

Criteria	IOA			NRM			Strategy
	SII	MOI	(SII, MOI)	$d + r$	$d-r$	(R, D)	
Feelings of perception (SE1)	1.017	−0.064	(H, L)	101.114	−0.150	ID (+,-)	D-
Handmade participation (SE2)	1.548	1.643	(H, H)	99.093	−0.262	ID (+,-)	A-
Field experience (SE3)	1.017	1.301	(H, H)	99.297	0.303	D (+,+)	A+
Ideation conveys (SE4)	−0.752	0.732	(L, H)	99.248	0.109	D (+,+)	B+

Notes 1: Improvement strategies include three types: Improvement Strategy A (maintain strategy), Improvement Strategy B (cultivate ability strategy), Improvement Strategy C (mixed strategy), and Improvement Strategy D (making market strategy).
Notes 2: "+" means the direct improvement and "-" mean the indirect improvement.

(SII>0 and MOI>0). As illustrated in Table 17 and Fig. 8., the criterion of the SE4 was located in the second quadrant [(SII, MOI)=(L, H)], so the criterion needs improvement. The criteria of the SE4 can then be improved upon by the criterion of the SE3. The criterion of the SE1 was located in the fourth quadrant [(SII, MOI)=(H, L)], so the criterion needs improvement. The criteria of the SE1 can then be improved upon by the criteria of the SE3 and SE4. The criteria of the SE2 and SE3 were located in the first quadrant [(SII, MOI)=(H, H)], so these criteria need to maintain. The criterion of the SE2 can then be improved upon by the criteria of the SE3, SE4, and SE1, and the developed of SE3 should be improved upon by itself as shown in Fig. 8.

In the suited improvement path analysis, the ranking of the SII

(Service Innovation Index, SII) is SE2⊃SE1 = SE3⊃SE4and the ranking of the MOI (Market Opportunity Index, MOI) is SE2⊃SE3⊃ SE4⊃SE1 as shown in Table 18. The four improvement paths (SE3→SE2; SE3→SE4→SE2; SE3→SE1→SE2; SE3 →SE4 → SE1 →SE2) could be determined by NRM analysis, and then advantage aspects/criteria can improve the disadvantage aspects/criteria. So the criterion of SE3 (field experience) cannot improve the criterion of SE2 (handmade participation) by the first improvement path (SE3 [2]→SE2 [1] {X}) as shown in Table 18. The criterion of SE3 (field experience) can improve the criterion of SE4 (ideation conveys) in the second improvement path (SE3 [2]→SE4 [4]→SE2 [1]), and then the criterion of SE3 (field experience) can improve the criterion of SE1 (feelings of perception) in the third improvement
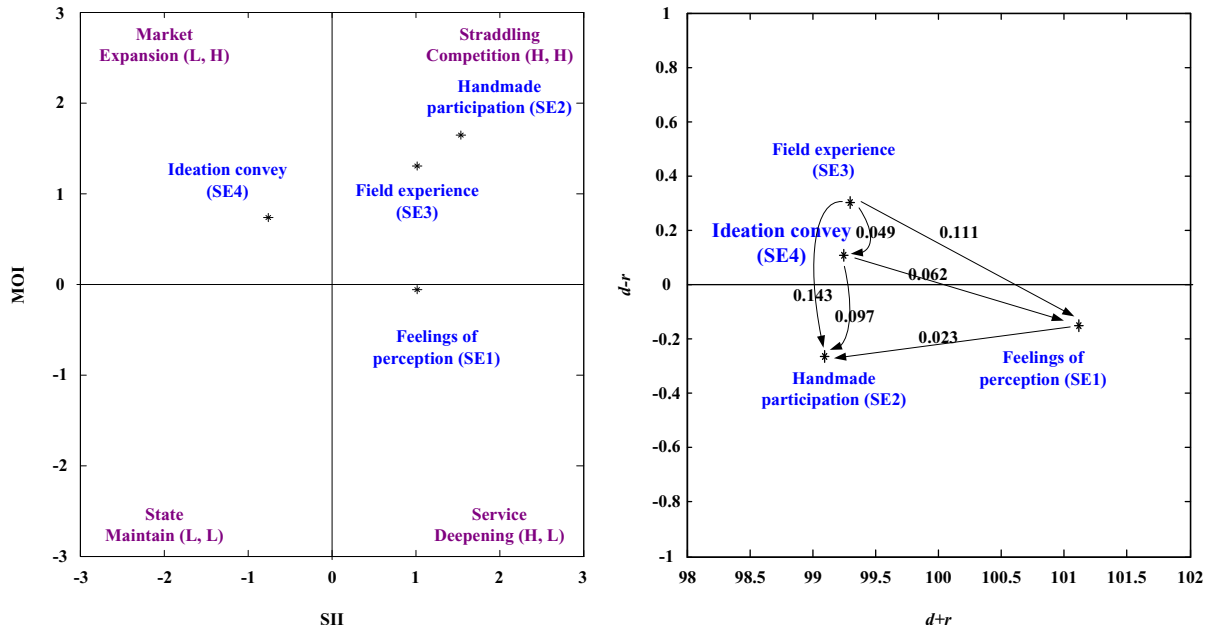
Fig. 8. The IOA-NRM analysis for the SE (service experience) aspect.

path (SE3 [2]→SE1 [2]→SE2 [1]). The criterion of SE3 can improve the criterion of SE4 in the fourth improvement path (SE3 [2]→SE4 [4]→SE1 [2]→SE2 [1]) as shown in Table 18. The ranking of the MOI (Market Opportunity Index, MOI) is SE2⊃SE3⊃SE4⊃SE1, and the disadvantage criterion of SE3 (field experience) cannot improve the advantage criterion of SE2 (handmade participation) by the first improvement path (SE3 [2]→SE2 [1] {X}), and the criterion of SE3 (field experience) can improve the criterion of SE4 (ideation conveys) in the second improvement path (SE3 [2]→SE4 [3]→SE2 [1]) as shown in Table 18. The criterion of SE3 can improve the criterion of SE1 in the third improvement path (SE3 [2]→SE1 [4]→SE2 [1]). Besides, the criterion of SE3 can improve the criterion of SE4, and the criterion of SE4 can improve the criterion of SE1 in the fourth improvement path (SE3 [2]→SE4 [3]→SE1 [4]→SE2 [1]) as shown in Table 18. Therefore the IOA-NRM technique combines the result of the SII improvement paths and MOI improvement paths, and the suited improvement paths can be determined as shown in Table 18. Because of the SII (Service Innovation Index) improvement paths and MOI (Market Opportunity Index) improvement paths are same for the SE (service experience) aspect, the suited improvement paths include the three improvement paths (SE3→SE4→SE2; SE3→SE1→SE2; SE3 →SE4 → SE1→SE2) as shown in Table 18.

4.4. Educational heritage (EH)

With the aspect of EH (educational heritage), the IOA-NRM integrated analysis is illustrated in Table 19 and Fig. 9. The net influence matrix of the EH (educational heritage) is presented in Table 19 and Fig. 9. In the analysis of the IOA, the criterion of the EH2 (artistry heritage) is the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) more than the average market opportunity degree (MOI> 0). Therefore, the criterion was located in the second quadrant, and then the criterion should be improved the degree of SII by adopting the cultivate ability strategy as shown in Table 19 and Fig. 9. The criterion of the EH3 (local endorsing) is the degree of service innovation (SII) less than the average service innovation degree (SII< 0) and the degree of market opportunity (MOI) less than the average market opportunity degree (MOI< 0). Therefore, the criterion was located in the third quadrant, and this criterion should be improved the degree of MOI by adopting the mixed strategy. The criteria of the EH1 (knowledge transmission) and EH4 (cultural communications) are the degree of service innovation (SII) more than the average service innovation degree (SII> 0) and the degree of market opportunity (MOI) more than the average market opportunity degree (MOI> 0). Therefore, the criterion was located in the first quadrant, and then these criteria should be improved the degree of MOI by adopting the maintain strategy as shown in Table 19 and Fig. 9.

In the analysis of NRM, the criteria of the EH2 (artistry heritage) and EH4 (cultural communications) are found to have a positive net influence effect ($d - r > 0$). They can improve the EH aspect from the criteria of the EH2 and EH4 as shown in Fig. 9. The three improvement strategies are presented in Table 19. Improvement

Table 18
The suited improvement paths of the SE (service experience) aspect.

Rank	SII	MOI
	SE2 [1]> SE1 [2] = SE3 [2]> SE4 [4]	SE2 [1]>SE3 [2]>SE4 [3]>SE1 [4]
Improvement paths	1. SE3 [2]→SE2 [1] {X}	1. SE3 [2]→SE2 [1] {X}
	2. SE3 [2]→SE4 [4]→SE2 [1]	2. SE3 [2]→SE4 [3]→SE2 [1]
	3. SE3 [2]→SE1 [2]→SE2 [1]	3. SE3 [2]→SE1 [4]→SE2 [1]
	4. SE3 [2]→SE4 [4]→SE1 [2]→SE2 [1]	4. SE3 [2]→SE4 [3]→SE1 [4]→SE2 [1]
Suited improvement paths	2. SE3 →SE4 →SE2	
	3. SE3 →SE1 →SE2	
	4. SE3 →SE4 →SE1 →SE2	

Table 19
The improvement strategy of the EH (educational heritage) aspect.

Criteria	IOA			NRM			Strategy
	SII	MOI	(SII, MOI)	$d + r$	$d-r$	(R, D)	
Knowledge transmission (EH1)	0.663	1.017	(H, H)	98.317	−0.035	ID (+,-)	A-
Artistry heritage (EH2)	−0.044	0.334	(L, H)	98.098	0.045	D (+,+)	B+
Local endorsing (EH3)	−0.398	−0.121	(L, L)	97.141	−0.683	ID (+,-)	C-
Cultural communications (EH4)	0.486	0.050	(H, H)	98.950	0.673	D (+,+)	A+

Notes 1: Improvement strategies include three types: Improvement Strategy A (maintain strategy), Improvement Strategy B (cultivate ability strategy), Improvement Strategy C (mixed strategy), and Improvement Strategy D (making market strategy).
Notes 2: "+" means the direct improvement and "-" mean the indirect improvement.
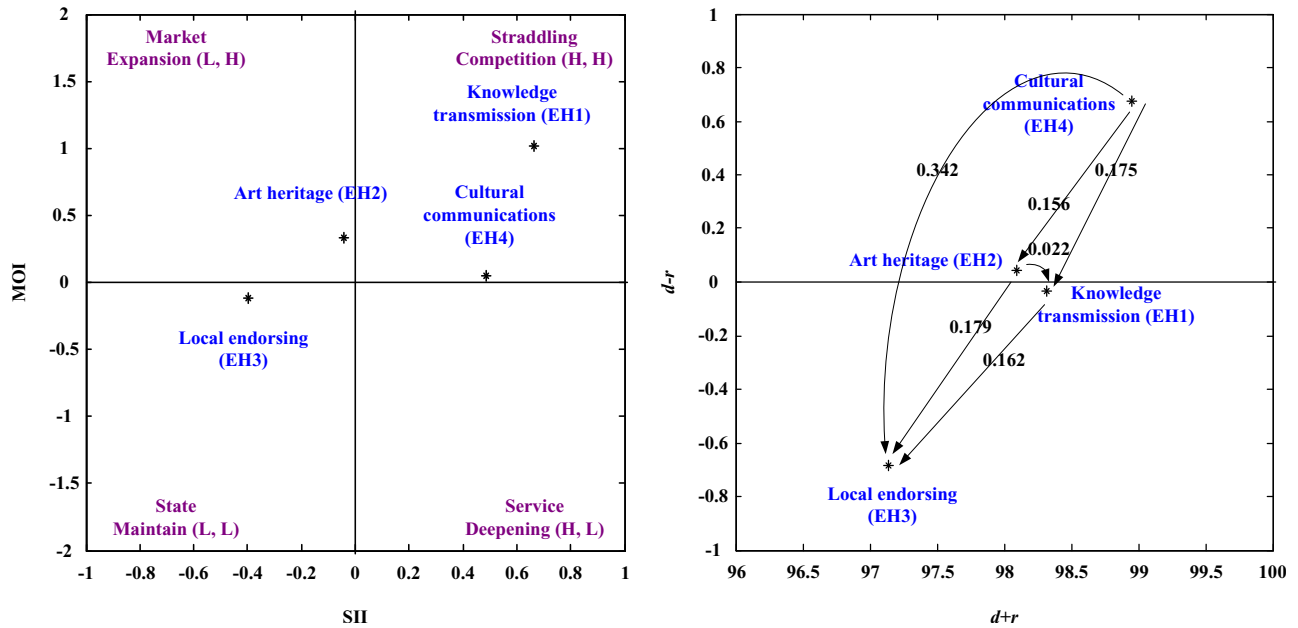

Fig. 9. The IOA-NRM analysis for the EH (educational heritage) aspect.

strategy B (cultivate ability strategy) can be applied to the criterion of the EH2 (SII<0 and MOI>0). Improvement Strategy C (mixed strategy) can be used to the criteria of the EH3, and the Improvement Strategy A (maintain strategy) can be applied to the criteria of the EH1 and EH4. As illustrated in Table 19 and Fig. 9, the criteria of the EH2 was located in the second quadrant [(SII, MOI)=(L, H)], so the criterion needs improvement. The criterion of the EH2 can then be improved upon by the criterion of the EH4. The criterion of the EH3 was located in the third quadrant [(SII, MOI) =(L, L)], so the criterion needs improvement. The criteria of the EH3 can then be improved upon by the criterion of the EH4, EH2, and EH1. The criteria of the EH4 and EH1 were located in the first quadrant [(SII, MOI)=(H, H)], so these criteria need to maintain. The EH1 criterion can then be improved upon by the criterion of the EH4 and EH2, and the EH4 criterion should be developed upon by itself as shown in Fig. 9.

In the suited improvement path analysis, the ranking of the SII (Service Innovation Index, SII) is EH1⊃EH4⊃EH2⊃EH3 and the ranking of the MOI (Market Opportunity Index, MOI) is EH1⊃EH2⊃EH4⊃EH3 as shown in Table 20. The four improvement paths (EH4→EH3; EH4→EH2→EH3; EH4→EH1→EH3; EH4→EH2→EH1→EH3) could been determined by NRM analysis, and then advantage aspects/criteria can improve the disadvantage aspects/criteria. So the criterion of EH4 (cultural communications) can improve the criterion of EH3 (local endorsing) by the first improvement path (EH4 [2]→EH3 [4]) as shown in Table 20. The

criterion of EH4 (cultural communications) can improve the criterion of EH2, (artistry heritage) and the criterion of EH2 (derivative applications) can improve the criterion of EH3 (local endorsing) in the second improvement path (EH4 [2]→EH2 [3]→EH3 [4]). The criterion of EH1 (knowledge transmission) can improve the criterion of EH3 (local endorsing) in the third improvement path (EH4 [2]→ EH1 [1]→EH3 [4]). The criterion of EH4 can improve the criterion of EH2, and the EH1 criterion can improve the criterion of EH3 in the fourth improvement path (EH4 [2]→EH2 [3]→EH1 [1]→EH3 [4]) as shown in Table 20.

The ranking of the MOI (Market Opportunity Index, MOI) is EH1⊃EH2⊃EH4⊃EH3, and the disadvantage criterion of EH4 (cultural communications) cannot improve the advantage criterion of EH3 (local endorsing) by the first improvement path (EH4 [3]→ EH3 [4]), but the criterion of EH2 (artistry heritage) can improve the criterion of EH3 in the second improvement path (EH4 [3]→EH2 [2]→EH3 [4]) as shown in Table 20. The criterion of EH1 (knowledge transmission) can improve the criterion of EH3 in the third improvement path (EH4 [3]→EH1 [1]→EH3 [4]). Besides, the criterion of EH1 can improve the criterion of EH3 in the fourth improvement path (EH4 [3]→EH2 [2]→EH1 [1]→EH3 [4]) as shown in Table 20. Therefore the IOA-NRM technique combines the result of the SII improvement paths and MOI improvement paths, and the suited improvement paths can be determined as shown in Table 20. Because of the SII (Service Innovation Index) improvement paths and MOI (Market Opportunity Index) improvement

Table 20
The suited improvement paths of the EH (educational heritage) aspect.

Rank	SII	MOI
	EH1 [1]> EH4 [2]> EH2 [3] >EH3 [4]	EH1 [1]> EH2 [2] >EH4 [3]>EH3 [4]
Improvement paths	1. EH4 [2]→EH3 [4]	1. EH4 [3]→EH3 [4]
	2. EH4 [2]→EH2 [3]→EH3 [4]	2. EH4 [3]→EH2 [2]→EH3 [4]
	3. EH4 [2]→EH1 [1]→EH3 [4]	3. EH4 [3]→EH1 [1]→EH3 [4]
	4. EH4 [2]→EH2 [3]→EH1 [1]→EH3 [4]	4. EH4 [3]→EH2 [2]→EH1 [1]→EH3 [4]
Suited improvement paths	EH4 →EH3	
	EH4 →EH2 →EH3	
	EH4 →EH1 →EH3	
	EH4 →EH2 →EH1 →EH3	

paths are same for the EH (educational heritage) aspect, the suited improvement paths include the three improvement paths (EH4→EH3; EH4→EH2→EH3; EH4→EH1→EH3; EH4→EH2→EH1→EH3) as shown in Table 20.

4.5. Discussion

In the aspect of PS (product show), the criteria of PS1 and PS3 are located in the third quadrant, and the criteria of PS2 (manufacturing process show) and PS4 (derivative applications) are located in the fourth quadrant. The improvement strategy C (mixed strategy) can be applied to the criteria of PS1 (material verification) and PS3 (product display), and the Improvement Strategy D (making market strategy) has been applied in the criteria of PS2 and PS4. There are three suited improvement paths (PS1→PS4→PS3; PS1→PS2→PS3; and PS1→PS4→PS2→PS3) for the PS aspect as shown in Table 21. The first suited improvement path is the criterion of PS1 (material verification) influence the criterion of PS4 (derivative applications), and the criterion of PS4 influence the criterion of PS3 (product display). So the service operators should let customers understand the raw material source and raw material verification, and then show derivative style applications of material sources for customers and tourists. Customers can understand the different material sources and derivative application by the processes of material verification and derivative applications. Besides, the customers can become familiar with the enterprise products and services in the process of product display. The second suited improvement path is the criterion of PS1 (material verification) influence the criterion of PS2 (manufacturing process show), and the criterion of PS2 influence the criterion of PS3 (product display). The material verification and manufacturing process show can increase trust for the customers, and the process of product display can increase the understanding of enterprises' products and services. The third suited improvement path is the criterion of PS1 (material verification) influence the criterion of PS4 (derivative applications), and the criterion of PS2 (manufacturing process show) influence the criterion of PS3 (product display). The process of material verification and derivative applications can increase the understanding for the tourists, and the process of manufacturing process show and product display can increase the familiar with products and services for industrial tourism.

In the aspect of MP (marketing promotion), the criteria of MP2 and MP4 are located in the second quadrant, the criterion of MP1 is located in the third quadrant, and the criterion of MP3 is located in the fourth quadrant. The improvement strategy B (cultivate ability strategy) can be applied in the criteria of MP2 and MP4. The improvement strategy C (mixed strategy) can be applied in the criteria of MP1, and the improvement strategy D (making market strategy) can be applied in the criteria of MP3. There are three suited improvement paths (MP2→MP3→ MP4; MP2→MP1→MP4; and MP2→MP1→MP3→MP4) for the MP

aspect as shown in Table 21. The first suited improvement path is the criterion of MP2 (experience sharing) influencing the criterion of MP3 (product extensions), and the criterion of MP3 influences the criterion of MP4 (brands deepening). So the service operators can let tourists understand their products and services via tourists' experience sharing, and service operators also offer diverse alternatives for their products and services by product extensions. Besides, the service operators can deepen their brand through the experience sharing and product extensions. The second suited improvement path is the criterion of MP2 (experience sharing) influencing the criterion of MP1 (product description), and the criterion of MP1 influences the criterion of MP4 (brands deepening). The tourists' experience sharing and product description can help tourists to understand enterprise' product functions and service items, and deepen their brand of product and service. The third suited improvement path is the criterion of MP2 (experience sharing) influencing the criterion of MP1 (product description), and the criterion of MP3 (product extensions) influences the criterion of MP4 (brands deepening). Customers' experience sharing can attract more potential customers to visit the industrial tourism and more detailed product descriptions can help tourists' to understand product function and service items. The diverse product and service can satisfy tourists' service needs and deepen brand image for their product and service.

In the aspect of SE (service experience), the criteria of SE2 and SE3 are located in the first quadrant, the criterion of SE4 is located in the second quadrant, and the criterion of SE1 is located in the fourth quadrant. The improvement strategy A (maintain strategy) can be applied to the criteria of SE2 and SE3. The improvement strategy B (cultivate ability strategy) can be applied to the criteria of SE4, and the improvement strategy D (making market strategy) can be used to the criteria of SE1. There are three suited improvement paths (SE3→SE4→SE2; SE3→SE1→SE2; and SE3→SE4→SE1→SE2) for the SE aspect as shown in Table 21. The first suited improvement path is the criterion of SE3 (field experience) influencing the criterion of SE4 (ideation conveys), and the criterion of SE4 influences the criterion of SE2 (handmade participation). So the service operators can let tourists understand the production and service process for industrial tourism by tourists' field experience and some activity planning would also strengthen the ideation conveys of core value for industrial tourism. Besides, DIY activities can also increase tourists' interests through handmade participation. The second suited improvement path is the criterion of SE3 (field experience) influencing the criterion of SE1 (feelings of perception), and the criterion of SE1 influences the criterion of SE2 (handmade participation). Field experience can help tourists to understand industrial tourism's production and service processes, and the service operators also strengthen tourists' feelings of perception by the emerging VR (virtual reality) technology. Then, service operators can also offer DIY activities to attract tourists' interests through handmade participation. Besides,

Table 21
The suited improvement paths for industrial tourism.

Aspects	Suited improvement paths
Product show (PS)	1. PS1 (material verification)→ PS4 (derivative applications)→PS3 (product display)
	2. PS1 (material verification)→ PS2 (manufacturing process show)→PS3 (product display)
	3. PS1 (material verification)→ PS4 (derivative applications)→PS2 (manufacturing process show)→PS3 (product display)
Marketing promotion (MP)	1. MP2 (experience sharing)→MP3 (product extensions)→MP4 (brands deepening)
	2. MP2 (experience sharing)→MP1 (product description)→MP4 (brands deepening)
	3. MP2 (experience sharing)→MP1 (product description)→MP3 (product extensions) →MP4 (brands deepening)
Service experience (SE)	1. SE3 (field experience)→SE4 (ideation conveys)→SE2 (handmade participation)
	2. SE3 (field experience)→SE1(feelings of perception)→ SE2 (handmade participation)
	3. SE3 (field experience)→SE4 (ideation conveys)→SE1(feelings of perception)→ SE2 (handmade participation)
Educational heritage (EH)	1. EH4 (cultural communications)→EH3 (local endorsing)
	2. EH4 (cultural communications) →EH2 (artistry heritage)→EH3 (local endorsing)
	3. EH4 (cultural communications)→EH1 (knowledge transmission)→EH3 (local endorsing)
	4. EH4 (cultural communications)→EH2 (artistry heritage)→EH1 (knowledge transmission)→EH3 (local endorsing)

the third suited improvement path is the criterion of SE3 (field experience) influencing the criterion of SE4 (ideation conveys), and the criterion of SE1 (feelings of perception) influences the criterion of SE2 (handmade participation). The service providers can let tourists understand the production and service process for industrial tourism by tourists' field experience, and service providers can let the tourists' to understand enterprise's core value by ideation conveys process. Some new technology adoption can increase the tourists' feelings of perception and some DIY activities also let tourists have new service experiences through handmade participation.

In the aspect of educational heritage (EH), the criteria of EH1 and EH4 are located in the first quadrant, the criterion of EH2 is located in the second quadrant, and the criterion of EH3 is located in the third quadrant. The improvement strategy A (maintain strategy) can be applied in the criteria of EH1 and EH4. The improvement strategy B (cultivate ability strategy) can be applied in the criteria of EH2, and the improvement strategy C (mixed strategy) can be applied in the criteria of EH3. There are four suited improvement paths (EH4→EH3; EH4→EH2→EH3; EH4→EH1→EH3; and EH4→EH2→EH1→EH3) for the EH aspect as shown in Table 21. The first suited improvement path is the criterion of EH4 (cultural communications) influence the criterion of EH3 (local endorsing). So the service operators can increase the residents' local endorsing through cultural communications, some cultural events, and industrial activities that can help residents to understand the local industry. The second suited improvement path is the criterion of EH4 (cultural communications) influencing the criterion of EH2 (artistry heritage), and the criterion of EH2 influences the criterion of EH3 (local endorsing). The service operators can let residents understand important local craft skills via artistry heritage and cultural communications, and then the artistry heritage of local craft skills also helps local residents pay attention to the local improvement and increase the residents' local endorsement. The third suited improvement path is the criterion of EH4 (cultural communications) influencing the criterion of EH1 (knowledge transmission), and the criterion of EH1 influences the criterion of EH3 (local endorsing). The service provider can use cultural communications to increase the understanding of local traditional culture and industrial craftsmanship for tourists and residents. The local knowledge transmission of the industrial and cultural event can also strengthen the local residents and tourists' local endorsing. The fourth suited improvement path is the criterion of EH4 (cultural communications) influencing the criterion of EH2 (artistry heritage), and the criterion of EH1 (knowledge transmission) influences the criterion of EH3 (local endorsing). The tourists and residents can increase their understanding of local traditional culture and artistry heritage by the cultural communications and industrial knowledge transmission can strengthen the local endorsement of local residents and tourists.

5. Conclusions

This study proposed the IOA-NRM approach that includes the two processes of IOA (Innovation-Opportunity Analysis) and NRM (Network Relation Map). The operators of industrial tourism can analyze their current state of service innovation and market opportunity using the IOA technique. The IOA technique can assist operators of industrial tourism in understanding their service value proposition and determining their competitive strategies based on their state of service innovation and market opportunity. When analyzing IOA, the SE (service experience) aspect and the EH (educational heritage) aspect are located in the first quadrant (straddling competition state) while the MP (marketing promotion) aspect was found in the second quadrant (market expansion state). The PS (product show) aspect was located in the third quadrant (state maintain state). Therefore, the industrial tourism operator can keep the current service based on the service value proposition of product show (PS), expand the market channel, and enhance market visibility based on the value proposition of marketing promotion (MP). However, if the operator of the industrial tourism adopts the service value proposition of educational heritage (EH), the traditional manufacturer/production plants can upgrade to the educational heritage level/field.

In the analysis of NRM, the study found that the EH (educational heritage) aspect is the dominant aspect whereas the PS (product show) aspect is being dominated in the service system of industrial tourism. Regarding the net influence effect, the EH (educational heritage) aspect dominates the MP (marketing promotion), SE (service experience), and PS (product show) aspects. The MP aspect dominates the SE (service experience) and PS (product show) aspects, and the SE (service experience) aspect dominates the PS (product show) aspect. Hence, the operators of industrial tourism should focus on the EH (educational heritage) value proposition to allow customers to understand entrepreneurs' original intentions and businesses' core values by reviewing the enterprises' development track and teaching the customers about the enterprises' products and services through industrial tourism. They should then allow customers to identify enterprises' business philosophy and learn more by participating personally in the events of industrial tourism.

Therefore, the operators of industrial tourism should maintain only the current operation style based on the service value proposition of PS (product show). PS (product show) is the fundamental

service value of industrial tourism, and a more significant number of operators of industrial tourism already provided the service function of the product shown in their tourism factories. Besides, the operators of industrial tourism can expand their market channel and improve their market visibility based on the value proposition of marketing promotion (MP). If the operator of the industrial tourism can provide the value of service experience, the traditional manufacturer/production plants can upgrade to the service experience level, and the new service value proposition of industrial tourism is to let the customers understand entrepreneurs' business philosophy and enjoy service experience value of industrial tourism. If the operator of industrial tourism can provide the benefit of educational heritage, the traditional manufacturer/production plants can upgrade to the educational heritage level. The new service value proposition of industrial tourism is that the operators of industrial tourism not only increase the customers' technical knowledge but also improve cultural communications and enhance customers' identity of sustainable industrial tourism.

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