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Article

Smart and Sustainable Management of Shoes Machinery Company in Taiwan during the Covid-19 Pandemic - Case Studies of the Tung Sheng Company and Strong Basic Enterprise Limited Company

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Abstract: During the Covid-19 pandemic in Taiwan, analytical tools of PEST (political, economic, social-cultural, and technological), SWOT (strength, weakness, opportunity, threat), nine building blocks of a business model canvas, and knowledge management were combined to develop a theoretical framework, and used to assess business, smart and sustainable management of two case companies: Tung Sheng Company Limited and its subsidiary, Strong Basic Enterprise Limited. A heuristic inquiry research design was adopted. In addition to secondary data from the two case companies, major top managers were interviewed to reveal constructive questions about the existing business models and to re-interpret strategy. The results showed that case companies own capabilities of R & D (research and development) as a foundation to further apply new smart ICT (information and communication technology) and execute green manufacturing. Additionally, strong key partnerships are used to diversify business investment for leveraging on limited resources given current insufficient qualified employees. Resilient practices adopted new and green technology to help mitigate the negative impacts of the Covid-19 pandemic. This study provides a useful framework and practical information about how to examine business models, smart and sustainable management processes of the two case companies and to make adjustments in strategies for the future.

Keywords: Covid-19; shoes; smart management; shoemaking machinery; sustainable management

1. Introduction

This study used PEST (political, economic, social-cultural, and technological) external environment analysis, SWOT (strength, weakness, opportunity, threat) analysis and business models to examine the current operating conditions of two related case companies: Tung Sheng Company and Strong Basic Enterprise Limited Company. A research framework was created by combining PEST, SWOT, and the concepts of knowledge management along with the tool of a business model canvas to examine business status of the two cases of companies, and to explore the potential application of smart and sustainable management during the pandemic Covid-19 environment in Taiwan (Figure 1). This framework provides a comprehensive perspective to analyze interal capabilities and external environment for these two case companies. This study contributes to increase the resilience and sustainability of a company's operation during the Covid-19 pandemic.

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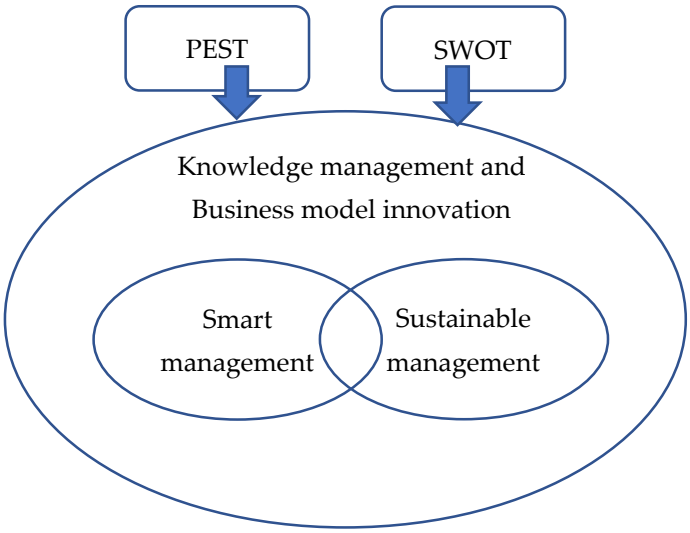

Figure 1. Research framework

1.1. PEST and SWOT

The PEST analysis tool was introduced to scan the business environment [1] including four environmental factors faced by enterprises: Economics, technology, politics and social culture. Through the examination of possible impacts of the four external macro-environments, companies can effectively understand their market situation and plan the future direction of operations. Based on their needs and characteristics such as strengths (S) and weaknesses (W), companies can use the PEST analysis method to discuss the overall environment in detail and learn about the opportunities (O) and threats (T) that external environmental factors bring to a company.

During the worldwide Covid-19 pandemic since December 8, 2019 when several cases caused by a Coronavirus variant were identified in China [2], the impact of Covid-19 was serious in 2020 and 2021 until now, 2022. On May 19th, 2021 Taiwan's Central Epidemic Command Center raised the Covid-19 alert to Level 3 for the whole island [3]. This alert imposed a series of strict prohibitions on gatherings [3] and formed a major threat to some business operations. According to a two-by-two matrix of SWOT analyses, a company should use its strengths to reduce the vulnerability to the threat and prevent its weaknesses to avoid making the company susceptible to the threat [4].

The Covid-19 pandemic threat might increase some disruption risks in demand, process, supply, and other areas of operations. Prior research has suggested that innovation is one of the capabilities contributing to a company's resilience [5]. That is, when a firm assigns enough resources to innovation, the firm would be able to adapt to rapid changes, respond to an environmental threat and proactively manage some disruption risks [5].

Given the development of artificial intelligence (AI), Internet of things (IoT), and the fifth generation (5G) of wireless technology, it seems an opportunity exists to benefit firms that initiate innovation associated with these types of smart information technology. During the Covid-19 pandemic environment, smart management might work well to help increase a firm's resilience when considered in knowledge management and business models. According to a two-by-two matrix of SWOT analyses, a company should match its strengths with the opportunity to take advantage and overcome its weaknesses to attain the opportunity [4].

1.2. Knowledge Management and Business Model Innovation

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In today's information and knowledge based business environment, a firm's knowledge management (KM) is defined as capabilities to continuously learn and leverage knowledge and convert that knowledge for new value proposition, creation, and capture in business model innovation [6]. Two streams on KM include internal and external knowledge management capabilities. The internal KM capabilities focus on maintaining and exploiting existing knowledge [6] to become a basis for further research and development (R & D) and a driver of the innovation process, whereas the external KM capabilities emphasize a firm's ability to grasp knowledge arising from sources outside a firm's boundary, identify new trends, convert, and apply that knowledge [6] into an effective business model.

Business models are conceptualized as an architecture of elements in value proposition, creation, and capture [6], and operationalized as a canvas with nine building blocks: customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure (Figure 2) [7]. New developments of information and communication technology have led to innovations in these elements and build new and updated blocks of a business model. PEST and SWOT analyses are performed for the current environment and each building block of a business model canvas to reveal constructive questions about the existing business models and to re-interpret strategy [8].

<table>
<tr><td rowspan="2">Key Partnerships</td><td>Key Activities</td><td rowspan="2">Value Propositions</td><td>Customer Relationships</td><td rowspan="2">Customer Segments</td></tr>
<tr><td>Key Resources</td><td>Channels</td></tr>
<tr><td colspan="2">Cost Structure</td><td colspan="3">Revenue Streams</td></tr>
</table>

Figure 2. Business model canvas

1.3. Smart Management

Smart management in this study mainly refers to a digital transformation of a company in which manages apply new smart information and communication technologies in smart manufacturing, smart factories and smart logistics along with suitable business and management models [9]. A new generation of information and communication technologies may include Internet of Things (IoT), cloud computing, big data, mobile Internet, the fifth generation (5G) wireless systems, artificial intelligence, robots, unmanned vehicles, block-chain technology, virtual reality (VR) and cyber-physical systems [9,10]. The tool of the business model canvas is adopted to help examine the application of smart management in two case studies during the Covid-19 pandemic in Taiwan.

1.4. Sustainable Management

Concerned by businesses was about the increasing pressures on global resources. To achieve responsible consumption and production, it is important to encourage industries, businesses, and consumers to recycle and reduce waste [11]. Instead of linear economies, that have excessively material consumption and eject large proportions of the material as waste, much more circular economies can be made to achieve more using less [12] towards a more resource efficient economy. Sustainable development, for business enterprises, means adopting business strategies and activities that meet the purpose and objectives of the enterprise and its stakeholders today while aligning with outside goas such as the sustainable development goals in protecting, sustaining and enhancing the human and natural resources that will be needed in the future [13, 14].

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Sustainable development in the business has the ability to increase customer loyalty to the brand and maintain competitiveness [15, 16]. In detail, enterprises pay more attention and respect to environmental and social factors to help themselves improve the brand's reputation and increase trust with partners as well as the social community. Thereby, businesses will have more opportunities to attract capital and human resources to expand their business, improve profits and contribute to the green economy.

Sustainable development helps to effectively exploit resources, improve productivity and reduce costs [17, 18]. Enterprises pursuing sustainable development goals always have specific strategies and plans from the input in using resources, conserving resources, saving costs for inputs such as raw materials, electricity, water, etc. overcoming systemic problems, purchasing renewable energy, saving energy, reducing carbon emissions, recycling waste while improving the quality of the working environment as well as employee productivity.

Sustainable development promotes corporate social responsibility (CSR) with environmental and social issues [19]. Businesses pursuing a sustainable business model actively pay attention to the laws and policies of enterprises when implementing social responsibility for environmental protection. In particular, businesses need to pay attention to product output to ensure quality and waste treatment processes in accordance with prescribed standards.

Sustainable management in this study mainly refers to achieve a circular economy with new forms of business model and invention as well as innovation in the shoes machinery industry. One of major focuses is about managing waste materials to recover valuable resources such as filler materials by an innovative recycling machinery system in the next cycle. The innovation basically applies the techno-sphere at the circular economy to keep down waste contamination and continue cycling materials as much as possible [20].

1.5. Smart Management and Sustainable Management

It is evident that there is a significant relationship between smart management and sustainable management. During the Covid-19 pandemic, businesses have to face several challenging economic crises due to the volatility, uncertainty, complexity, and ambiguity. In order to combat this issue, enterprises who opt for implementing sustainable smart working management on the support of IoT and smart technologies could gain economic sustainability [21].

Sustainable technology in management is a term that means innovative and creative production processes that consider environmental resources and promote social and economic development. One significant goal of sustainable technology in management is to lower environmental risks, to produce sustainable products through a green manufacturing process, and to provide sustainable products to consumers. By doing so, businesses can be involved in a socially responsible business and their consumers can use products made from a socially responsible business. Therefore, consumers can believe that they are consuming the right products for societal well-being and at the same time that also keep their satisfaction high. Both businesses and consumers can recognize good work and they expect to develop a long-term relationship as a producer and consumer [22].

2. Practical Case Studies

2.1. Tung Sheng Company Limited

The first case company in this study is Tung Sheng Company Limited founded in 1965 in the Feng Yuan district, Taichung, Taiwan, specializing in rubber and vulcanized footwear manufacturing machines [23]. This company has developed a series of relevant machines for making vulcanized shoes, manufactured automation equipment and helped firms establish their own shoes factories in developing (or developed) countries such as Tunisia, Indonesia, Ethiopia, Argentina, Cambodia, Vietnam, Mexico, Ecuador, Turkey,

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Mainland China, and more. Tung Sheng Company offered three major services: Whole plant making shoes equipment and production technology, rubber and EVA machines, and after-sales service [24]. Additionally, Tung Sheng Company also designs and provides autoclaves. Tung Sheng is the leading machinery manufacturer in Taiwan for making vulcanized shoes and appointed to many popular shoe brands such as Nike, Adidas, Converse, Vans, Fila, Reebok, Asics to name a few [24].

Sustainability in Tung Sheng is demonstrated in two aspects with an emphasis on responsible production. First, the company promotes circular economy to recycle, reuse, and renew materials. In 2015, this company developed a fully automatic rubber and EVA recycle pulverizing system, and assisted factories in reducing wastes and saving production costs, endeavoring to the environmental protection. Second, green innovation is executed in machinery design. For example, refrigerating type rubber sheet cooling machine uses automatic feeding to improve efficiency and adopts green design without water pollution [24]. Currently, the case company tries to play the role of being a pioneer as a total solution provider of whole-plant equipment and environment friendly technology for helping factories make vulcanized shoes and recycle rubber.

2.2. Strong Basic Enterprise Limited

Another case company, Strong Basic Enterprise Limited, was established in 1992 and is closely associated with Tung Sheng Company as a subsidiary for the purpose to provide a complete and comprehensive service including plans for customers to design production equipment and set up local plants, after-sales service, and follow-up maintenance [23, 25]. The major purpose of this company is to integrate turnkey equipment, shoe-making technology, and after-sale-service network [26]. The company has worked for more than 125 factories across nearly 30 countries around the world.

The case company aligned with other related machine makers to create a group providing consultancy, production technology, and whole plant equipment, and initiated co-development in certified equipment and automation systems [26]. The company is actively diversifying its business scope, seeking cooperation partners in upstream, downstream firms and other related fields and brands for investment and strategic alliances. For example, the company invested in a Hong Kong department store selling footwear products and has also cooperated with a Japanese company to produce a limited number of Hello Kitty canvas shoes [27].

3. Research Methods

3.1. Research Design

Two practical case studies were included with a heuristic inquiry research design [28]. The president of the major case company, Tung Sheng Company Limited, initiated this research project as the leading author. This helps data collection, analysis and interpretation with an advantage of persistent and deep observation as well as being able to acquire direct information along with other secondary data. This enhances insights in the development of the research framework and in discussion of the results and ensures the credibility of the study.

3.2. Data Collection

The research framework (Figure 1) is used as a guiding measure to assess case companies' business and management. In addition to existing internal documents from the two case companies for data collection, major top managers were interviewed. The interview outline included questions:

- How do you SWOT-analyze the current PEST environment and adjust your business model?

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- By using the business model canvas and your knowledge management, how do you respond to the new generation of information and communication technologies as an opportunity to leverage your strengths and weakness for innovation in smart management?
- During the Covid-19 pandemic in Taiwan, how do you respond to this threat effectively?
- How do your responses to new smart information and communication technologies help you face the threat of the Covid-19 pandemic?
- During Covid-19 pandemic, what are your vision and practices related to sustainability goals in potential combination with the application of smart technology?

4. Results and Discussion

4.1. Two-by-two Matrix of SWOT Analysis in Combination with PEST

Thanks to the rapid development of technology, it becomes more feasible than before for manufacturers to establish an automated production line, which can save labor, reduce production time and cost, and cope with a large volume of orders. Additionally, in the trend of leisure sports receiving more attention, the sport shoes market is expanding, and this increases demand for shoe-making machinery and equipment for shoes factories. The brand strength of the case companies helps share the expanding market and the capabilities of their R & D assist develop updated and customized production equipment and services to meet diverse customer requirements and needs.

Application of new information and communication technology (ICT) effectively promotes cooperation with many partners and integration of resources and cultivates an ability to export complete equipment for an entire plant in many countries around the world. A few examples of partners listed in Taiwan's stock market include Pou Chen Group, the world's largest shoe manufacturer, Feng Tay Group, the largest manufacturer of Nike sports shoes, and Fulgent Sun Group. This cooperation and integration also extends investment in vertical firms, rubber-related industries, and other brands to leverage on limited resources of insufficient qualified employees.

Major revenue of the case companies in Taiwan came from exporting machine and equipment to other countries. However, Taiwan was unable to become a member of all regional economic and trade organizations and was unable to obtain preferential treatment among members of regional organizations. This became detrimental in the international competition to Taiwan's case companies. Strategic alliances in global outsourcing and establishment of foreign branches and factories are used to export products from other countries with lower tariffs than Taiwan. This would also expand markets and increase competitiveness with a lower exporting cost and labor costs in other countries, particularly when the labor policy of "one fixed and one flexible day off per week" (that is, five working days per week) imposed in 2017 increases enterprises' labor costs in Taiwan (Table 1).

Suspected counterfeit products are another threat causing a decrease in sales and revenue. Strategies to overcome the threat are to apply artificial intelligence of things (AIoT) and other information technology for continuous development of customized machinery. Using an ability in AIoT integration, the case companies can help customers set up an entire plant and build up a smart factory. Case companies also used AIoT to continue their services online when the Covid-19 was serious. Such application of new technology is difficult to be imitated.

During the worldwide Covid-19 pandemic since near the end of 2019 through 2020 and 2021, the impact was serious. Revenue and profit fell dramatically because people could not work, shipping costs increased causing raw material shortages, and orders for new machinery and plants were postponed. Employees are forced to work from home, attend online meetings with clients, and use AIoT monitoring preventive maintenance of

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production machinery. The Covid-19 threat seems to inspire development of automated and intelligent machines (Table 1).

Table 1. Two-by-two matrix of SWOT analysis in Combination with PEST

	Strength	**Weakness**
O	1. Rapid development of technology helps establish an automated production line. 2. The brand strength helps share the expanding market in sport shoes. 3. The capabilities of R & D assists in the development of customized production equipment to meet diverse customer requirements and needs.	1. An automated production line helps overcome the difficulty in absence of qualified workers. 2. Application of new information and communication technology cultivates an ability to export complete equipment for an entire plant. 3. Application of ICT extends investment in vertical firms, rubber-related industries, and other brands to leverage on limited resources of insufficient employees.
T	1. Strategic alliances in global outsourcing and establishment of foreign branches and factories are used to export products from other countries with lower tariffs. 2. Apply artificial intelligence of things (AIoT) to develop customized machinery. 3. An ability in AIoT integration helps customers set up a smart factory. This is difficult to be imitated. 4. It seems that the Covid-19 threat inspires development of automated and intelligent machines. Case companies use AIoT to continue their services online.	1. The labor policy of "one fixed and one flexible day off per week" was imposed in 2017 in Taiwan. 2. Strategic alliances in global outsourcing and establishment of foreign branches and factories will decrease labor costs and export costs. 3. The Covid-19 impact is serious because people cannot work or are forced to work from home and attend online meetings with clients. 4. During the Covid-19 pandemic, revenue fell dramatically due to cost increase, raw material shortages, and orders postponed.

Notes: **O** means opportunity whereas **T** means threat.

4.2. Analysis of Business Model Canvas and Innovation

- Customer segments include firms that produce shoes for sport brands and manufacturers that make rubber products for automobile industries.
- Value propositions are to keep being a pioneer as a total solution provider for establishment of an entire plant, after-sales service, and follow-up maintenance.
- Channels include international exhibitions, participation in local shoes-making associations and trade organizations, and online platforms for instant communication. PEST and SWOT analysis suggests to extend participation in African economic and trade network and exhibition and to increase ICT application into connection with customers and partners.
- Customer relationships are primarily based on customized machinery and service as well as cross investment to build up trust.
- Revenue streams are majorly from machinery product sales, the total solution for establishment of a whole plant, commission of introducing and transferring orders, and cross-shareholding investment.
- Key resources include capabilities of R & D, many granted patents for innovative machines, and development of diversified machinery products and automatic rubber recycle system.
- Key activities contain participation in international exhibitions and exposure to governmental trade units, relevant associations and organizations, in order to reach more potential customers. It might be worthwhile to invite customers to visit the case companies or to apply VR and 5G for virtual experiences in understanding the products.

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- Key partnerships include upstream suppliers for materials and semi-finished products, strategic partners, outsourcing firms, and customers. For diversifying their business scope and partnerships, case companies invest in a department store in Hong Kong, cooperate with shoes brands in Japan, and keep looking for other potential investment opportunities.
- Cost structure consists of expenses from materials, production, logistics, R & D, and marketing, manufacturing overhead and administration cost, employees' salary, and equipment depreciation.

4.3. Smart Knowledge Management

In the process of knowledge management to identify, acquire, use, and share new knowledge about smart information technology, case companies first join the Taiwan Footwear Industry Association as a member and use this platform to interact with other firms in the same industry, and second attend workshops and seminars held by the Industrial Technology Research Institute [29] to learn new information and knowledge about the smart technology. This further initiates research projects executed by R & D with a Gantt chart, checking points, and records for knowledge storage and subsequent sharing. Current technical gaps push some R & D research projects while other projects are carried out to satisfy customers' needs. Examples may include innovative and automatic machines, smart boxes and production lines, robotic mechanical arms, and unmanned vehicles by using AIoT as well as 5G and leveraging on the internal and external knowledge for innovation.

4.4. Sustainable Management in Responsible Production

The case company missions declare a commitment to sustainability and dedication to green environment protection. Green design is adopted in machine innovation and development. Fully Automatic Rubber and EVA recycle pulverizing system has been implemented to Nike, Adidas, and Vans factories since 2015, that grinds rubber scraps to become rubber powders for reuse. This brings factories profits by saving approximately 10% production cost and also fulfills the brand shoes' commitment to reduce global wastes [26].

A major example of a green machinery system in case companies is the fully automatic rubber outsole and EVA recycle plant pulverizing system [30, 31, 32] (Figure 3), which primarily grinds rubber outsole and flash scraps into 60-mesh rubber powders as a filler in rubber calendaring during the rubber manufacturing process. The mechanical operation of this system features automatic working and conveying processes in a closed space or pipe. Through this process, the powder will *not* permeate the factory and a serious harmful air pollution can be avoided. A goal of 100% recycle and reuse can be achieved.

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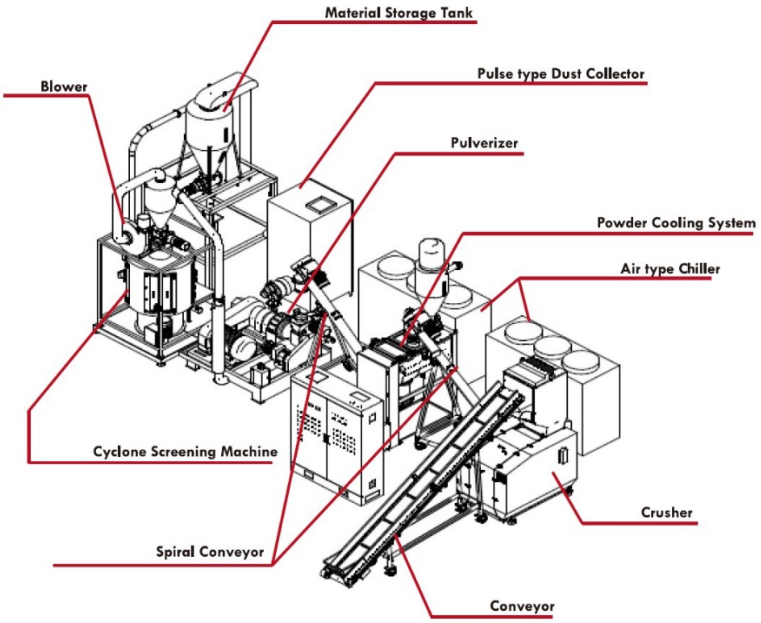

Figure 3. Fully automatic rubber and EVA recycle plant pulverizing system

The process of knowledge management to develop this recycle system follows the research framework (Figure 1). PEST and SWOT analyses showed that environmental protection and green manufacturing were expected by the public and became required by major brands such as Nike and Adidas. The Covid-19 threat also inspired development of automatic and smart machines. A strength of the case companies in the capabilities of R & D assists in the development of this system to meet customer needs. From a perspective of business model innovation, cooperation with key partners and customers helped develop and revise the system to overcome the drawbacks and make the machinery system more flexible to align with various compositions of rubber materials.

5. Conclusions

This study used the analytical tools of PEST, SWOT, business model canvas, and knowledge management to assess case companies' business, smart and sustainable management during the Covid-19 pandemic in Taiwan. The results show that case companies own capabilities of R & D as a foundation to apply new smart ICT, pursue sustainable management and have strong key partnerships to diversify business investment. These resilient practices combined smart and sustainable management and helps mitigate the negative impacts of the Covid-19 pandemic. For example, a new machine was developed to make masks. In green design, an automatic refrigerating type cooling machine was designed to avoid water pollution [24]. In green manufacturing, an automatic recycle pulverizing system [30-32] was developed to follow the circular economy [12].

Although Covid-19 impacts dramatically decreased revenue, it seems that it is an appropriate time for case companies to examine their business and management processes and to make adjustments in strategies for the future. This study provides useful and practical information for case companies and other similar firms. Further research can focus on competitive analyses in the industry of shoes-making machinery. More research is required to apply artificial intelligence or any new technology for increase of automation in the shoes-making process, because it keeps a challenge to standardize the accessories or semi-products in the manufacturing process of making vulcanized shoes due to changeable characteristics of rubber materials. Future research may adopt an action or practice research design to setting or re-examine SDG (sustainable development goals) strategy for case enterprises in 5 steps [11, 14].

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