The Study of Evaluation Index of Growth Evaluation of Science and Technological Innovation Micro-Enterprises

Yao-Chin Lin, Chun-Liang Chen, Cheng-Fu Chao, Wei-Hung Chen and Henry Pandia

1 Department of Information Management, Yuan Ze University, Taoyuan City 32003, Taiwan; imyclin@saturn.yzu.edu.tw (Y.-C.L.); s999202@mail.yzu.edu.tw (W.-H.C.)
2 Graduate School of Creative Industry Design, National Taiwan University of Arts, New Taipei City 22058, Taiwan; jun@ntua.edu.tw
3 National Association of Small and Medium Enterprises, Taipei City 10646, Taiwan; frank_chao@nasme.org.tw
* Correspondence: s1079204@mail.yzu.edu.tw or pandiahenry@unai.edu

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Abstract: Micro-enterprises are critical to the national economy in many countries, although they have many limitations. Therefore, governments have proposed many policies and programs to generate and enhance micro-enterprises’ growth to assure national economies’ growth and sustainability. This study evolves an index to evaluate growth in science and technological innovation among micro-enterprises that participated in collaborative innovation through a counselling program. The results not only define growth indicators through a literature review but also examine evidence of growth among 10 micro-enterprises through interviewing subjects located in various regions in Taiwan and related to different industries. This study uses multiple case study methods and data statistics to verify growth indicators; this reveals that micro-enterprises focusing on collaborative technological innovation demonstrated an increasing trend toward this study’s chosen growth indicators in a majority of cases. According to the survey results, nine indicators lead to positive growth. Finally, after establishing growth assessment indicators, the data collected from an empirical investigation proves the indicators’ credibility. The study then discusses the chosen cases’ experiences with growth and presents managerial implications.

Keywords: growth; growth evaluation; science and technological innovation; collaborative innovation; micro-enterprise

1. Introduction

Micro-enterprises significantly contribute to the labour force in many developed and developing countries [1–3]. They are also critical to national economic strategies, as they support industrial and economic development to drive and maintain long-term economic growth.

Despite their contribution to national economies and industries, micro-enterprises encounter increasingly uncertain and severely competitive markets. To survive, gain market share and grow, organisations must technologically innovate in their products, services and processes [4]. Micro-enterprises have various opportunities to innovate, such as through their products, processes, services, human capital and marketing [5]. Although technological innovation gives micro-enterprises a competitive advantage to survive in business competition, in the general economy these businesses hardly can compete with larger organisations based solely on their knowledge and value [6].
Given micro-enterprises’ significant role in labour and driving national economies, many governments as policy-makers expect micro-enterprises to grow and create greater economic impacts. Governments can create various policies and projects to support micro-enterprises, such as counselling programs, tax breaks, and access to strategic financing [7]. Therefore, we can conclude that many countries’ governments have been indispensable in supporting micro-enterprises’ growth and performance, although in some cases their roles and policies to promote small and medium-sized enterprises (SMEs) has had no significant impact on these organisations’ performance and growth [8].

Studies of firm growth should be of concern to practitioners and governments as well as researchers. First, the government’s concern with organisation growth involves measuring the impacts of the former’s policies and programs in organisations [9,10]. Second, practitioners can consider organisational growth in evaluating their business strategies [11–14]. Many researchers have examined how firms grow by identifying and describing their growth factors, developing and proposing frameworks to measure growth and building theory [15].

Despite the extensive research on the topic, a majority of these studies have only included larger firms and SMEs and have failed to analyse micro-enterprises. As size significantly impacts firm growth, a study of micro-enterprises’ growth is needed to fill this gap. Therefore, this case study aims to examine an index evaluating the growth of Taiwanese micro-enterprises focusing on collaborative scientific and technological innovation. The study first determines the appropriate indicators to evaluate growth among micro-enterprises, then seeks to explain how and why technological innovation impacts growth among micro-enterprises that participate in collaborative innovation. Subsequently, this study will provide a broader understanding of how and why scientific and technological innovation of micro-enterprises that involves participation in clustering strategies helps them grow, and how to evaluate this growth appropriately.

2. Literature Review

2.1. Micro-Enterprises

Each country has its own definition of a ‘micro-enterprise’, and no definition has been established globally [16] due to each country’s various levels of economic progress. Therefore, it is difficult to formulate a worldwide definition [17]. Commonly, micro-enterprises are categorised by their quantity of employees, turnover, or assets, or combinations of those criteria. The European Union defines a micro-enterprise as an organisation with fewer than 10 employees [18]; by contrast, Taiwan’s Small and Medium Enterprise Administration, a subsidiary of the Ministry of Economic Affairs, defines a micro-enterprise as an organisation with fewer than 5 employees [19].

The micro-enterprise is the smallest type of business organisation in terms of size, and a majority of business organisations worldwide belong to this group. Data released by the MSME (Ministry of Micro, Small & Medium Enterprises) Country Indicators in 2014 indicates that 131 million formal micro-enterprises operate in 155 countries worldwide [1]. Therefore, micro-enterprises are crucial in creating jobs [1–3], supporting industrial development, developing and sustaining national economies [11,20] and providing opportunities for women to establish their own businesses [21].

Regarding micro-enterprises’ role in driving and maintaining sustainable long-term economic growth, many governments have specific policies and budgets to support micro-enterprises as a part of their national economic strategies [7].

Previous research has sufficiently confirmed that micro-enterprises must overcome many obstacles in expanding their businesses and increasing their market share, including a lack of technological or managerial skill, limited access to financial resources or raw materials, or the restricted availability of infrastructure for goods or utilities, among others [22,23]. Wang empirically studied 119 SMEs worldwide to conclude that the five most significant difficulties as perceived by SME owners and managers were the access to funding, tax rates, competition, utilities and political factors; the greatest barrier was the access to funding, followed by competition [24].
Every business organisation, including micro-enterprises, strives for business growth and excellent business performance. Micro-enterprises address their limitations by using their resources to gain business growth. Many studies have identified the important factors in supporting business growth. Mateev and Anastasov divided these into two categories: the effects of firm size and age on growth and the effects of multiple variables, such as the organisation, the organisation’s strategy and the characteristics of the firm’s owners and managers [25].

From the resource-based perspective, large firms have more resources, which results in a greater competitive advantage and increased productivity. This logic is supported by Perényi and Yukhanaev’s finding that the organisation’s size positively correlates with profitability and potential growth [26]. Further, this aligns with Canarella and Miller’s study of 85 ICT (information and communications technology) firms that have operated in the United States between 1990 and 2013; the latter authors concluded that large companies can potentially grow faster than smaller ones but also experience greater rates of decline [27]. Otherwise, new organisations exhibit a positive autocorrelation with sales growth [28]. Relative to their size, micro-enterprises are less likely to grow compared to larger organisations. Therefore, in many cases the primary aspect that impacts small firms’ success involves support, such as financial or government support [29,30].

Organisations must adopt appropriate strategies to survive and pursue future business growth. Thus, managers and other stakeholders should be aware of the strategies that perform well at different times and in various business situations. Most new organisations have developed strategies to combine innovation with the exploration of opportunity in new markets, and these firms create competitive advantage based on their products rather than price [31]. Li and Tan studied three SMEs that evolved into multinational corporations to discover that all three firms had similar strategies: pursue specific market niches, cultivate the ability to use available technology and local resources and create varied but related products [32]. As organisations may struggle to survive during business cycle fluctuations, they should constantly focus on innovation and ignore the business cycle [12], and should be flexible and focus on the product and associated reliable post-market services [33]. Alternatively, enterprises in periods conducive to growth can progressively innovate with a technological overlap into periods of decline [12].

Micro-enterprises have limited human resources, and therefore, their growth depends on the owner/manager’s role. The owner/manager characteristics that most critically affect the small business’ success are his or her age, practical or business skills, ability to use professional advisors and personal financial needs. These firms can grow rapidly and intensely if the owner/manager has high marketing and finance capabilities [13]. Further, Mateev and Anastasov considered that small business’ growth depends on the firm’s entrepreneurial orientation, which includes three dimensions: innovative, proactive and risk-taking behaviours [25]. As micro-enterprises’ growth is also determined by environmental factors, the owner must have the ability to address environmental changes [34].

2.2. Scientific and Technological Innovation

Scientific and technological innovation is defined as entrepreneurs’ use of science and technology to apply new ideas, process, and procedures in practices or business [35]. Technological innovation enables organisations to apply new ideas by creating new technology-based products or services to reach new market opportunities and pursue commercial success [36]. In the current advanced technology era, technological innovation is a critical form of innovation in many fields [37,38], and thus, it should be applied in many companies [39]. Many previous studies have concluded that technology is the most significant driving factor in firms gaining successful innovation practices and achieving a competitive advantage [40], and these works have noted the firm impacts that justify direct and rate-based innovation [41]. Technological innovation in some industries’ competitive environments is not an option, but a fundamental requirement for survival [2], as the fight for continuous business is more critical in uncertain environments than the pursuit of business growth and profitability [42].

Many studies have also concluded that technological innovation positively impacts business performance [43–47], although some demonstrate different findings [48]. For example, Lecerf and
Omrani argue that SMEs’ innovative performance significantly impacts their growth [49]. This argument parallels many other studies also demonstrating innovative practices’ effects on SMEs’ growth [50–52]. In facing rapid competitive business markets in their specific industries, SMEs’ success and growth are primarily driven by innovative practices. These provide SMEs the ability to create new, innovative products or services or to add new features and value to existing products or services. These practices are critical for small businesses, which may struggle with industries’ rapidly changing technological development and customer demands.

As innovations positively affect organisations’ growth, many studies have also examined the factors that influence innovation performance and its impacts on the organisation and its business performance [2, 5, 53, 54]. Therefore, innovation capability is an important aspect in developing an organisation’s innovation activities, as this provides the organisation insight about the areas and assets with the potential for innovation. Hence, organisations should increase their innovation capability to effectively innovate, use available resources and continuously transform knowledge and skill into products, processes and systems to benefit the organisation and its stakeholders [55]. Innovation capability and capacity both determine how an organisation handles its innovation. For example, technological innovation involves applying technologies in the innovation process; one study found that technological and innovation capabilities are the most important factors impacting SMEs’ innovation performance [5]. In addition, technology capabilities have a significant role in the innovation of process, procedure and management, all of which contribute to ‘economic success and sustainable business’ [56, 57]. Technological capability refers to all organisations’ actions that support the organisation’s examination, choice and use of technology to gain competitive advantage [58].

Dziallas and Blind [59] evaluated how organisations handle innovation through a literature review, which established the criteria to evaluate non-technological and technological innovations; the authors divided these criteria into ex ante and ex post indicators of innovation. The former are used to evaluate early-stage innovation processes, such as the total number of ideas, percentage of ideas with commercialisation potential, dependency on other products and customer orientation. In contrast, the latter are identified in a product and process evaluation phase after market introduction, and they include the number of new products, the product advantage, new product success rate, and timespan between the customers’ identified need and the final product’s launch.

2.3. Partners’ Collaborative Innovation

Collaborative innovations refer to the process of building demand-based partnerships to propose and develop new products, services or processes that involve information-sharing, mutual planning, integrated activities and mutual problem-solving [60]. Every collaborative innovator provides its partners with access to their resources and augments complementary resources to increase the group’s ability to innovate [61]. Therefore, collaborative innovation gives participants various benefits, such as the access to reliable, trustworthy information; the chance to interact with higher-level management; increased communication; and the opportunity to work in harmony with designers and engineers as well as supplier representatives, customers and service providers, among others [60].

Collaborative innovation is one solution for micro-enterprises, as they have limited resources [22, 23] that restrict their innovation and ability to generate competitive advantage. Small businesses generally lack access to distribution channels, which is a critical resource to sustain their operations. Collaborative innovation is also advantageous for these organisations, as it allows participants the chance to use other marketing channel networks. Moreover, collaborative innovation also continuously facilitates innovation, in that an organisation can improve its existing products by creating interactive channels that involve key customers and suppliers [62]. In addition, previous studies [63–66] conclude that different types of collaboration can lead to sustainable business.

Hagen et al. [67] empirically studied 148 SMEs to reveal four types of collaborative SME clusters: customer-oriented, lacking strategic orientation and strategy, entrepreneurial growth-oriented and product-oriented. The primary objective in customer-oriented collaborations is customer satisfaction.
Organisations fight to provide different satisfactory products to different types of markets. Therefore, collaborating organisations develop their knowledge about their customers, including their satisfaction, and information on their competitors. In contrast, collaboration involving a ‘lack of strategic orientation and strategy’ demonstrates no clear strategy and no clear definition of a target market, product development, marketing strategy or resource allocation. The third strategic collaboration type is the entrepreneurial-growth orientation, which primarily aims to achieve the most rapid business growth possible. Therefore, such collaborations establish successful business definitions, competitive positioning and innovation and are quality-oriented. The product-oriented collaboration primarily aims to develop solid products. Therefore, these organisations generate many product-related policies, such as those pertaining to a product’s design and packaging, label or brand, product and service quality, and in-time delivery, among others. Organisations in this type of collaboration should focus on production efficiency and specialisation, increase their levels of skilled services and pursue a higher reputation of quality in their industry.

2.4. Micro-Enterprise Growth and Indicators

Penrose [68] defines growth in two different ways: ‘the product of an internal process in the development of an enterprise’, which indicates an increase in one or more characteristics of an object or a process’ quality, and an ‘increase in amount’, such as annual sales, production or turnover. An organisation’s growth can be multidimensional and include complex processes related to internal development that increase the organisation’s value. Thus, entrepreneurs use indicators of internal development as a sign of organisational growth [69].

Scholars address four aspects in studying organisational growth: the indicators of growth, a basic scale of growth measurement, evaluation period and how the firm grows. Growth indicators refer to the variables used to observe growth. The basic scale of growth measurement measures the scale of the dimension that the researcher uses to assess growth, which can involve either an absolute or relative scale. The evaluation period is a time variable that indicates how long the firm’s growth is studied. How firms grow concerns the organic or acquired growth processes and can be studied from many perspectives [70,71].

Achtenhagen et al. [69] and Elaswad [15] and subsequent research [72–75] have comprehensively examined firm growth to reveal many possible empirical indicators to measure this growth, as Table 1 illustrates. Most of these previous researchers use financial indicators to evaluate firm growth, which addresses the concerns of owners and investors. These financial indicators are used in internal and external evaluations of financial policies, including investment, financial and dividend policies; the economic value added; financial feasibility assessments; cost–benefit analyses; financing terms; profitability; and business expansion.

Micro-enterprises have a low survival rate, and two of five SMEs will close in their first six months of operation [75]. Thus, micro-enterprises’ growth is crucial to increase their likelihood of survival, especially in their early stages. This survival can be analysed using net profit as a key variable, as small businesses are required to gain positive net profits to remain in business over a specific period [77]. In other words, micro-enterprises’ survival indicates their capability to resist business risks [20]. Given micro-enterprises’ high failure rates, business owners and governments are highly concerned with micro-enterprises’ business survival and continuity. As growth in an organisation’s business will decrease its risk of failure, this study uses the business survival dimension as an important factor in evaluating growth.

Another noteworthy indicator is innovation capability, as micro-enterprises must expand their innovation capability—in addition to other indicators—to increase competitive advantages and gain market share. Two indicators to measure firms’ innovation growth are the number of patents applied and the amount of research and development (R&D) that occurs [78]. A firm’s effort towards R&D can be measured by the resources allocated to its R&D department, which includes both human and financial resources. Subsequently, as organisations should apply technological innovation in
developing their products, they should also include the number of new products developed as an indicator of innovation growth. Coad and Rao observed that innovative activity among high-growth firms can significantly contribute to their rapid growth; however, some organisations experience poor or negative sales growth as a result of their R&D and patent activity [78]. Therefore, organisations should consider their R&D resources and number of patents in addition to their ratio of new product revenue to total revenue.

Table 1. Previous researchers’ indicators of firm growth.

| Indicators                              | Authors                      | Indicators                              | Authors                      |
|-----------------------------------------|------------------------------|-----------------------------------------|------------------------------|
| Sales                                   | Weinzimmer [76]              | Total assets profit margin              |                              |
| Assets                                  |                              | Sales margin                            |                              |
| Employees                               |                              | Return on equity                        |                              |
| Absolute total employment growth        | Delmar et al. [71]           | Return on total assets                  |                              |
| Absolute organic employment growth      |                              | Main operating margins                  |                              |
| Absolute sales growth                   |                              | Current ratio                           |                              |
| Relative total employment growth        |                              | Quick ratio                             |                              |
| Relative organic employment growth      |                              | Asset-liability ratio                   |                              |
| Relative sales growth                   |                              | Equity ratio                            |                              |
| Sales growth rate                       | Lee and Tsang [14]           | Total assets                            | Li et al. [20]               |
| Profit                                  |                              | Operating income                        |                              |
| Absolute employee growth                | Achtenhagen et al. [69]      | Number of employees                     |                              |
| Absolute sales growth                   |                              | Total assets’ turnover                   |                              |
| Employee growth rate                    |                              | Inventory turnover                      |                              |
| Sales growth rate                       |                              | Accounts receivable turnover            |                              |
| Profit                                  |                              | Current assets’ growth rate             |                              |
| Return on equity                        |                              | Fixed assets’ turnover                   |                              |
| Return on assets                        |                              | Net profit growth                       |                              |
| Growth in firm value                    |                              | Total assets’ growth rate               |                              |
| Sales from new customers                |                              | Net assets’ growth                      |                              |
| Sales from new products/services        |                              | Main business revenue growth            |                              |
| Sales from new markets                  |                              | Intangible assets ratio                 |                              |
| Percentage growth of employment         | Leković and Marić [73]       | Integrated leverage                     |                              |
| Percentage growth of total income       |                              |                                        |                              |
| Percentage growth of property           |                              |                                        |                              |
| Profit                                  |                              |                                        |                              |

The absolute and relative approaches can also be applied to measure firm growth. The absolute growth approach indicates growth by measuring two specific periods and is primarily used when studying growth in small business organisations. By contrast, relative growth refers to the relative changes in a growth indicator; this is primarily used in labour economics studies of business organisations. Thus, researchers must carefully choose their measurement approach to avoid biased results based on the organisation’s size, as measuring growth using the absolute or relative approaches will obtain different outcomes [79]. Specifically, the absolute and relative growth approaches are biased towards larger and smaller firms, respectively. Schreyer [80] addresses this issue by using the Birch index as a growth indicator, as this index combines both absolute and relative growth rates.
Delmar et al. [71] studied high-growth firms to discover four different types of firm growth patterns relating to SMEs. First, ‘super absolute growers’ are firms that exhibit very high absolute growth in both employment (total and organic) and sales. These firms exhibit strong but somewhat unpredictable improvements in both sales and employment. Second, ‘erratic one-shot growers’ demonstrate negative size growth, except in a single year with highly sturdy development. Third, ‘employment growers’ exhibit relatively higher employment growth, although in contrast, these firms have negative growth in sales or other indicators. Fourth, ‘steady overall growers’ are characterised by relatively strong development in their absolute sales and employment growth, but weaker development overall. From this perspective, steady overall growers are fairly similar to super absolute growers, but with weaker growth.

As there is no ‘best’ approach and multiple methods exist to evaluate firm growth, scholars should use multiple evaluation techniques to more comprehensively illustrate any empirical relationship. Additionally, multiple evaluations provide researchers the opportunity to formulate an optimised assessment of specific studies’ objectives; they can then compare their results to previous studies using different growth evaluation methods [71].

2.5. Determinants of Firm Growth and the Role of Business Support

Previous studies have examined many factors to determine firm growth. Delmar et al. [71] argued that an organisation grows in various ways and can exhibit different growth patterns over time with different causes. Further, Rafiki’s [81] study of SMEs in Saudi Arabia using the resource-based view found that several factors significantly affect firm growth, such as the manager’s experience, the firm’s size, training, network relationships and funding. Nevertheless, other variables do not significantly influence firm growth, such as the firm’s age and manager’s education. The determinants of firm growth can be categorised as either internal or external factors. Internal factors involve the firm’s internal environment, and collectively determine the organisation’s capability relative to different business functions, such as marketing, human resources, operations and technology and finance, among others. Internal factors include the firm’s synergy, resources, and unique competencies [79]. External factors, such as demographics, the societal or cultural environment, politics or the economy, are all centred in the firm’s business environment and can either provide opportunities to or threaten an organisation.

De Wit and Zhou [82] classified three dimensions of firm growth: individual, organisational and environmental determinants. Individual factors consist of personal traits, motivations, growth, competencies, and individual and personal backgrounds. Organisational factors are measured by a company’s attributes, dynamic capability, and corporate resources and strategy. Environmental factors include the market, technology and diversity efforts. Meanwhile, one study of 385 manufacturing SMEs revealed that more rapid growth occurs given the quality of staff, industry advantages and organisations located in developing regions [20]. Additionally, a study of high-growth firms demonstrated that their innovation activities significantly contributed to their superior growth [80].

Studies of firm growth are important to SMEs’ owners, policymakers, researchers and other stakeholders to gain an understanding of the exposure and experience needed for firms to grow. Their results can reveal the path of growth for a firm [81]. Moreover, researchers’ analyses of how firms grow—and their limitations—have revealed that small businesses need external support to facilitate rapid growth. Business support for SMEs can be categorised as direct support, such as grant-matching, providing credit, training, local production systems, supporting innovation and exports; and indirect support, such as tax simplification [83]. Previous research indicates that various types of business support for SMEs, [83] such as training [84,85], business advising [86], entrepreneurship training [87] and loan financing [88], positively contribute to their productivity, performance or growth.
3. Research Methodology

3.1. Methods

This research used a case study method to explore multiple examples, as this method provides researchers the opportunity for a more comprehensive examination [89]. Moreover, the case study is suitable to explain various cases and explore their settings to offer a deeper comprehension of their implications [90]. For example, Cresweel [91] defined the case study method as one that examines an actual case through comprehensive and in-depth data collection by including various sources of information.

Authors studying the growth evaluation index have preferred a multiple case study method rather than examining a single case, as the former not only offers an understanding of the variances and correlations between the chosen cases [92] but also clarifies whether the findings are valuable [93]. While conducted to ultimately derive theories, researchers consider the multiple case study method as superior when the recommendations are more intensely grounded in widespread empirical evidence. Additionally, multiple cases allow researchers to explore broader research questions and theoretical evolutions [94]. Although the multiple case study method provides stronger, more reliable evidence than a single-case study, the former is more expensive and requires more time to apply [92].

Despite its advantages, the case study method has been criticised for its lack of meaningful generalisations given its unique results; specifically, researchers [95] have considered that the case study method is not suitable to theory-building and hypothesis-testing. However, this perspective is not completely accurate, as case studies provide the researcher the opportunity to develop new theories or explanatory hypotheses [94]. While studying a single case or a small number of cases, it is impossible for the researcher to draw inferential statistics, but logical conclusions can be drawn based on simple descriptive statistics. By replicating the case methodology, the researcher can construct a larger database to generate inferential statistics [95].

3.2. Subjects

Subjects of this study were 10 science and technological innovation micro-enterprises that participated in the ‘Micro and Personal Care Support and Counselling Program’ from 2014 to 2017. This program was directed by the Small and Medium-Sized Enterprise Administration under Taiwan’s Ministry of Economic Affairs to enhance professional, scientific, technological, and technical service skills among micro-enterprise organisations. The Ministry of Economic Affairs used this program to propose a promotional strategy for SMEs to develop an environment conducive to growth among micro-sized and personal businesses. By building communities or through network collaborations and communication, the government can help micro-sized and personal business solve various management problems, such as a lack of managerial and technical skill, marketing, and distribution issues and a lack of access to funding, among others. The program ultimately included 839 micro-enterprises from various industries across the country.

This program has also allowed the government to facilitate and enhance collaborative innovation among partners who have committed to participating in the program. The program supports micro-enterprises’ differentiation by helping them integrate technology-intensive services with the capabilities in existing industries; ultimately, the program aims to transform them from independent to collaborative innovative organisations. These micro-enterprises can then create excellent new products that deliver differentiated value for consumers. The SME Administration invited professionals, academics, entrepreneurs and consultants with expertise in their field to share their knowledge and experiences with micro-enterprises’ managers and owners through this counselling program. Through the program, the government encouraged micro-enterprises’ growth that will contribute to the nation’s economic growth and sustainability.

The organisations examined in this study were selected using a judgment-sampling method from a list of micro-enterprises participating in a business counselling program. These subjects were chosen
because of their beneficial location or because they could best deliver the information required [96] that could not be gained from other choices [97]. The judgment-sampling method benefits researchers, as it is convenient, low-cost, less time-consuming and ideal for exploratory research; however, it is limited in its generalisability and subjectivity [98]. Table 2 displays the studied firms’ basic information. These firms are located in different areas and produce various types of products or services.

Table 2. Companies’ basic information.

| No. | Organisation | Location | Major Commodities | Job Title                        |
|-----|--------------|----------|-------------------|----------------------------------|
| 1   | A            | North    | 3C products; music boxes | Co-founder/Chief Technology Officer |
| 2   | B            | East     | Environmental protection products | Founder                           |
| 3   | C            | North    | Design products    | CEO                               |
| 4   | D            | North    | Wearable technology products | Principal                         |
| 5   | E            | Middle   | Agricultural information technology products | Principal                         |
| 6   | F            | North    | Digital and paper cameras | Principal                         |
| 7   | G            | North    | Handmade shampoo mould design and manufacturing | Business Manager                 |
| 8   | H            | South    | e-Commerce company (web and app design) | General Manager                   |
| 9   | I            | North    | Feminine care products | General Manager                   |
| 10  | J            | South    | Micro-molecular water masks | Business Manager                  |

This study was conducted by interviewing micro-enterprises’ management with closed engagement in their companies’ operations and management, such as their founder, co-founder, Chief Technology Officer, CEO, principals, and business and general managers. This study’s interviewees are also case respondents from enterprises with basic information as presented in the previous Table 2, and most are micro-enterprise technological innovation leaders or founders who have actually engaged in their companies’ operation and management.

3.3. Establishment of Growth Evaluation Indicators

The study examined the research as mentioned in Section 2.4 and referred to the counselling program’s goals, plan and targets to establish growth evaluation indicators. After choosing the proper indicators, the study used an expert panel to confirm the content’s validity [96]. Science and technological micro-enterprises’ growth indicators include capital, organisational and innovation capability growth and business survival. These dimensions were chosen due to the researchers’ concerns with subjective, practical purposes and alignment with the counselling program’s goals. Table 3 lists the growth evaluation indicators established in this study, which will be explained in the rest of this subsection.

Capital growth is a main indicator of concern for owners, investors and government agencies in evaluating their businesses, and particularly the investments and subsidies for micro-enterprises. Therefore, this study uses the capital growth dimension to evaluate micro-enterprises’ growth with two indicators: annual turnover and total assets. Although easy to measure and calculate, annual turnover was chosen because it visibly illustrates the organisation’s capability to operate and create income. In contrast, total assets clearly represent the organisation’s current wealth and indicate its capability and resources to create future benefits.

Micro-enterprises’ role in labour [1–3] impacts the national economy’s sustainability as well as social stability; thus, the government as their sponsor can consider the organisational growth dimension as a primary concern. Micro-enterprises’ organisational growth can potentially create new
jobs and develop local economies. Organisational growth in this study involves one variable—namely, the number of employees—as a growth indicator.

Table 3. Growth indicators of micro-enterprises’ scientific and technological innovation.

| Dimensions           | Indicators                                                                 |
|----------------------|----------------------------------------------------------------------------|
| Capital growth       | Annual turnover                                                            |
|                      | Total assets                                                               |
| Organisational growth| Number of employees                                                        |
| Business survival    | Years estimation of survival                                               |
| Innovation capability| Proportion of technology (R&D) personnel                                   |
|                      | R&D expenditures as a percentage of annual turnover                         |
|                      | Number of new products developed annually                                  |
|                      | Number of patent applications                                               |
|                      | New product revenue as a percentage of total revenue                       |

Given micro-enterprises’ high failure rates, owners and the government are highly concerned with these firms’ survival and continuity; in particular, growth will decrease their risk of failure. Therefore, this study uses the business survival dimension as an important factor in evaluating growth. Additionally, one goal in the counselling program is to increase micro-enterprises’ rates of survival. The business survival dimension incorporates an existence variable indicating the estimation of how long the firm will survive in the industry as a growth indicator.

The government is also interested in how science and technological micro-enterprises that experience collaborative innovation have increased their innovation capability. Therefore, this study includes the innovation capability dimension as one factor in evaluating growth. As these firms apply innovation in developing their products, their innovation capability will influence their product development capability. Therefore, this study evaluates both development capabilities through the following variables as growth indicators: the proportion of technological (R&D) personnel, percentage of R&D expenditures, number of new products developed, number of patent applications and percentage of new product revenues.

3.4. Instrument

Interviewing is a verbal communication method in which researchers aim to comprehensively understand a specific topic or action. Three types of interview methods can be applied: ‘structured’, ‘semi-structured’ and ‘unstructured’ interviews [99]. Structured interviews use research procedures to further explain thought processes or decision-making activities. Semi-structured interviews are directed in an ‘outlined interview’ format, which can include individuals or groups; these interviews do not need to conceal their research purposes. Unstructured interviews are often based on everyday conversations or informed expert interviews.

The study uses an outlined interview as a research instrument, which was developed by referring to the counselling program’s goals as well as the chosen growth indicators. Therefore, the study asks a panel of experts—consisting of three scholars and one professional—to validate the instrument [96]. The interview was conducted using an outline but is not limited to the following:

1. What is your company’s approximate annual turnover before and after the counselling program? What factors have contributed to the difference in annual turnover?
2. What is your company’s total assets before and after the counselling program?
3. How many employees does your company have before and after the counselling program? Did any increase or decrease occur? How is the division of work and labour distributed among the team?
4. How many years do you believe your company will survive in its industry?

5. What is the ratio of employee technology (R&D) personnel before and after the counselling program? Do you desire to increase its proportion of technology (R&D) personnel in the future? If so, by how much? Why?

6. What is the ratio of your company’s R&D expenditures to annual turnover before and after the counselling program? How has the change (increase or decrease) in this data affected your company? What are the key factors in these changes?

7. What is the annual number of new product developments before and after the counselling program? What are the reasons for this difference?

8. What is your company’s approximate number of annual patent applications before and after counselling? Do you have any reasons why the number increased, decreased or remained steady?

9. What is the ratio of new product revenue to total revenue before and after the counselling program? Why did the ratio increase or decrease?

To supplement the evidence gathered through this primary instrument, a multiple case study requires other sources of information, such as that gathered through a secondary qualitative study. This type of research uses data gathered or prepared by other parties, such as reports, briefs or policy statements, among others. A secondary data analysis is advantageous, as it saves researchers cost and time to gain a large sample of data. Therefore, many researchers use this strategy to obtain cost-efficient research results in a short period of time. The primary sources of secondary data could be a database published by previous researchers, internal government plans, websites, case albums, electronic newspapers and magazines, or related books. In the data-collection process, this study verifies the integrity of this data by cross-checks to exclude any data with errors. Simultaneously, extensive efforts have been made to improve the data during the information-collecting process. In this study, additional evidence was collected from September to October 2016 from subjects during the counselling program.

3.5. Hypothesis

This study considered the counselling program’s goals as well as the discussions presented in prior literature to formulate the following set of hypotheses:

Hypothesis 1 (H1). Capital Growth.

Hypothesis 1a (H1a). The annual turnover is positive growth.

Hypothesis 1b (H1b). Total assets increases.

Hypothesis 2 (H2). Organisational Growth, in that the number of employees increases.

Hypothesis 3 (H3). Business Survival, in that the years’ estimation of business survival increases.

Hypothesis 4 (H4). Innovation Capability.

Hypothesis 4a (H4a). Increasing the proportion of technology (R&D) personnel.

Hypothesis 4b (H4b). R&D expenditures as a percentage of annual turnover increases.

Hypothesis 4c (H4c). The number of new products developed every year increases.

Hypothesis 4d (H4d). Increasing the number of patent applications.

Hypothesis 4e (H4e). Increasing new product revenue as percentage of total revenue.
4. Results and Discussion

4.1. Data

This study's case interviews aim to reveal current developmental trends and provide an overview of domestic technological micro-enterprises, but also to explore the organisation's current situation and the problems encountered before and after counselling. Tables 4–7 displays a summary of the interview results.

**Table 4.** Data regarding growth indicators before and after the counselling program (case A, B and C).

| No. | Indicators                        | A Before | A After | B Before | B After | C Before | C After |
|-----|-----------------------------------|----------|---------|----------|---------|----------|---------|
| 1   | Annual turnover (in NTD)          | <500,000 | <500,000| 1.5 M    | 2.5 M   | >1 M     | >3 M    |
| 2   | Total assets (in millions/NTD)    | 100–300  | 301–600 | 100–300  | 100–300 | 5        | 5       |
| 3   | Number of workers                 | 2        | 2       | 3        | 3       | 1        | 2       |
| 4   | Years estimation of survival      | 1–3      | 1–3     | 5–7      | 5–7     | 5–7      | 5–7     |
| 5   | Technology (R&D) personnel ratio  | 41–60%   | 41–60%  | 61–80%   | 61–80%  | ≤20%     | ≤20%    |
| 6   | R&D expenditures to turnover ratio| ≥15%     | ≥15%    | ≥15%     | ≥15%    | 11–15%   | 11–15%  |
| 7   | Number of new products            | 2        | 8       | 1        | 2       | 1        | 2       |
| 8   | Number of patent applications     | 0        | 3       | 5        | 9       | 1–2      | 6–7     |
| 9   | Percentage of new product revenue | 0        | 0       | ≥16%     | ≥16%    | 11–15%   | 11–15%  |

**Table 5.** Data regarding growth indicators before and after the counselling program (case D, E and F).

| No. | Indicators                        | D Before | D After | E Before | E After | F Before | F After |
|-----|-----------------------------------|----------|---------|----------|---------|----------|---------|
| 1   | Annual turnover (in NTD)          | <500,000 | <500,000| >3.5 million | 6 million | 9 million | 15 million |
| 2   | Total assets (in millions/NTD)    | 100–300  | 100–300 | 3        | >9.01   | 301–900  | 601–900 |
| 3   | Number of workers                 | 5        | 6       | 4        | 6       | 4        | 8       |
| 4   | Years estimation of survival      | 3–5      | 3–5     | 3–5      | 3–5     | 5–7      | 5–7     |
| 5   | Technology (R&D) personnel ratio  | ≥81%     | ≥81%    | 21–40%   | 21–40%  | 21–40%   | 21–40%  |
| 6   | R&D expenditures to turnover ratio| ≥15%     | ≥15%    | 6–10%    | 6–10%   | ≥15%     | ≥15%    |
| 7   | Number of new products            | 2        | 4       | 3        | 10      | 3        | 6       |
| 8   | Number of patent applications     | 1        | 6       | 0        | 1       | 1        | 2       |
| 9   | Percentage of new product revenue | 0        | 0       | ≤5%      | 11–15%  | ≥16%     | ≥16%    |

**Table 6.** Data regarding growth indicators before and after the counselling program (case G, H and I).

| No. | Indicators                        | G Before | G After | H Before | H After | I Before | I After |
|-----|-----------------------------------|----------|---------|----------|---------|----------|---------|
| 1   | Annual turnover (in NTD)          | 1.2 million | 4 million | 2.5 million | 5 million | 200,000  | 1,200,000 |
| 2   | Total assets (in millions/NTD)    | 100–300  | 100–300 | 100–300  | 301–600 | <1       | 1–3     |
| 3   | Number of workers                 | 3        | 4       | 3        | 8       | 2        | 4       |
| 4   | Years estimation of survival      | ≥7       | ≥7      | 5–7      | 5–7     | 1–3      | 1–3     |
| 5   | Technology (R&D) personnel ratio  | ≤20%     | ≤20%    | 21–40%   | 41–60%  | ≤20%     | 21–40%  |
| 6   | R&D expenditures to turnover ratio| 11–15%   | 11–15%  | 5%       | 6–10%   | ≤5%      | ≥15%    |
| 7   | Number of new products            | 72       | 72      | 0        | 2       | 1        | 6       |
| 8   | Number of patent applications     | 0        | 0       | 0        | 0       | 0        | 1       |
| 9   | Percentage of new product revenue | ≥16%     | ≥16%    | ≤5%      | 6–10%   | 6–10%    | ≥16%    |
Table 7. Data regarding growth indicators before and after the counselling program (case J).

| No. | Indicators                                   | J       |
|-----|---------------------------------------------|---------|
|     |                                             | Before  | After  |
| 1   | Annual turnover (in NTD)                    | 500,000 | 1,300,000 |
| 2   | Total assets (in millions/NTD)              | <1      | 1–3    |
| 3   | Number of workers                           | 2       | 5      |
| 4   | Years estimation of survival                | < 1     | < 1    |
| 5   | Technology (R&D) personnel ratio            | ≤20%    | ≤20%   |
| 6   | R&D expenditures to turnover ratio          | ≥15%    | ≥15%   |
| 7   | Number of new products                      | 1       | 3      |
| 8   | Number of patent applications               | 2       | 4      |
| 9   | Percentage of new product revenue           | 6%      | 10%    |

Organisation A is located in northern Taiwan and produces 3C (computers, communications and consumer electronics) products and music boxes. This company exhibits steady trends for some indicators, such as the number of workers, annual turnover, the enterprise’s survival, technological personnel ratio and the ratio of R&D expenditures to turnover. Given these trends, the organisation has also increased its number of customers. However, other indicators have also significantly increased by more than 200%, such as total assets, the number of new products and the number of patent applications.

Organisation B is located in eastern Taiwan and produces environmental protection products. Table 4 compares this organisation’s indicator results before and after counselling, with some indicators exhibiting an increasing trend, such as annual turnover, total assets, the number of products and the number of patent applications. Otherwise, the other indicators remain constant.

Organisation C is located in northern Taiwan and involves product design. Table 4 notes that this organisation maintains steady trends for total assets, the enterprise’s survival, technological personnel ratio, the ratio of R&D expenditures to turnover and new product revenue as a percentage of total revenue. Otherwise, the organisation has successfully and significantly increased its annual turnover and numbers of new products, patent applications and new products by more than 200%.

Organisation D is located in northern Taiwan and produces wearable technology products. Table 5 demonstrates that the enterprise’s number of employees has increased slightly. However, most of the other indicators—such as annual turnover, total assets, the enterprise’s survival, technological personnel ratio, inventory turnover, the net interest rate and the ratio of R&D expenditures to turnover—remain constant. Moreover, significant growth can be observed in the number of new products and number of patent applications, as these indicators have increased by 200% and 600%, respectively.

Organisation E is located in central Taiwan and produces agricultural information technology products. During the counselling program, the organisation moderately increased its number of workers, annual turnover, number of patent applications and number of customers. Moreover, a significant increase was observed in the organisation’s assets and the number of new products developed each year. However, the organisation failed to increase its survival rate, technological personnel ratio and ratio of R&D expenditures to turnover, as these remained constant during the study period.

Organisation F is located in northern Taiwan and produces digital and paper cameras. Table 5 indicates that the organisation has significantly increased its number of workers, total assets, number of new products and number of patent applications. Moreover, the organisation’s assets have increased from 9 million to 15 million NTD, while the other indicators remain steady.

Organisation G is located in northern Taiwan and designs and manufactures handmade shampoo moulds. This company only experienced growth in a few indicators compared to the other firms, such as the number of workers, annual turnover and the number of customers. However, the counselling
program significantly increased the organisation’s annual turnover from 1.2 million to 4 million NTD. Otherwise, the rest of the indicators remain steady.

Organisation H is an e-commerce company located in southern Taiwan and has demonstrated growth in almost all indicators. This firm has experienced a significant increase in its number of workers, annual turnover, total assets, technology personnel ratio, ratio of R&D expenditures to turnover and new product revenue as a percentage of total revenue. However, this organisation failed to increase its survival indicator and its number of patent applications.

Organisation I is located in northern Taiwan and produces feminine care products. The organisation experienced a significant increase in its number of workers, annual turnover, total assets and number of new products after participating in the counselling program. Moreover, this organisation slightly expanded its technology personnel ratio, ratio of R&D expenditures to turnover and its number of patent applications. However, the organisation maintained a steady enterprise survival indicator.

Organisation J is located in southern Taiwan and produces micro-molecular water masks. Table 7 reveals that this firm has rapidly increased its number of workers, annual turnover, total assets and number of new products and patent applications. Moreover, the organisation expanded its new product revenue as a percentage of total revenue, although its enterprise survival indicator, technology personnel ratio and ratio of R&D expenditures to turnover remained steady.

4.2. Discussion

This study analysed the results of the individual case interviews by comparing the state of every case before and after the counselling program using various indicators formulated from a literature review. Tables 8 and 9 illustrates the results from comparing every indicator in every case before and after the counselling program. Consequently, the study uses a qualitative scale ranging from increase (I) and increase not significant (INS) to constant (C) and decrease (D). This table demonstrates that annual turnover and total asset indicators increase for a majority of cases, although two cases exhibit an insignificant increase and a constant trend for the total asset indicator. Moreover, this table reveals an increasing trend for employee numbers, except for two cases with a constant trend. Otherwise, all cases note a constant trend for the survival indicator.

As previously mentioned, this study uses the technology (R&D) personnel ratio and proportion of R&D expenditures as innovation capability growth indicators. Tables 8 and 9 indicates that the technology (R&D) personnel ratio accounted for a majority of cases with increasing trends, followed by the cases with an insignificantly increasing trend, then those with no change. Moreover, the proportion of R&D expenditures to annual turnover increases in most cases, except for three with significant increases.

Table 8. Comparison data of growth indicators before and after the counselling program (case A, B, C, D and E).

| No. | Indicators                        | A | B | C | D | E |
|-----|-----------------------------------|---|---|---|---|---|
| 1   | Annual turnover                   | INS | I | I | INS | I |
| 2   | Total assets                      | I | INS | C | INS | I |
| 3   | Number of workers                 | C | C | I | I | I |
| 4   | Years estimation of survival      | C | C | C | C | C |
| 5   | Technology (R&D) personnel ratio  | C | C | C | I | I |
| 6   | R&D expenditures as a percentage of annual turnover | I | I | INS | I | INS |
| 7   | Number of new products developed  | I | I | I | I | I |
| 8   | Number of patent applications     | I | I | I | I | I |
| 9   | New product revenue to total revenue | C | INS | INS | C | I |
Table 9. Comparison data of growth indicators before and after the counselling program (case F, G, H, I and J).

| No. | Indicators                        | F   | G   | H   | I   | J   |
|-----|-----------------------------------|-----|-----|-----|-----|-----|
| 1   | Annual turnover                   | I   | INS | I   | I   | I   |
| 2   | Total assets                      | I   | INS | I   | I   | I   |
| 3   | Number of workers                 | I   | I   | I   | I   | I   |
| 4   | Years estimation of survival      | C   | C   | C   | C   | C   |
| 5   | Technology (R&D) personnel ratio  | INS | INS | I   | I   | INS |
| 6   | R&D expenditure as a percentage of annual turnover | I   | INS | I   | I   | I   |
| 7   | Number of new products developed  | I   | C   | I   | I   | I   |
| 8   | Number of patent applications     | I   | C   | C   | I   | I   |
| 9   | New product revenue to total revenue | I   | INS | I   | I   | I   |

I = Increase; INS = Increase is insignificant; C = constant; D = Decrease.

Annual new product development increased in almost every case except for one. Further, the number of patent applications increased in most cases, while some cases remained constant. A majority of cases involving the ratio of new product revenue to total revenue increased, although some insignificantly increased and remained constant. Product innovation in line with Sirilli and Evangelista’s [4] methodology will give micro-enterprises the opportunity to pursue new markets [36] and gain competitive advantage. Further, Silvestri et al. [31] suggest that micro-enterprises should pursue competitive advantage based on product innovation rather than price. Using the result of comparison of every indicator, as Tables 8 and 9 shows, this study validates hypotheses as shown in Table 10.

Table 10. Hypotheses’ validation.

| Dimensions           | Indicators                          | Hypotheses | Outcome |
|----------------------|-------------------------------------|------------|---------|
| Capital growth       | Annual turnover                     | H1a        | Confirmed |
|                      | Total assets                         | H1b        | Confirmed |
| Organisation growth  | Number of employees                 | H2         | Confirmed |
| Business survival    | Years estimation of survival        | H3         | Rejected |
| Innovation capability| Proportion of technology (R&D) personnel | H4a       | Confirmed |
|                      | R&D expenditures as a percentage of annual turnover | H4b       | Confirmed |
|                      | Number of new products developed annually | H4c       | Confirmed |
|                      | Number of patent applications        | H4d        | Confirmed |
|                      | New product revenue as a percentage of total revenue | H4e       | Confirmed |

The analysis found that by applying science and technology through collaborative innovation to develop several new products and increase their revenue, organisations could expand their annual turnover and total assets from before to after the counselling program. A majority of these cases experienced growth in their amount of annual turnover and total assets. All micro-enterprises except for two experienced organisational growth as reflected by increased numbers of employees. Among all cases, the total employees increased from 30 to 49, and four of the counselling participants grew from micro-enterprises to small businesses. Despite this financial and organisational growth, all cases exhibited a constant value for the survival indicator. According to Tuan and Yoshi [100], small businesses that successfully pursue new product innovation have higher growth rates than small businesses that do not innovate and generate new products.
These firms’ increasing number of employees impacts the number of technology (R&D) personnel. Further, organisations can increase the number of products they develop by increasing their percentage of R&D expenditures. Although literature posits that R&D expenditures have no impacts on firm growth [72], this study determined otherwise, as all cases experienced increased numbers of new products except for one, which had many new products developed each year. Increasing the number of new products will directly affect the firm’s annual number of patent applications. As new product revenues increase in a majority of cases, this study concludes that new products are well-accepted in the market. Therefore, collaborative innovation among science and technology micro-enterprises impacts organisation growth in firms’ capital, organisational and innovation capabilities.

This study’s data also reveal an increasing trend in almost all growth indicators to conclude that the counselling program positively contributed to micro-enterprises’ growth. The counselling program also successfully created a collaborative environment while supporting micro-enterprises. Further, it enhanced micro-enterprises’ growth capability by increasing their managerial and technical skills and innovation capabilities, providing business consultations, facilitating loan financing and enhancing micro-enterprises’ networks. This finding parallels previous research [83–85,87,88].

To gain a deeper knowledge of the ‘how and why’ surrounding micro-enterprises, this study established an assessment of growth indicators for scientific and technological micro-enterprises by analysing cases of 10 businesses that were involved in Taiwan’s business counselling program. A comprehensive analysis and collaborative innovation perspective allowed this study to develop an innovation mode for science and technology micro-enterprises, as displayed in Table 11. Four collaborative innovation models exist for technological innovation micro-enterprises: the product/service innovation, marketing innovation, knowledge-sharing and resource-sharing models.

The product and service collaborative innovation model involves partnerships to develop a new product or service aligned with market demand. Team members collaborate in many projects in the innovation and collaboration model—including product development, product design and packaging, and product production—by focusing their innovation creativity in these areas. The collaborative partnership can also learn about different manufacturing technologies, whether foreign or domestic, through exhibitions to develop collaborative business models. Moreover, these organisations gain the opportunity to develop their professional skills and use different materials to develop and design products while striving to cultivate an international market. Therefore, members in the collaborative innovation partnership can develop new products aligned to market demand, apply new patents, and increase their new product revenues. Hagen et al. [67] note that the collaboration model is also known as a ‘product-orientation cluster’. This collaboration model must be followed by an innovative and collaborative marketing model to guarantee the products produced can be accepted in the market.

The collaborative marketing innovation model is oriented towards the desire to discover customers’ values and meet their needs. Partners in collaboration share their knowledge of customers to create new markets while maintaining their current market share. Collaboration occurs to determine which niche customers can align with the company’s products. Forms of this collaboration include marketing innovations in branding and marketing strategies, promotions, channels, distribution and networks. Hagen et al. [67] also observe that this collaboration model is common in customer-oriented clusters.

The knowledge-sharing collaborative innovation model creates mutual benefits to participants by sharing new information among partners. This model provides organisations access to their partners’ knowledge and sources to develop innovative, joint R&D. Such collaborations allow an organisation to improve their innovation processes and transform their businesses by learning of their partners’ experiences, knowledge and skill. Another form of collaborative innovation can combine R&D technological innovation and mediations with other companies to assist other domestic companies in transforming their innovation processes.
### Table 11. A comprehensive analysis of collaborative innovation models for technologically innovating micro-enterprises.

| Organisation | Partner Collaborative Innovation Models | Partners’ Collaborative Content | Partners’ Driver for Collaborative Innovation | Impacts of Partners’ Collaborative Innovation on Business Growth |
|--------------|----------------------------------------|--------------------------------|---------------------------------------------|---------------------------------------------------------------|
| A            | Product and service innovation          | Work with music box clubs and music teachers to create music with specific themes | Need for each other and no conflicts of interest | Joint research and development                                  |
| B            | Product, marketing and service innovation | Collaborate with 3-D forces to develop a business model for follow-up fundraising | 3-D Power Party (leader) provides rich marketing experience, sharing and assistance | Participate in overseas business exchanges and one-on-one counselling, among other impacts. |
| C            | 1. Collaboration with other companies is primarily based on commodity distribution planning and assistance with local domestic enterprises to cooperate in transformation and innovation processes | Media cooperation | 1. Branding, marketing and operating three junctions with combined footing 2. Clustered business opportunities 3. Entering the international market | Enhance the company’s visibility and increase its sales volume by communication through business opportunities, small gatherings and clusters |
| D            | 1. Product innovation 2. Marketing channels | Collaborate with domestic enterprises to develop R&D technology | Complementary cooperation between different businesses | Significant influence by participating in Chamber of Commerce seminars and other activities to create awareness-related pathways |
| E            | 1. R&D technological innovation 2. Product innovation | Collaborating with relevant companies, such as biological technology or food companies and other original equipment manufacturers. Collaborate with the company’s R&D products and technology vendors | Collaboration with other industries, and collaboration with different industries | Collaborate with the products developed by the company to sell them, and combine new technology management systems to make the company’s management system easier to operate |
| F            | 1. Product and service innovation 2. Pathway innovation | 1. Collaborate with professional companies selling different materials, both domestic and foreign, to develop design products 2. Co-exhibition | Mutual benefits, as both sides need each other | Meet more manufacturers through exhibitors |
| G            | 1. Pathway innovation 2. Marketing innovation | In the ‘big and small’ cooperation mode, such as the 106th Annual Joint Marketing and Sales Collaboration | Mutual benefits and a mutual need for cooperation | Accumulate experience and education |
Table 11. Cont.

| Organisation | Partner Collaborative Innovation Models | Partners’ Collaborative Content | Partners’ Driver for Collaborative Innovation | Impacts of Partners’ Collaborative Innovation on Business Growth |
|--------------|----------------------------------------|--------------------------------|-----------------------------------------------|---------------------------------------------------------------|
| H            | Marketing innovation                   | Member goods, advertisements in smart vending machines, small games as gifts | Mutual benefit, mutual demand                      | Increase in turnover leads to more business opportunities and resources |
| I            | 1. R&D technology innovation          | Company groups work together to encourage new cooperation modules and create new business results | Industry and cross-industry collaboration, mutual benefit and mode style | Leader in assisting companies’ joint matchmaking to develop new products and services while strengthening their marketing innovation ability |
|              | 2. Product innovation                 |                                  |                                               |                                                               |
| J            | Product and service innovation        | Collaborate with the biotechnology R&D team to develop products | Clustered business opportunities, mutual benefits and mutual cooperation | The over-clustering of a cross-border electricity supplier to integrate into a service-oriented brand channel is supplemented using cross-border system services. Each series includes a large platform and other forward-generating operations in the international market, such as jointly acquired orders. These will expand overseas markets to enhance micro-enterprises’ competitiveness, and they can further use a common platform for communications and business applications |
The resource-sharing collaborative innovation model is corporation-based and allows an organisation to use others’ organisational resources. This model involves common, important collaborations in compensating for micro-enterprises’ lack of resources. These collaborations also allow an organisation to use its partners’ business networks, distribution and marketing channels, communication platforms, research facilities and tools and to share business events. From the resource-based view, collaboratively sharing resources solves the micro-enterprise’s issues arising from a lack of resources and enhances their competitive advantage to facilitate more rapid growth. This finding aligns with Davis and Eisenhardt’s [61] work, which discovered that small businesses that share their resources among partners can solve their problems with limited resources and innovate together.

This study observed that collaborative innovation involves partnerships between enterprises in the same or different industries. Collaborations in the same industry occur when a mutual interest exists to develop the industry by creating demand, encouraging business ecosystems and creating products and services that will benefit all organisations involved. Alternatively, collaborations in different industries bind firms to create mutual benefits and fewer conflicts of interest. This type of collaboration requires partners’ commitment to share resources and knowledge for other partners’ benefit and in exchange for benefits in the future. Whether it involves peer-to-peer or cross-industry cooperation, the partners in the collaborative innovation cooperative model grow through mutual assistance among clusters and an understanding of the needs of each other’s organisations. A mutually beneficial, complementary mode of cooperation evolves to deter conflicts of interest.

In the perspective of business sustainability, referring to United Nations Development Programme’s (UNDP) Sustainable Development Goals (SDG) [101], organisational growth affects sustainability. First, an organisation’s growth creates new jobs, drives the local economy and decreases the level of poverty as well as supports the nation’s economic growth. Second, since small businesses are mostly located in rural and small cities [102], organizational growth helps create sustainable cities by preventing urbanization. Third, by participating in collaborative innovation, technological innovation micro-enterprises enhance the efficiency of resources usage and maximize the usefulness of knowledge by sharing resources and knowledge among partners. Fourth, collaborative innovation among partners generate business communities and promote partnerships in pursuing common goals and supporting the national economy. This conclusion aligns with previous studies [56,57,63–66] that concluded that technological innovation and collaborative innovation give positive impact on sustainability.

5. Conclusions and Managerial Implications

5.1. Conclusions

This study aligns with the counselling program’s goals by gaining a more detailed, extensive knowledge of science and technology micro-enterprises in creating collaborative innovation in products or services that meet the market’s demands. Scientific and technological innovation can fully increase micro-enterprises’ operational flexibility, and sharing their resources and knowledge will allow them to overcome their limitations in these areas. The high-tech R&D innovation in science and technology micro-enterprises can be used to meet market demand through technological developments and technical consulting and services. Moreover, sharing resources and knowledge provides micro-enterprises such advantages as supply chain integration, market innovation, value-based activities and knowledge management while increasing their innovation capability.

Collaborative innovation among developmental partners positively impacts science and technology innovation among these micro-enterprises from the performance, product, marketing and marketing channel perspectives. In addition to the cooperation among cluster members, corporate cooperation also occurs through group referrals. The key factor in successful collaborations is the mutually beneficial relationships with cluster enterprises. Therefore, this study concludes that collaborative innovation partnerships will create positive benefits for science and technological
innovation micro-enterprises growth. This proves that the collaborative innovation in these partnerships positively impacts science and technology micro-enterprises.

This study also found that most micro-enterprises use scientific and technological innovation to develop new products and services. While these micro-enterprises can successfully develop new products or technologies, they lack the time and personnel to fully understand the patent application process, and thus, they are less eager to apply for patents. Regarding micro-enterprises’ personnel limitations in particular, these firms experience many difficulties in deepening their administrative capabilities to handle the increased documentation associated with various functions, such as patent applications, although they do have high R&D and production capabilities. Consequently, micro-enterprises rarely possess the ability to apply for subsidy programs and cannot successfully fight for R&D funding. This research suggests that relevant mentorship programs for science and technology micro-enterprises can provide courses to improve their abilities; relevant practitioners and enterprises can also be invited to participate in sharing their experiences and exchange information through thematic courses.

5.2. Managerial Implications

The study not only expands how micro-enterprises apply scientific and technological innovation in collaborations but also evaluates their growth for future planning, such as selecting clusters of micro-enterprises, guiding performance evaluations and assessing projects’ overall performance. This study’s results are used to determine the criteria for selecting clusters as well as internal references in choosing a counselling program according to the organisation’s resources, conditions and needs. In terms of evaluating growth, growth structures and indicators can be used to evaluate and compare performance among science and technology micro-enterprises before and after Taiwan’s counselling program was implemented. Moreover, this study demonstrates how to evaluate the performance of a program that was applied to drive micro-enterprises’ growth. Therefore, the government as a primary sponsor can gain feedback regarding how the program, policies and investments align with the nation’s business objectives.

Governments can help micro-sized and personal businesses resolve their issues with scarce resources and knowledge by building community or network collaborations and facilitate partners’ communication. Thus, these governments should build a common or fixed third-party platform to address any gaps in information communications. They can also provide space for micro-enterprises to communicate and discuss in groups, such that information no longer stays within its own cluster but is shared across groups or even all micro-enterprises in Taiwan. This study suggests that the information and activities provided to clustered micro-enterprises can be further distinguished by industry category. Therefore, participation can improve the practicality and efficiency of the information content received and anticipate that more exchanges and mediated information in the same industries can be simultaneously updated. Additionally, organisations can participate in other cluster-based discussion topics and exchange, share experiences and explore the possibility of collaborative innovation across multiple groups.

This study clearly and empirically indicates that a flexible corporate culture and micro-enterprises’ resilience are factors that stimulate internal growth. However, governmental policies and the business environment are an important part of the external factors that enhance micro-enterprises’ survival ability. The incentives and norms provided by the counselling program influenced the participating micro-enterprises’ scope of operations. The external environment—including government business counselling resources and laws—is even more important for growth and continuation among the micro-enterprises with a relatively weak ability to compete in the market. Technologically innovative micro-enterprises need the government’s policy support and resources to promote its comprehensive, rapid development. This also reflects the government’s initiative to encourage micro-enterprises.

Reliance on a single enterprise is not conducive to forming a powerful force for innovation. Therefore, this study suggests that the government can assist micro-enterprises’ scientific and
technological innovation so these firms can provide their business partners with a way to aggregate in clusters with high-technology companies, universities, research institutes, public associations and other network-based partners. This will promote joint collaboration mechanisms through irregular contacts and participation in business activities. Science and technological micro-enterprises and these organisations are mutually dependent and collaborate and communicate with each other; this helps to form cross-organisational and cross-regional cooperative innovation networks. This synergy fostered among partners will promote the growth of science and technology micro-enterprises’ research and development and ultimately promote these firms’ development.

5.3. Research Limitations and Future Research

This study reveals that micro-enterprises focusing on science and technological innovation exhibit positive growth in collaborative innovation, with four collaboration models that micro-enterprises employed with their partners. This research method’s limitations prevent this study from determining which collaborative innovation model is the most influential in micro-enterprises’ growth. Therefore, future research should incorporate a quantitative examination to determine the collaborative innovation model that can substantially impact micro-enterprises’ growth.

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