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Towards Sustainable Business Model Innovation for the Pharmaceutical Industry

Li-Min Chuang [1], Yu-Po Lee [2,*] and Te-Hui Liu [3]

[1] Department of International Business, Chang Jung Christian University, Tainan 711301, Taiwan
[2] The Ph.D. Program in Business and Operations Management, College of Management, Chang Jung Christian University, Tainan 711301, Taiwan
[3] Taiwan Biotech Co., Ltd., Taoyuan 330042, Taiwan
* Correspondence: 109d00107@mail.cjcu.edu.tw

Abstract: This study examines pharmaceutical companies in the context of BMI. The purpose is to develop an SBM for the pharmaceutical industry and then to validate the causal relationships of the variables in such a business model. This study used purposive sampling by issuing questionnaires to 12 companies. The research consisted of the following four studies: Study 1: construction of dimension conceptualization. The conceptualization of BMI consists of three dimensions, i.e., technological, social, and organizational. Study 2 and study 3 are about process development and the construction of a unique BM. Study 2 explores the evolution of innovations in an SBM on the basis of a balance scorecard. Study 3 develops a unique SBM by referring to a focus group comprised of senior executives. Study 4: model validation. This stage is about the synthesis of research frameworks in the literature on BMI and an empirical study on the causal relationships in the context of SBMI.

Keywords: sustainable business model (SBM); business model innovation (BMI); sustainable development; circular economy; systems design

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1. Introduction

1.1. Research Motives

Following the first United Nations Conference on Sustainable Development (UNCSD), all countries around the globe have been working to enhance environmental protection awareness, participating in the construction of international environmental protection products, creating environmental protection laws and systems, and improving pollution prevention technologies. This is consistent with the fundamental concept of a circular economy, a transformation from the old economy that grows linearly along with the resources consumed into the new economy that develops by circulating resources. Production and consumption should be centered on the natural economy, by reducing the negative impact caused by the overconsumption of resources, as part of the economic activities, on the environment. The circular economy will play an increasingly important role in the global supply chain. It will become the source of global economic growth and the creation of long-term job opportunities. The establishment of a circular society requires the introduction of circularity in raw material acquisitions, and in production, manufacturing, and consumption processes. Given the extreme lack of natural resources, Taiwan should step up its efforts in the innovation of business models in the circular economy. This will reduce the requirement for external resources and improve the efficiency of resources utilization in order to achieve sustainable development. Over the past few years, the Taiwanese government has been promoting the 5 + 2 Industrial Innovation Plan so as to enhance national competitiveness. It is essential to combine new technologies and business model innovations to create cross-disciplinary and multi-domain cooperation. The vision is to ensure that the pharmaceutical industry continues to play a pivotal role in the ecosystem of the new circular economy.

An increasing number of studies in recent years has been dedicated to empirical research on business models and business model innovation. Business model innovation, as a new integrated logic, explores how companies create value and secure new value for customers [1]. Different business models in fact lead to different market results, even with the same technologies.

By comprehensively viewing research backgrounds and the motives listed above, both academia and industry have considered that rather than focusing on financial viewpoints, business models should involve environmental and social views, forming the triple bottom line. As the business models are adding social and environmental goals into enterprises' missions, operating strategies will be transformed to be pre-responsive on an on-going basis [2]. However, the transformation process of business models is extremely complicated [3], and scholars have started to bring up integrated viewpoints for sustainable business models. For instance, Geissdoerfer et al. [4] mentioned that the pre-responsive integration of a business model and multiple related party management may create extensive monetary and non-monetary value in order to satisfy hugely related parties. In addition, scholars focusing on sustainable business model innovation discovered that studies into SBMI are lacking in the implementation and evolution process for an SBM; hence, many studies start by bringing up research tools for further discussion [5]. Development of sustainable business models is a new endeavor for the pharmaceutical industry in Taiwan. To date, the literature is lacking in Taiwan and overseas concerning sustainable business models of the pharmaceutical industry.

1.2. Research Purpose

In order to understand the contents and the analytical framework of the sustainable business model for the pharmaceutical industry, this paper seeks to examine the following issues:

(1) A review of the literature in Taiwan and overseas on business model innovation, sustainable business models, and the circular economy in order to conceptualize the dimensions of sustainable business models and conduct a statistical analysis accordingly;
(2) An exploration of the substance of sustainable business models for the pharmaceutical industry from the process perspective;
(3) A deep-dive into the details of sustainable business models for the pharmaceutical industry via a literature review and a focus group discussion, so as to analyze the key dimension and processes and then develop a unique sustainable business model;
(4) An evaluation of the causal relationship in the sustainable business model for the pharmaceutical industry by delving into the factors such as external environments, innovative support from management and the correlation between company performance and sustainable business models.

1.3. Research Questions

This study integrates a sustainable business model and business model innovation, and a sustainable business model innovation is constructed using the research approach and gaps of a business model innovation; moreover, four sub-studies on the dimension conceptualization, process development, and construction of a unique SBMI, and an empirical study on the causal relationships in the context of an SBMI are analyzed. This study addresses the following research questions: What is the meaning of a sustainable business model innovation? What are the key components? What are the processes required to develop the business model? What is the unique sustainable business model innovation in the pharmaceutical industry? What factors are conducive to the development of a sustainable business model innovation? Finally, is a sustainable business innovation conducive to improving organizational performance?

1.4. Research Flow

Through research design, this study was conducted as a multiple-viewpoint empirical study (Figure 1).

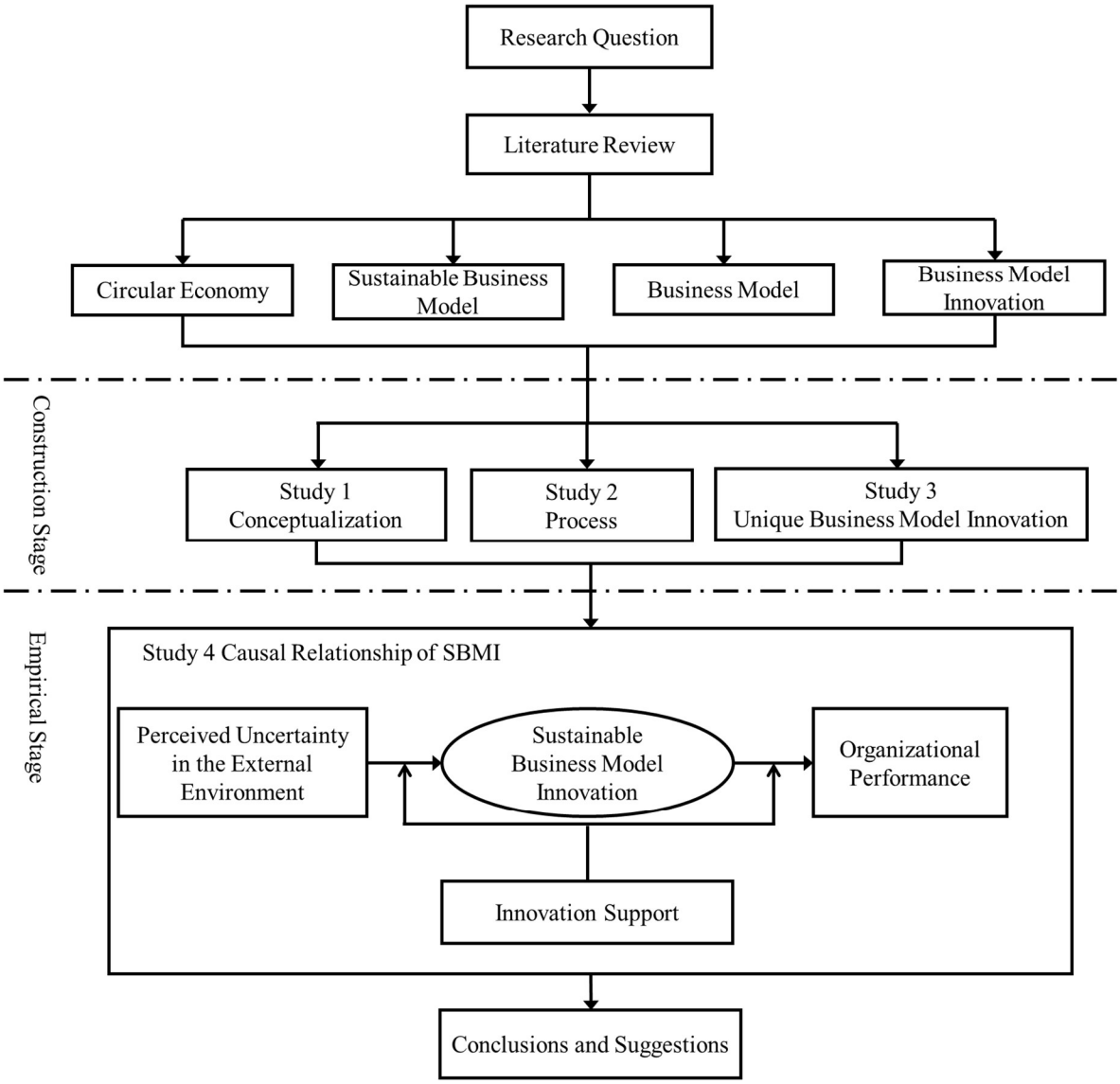

Figure 1. Research flow.

2. Literature Review

The dramatic market changes and intense competition in recent years have redefined business models. For this reason, open and innovative thinking is finding its way into the discussion of business models. Organizations are learning to stay in the game by accelerating the transformation of business models and leveraging external resources. As a result, BMI has become an important research topic. Foss and Saebi summarize four BMI streams and relevant scholars and discourse [6,7]:

(1) Conceptualizing a BMI [8–10], and hence the necessity for augmenting the BMI dimension, contents, and indicators;
(2) BMI as an organizational change process [11–14], and hence the necessity to define the BMI competences and work flows that organizations require to drive transformations;

(3) BMI as an outcome [15–20]. BMI is manifested differently in different industries. One of the research focuses is the development of BMI for the pharmaceutical industry;
(4) Consequences of BMI [21–24]. As far as the effects of BMI on organizational performances are concerned, BMI can be divided into a study that connects behaviors, processes and outcomes, and a study of the influence of different BMs on firm performances.

As the world's population continues to grow and the pace of developments continues to accelerate, the strain of resource utilization on the environment is also increasing. Obviously, we can no longer choose what we want to use in the same way as before. It is important to realize that the ecosystem and natural resources required for our civilization are exhausted. In fact, the corporate world has yet to acknowledge the value of "free" natural resources. It is necessary to take a holistic approach to deal with the challenges ahead. This requires the synchronization of responses to environmental changes and changes in our economy and society. All these changes impose a fundamental shift in mission statements, strategies, and implementations for corporations. BMI provides a set of methods to reconceptualize company goals and value creation in order to facilitate the necessary changes. It also encourages reflection on values and the re-design of business models. In essence, this framework makes it easier for mainstream companies to incorporate sustainable development into operational systems. According to Stubbs and Cocklin [25] and Porter and Kramer [26], BMI can systematically support and create sustainable developments [27]. BMI is increasingly considered the key to social and environmental sustainability in the corporate system [27]. However, the current understanding of sustainable business models and choices of sustainable development innovations seem rather limited. Very little is known about the key success factors of SBM. Regardless of whether it is gradual innovation or a disruptive innovation, innovation is must-have business competence for sustainable development [22]. BM, BMI, and SBM all lack concise and consistent definitions [28–30]. There are very few empirical studies on BMI and SBM [25,27,31]. Bocken et al. [32] conducted a literature review on the development of sustainable business model archetypes. This study used this model and its theoretic foundation, in combination with the theories presented by Foss and Saebi [6], to empirically study the conceptualization, process analysis, uniqueness, and integrated framework of sustainable business models for the pharmaceutical industry.

According to Foss and Saebi's research [33], business models are presented differently in various contexts. There is no consistent definition of a business model or analytical construct. The majority of studies explore how business models work from a static perspective. However, a business model is a dynamic concept that is linked to the whole market environment. Because it is dynamic and linked, the business model must adapt and innovate as the overall environment changes. Most of the empirical studies on the business model of the pharmaceutical industry focus on previous studies, which are mainly based on the perspectives of strategy and corporate positioning. In recent years, the study of business models has been gradually transformed into a study of business model innovation. Schneider and Spieth [17] reviewed the literature on business model innovation and attempted to propose an integrated research framework for the future. They suggested that the research on BMI lacks a complete theoretical foundation, and thus adopting a theoretical basis using multiple viewpoints helps to select appropriate theories in the process of constructing the business model innovation model. To date, no single theory or integrated theory is applicable to all business model innovation studies. Although an increasing number of companies are adopting ESG norms and practices, few know how to integrate ESG into business models. Therefore, constructing sustainable business model innovation can help companies to innovate through the sustainability of the mechanism and thereby balance natural resources and social and environmental issues [34].

3. Methods, Results, and Discussion

3.1. Construction Stage

3.1.1. Study 1: Conceptualization of Sustainable Business Model Dimension

This paper refers to the model described by Bocken et al. [32] in the development of the sustainable business model dimension and the design of a questionnaire divided into three dimensions, i.e., technological, social, and organizational. A pre-test version was first developed on the basis of execution emphasis and importance levels for the pharmaceutical companies in Taiwan. Unsuitable questions were removed according to discriminant analysis on the collected pre-test questionnaires. The questionnaire was based on a Likert 6-point scale. This research used purposive sampling by issuing the questionnaires to 12 pharmaceutical companies listed in the 2016 Biotechnology Industry White Paper. A total of 240 questionnaires was released, i.e., 20 questionnaires issued to each of the 12 sampled companies. The survey recovered 166 questionnaires, and after the elimination of three invalid questionnaires with incomplete answers, a total of 163 effective questionnaires was gathered at a recovery rate of 69% and an effective recovery rate of 67%. Before explorative factor analysis (EFA), it was necessary to conduct a factory analysis on individual dimensions as an ex ante test. All the KMO values indicative of sampling adequacy were above 0.7, and the *p*-value of the spherical Bartlett test of 0 was statistically significant. These numbers suggest that the research variables and dimensions in this research were suitable for factor analysis.

Exploratory Factor Analysis (EFA)

(1) A total of three factors was extracted with factor analysis on the technological dimension of sustainable business models. There was a total of 14 questions, and all the questions had a factor loading of above 0.6, i.e., higher than the threshold of 0.5 in absolute value. In terms of reliability, all the coefficients for individual items were greater than 0.5, and the cumulative explained variances reached 88.811. Moreover, the Cronbach's α values of all the factors were higher than the reliability threshold of 0.8, indicative of a good internal questionnaire consistency. The factors are named below (detailed numbers are shown in Table 1).

Factor 1: maximize material and energy effectiveness (eigenvalue = 2.679, explained variance = 66.986%). Factor 2: create value from waste (eigenvalue = 3.994, explained variance = 66.572%). Factor 3: substitute with renewables and natural processes (eigenvalue = 3.552, explained variance = 88.811%).

(2) A total of three factors was extracted with factor analysis on the social dimension of sustainable business models. There was a total of 11 questions, and all the questions had a factor loading of above 0.6, i.e., higher than the threshold of 0.5 in absolute value [35]. In terms of reliability, all the coefficients for individual items were greater than 0.5, and the cumulative explained variances reached 87.576. The Cronbach's α values of all the factors were higher than the reliability threshold of 0.8, indicative of good internal questionnaire consistency. The factors are named below (detailed numbers are shown in Table 2).

Factor 1: deliver functionality rather than ownership (eigenvalue = 2.543, explained variance = 84.769%). Factor 2: adopt a stewardship role (eigenvalue = 3.769, explained variance = 75.373%). Factor 3: encourage sufficiency (eigenvalue = 2.627, explained variance = 87.576%).

Table 1. Sustainable business model innovation—technological dimension.

Dimension (Cronbach's α)	Item	Factor Loading	Eigenvalue	Cumulative Variance Explained	Item-Total Correlation
Maximize material and energy effectiveness (0.835)	1. Low carbon manufacturing/solution	0.906	2.679	66.986	0.801
	4. Increased functionality (to reduce total number of packaging)	0.858			0.720
	2. Lean manufacturing	0.810			0.647
	3. Additive manufacturing	0.683			0.503
Create value from waste (0.897)	6. Cradle 2 Cradle	0.907	3.994	66.572	0.851
	10. Extended producer responsibility	0.843			0.763
	7. Industrial symbiosis	0.840			0.751
	9. Take back management	0.829			0.741
	8. Reuse, recycle, re-manufacture	0.785			0.687
	5. Circular economy, close loop	0.672			0.559
Substitute with renewables and natural processes (0.958)	14. Green chemistry	0.963	3.552	88.811	0.930
	13. The natural step (blue economy, bio-mimicry)	0.959			0.925
	12. Zero emissions initiative	0.928			0.874
	11. Move from non-renewable energy sources	0.918			0.857

Table 2. Sustainable business model innovation—social dimension.

Dimension (Cronbach's α)	Item	Factor Loading	Eigenvalue	Cumulative Variance Explained	Item-Total Correlation
Deliver functionality rather than ownership (0.910)	15. Product-oriented PSS—maintenance extended warrantee	0.941	2.543	84.769	0.861
	16. User oriented PSS—rental, lease, shared	0.935			0.849
	17. Result-oriented PSS—pay per use	0.885			0.755
Adopt a stewardship role (0.915)	18. Biodiversity protection	0.739	3.769	75.373	0.625
	19. Ethical trade (fair trade)	0.915			0.857
	20. Choice editing by retailers	0.879			0.797
	21. Radical transparency about environmental/societal impacts	0.928			0.873
	22. Resource stewardship	0.868			0.779
Encourage sufficiency (0.929)	23. Consumer education (models); communication and awareness	0.902	2.627	87.576	0.790
	24. Demand management (including cap and trade)	0.956			0.894
	25. Responsible product distribution/promotion	0.949			0.879

(1) A total of two factors was extracted with the factor analysis on the organizational dimension of sustainable business models. There was a total of 10 questions, and all the questions had a factor loading of above 0.6, i.e., higher than the threshold of 0.5 in absolute value [35]. As far as reliability is concerned, all the coefficients for individual items were greater than 0.5, and the cumulative explained variances reached 67.391. Moreover, the Cronbach's α values of all the factors were higher than the reliability

threshold of 0.8, indicative of good internal questionnaire consistency. The factors are named below (detailed numbers are shown in Table 3).

Factor 1: Repurpose the environment for society (eigenvalue = 4.403, explained variance = 67.391%). Factor 2: develop scale-up solutions (eigenvalue = 2.600, explained variance = 64.997%).

Table 3. Sustainable business model innovation—organizational dimension.

Dimension (Cronbach's α)	Item	Factor Loading	Eigenvalue	Cumulative Variance Explained	Item-Total Correlation
Repurpose for society environment (0.895)	26. Hybrid businesses, social enterprise (for profit)	0.780	4.043	67.391	0.666
	27. Alternative ownership: cooperative, mutual, (farmers)collectives	0.882			0.805
	28. Social and biodiversity regeneration initiatives ("net positive")	0.887			0.826
	29. Base of pyramid solutions	0.888			0.813
	30. Localization	0.811			0.717
	31. Home based, flexible working	0.651			0.536
Develop scale-up solutions (0.891)	32. Incubators and entrepreneur support models	0.913	2.600	64.997	0.510
	33. Licensing franchising	0.913			0.545
	34. Open innovation (platforms)	0.856			0.440
	35. Crowd sourcing/funding	0.447			0.292

3.1.2. Study 2: Process Development for Sustainable Business Models

The innovation process for sustainable business models was mainly achieved with focus group discussions. These were essentially interviews with senior executives from pharmaceutical companies concerning the balance scorecard, i.e., learning and growth, internal process, and customer and financial aspects, on the three dimensions of innovation of sustainable business models. In this research, we interviewed the 12 benchmark companies listed in the 2016 Biotechnology Industry White Paper: CCPC, Everlight Chemical, Yungshin Pharm, Standard Chem and Pharm, Sinphar, SCI Pharmtech, PhytoHealth, Formosa Laboratories, Chunghwa Chemical Synthesis and Biotech, ScinoPharm Taiwan, Adimmune Corporation, and SciVision Biotech. The majority of the companies interviewed indicated that sustainability and innovation were the most important factors in corporate development. Therefore, this research contacted these companies on the basis of recommendations from scholars and experts and their willingness to participate.

As shown in Figure 2, technological innovation for the sustainable business model requires learning and growth in low-carbon manufacturing, lean manufacturing, and additive manufacturing. Low-carbon manufacturing and lean manufacturing allow the internal manufacturing process to shift from non-renewables to renewables. In addition, lean manufacturing and additive manufacturing serve as an opportunity to pursue green chemistry for pharmaceutical companies. For customers, renewable resources and green chemistry are catalysts for industrial symbiosis, cooperation with other industries, and manufacturing in a natural way (i.e., bionics and the blue economy). This will reduce the environmental impact and eventually produce a closed-loop circular economy.

As illustrated in Figure 3, social innovation for a sustainable business model requires learning and growth via the development of fair and ethical trade for products and channels. As far as customers are concerned, companies should ensure transparency regarding environmental and social impacts and protection of biodiversity. Good demand management assists customer education and communication. This will create three products/services systems (PSS) that are product oriented, user oriented, and results oriented.

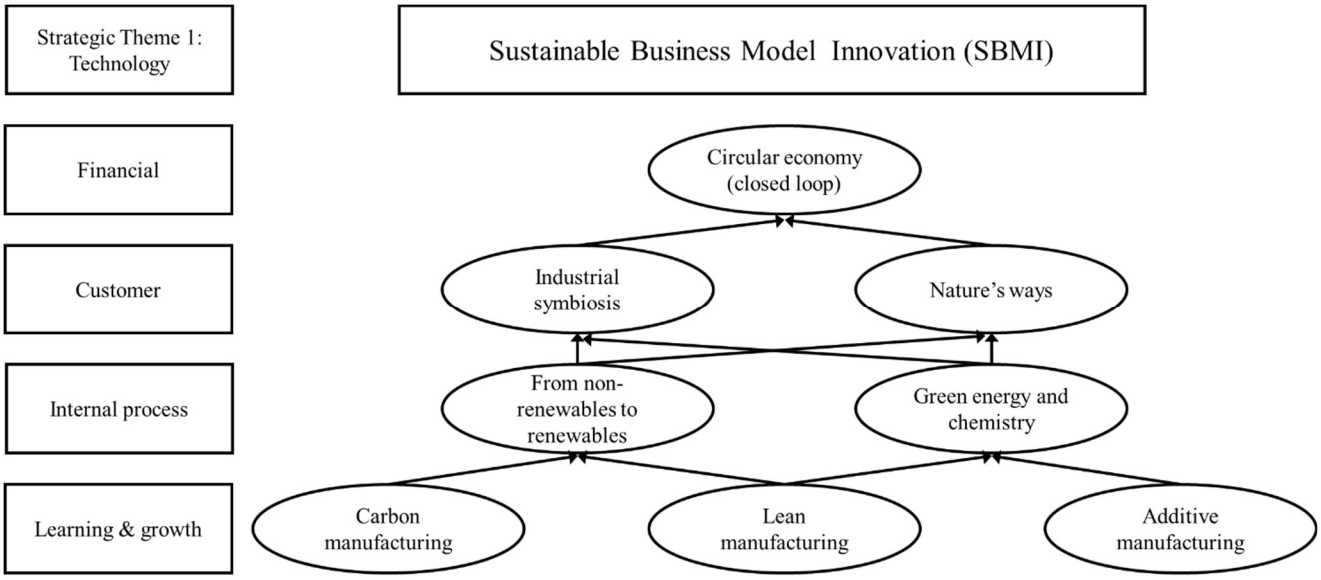

Figure 2. Towards sustainable business model innovation—technological dimension development process.

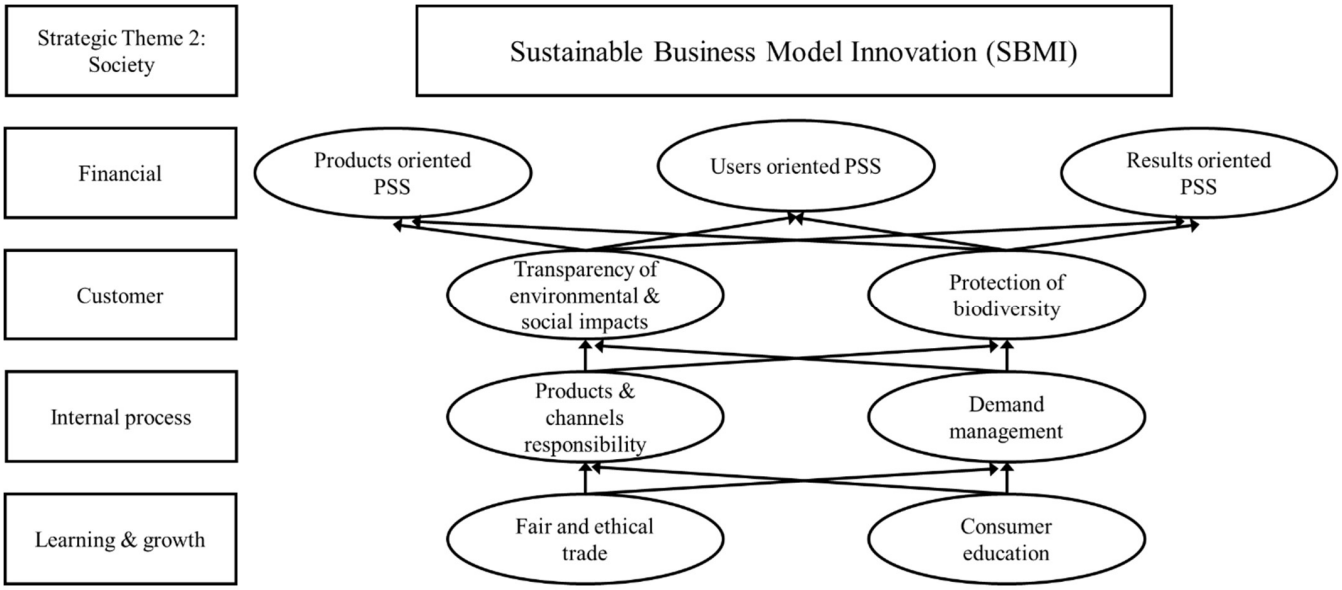

Figure 3. Towards sustainable business model innovation—social dimension development process.

As depicted in Figure 4, organizational innovation for a sustainable business model requires learning and growth via localized management or incubator support. Localization and incubators facilitate open innovation and foster gradual solutions to internal procedural problems. As regards customers, the establishment of franchise systems helps in finding more people who share the same belief to join the movement. Co-ops and societies may be the new form of ownership, in contrast with the previous mainstream approach of shareholder ownership. Finally, collective effort or crowd funding may serve as a mechanism with which to develop hybrid enterprises.

3.1.3. Study 3: Development of Unique Sustainable Business Models

Study 2 spells out the process of developing unique sustainable business models. This research refers to the two new business models proposed by Joyce and Paquin [36], i.e., environmental life-cycle business models, and social business models. The dimension mentioned in study 1 and these two business models were explored and integrated through

focus group discussions. The focus groups comprised senior executives from the sampled pharmaceutical companies (the same people interviewed in study 2). They were tasked with developing these two sustainable business models.

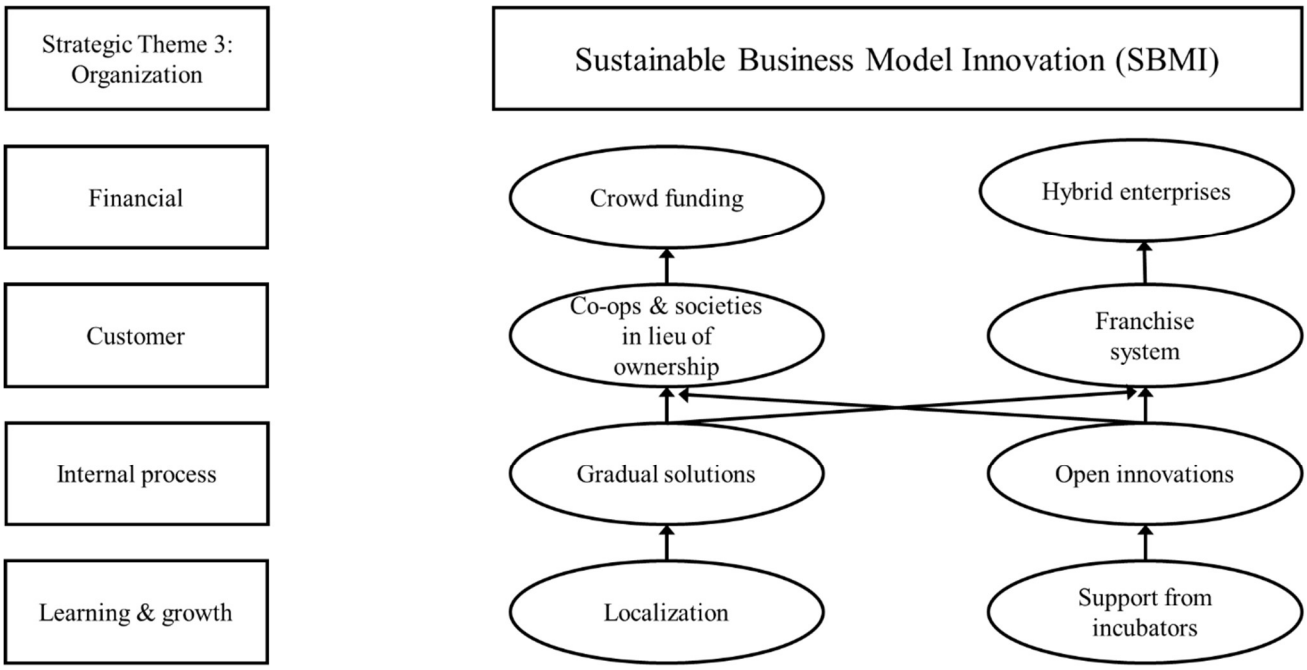

Figure 4. Towards sustainable business model innovation—organizational dimension development process.

Figure 5 illustrates the environmental dimension of unique and sustainable business models. Suppliers and contractors can work across industries to form an ecosystem of industrial symbiosis. Producers assume greater responsibility in oversight. To achieve sustainability, lean manufacturing and low-carbon manufacturing are deployed to minimize the burden on the environment. Excess resources or raw materials may be recovered for reuse or re-manufacturing. Functional value is delivered by enhancing product functionality and reducing the total volumes required in a natural way. At the end of the product's life, the result-oriented products and services system (PSS) ensures product recycling. During the usage stage, user-oriented PSS can be implemented. The number of trips required for transportation can be reduced via demand and trading management. Zero emissions is the goal, as emissions impose the greatest strain on the environment. Biodiversity production is the ultimate benefit for the environment.

As illustrated in Figure 6 regarding the social dimension of unique and sustainable business models, it is recommended that incubation centers should be developed for local communities. Companies should pursue localization and create job opportunities in a natural way. Management should take a from-cradle-to-cradle approach, covering the full cycle from product design to end of life, so as to ensure material recycling. This is part of the extended responsibility for producers. Currently, the Taiwanese government advocates policies on the circular economy so that the public can begin to consider how to embrace sustainability as part of the social culture. This helps to create social value and promote social diversity and biodiversity. Scale expansion may be achieved with franchise chains. As far as end users are concerned, co-ops and societies may replace the ownership system. As the phase-out of the ownership system remains a nascent concept, it may have certain effects on fair trading. Social gains become synonymous with profits for the company and society after transforming companies into hybrid enterprises.

Suppliers and Contractors	Production	Functional value	End of product life	Usage stage
● Industrial symbiosis ● Expansion of producer's responsibility	● Low carbon manufacturing ● Lean manufacturing	● Enhancement of product functionality to reduce total volumes ● Natural's ways ● Bionics	● Results oriented PSS	● Users oriented PSS
	Raw materials		Transportation	
	● Utilization of excess resources recycle and reuse		● Demand management (including trading)	
Environmental impact		Environmental gains		
Zero emissions		Biodiversity protection		

Figure 5. Unique sustainable business model—environmental dimension.

Communities	Management	Social value	Social culture	End users
● Localization ● Support model by incubation centers	● Cradle to cradle ● Expansion of producer responsibility	● Social and bio diversity and rebirth	● Circular economy	● Co-ops and societies in lieu of ownership
	Employees		Scale up	
	● Natural's way ● Blue economy		● Franchise system	
Social impact		Social gains		
● Fair and ethical trade		● Hybrid enterprises		

Figure 6. Unique sustainable business model—social dimension.

3.2. Empirical Stage

3.2.1. Research Framework and Research Sample

This section aims to examine the causal relationships in the sustainable business models for the pharmaceutical industry in Taiwan. The research framework was based on the conceptual framework proposed by Foss and Saebi [6] (Figure 7). In the research framework for the validation model, the cause is "perceived uncertainty about external environments", the result is "organizational performance", the mediating variable is "innovations of sustainable business models", and the moderating variable is "support for innovation". A pre-test questionnaire was issued to the sampled pharmaceutical companies in Taiwan to assess the level of implementation and the strength of awareness. Discriminant analysis was conducted to eliminate unsuitable questionnaires according to the collected feedback. The questionnaire was based on the Likert 6-point scale. The advantage of even-point scales lies in the fact that participants who are less serious about their responses tend to choose "no opinion", resulting in the obtained data being of little significance. Therefore, the even-point scale is a better indicator of the attitude of the respondents. The Likert 6-point scale was therefore used in this study. This research used purposive sampling by releasing questionnaires to the 12 pharmaceutical companies listed in the 2016 Biotechnology Industry White Paper. A total of 240 questionnaires was issued, i.e., 20 to each of the 12 companies. The survey recovered 166 questionnaires. After the removal of three invalid questionnaires due to incomplete responses, this research collected a total of 163 effective questionnaires at a recovery rate of 69% and an effective recovery rate of 67%. The questions on "perceived uncertainty about external environments" were modified versions from the

perspectives of Han et al. [37], Jaworski et al. [38], Andrews [39], Boseman [40], Robbins and Maddock [41], and Miller and Friesen [42]. The questions on "organizational performance" were modified versions from the questionnaire developed by Kaplan and Norton [43]. The questions on the "innovation of sustainable business models" were amended versions from the questionnaire designed in study 1. The questions on "support for innovations" were modified version from the KYES questionnaire proposed by Amabile [44].

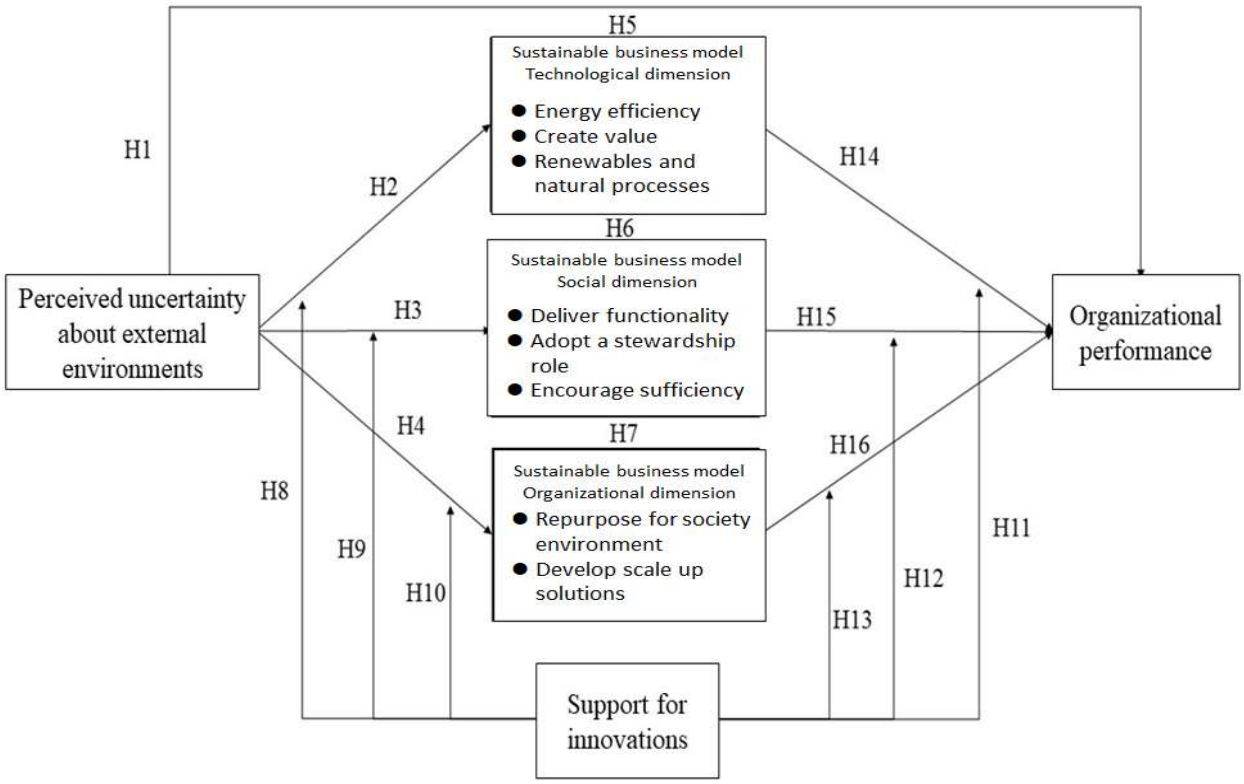

Figure 7. Research framework.

3.2.2. Hypothesis Tests

Once the relationships between the technological, social, and organizational dimensions, and between perceived uncertainty about external environments and organizational performance were established for the innovation of sustainable business models, we were able to examine the influence of individual variables with regression analysis. The purpose was to identify possible effects and correlations so as to understand the predictive power and impacts of different dimensions. Thereafter, the moderating variable was incorporated into the regression analysis in order to gauge the moderating effects in terms of its predictability and influence on different dimensions.

As shown in the analysis in Table 4, perceived uncertainty about external environments had a significant and positive influence on organizational innovations. The regression equation results were statistically significant ($F = 89.915$, $p < 0.001$). In other words, the level of perceived uncertainty about external environments affected organizational performance. Therefore, the findings support the following hypothesis:

Hypothesis 1 (H1). *Perceived uncertainty about external environments has a significant influence on organizational performance.*

Table 5 shows the analytical findings regarding the effects of perceived uncertainty about external environments on the technological dimension of innovation for sustainable business models. First of all, perceived uncertainty about external environments had a significant and positive influence on energy effectiveness. The regression equation results

were statistically significant ($F = 45.499$, $p < 0.001$). Moreover, perceived uncertainty about external environments exhibited a significant and positive influence on value creation. The regression equation results were statistically significant ($F = 103.195$, $p < 0.001$). Moreover, perceived uncertainty about external environments boasted a significant and positive influence on renewable and natural processing. The regression equation results were statistically significant ($F = 76.946$, $p < 0.001$). In summary, the level of perceived uncertainty about external environments had an influence on the degree of innovation for the technological dimension of sustainable business models. Thus, the research findings support the following hypothesis:

Table 4. The relationship among perceived uncertainty about external environment, sustainable business model innovation, and organizational performance.

Variable	Organizational Performance		
	Mode 1	**Mode 2**	**Mode 3**
Control variable			
sex	−0.156	−0.390 ***	−0.152 *
Independ variable			
Perceived uncertainty about external environment	0.657 ***		0.667 ***
Mediation variable 1	**Sustainable business models—technological dimension**		
Maximize material and energy effectiveness		0.292 ***	−0.019
R^2	0.529	0.239	0.529
Adjusted R^2	0.523	0.229	0.521
F value	89.915 ***	25.118 ***	59.637 ***
Create value from waste		0.451 ***	0.069
R^2	0.529	0.357	0.532
Adjusted R^2	0.523	0.349	0.523
F value	89.915 ***	44.443 ***	60.190 ***
Substitute with renewables and natural processes		0.403 ***	0.043
R^2	0.529	0.316	0.530
Adjusted R^2	0.523	0.307	0.521
F value	89.915 ***	36.907 ***	59.849 ***
Mediation variable 2	**Sustainable business models—social dimension**		
Deliver functionality rather than ownership		0.492 ***	0.097
R^2	0.529	0.393	0.534
Adjusted R^2	0.523	0.386	0.525
F value	89.915 ***	51.834 ***	60.632 ***
Adopt a stewardship role		0.359 ***	−0.262 **
R^2	0.529	0.277	0.558
Adjusted R^2	0.523	0.268	0.549
F value	89.915 ***	30.672 ***	66.812 ***
Encourage sufficiency		0.220 **	−0.254 ***
R^2	0.529	0.201	0.569
Adjusted R^2	0.523	0.191	0.561
F value	89.915 ***	20.174 ***	69.910 ***
Mediation variable 3	**Sustainable business models—organizational dimension**		
Repurpose for society environment		0.227 **	−0.211 **
R^2	0.529	0.205	0.558
Adjusted R^2	0.523	0.195	0.550
F value	89.915 ***	20.628 ***	66.883 ***
Develop scale-up solutions		−0.266 ***	−0.018
R^2	0.529	0.223	0.529
Adjusted R^2	0.523	0.213	0.521
F value	89.915 ***	22.970 ***	59.628 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 5. The relationship among perceived uncertainty about external environment, support for innovation, and sustainable business model innovation.

Variable	Sustainable Business Models—Technological Dimension								
	Maximize Material and Energy Effectiveness			Create Value from Waste			Substitute with Renewables and Natural Processes		
	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3
Perceived uncertainty about external environment	0.469 ***		−1.030 ***	0.625 ***		−0.944 ***	0.569 ***		−0.665 ***
Support for innovation		0.799 ***	−0.526		0.875 ***	−0.435 *		0.810 ***	−0.027
Perceived uncertainty about external environment × support for innovation			4.861 ***			2.113 ***			3.616 ***
R^2	0.220	0.638	0.718	0.391	0.766	0.828	0.323	0.656	0.685
Adjusted R^2	0.215	0.635	0.712	0.387	0.765	0.824	0.319	0.654	0.679
F value	45.499 ***	283.332 ***	134.803 ***	103.195 ***	527.910 ***	254.525 ***	76.946 ***	306.916 ***	115.365 ***
Variable	**Sustainable business models—social dimension**								
	Deliver functionality rather than ownership			Adopt a stewardship role			Encourage sufficiency		
	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3
Perceived uncertainty about external environment	0.706 ***		0.044	0.761 ***		0.446 **	0.611 ***		0.239
Support for innovation		0.821 ***	0.413		0.875 ***	1.020 ***		0.788 ***	1.058 ***
Perceived uncertainty about external environment × support for innovation			0.392			−0.502 *			−0.470
R^2	0.498	0.674	0.694	0.579	0.766	0.794	0.373	0.621	0.625
Adjusted R^2	0.495	0.672	0.689	0.576	0.764	0.790	0.369	0.619	0.618
F value	159.591 ***	332.767 ***	120.480 ***	221.234 ***	525.861 ***	204.274 ***	95.696 ***	263.664 ***	88.220 ***
Variable	**Sustainable business models—organization dimension**								
	Repurpose for society environment			Develop scale-up solutions					
	Mode 1	Mode 2	Mode 3	Mode 1	Mode 2	Mode 3			
Perceived uncertainty about external environment	0.574 ***		−0.412 **	0.372 ***		−0.543 *			
Support for innovation		0.854 ***	0.559 *		0.530 ***	−0.188			
Perceived uncertainty about external environment × support for innovation			0.632			1.177 *			
R^2	0.329	0.729	0.744	0.138	0.280	0.300			
Adjusted R^2	0.325	0.727	0.740	0.133	0.276	0.287			
F value	79.057 ***	433.123 ***	154.306 ***	25.879 ***	62.740 ***	22.735 ***			

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Hypothesis (H2). *Perceived uncertainty about external environments has significant effects on the technological dimension of innovation for sustainable business models.*

Perceived uncertainty about external environments had a significant and positive influence on functionality in lieu of ownership as a social aspect. The regression equation results were statistically significant ($F = 159.591$, $p < 0.001$). Perceived uncertainty about external environments exhibited a significant and positive impact on the responsibility system for management as a social aspect. The regression equation yielded statistically significant results ($F = 221.234$, $p < 0.001$). Perceived uncertainty about external environments had a significant and positive influence on incentive sufficiency as a social aspect. The regression equation produced statistically significant results ($F = 95.696$, $p < 0.001$). In other words, the level of perceived uncertainty about external environments affected the degree of innovation for the social dimension of sustainable business models. Hence, the research findings support the following hypothesis:

Hypothesis (H3). *Perceived uncertainty about external environments has significant effects on the social dimension of innovation for sustainable business models.*

As summarized in Table 5, the analysis found that perceived uncertainty about external environments had a significant and positive influence on the re-creation of social environments as an organizational aspect. The regression equation produced statistically significant results ($F = 79.057$, $p < 0.001$). Moreover, perceived uncertainty about external environments had a significant and positive influence on the breadth of solutions developed as an organizational aspect. The regression equation yielded statistically significant results ($F = 25.879$, $p < 0.001$). The level of perceived uncertainty about external environments affected the degree of innovation for the organizational dimension of sustainable business models. Hence, the research findings support the following hypothesis:

Hypothesis (H4). *Perceived uncertainty about external environments has significant effects on the organization of innovation for sustainable business models*.

Energy effectiveness, value creation, and renewable and natural processing as the technological dimensions of the innovation for sustainable business models boasted significant and positive influences on organizational performance. However, if they were the mediation variables, there was no significant correlation. In other words, the effect of perceived uncertainty about external environments did not differ simply because of the changes to the technological dimension for the innovation of sustainable business models. Hence, the results do not support the following hypothesis:

Hypothesis (H5). *Innovation in the technological dimension of the innovation for sustainable business models has significant mediation effects on the relationship between perceived uncertainty about external environments and organizational performance*.

Functionality in lieu of ownership, a responsibility system for management, and incentive sufficiency as the social dimensions of the innovation for sustainable business models exhibited positive and significant effects on organizational performance. However, functionality in lieu of ownership had no significantly positive influence if it served as a mediation variable. However, a responsibility system for management ($F = 66.812$, $p < 0.01$) and incentive sufficiency ($F = 69.910$, $p < 0.001$) had significant and positive effects. In other words, the influence of perceived uncertainty about external environments on organizational performance changed as a result of different social dimensions for the innovation of sustainable business models. Therefore, the results partially supported the following hypothesis:

Hypothesis (H6). *The social dimension of the innovation for sustainable business models has significant mediation effects on organizational performance*.

The re-creation of social environments and the breadth of solutions developed as the organizational dimension of the innovation for sustainable business models had a significant and positive influence on organizational performance. However, the breadth of solutions developed as a mediation variable did not have significantly positive effects. The re-creation of social environments ($F = 66.883$, $p < 0.01$) did exhibit a positive and significant influence. Stated differently, the impact of perceived uncertainty about external environments on organizational performance changed as a result of different organizational dimensions in the innovation for sustainable business models. Therefore, the results partially support the following hypothesis:

Hypothesis (H7). *The organizational dimension of the innovation for sustainable business models has significant mediation effects on the relationship between perceived uncertainty about external environments and organizational performance.*

Support for innovations exhibited a significant and positive influence on all the technological dimensions for the innovation of sustainable business models. As a moderating variable, support for innovations demonstrated significant and positive moderating effects

on all the technological dimensions for the innovation of sustainable business models: energy effectiveness ($F = 134.803$, $p < 0.001$), value creation ($F = 254.525$, $p < 0.001$), and renewable and natural processing ($F = 115.365$, $p < 0.001$). In other words, the impact of perceived uncertainty about external environments on the technological dimension of the innovation for sustainable business models differed as a result of various levels of support for innovations. Hence, the research findings support the following hypothesis:

Hypothesis (H8). Support for innovations has significant moderating effects on the influence of perceived uncertainty about external environments on the technological dimension.

Support for innovations demonstrated a significant and positive influence on all the social dimensions for the innovation of sustainable business models. As a moderating variable, support for innovations exhibited significant and positive moderating effects on a responsibility system for management as a social aspect for the innovation of sustainable business models ($F = 204.274$, $p < 0.05$). However, support for innovations produced no significantly positive influences on functionality in lieu of ownership or incentive sufficiency. In other words, the influence of perceived uncertainty about external environments on the social dimension of the innovation for sustainable business models differed as a consequence of different levels of support for innovations, but this did not apply to other dimensions of the innovation for sustainable business models. In conclusion, the research results partially support the following hypothesis:

Hypothesis (H9). *Support for innovations has significant moderating effects on the influence of perceived uncertainty about external environments on the social dimension*.

Support for innovations had a significant and positive impact on the organizational dimension for the innovation of sustainable business models. As a moderating variable, support for innovations exhibited significant and positive moderating effects on the recreation of social environments ($F = 154.306$, $p < 0.001$) and the breadth of solutions developed ($F = 154.306$, $p < 0.05$) as the two organizational dimensions. The influence of perceived uncertainty about external environments on the organizational dimension of the innovations for sustainable business models changed as a result of different levels of support for innovations. In summary, the research results support the following hypothesis:

Hypothesis (H10). *Support for innovation has significant moderating effects on the influence of perceived uncertainty about external environments on organizational dimension*.

See Appendix A Table A4 for details of the measurement of organizational performance. Mode 1, Mode 2, and Mode 3 in Table 5 refer to the regression coefficients obtained by specifying the entry order of the explanatory variables, which are independent variables, moderating variables, and the interaction between independent variables and moderating variables.

As presented in the analytical results in Table 6, support for innovations had significant and positive effects on organizational performance. As a moderating variable, support for innovation exhibited significant and positive moderating effects on the influence of the organizational dimension of the sustainable business models upon organizational performance: energy effectiveness ($F = 35.797$, $p < 0.001$), value creation ($F = 32.298$, $p < 0.001$), and renewable and natural processing ($F = 28.058$, $p < 0.001$). In other words, the influence of the technological dimension of innovations for sustainable business models on organizational performance differed as a consequence of different levels of support for innovations. In summary, the research results support the following hypotheses:

Table 6. The relationship among organizational dimensions of the sustainable business model: support for innovation and organizational performance.

Variable	Organizational Performance						
	Mode 1	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Mode 6**	**Mode 7**
Technological dimension							
Support for innovation	0.461 ***				−0.662 **	−0.768 ***	−0.406 *
Maximize material and energy effectiveness		0.295 ***			−1.417 ***		
Create value from waste			0.446 ***			−1.253 ***	
Substitute with renewables and natural processes				0.399 ***			
Maximize material and energy effectiveness × support for innovation					2.407 ***		−1.637 ***
Create value from waste × support for innovation						2.460 ***	
Substitute with renewables and natural processes × support for innovation							2.438 ***
R^2	0.213	0.087	0.199	0.159	0.403	0.379	0.346
Adjusted R^2	0.208	0.081	0.194	0.154	0.392	0.367	0.334
F value	43.553 ***	15.297 ***	39.920 ***	30.487 ***	35.797 ***	32.298 ***	28.058 ***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Hypothesis (H11). *Support for innovations has significant moderating effects on the influence of the technological dimension of the innovation of sustainable business models on organizational performance.*

Hypothesis (H14). *All the technological dimensions of the innovation for sustainable business models have significant effects on organizational performance.*

According to the analytical results shown in Table 7, support for innovations had a significant and positive influence on organizational performance. As a moderating variable, support for innovation exhibited significant and positive moderating effects on the influence of the social dimension of the sustainable business models upon organizational performance: functionality in lieu of ownership ($F = 38.029$, $p < 0.001$), a responsibility system for management ($F = 30.514$, $p < 0.001$), and incentive sufficiency ($F = 36.369$, $p < 0.001$). Put differently, the influence of the social dimension of innovations for sustainable business models upon organizational performance differed as a consequence of different levels of support for innovations. Therefore, the research results support the following hypotheses:

Hypothesis (H12). *Support for innovations has significant moderating effects on the influence of the social dimension on the innovation of sustainable business models on organizational performance.*

Hypothesis (H15). *All the social dimensions of the innovation for sustainable business models have significant effects on organizational performance.*

According to the analytical results shown in Table 8, support for innovations exhibited a significant and positive influence on organizational performance. As a moderating variable, support for innovation exhibited significant and positive moderating effects on the influence of the organizational dimension of the sustainable business models upon organizational performance: re-creation of social environments ($F = 38.029$, $p < 0.001$) and the breadth of solutions developed ($F = 36.369$, $p < 0.001$). The influence of the organizational dimension of innovation for sustainable business models on organizational performance differed if the levels of support for innovations were different. Therefore, the research results support the following hypotheses:

Table 7. The relationship among social dimensions of the sustainable business model: support for innovation and organizational performance.

Variable	Organizational Performance						
	Mode 1	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**	**Mode 6**	**Mode 7**
Social dimension							
Support for innovation	0.461 ***				−0.828 ***	−0.782 ***	−0.708 **
Deliver functionality rather than ownership		0.523 ***			−1.039 ***	−0.976 ***	−1.303 ***
Adopt a stewardship role			0.422 ***				
Encourage sufficiency				0.263 ***			
Deliver functionality rather than ownership × support for innovation					2.333 ***		
Adopt a stewardship role × support for innovation						2.192 ***	
Encourage sufficiency × support for innovation							2.323 ***
R^2	0.213	0.274	0.178	0.069	0.418	0.365	0.407
Adjusted R^2	0.208	0.269	0.173	0.063	0.407	0.353	0.396
F value	43.553 ***	60.642 ***	34.802 ***	11.975 ***	38.029 ***	30.514 ***	36.369 ***

** $p < 0.01$; *** $p < 0.001$.

Table 8. The relationship among organizational dimensions of the sustainable business model, support for innovation, and organizational performance.

Variable	Organizational Performance				
	Mode 1	**Mode 2**	**Mode 3**	**Mode 4**	**Mode 5**
Organizational dimension					
Support for innovation	0.461 ***			−0.139	0.030
Repurpose for society environment		0.250 ***		−1.467 ***	−2.531 ***
Develop scale-up solutions			0.210 **		
Repurpose for society environment × support for innovation				1.951 ***	
Develop scale-up solutions × support for innovation					2.776 ***
R^2	0.213	0.062	0.044	0.426	0.340
Adjusted R^2	0.208	0.057	0.038	0.415	0.328
F value	43.553 ***	10.732 ***	7.427 **	39.268 ***	27.308 ***

** $p < 0.01$; *** $p < 0.001$.

Hypothesis (H13). *Support for innovations exhibits significant moderating effects on the influence of the organizational dimension of the innovation of sustainable business models upon organizational performance.*

Hypothesis (H16). *The organizational dimension of the innovation for sustainable business models has significant effects on organizational performance.*

4. Conclusions and Research Limitations

4.1. Conclusions

This research refers to the four gaps and research prospects identified by Foss and Saebi [6] concerning BMI studies. It also integrates the sustainable business model archetypes developed by Bocken et al. [32] and the environmental life-cycle business models and social business models proposed by Rutherford et al. [35] and Joyce and Paquin [36] in the conceptualization and process analysis of sustainable business models and the empirical research of unique business models and integrated frameworks for the pharmaceutical industry. Below is

a discourse on the theoretical and managerial implications. The theoretic implications of this study are as follows:

(1) Implications of conceptualized BMI

This research designed a questionnaire by referring to the dimensions of sustainable business models. This research conceptualized the innovation dimension of sustainable business models and created a questionnaire for academics accordingly. The questionnaire covers three dimensions of sustainable business models, i.e., technological, social, and organization, and contains a total of 35 questions. In summary, this research addresses the first research gap: "construction definition and dimensionalization".

(2) Implications of BMI as a process for organizational change

This research used the framework of balance scorecards in the study of the innovation process of sustainable business models. This was primarily achieved via focus group interviews with senior executives from pharmaceutical companies. The three dimensions for the innovation of sustainable business models were analyzed for the process in terms of learning and growth, internal processes, and customer and financial aspects. The majority of the surveyed companies believed that sustainability and innovation were the most important factors in corporate development. It was necessary, however, to explore the development of sustainable business models in the dynamic perspective of process theory in order to fully grasp the characteristics of the innovation process. Research was typically conducted with a stage/process model. The processes of business model innovations were examined in the context of sustainability so as to understand the factors that influence different stages of the process. The interpretation in this research establishes an understanding of how sustainable business models are constructed via strategic mapping.

(3) Implications of unique BMI development

This research developed unique sustainable business models in study 2. The unique BMI built by this research for the pharmaceutical industry is also one of its key contributions. Many issues related to the environment, natural resources, and climate change are the themes linked to business model innovation. The most interesting of these is the process of transformation or adaptation and how it generates economic, social, and environmental benefits through value creation. The literature and theoretical framework of business models and sustainable business innovation provide a mechanism and guidance for companies to think about how to move toward sustainable development at the corporate level and to continuously think about caring for natural resources and the environment. The empirical studies of Molina-Castillo et al. [45] examined the value of uncaptured sustainable business model innovation in manufacturing. Furthermore, Gomes et al. [46] discussed how two Brazilian logistics companies in different market segments continued to develop sustainably, socially, and environmentally sustainable business model innovations. In these studies, qualitative or quantitative research methods were adopted. As empirical data concerning sustainable business model innovation continuously accumulate, sustainable business model innovation research becomes more inevitable.

(4) Implication of the causal relationships in the sustainable business models for the Taiwanese pharmaceutical industry

In the research framework for the validation model, the cause is "perceived uncertainty about external environments", the result is "organizational performance", the mediating variable is "innovations of sustainable business models", and the moderating variable is "support for innovation". The research findings indicate that perceived uncertainty about external environments can only affect organizational performance via the mediation mechanism of innovation development for sustainable business models. The key is to effectively enhance the influence on the innovation of sustainable business models with support for innovations. Therefore, it is imperative for companies to seek "sufficient resources", "challenging tasks", "encouragement from supervisors/organizations", and "support for the team" as the supports for innovation. In summary, this research addresses

the following research gaps: "congruence and identifying antecedents and outcomes" and "contingency and moderating variables".

The practical implications of this study are as follows:

(1) The development process of sustainable business model innovations is, in its own right, the process of organizational innovation. This research develops a process for the technological, social, and organizational dimensions for the pharmaceutical industry and maps the path for organizational change for this industry in three dimensions. This improves the feasibility of strategic mapping and KPI establishment.
(2) Many frameworks have been developed in recent years by integrating corporate sustainability and traditional business models. Examples include social business models, green business models, triple-bottom-line business models, green business models, social-development business models, inclusive business models, and sustainable business models. These concepts have been applied to social and corporate issues. Going forward, vision and mission statements for companies will go beyond profitability. Sustainability and innovation will become the most important strategic options for corporate management.

4.2. Research Limitations and Future Research

Sustainable business model innovation focuses on creating sustainable value by changing the way organizations and their broader networks create value. However, we are concerned with the broader category of business model innovation. Nevertheless, the study of sustainable business model innovation is helpful and relevant, since it focuses on the broader value of sustainability and explicitly incorporates social and ethical considerations. As the environment evolves, an increasing number of companies are adopting ESG norms and practices. However, related studies in the past have shown that the integration of ESG into business models is worth investing in and deepening. The literature on ESG integration into business model innovation is still at the analytical framework stage, with most studies only examining whether ESG investments are beneficial to financial performance. There are two main streams of ESG research, i.e., socially responsible investment and sustainable development. The majority of the literature focuses on socially responsible investment, with only a few papers integrating ESG considerations into corporate operations. Foss and Saebi [6] mention the problems associated with boundary conditions. However, the literature on BMI has not definitely resolved these issues. Follow-up studies may expand the coverage of industries or countries and develop scenario models for Taiwanese pharmaceutical companies and the subsidies of foreign pharmaceutical companies in Taiwan.

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Appendix A

Table A1. Sustainable business model (SBM).

Sustainable Business Model (SBM)							
(1)	Low carbon manufacturing/solution	1	2	3	4	5	6
(2)	Lean manufacturing	1	2	3	4	5	6
(3)	Additive manufacturing	1	2	3	4	5	6
(4)	Increased functionality (to reduce total amount of packaging)	1	2	3	4	5	6
(5)	Circular economy, closed loop	1	2	3	4	5	6
(6)	Cradle 2 Cradle	1	2	3	4	5	6
(7)	Industrial symbiosis	1	2	3	4	5	6
(8)	Reuse, recycle, re-manufacture	1	2	3	4	5	6
(9)	Take back management	1	2	3	4	5	6
(10)	Extended producer responsibility	1	2	3	4	5	6
(11)	Move from non-renewable energy sources	1	2	3	4	5	6
(12)	Zero emissions initiative	1	2	3	4	5	6
(13)	The natural step (blue economy, biomimicry)	1	2	3	4	5	6
(14)	Green chemistry	1	2	3	4	5	6
(15)	Product-oriented PSS—maintenance extended warranty	1	2	3	4	5	6
(16)	User oriented PSS—rental, lease, shared	1	2	3	4	5	6
(17)	Result-oriented PSS—Pay per use	1	2	3	4	5	6
(18)	Biodiversity protection	1	2	3	4	5	6
(19)	Ethical trade (fair trade)	1	2	3	4	5	6
(20)	Choice editing by retailers	1	2	3	4	5	6
(21)	Radical transparency about environmental/societal impacts	1	2	3	4	5	6
(22)	Resource stewardship	1	2	3	4	5	6
(23)	Consumer education (models); communication and awareness	1	2	3	4	5	6
(24)	Demand management (including cap and trade)	1	2	3	4	5	6
(25)	Responsible product distribution/promotion	1	2	3	4	5	6
(26)	Hybrid businesses, social enterprise (for profit)	1	2	3	4	5	6
(27)	Alternative ownership: cooperative, mutual, (farmer) collectives	1	2	3	4	5	6
(28)	Social and biodiversity regeneration initiatives ("net positive")	1	2	3	4	5	6
(29)	Base of pyramid solutions	1	2	3	4	5	6
(30)	Localization	1	2	3	4	5	6
(31)	Home based, flexible working	1	2	3	4	5	6
(32)	Incubators and entrepreneur support models	1	2	3	4	5	6
(33)	Licensing franchising	1	2	3	4	5	6
(34)	Open innovation (platforms)	1	2	3	4	5	6
(35)	Crowd sourcing/funding	1	2	3	4	5	6

1 = totally disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = totally agree.

Table A2. Innovation Support.

	Innovation support						
(1)	Many senior executives of our company have extensive experience in how to implement innovation.	1	2	3	4	5	6
(2)	In order to realize ideas, senior executives of our company often encourage innovators to break through the constraints of routines and procedures.	1	2	3	4	5	6
(3)	There are many employees of "risk appetites" in our company. They often devote themselves to the development of new projects regardless of success or failure.	1	2	3	4	5	6
(4)	Our company encourages employees to develop creativity.	1	2	3	4	5	6
(5)	For our company employees, "taking a risk" may help their job performance.	1	2	3	4	5	6
(6)	Our company usually adopts promotional actions immediately after employees develop innovative ideas.	1	2	3	4	5	6
(7)	Our company's senior executives are willing to accept ideas and suggestions from employees.	1	2	3	4	5	6
(8)	Many new creative projects of our company are often able to obtain sufficient budget support in time.	1	2	3	4	5	6
(9)	Our company will provide additional compensation to employees who successfully propose innovative projects.	1	2	3	4	5	6
(10)	Our company allows employees to have free time to develop good ideas.	1	2	3	4	5	6
(11)	In our company, project executors can often make decisions directly without going through complicated approval procedures.	1	2	3	4	5	6
(12)	Our company encourages employees who come up with innovative concepts.	1	2	3	4	5	6
(13)	When the employees of our company develop new ideas, they always list the "estimated risk" as an important factor in their evaluation.	1	2	3	4	5	6
(14)	For employees who successfully put forward innovative projects, our company has a variety of additional reward methods for them to choose.	1	2	3	4	5	6

1 = totally disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = totally agree.

Table A3. Perceive the uncertainty of the external environment.

	Perceive the Uncertainty of the External Environment						
(1)	Intra-industry market turbulence.	1	2	3	4	5	6
(2)	The degree to which customer preferences often change.	1	2	3	4	5	6
(3)	The ability to reduce market uncertainty.	1	2	3	4	5	6
(4)	The ability to respond to market opportunities.	1	2	3	4	5	6
(5)	The degree of competition in our company's leading industry compared to competitors.	1	2	3	4	5	6
(6)	The degree of competitive intensity in our company's compared to competitors.	1	2	3	4	5	6
(7)	The degree of similarity between our company's products and competitors' products.	1	2	3	4	5	6

1 = totally disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = totally agree.

Table A4. Organizational performance.

	Organizational Performance						
(1)	Our company's return on assets (ROE) is higher than that of competitors.	1	2	3	4	5	6
(2)	Our company's earnings per share (EPS) is higher than that of competitors.	1	2	3	4	5	6
(3)	Our company's sales growth rate is higher than that of competitors.	1	2	3	4	5	6
(4)	Our company's market share is higher than that of its competitors.	1	2	3	4	5	6

1 = totally disagree, 2 = disagree, 3 = slightly disagree, 4 = slightly agree, 5 = agree, 6 = totally agree.

Table A5. Personal information.

	Personal Information
(1)	Gender: ☐Male ☐Female
(2)	Position: ☐Employer ☐Executive Manager ☐Mid-level Manager ☐Junior Manager; Employee
(3)	Age: ☐26–35 ☐36–45 ☐46–55 ☐Over 55
(4)	Seniority: ☐Less than 6 years ☐6–10 years ☐11–15 years ☐16–20 years ☐Over 20 years
(5)	Company:

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