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The Role of Technological Innovation in Start-Up Performance: The Case of Start-Up Firms in Ba Ria-Vung Tau Province

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Abstract:- This study examines the role of technological innovation in conducting business model innovation and improving start-up performance of 425 start-up firms in Ba Ria – Vung Tau province. The partial least squares structural equation modelling (PLS-SEM) has been applied in this study. The findings show that technological innovation positively influences new capabilities, new offerings, new markets, and contributes in increasing start-up performance. In addition, the components such as new capabilities, new offerings and new markets contribute in renewing revenue models, cost structures and have positive influences in start-up performance. Finally, the study proposes managerial implications for start-up firms, mentions limitations and suggests directions for further research.

Keywords:- *Technological Innovation; Business Model Innovation; Start-Up Performance.*

I. INTRODUCTION

Applying the theory of business model innovation for start-up firms is a recent topic attracting the attention of researchers (Trimi & Berbegal-Mirabent, 2012). Business model innovation (BMI) will create a competitive advantage, bringing firm performance (Aspara et al, 2010). BMI is closely related to the vision, creativity and judgment of businesses (Foss & Saebi, 2016). BMI will help start-up firms make the right decisions to increase the chances of success.

In Vietnam, the rate of successful starting business (less than 3.5 years) is 12.7% (GEM, 2016). The reason of failure is not to build the quality of the relationship with the partners and renew the business model (Nguyen Quang Thu et al, 2017). Foss & Saebi (2016) has synthesized researches on BMI in the period of 2000 - 2015 in order to propose the research direction to verify the relationship between BMI and start-up performance (innovation, cost reduction, financial effectiveness). Clauss (2016) has explored the components of BMI, the results show that BMI is a concept of third-level, consisting of 10 components (new capabilities, new technology, new partnerships, new processes, new offerings, new markets, new channels, new customer relationships, new revenue models and new cost structures). The study by Nguyen Quang Thu et al (2018) has inherited the components of BMI from Clauss (2016) to test the relationship between BMI and start-up performance of small and medium enterprises in Ba Ria - Vung Tau province. The results show that the components of BMI impact positively on start-up performance.

From the above analysis, there has been no study examining the relationship among the components of BMI. There are close relationships among the components of a business model. In the era of industrial revolution 4.0, technological innovation plays an important role in the innovation of capabilities, products/services, markets, revenue models, cost structures and helps improve start-up performance. Therefore, this research is conducted in this approach. The research objective is to consider the role of technological innovation in implementing BMI in order to improve start-up performance. This will help start-up firms in Vietnam reduce the risk of failure when starting business. This study has 2 new contributions:

- Testing the role of technological innovation in implementing BMI and its impact on start-up performances of start-up firms;
- Verifying the relationships among the components of BMI and their impacts on start-up performances.

Units of observation are owners of small and medium start-up firms in Ba Ria - Vung Tau province, excluding those operating in the financial sector. The article structure follows the introduction: (1) literature review, (2) research data and methodology, (3) Findings and discussion, and (4) conclusion and managerial implications.

II. LITERATURE REVIEW

A. Innovation Theory

Organization for Economic Cooperation and Development (2005) defined "an innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". According to OECD (2005), innovation has been classified into four categories:

- Product innovation: introducing new/significantly improved products/services in terms of characteristics, purpose, specification, components and materials, combined software, user-friendliness or other functional characteristics.
- Process innovation: implementing improved production or distribution methods.
- Marketing innovation: implementing new marketing methods related to significant changes in design, product packaging, promotion or product pricing.
- Organizational innovation: implementing new organizational methods in business practices, workplace organization or external relations of enterprises.

B. VARIM Theory

VARIM theory is used to assess the potential profitability of business models (Afuah, 2014) and evaluate the potential profit of BMI when business model changes. VARIM theory proposed following questions:

- *Value:* Does the business model benefit customers as they feel?
- *Adaptability:* Can the business model be restructured to bring the benefits that customers find valuable to them?
- *Rareness*: Is the business the only one providing benefits to customers? If not, is the business's level of benefit higher than its competitors'?
- *Inimitability*: Are the customer benefits difficult to be imitated and replaced by the competitors?
- *Monetization*: Does the business generate money from providing benefits to customers?

C. Research Concepts

- *Technological Innovation*:

focusing on the scientific and technological resources/equipment needed to conduct BMI (Clauss, 2016). Wei et al. (2014) demonstrated the development of technology in accordance with the successful business model. Enterprises need to have new technology to restructure the business model.

- *Business Model Innovation*:

BMI is to restructure the activities in the current business model of the enterprise to create product/service innovation, is a streamlined innovation method since resources and capacities are available and can be saved to a minimum (Santos et al, 2009). For businesses to grow sustainably, they need to renew the components of their business models (Carayannis et al., 2014). Clauss (2016) proposed BMI components including:

- *New Capabilities*: Enterprises need new capabilities to implement BMI to grasp opportunities arising from the external environment (Teece et al., 1997). New capacities are developed through training, learning, integrating knowledge, developing new ideas and learning from experience (Achtenhagen et al., 2013).

- *New Offerings:* Enterprises provide products/services to solve customer problems or meet their needs in new or better ways (Johnson et al., 2008). Products/services are innovated through R&D or using new technologies (Teece, 2010). New products/services are the most obvious changes in the business models of enterprises.

- *New Markets:* are groups of customers or market segments where businesses provide current or future products/services (Afuah, 2014). BMI is to redefine the current markets or penetrate new markets. Target customers/markets are determined by the question "Who is willing to pay for the products/services that the business provides?" (Baden-Fuller & Haefliger, 2013).

- *New Revenue Models*: customers pay for the value that businesses provide (Afuah, 2014). The questions relating to this issue are "When is revenue generated?", "For how long?", "Who is the revenue-generating party?" (Baden-Fuller & Haefliger, 2013).

- *New Cost Structures*: are direct and indirect costs relating to business operations of enterprises (Casadesus-Masanell & Ricart, 2010). The established cost structure will determine the scope of the products/services strategy and its relevance to the market strategy (Zott & Amit, 2008). The cost structure in the business model will be influenced by the business strategy.

- *Start-up performance:*

Littunen et al. (1998) believe that start-up performance is the existence/survival over the first 3 years since starting the business of start-up firms. The continuation of business is a sign of the success of start-up performance. The maintenance of operations in the first years is very important for start-up firms to conduct long-term stable business. Based on VARIM theory, GEM's perspective (2016), the study of Littunen et al (1998), the study of Nguyen Dinh Tho & Nguyen Thi Mai Trang (2009), the startup performance is considered as the existence of start-up firms in the starting stage (less than 3.5 years), stable operation, goals achievement (revenue, profit and market share as desired) and potential future development.

D. Research Model and Hypotheses

BMI is implemented in order to reducing costs, introducing new products, accessing new markets and improving financial efficiency (Foss & Saebi, 2016). Based on the BMI components of Pedersen et al (2016), the results of the synthesis and proposed research on BMI of Foss and Saebi (2016), Nguyen Quang Thu et al. (2018) showed that innovation of business model components will contribute to improving firm performance. The research model is proposed specifically in Figure 1.

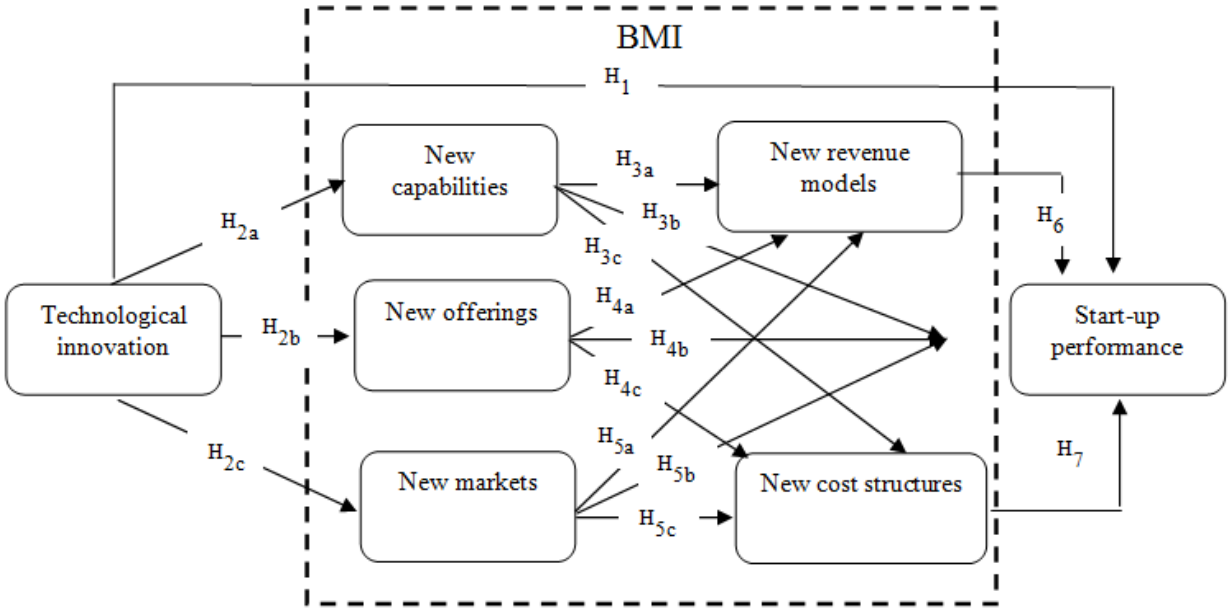

Fig 1:- The Proposed Research Model

Reichert & Zawislak (2014) demonstrated a positive relationship between technological capacity and firm performance of 133 businesses in Brazil. Technological innovation will positively affect firm performance. Hypothesis H1 is proposed:

- *H1: Technological innovation positively affects start-up performance of start-up firms.*

Technological innovations include innovating products/services, organizing in new processes or changing the methods of producing and distributing products to customers (Avermaete et al., 2003). When firms update and improve technology, they are able to develop new products. At that time, firms need to equip their employees with new capabilities to meet the changes in technology and external environment. Moreover, firms need to look for new customer segments and markets for their new products (Clauss, 2016). Hypotheses H2a, H2b and H2c are proposed:

- *H2a: Technological innovation positively affects new capabilities of start-up firms.*
- *H2b: Technological innovation positively affects new offerings of start-up firms.*
- *H2c: Technological innovation positively affects new markets of start-up firms.*

New capabilities will help firms develop new markets' revenue and capture opportunities to save production costs as well as adjust costs according to appropriate market prices (Clauss, 2016). Alam & Associates (2013) demonstrated a positive relationship between innovation in capabilities and firm performance of Malaysian manufacturing enterprises. Hypotheses H3a, H3b and H3c are stated:

- *H3a: New capabilities positively affect new revenue models of start-up firms.*
- *H3b: New capabilities positively affect start-up performance of start-up firms.*
- *H3c: New capabilities positively affect new cost structures of start-up firms.*

Firms produce new products/services to meet customers' needs, generate revenue and contribute to improving firm performance (Clauss, 2016). Atalay et al. (2013) demonstrated a positive relationship between product innovation and firm performance of the automobile industry in Turkey. Moreover, firms renew products in order to save costs and increase their competitive advantages in the market. Hypotheses H4a, H4b and H4c are stated:

- *H4a: New offerings positively affect new revenue models of start-up firms.*
- *H4b: New offerings positively affect start-up performance of start-up firms.*
- *H4c: New offerings positively affect new cost structures of start-up firms.*

Market innovation focuses on developing the target market and determining how to best serve customers in the target market and generate revenue (Shirokova & Socolova, 2013). Market innovation helps firms achieve potential market share and expected revenue growth. In addition, firms develop new markets to seize many more opportunities and consider appropriate pricing strategies in each market (Clauss, 2016). Hypotheses H5a, H5b and H5c are stated:

- *H5a: New markets positively affect new revenue models of start-up firms.*
- *H5b: New markets positively affect start-up performance of start-up firms.*
- *H5c: New markets positively affect new cost structures of start-up firms.*

Customers are those who bring in business revenue for firms. Innovating revenue models will create opportunities for new revenue growth and long-term profitability (Clauss, 2016). New revenue models will help firms achieve the expected revenue and profit growth. Hypothesis H6 is stated:

- *H6: New revenue models positively affect start-up performance of start-up firms.*

In the starting phase, start-up firms have incurred many costs of initial investments and fixed investments. The cost structure determines the performance. Innovating cost structures determines types of costs associated with the operation of firms at the lowest level. Hypothesis H7 is stated:

- *H7: New cost structures positively affect start-up performance of start-up firms.*

III. DATA AND RESEARCH METHODOLOGY

A. Research Sample and Data

This study uses direct interview and emails with a detailed questionnaire consisting 5-level Liker scale (from "1": "completely disagree" to "5": "totally agree"). Subjects of the survey are owners of start-up firms in Ba Ria - Vung Tau province. Interview time is August 2017.

The research sample is selected by convenient method. According to the statistics of Ba Ria - Vung Tau Department of Planning and Investment (2017), the number of start-up firms established from 2014 to August 2017 is 4470. The number of questionnaire sent is 459, and 431 questionnaires are collected. There are 6 invalid questionnaires, so the official sample is 425.

Characteristics of the sample according to the type of activity (private enterprise, limited liability company and corporation), field of operation and labor scale are presented in Table 1.

Characteristics		Frequency	%
Type of activity	Private enterprise	20	4,7
	Limited liability company	343	80,7
	Joint stock company	62	14,6
	Others	0	0,0
Field of operation	Agriculture, forestry and fisheries	71	17
	Mining	25	6
	Manufacturing and processing industry	329	77
Labor scale	< 10	306	72
	10-30	79	19
	30-50	11	3
	> 50	29	7

Table 1:- Characteristics of the Sample

B. Scales

The scales in the research model are developed based on the original scales of researches in the world and need to be adjusted to suit the research context after the qualitative research phase. The research model has 7 research concepts with 25 observed variables presented in Table 2.

Research concepts	No. of observation	Source
TEC	3	Clauss (2016)
CAP	3	Clauss (2016)
OFF	3	Cooper and Kleinschmidt (1987), Clauss (2016)
MARK	3	Jansen et al. (2006), Clauss (2016)
REV	4	Osterwalder and Pigneur (2010), Clauss (2016)
COST	4	Osterwalder and Pigneur (2010), Clauss (2016)
STARTPERF	5	Pirolo and Presutti (2010), Nguyen Dinh Tho and Nguyen Thi Mai Trang (2009), qualitative results

Table 2:- Scales and Sources

C. Research Methodology

Research methodology includes two stages: (1) preliminary research; and (2) formal research.

➢ *Preliminary qualitative research*:

used to adjust observed variables in measuring research concepts. The author performs through group discussion techniques so that the scales are understood clearly and uniformly about the concepts. Group discussions are conducted with 5 experts including 2 scientists and 3 owners of start-up firms with successful business models. The scales in the research model is adjusted to suit the start-up firms in Ba Ria - Vung Tau province. Interview results were recorded, developed and adjusted to draft scale.

➢ *Quantitative preliminary research*:

Draft scale is used to interview in the sample of 101 start-up firms according to convenient sampling method to test the reliability of the scale. After this step, the scale is completed and used for the official quantitative research step.

➢ *Official research:*

conducted by quantitative research method with the official sample of 425. This step is conducted to test the model and research hypotheses by the partial least squares linear structure model (PLS-SEM).

IV. FINDINGS AND DISCUSSION

A. Scale Evaluation

The results show that the load factor of all observed variables is over 0.5 (minimum 0.66), so the scales used in the research model reach convergent values. In addition, the results show that the scales meet the requirements for CR ≥ 0,804 and AVE ≥ 0,570.

	M	**SD**	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
CAP (1)	2,95	0,86	**0,797**						
COST (2)	2,86	0,89	0,343	**0,809**					
MARK (3)	2,72	0,76	0,263	0,279	**0,760**				
OFF (4)	2,53	0,81	0,321	0,352	0,341	**0,782**			
REV (5)	2,74	0,84	0,312	0,543	0,263	0,324	**0,802**		
STARTPERF (5)	3,47	0,89	0,600	0,691	0,510	0,594	0,609	**0,755**	
TEC (6)	3,47	0,89	0,323	0,422	0,397	0,525	0,421	0,666	**0,783**

Table 3:- Correlation between Concepts

The results in Table 3 show that the smallest square root of AVE is 0.755, greater than the maximum value of the correlation between the concept pairs (0.691), so the research concepts have differentiated values.

	Critical model	Estimated model
SRMR	0,049	0,096
d_ULS	0,724	2,742
d_G	0,364	0,408
Chi-Square	948,215	971,108
NFI	0.827	0.823

Table 4:- The Relevance of Model with Market Data

Henseler et al. (2016) suggested that to measure the relevance of the model with market data (Goodness of Fit, GOF), the difference in the correlation between the actual data and the predictive model part (Standardized Root Mean Square Residual - SRMR) <0.08 (0.12 is still acceptable in case of discovery research). Therefore, Table 4 shows that the GOF index reaches the permitted level.

B. Research Hypotheses Testing

Relation	Estimation		se	t	VIF	P
	β	β (Bootstrap)				
TEC -> STARTPERF	0,212	0,212	0,034	6,266	1,435	0,000
TEC -> OFF	0,436	0,438	0,04	10,793	1,000	0,000
TEC -> MARK	0,324	0,327	0,044	7,340	1,000	0,000
TEC -> CAP	0,27	0,272	0,051	5,335	1,000	0,000
REV -> STARTPERF	0,178	0,178	0,034	5,179	1,389	0,000
OFF -> STARTPERF	0,172	0,173	0,034	5,135	1,325	0,000
OFF -> REV	0,191	0,192	0,049	3,912	1,141	0,000
OFF -> COST	0,204	0,204	0,048	4,280	1,141	0,000
MARK -> STARTPERF	0,153	0,153	0,029	5,212	1,176	0,000
MARK -> REV	0,127	0,128	0,048	2,631	1,111	0,009
MARK -> COST	0,129	0,13	0,049	2,615	1,111	0,009
COST -> STARTPERF	0,277	0,277	0,036	7,797	1,407	0,000
CAP -> STARTPERF	0,249	0,248	0,033	7,609	1,179	0,000
CAP -> REV	0,191	0,191	0,046	4,155	1,104	0,000
CAP -> COST	0,208	0,209	0,049	4,234	1,104	0,000
R^2 adjust	R^2_{CAP} = 0,071; R^2_{OFF} = 0,188; R^2_{MARK} = 0,103; R^2_{REV} = 0,126; R^2_{COST} = 0,145; $R^2_{STARTPERF}$ = 0,656					
Impact scale f^2	$f^2_{TEC->CAP}$ = 0,079; $f^2_{TEC->MARK}$ = 0,118; $f^2_{TEC->OFF}$ = 0,235; $f^2_{TEC->STARTPERF}$ = 0,093; $f^2_{CAP->COST}$ = 0,046; $f^2_{CAP->REV}$ = 0,038; $f^2_{CAP->STARTPERF}$ = 0,115; $f^2_{COST->STARTPERF}$ = 0,161; $f^2_{MARK->COST}$ = 0,018; $f^2_{MARK->REV}$ = 0,017; $f^2_{MARK->STARTPERF}$ = 0,058; $f^2_{OFF->COST}$ = 0,043; $f^2_{OFF->REV}$ = 0,037; $f^2_{OFF->STARTPERF}$ = 0,058; $f^2_{REV->STARTPERF}$ = 0,068					

Table 5:- Results of Model Estimation

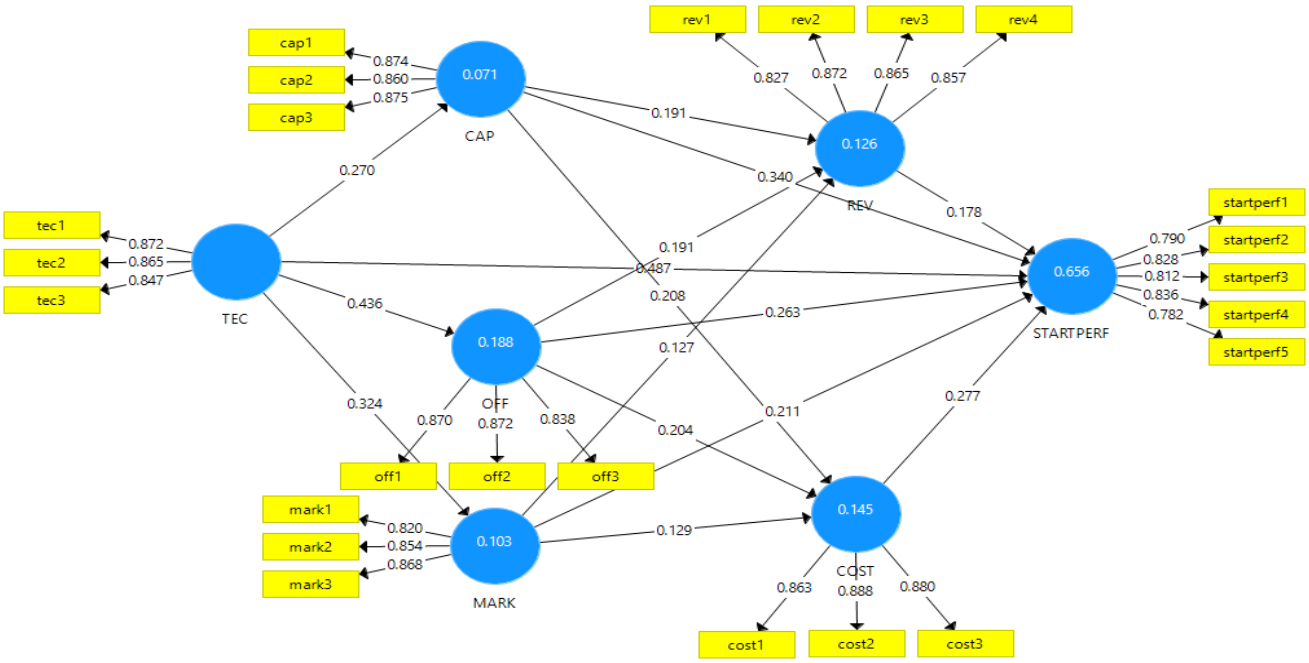

Fig 2:- Estimated Model PLS-SEM

Bootstrap test results with a sample of 5000 with different path coefficients are differ from 0. Research results show that the hypotheses are accepted (p-value <5%). The explanation of technological innovation and BMI components to start-up performance is 65.5%; which is considered significant, and the magnitude of the impact between the research concepts is small and medium (less than 0.02 and 0.35) (Hair et al., 2017). Finally, the VIF is <5, therefore, the estimation model does not multicollinearity (Henseler et al., 2016).

Dependent variable	Type of impact	Technological innovation	New capabilities	New offerings	New markets	New cost structures	New revenue models
New capabilities	Direct	0,272					
	Indirect	0,000					
	Total	**0,272**					
New offerings	Direct	0,438					
	Indirect	0,000					
	Total	**0,438**					
New markets	Direct	0,327					
	Indirect	0,000					
	Total	**0,327**					
New cost structures	Direct	0,000	0,209	0,204	0,130		
	Indirect	0,190	0,000	0,000	0,000		
	Total	**0,190**	**0,209**	**0,204**	**0,130**		
New revenue models	Direct	0,000	0,191	0,192	0,128		
	Indirect	0,180	0,000	0,000	0,000		
	Total	**0,180**	**0,191**	**0,192**	**0,128**		
Start-up performance	Direct	0,212	0,248	0,173	0,153	0,277	0,178
	Indirect	0,278	0,092	0,091	0,059	0,000	0,000
	Total	**0,490**	**0,340**	**0,264**	**0,212**	**0,277**	**0,178**

Table 6:- The Degree of Impact between Research Concepts

Technological innovation has the largest positive impact on start-up performance (βtotal = 0.49). Followings are new capabilities (βtotal = 0.34), new cost structures (β direct = 0.277), new offerings (βtotal = 0.264), new markets (βtotal = 0.212) and finally new revenue models (β direct = 0.178) having positive impacts on start-up performance.

C. Discussion

The research model proposed has 7 unidirectional research concepts: technological innovation, new capabilities, new offerings, new markets, new revenue models, new cost structures and start-up performance. The scale has 25 observed variables, the results of the measurement model show that the scale value achieves reliability (Cronbach's Alpha coefficient, general reliability) and permitted values (extract variance, value convergence and discrimination).

The research results have added to the theoretical framework the positive relationships among BMI components and the positive impact on the start-up performance. Research results are consistent with previous studies. For example, in the study of Nguyen Quang Thu et al (2018), the components of BMI impact positively on start-up performance. Moreover, the relationship among the components of BMI has not been tested in previous studies and the research results have answered the research problem of Foss & Saebi (2016) between BMI and business performance. In addition, the research results have confirmed the role of technological innovation in implementing BMI and contributing to increase start-up performance.

V. CONCLUSION AND MANAGERIAL IMPLICATIONS

A. Conclusion

This study examined the BMI components and start-up performances of start-up firms in Ba Ria - Vung Tau province. The research results show that technological innovation plays an important role in implementing BMI and contributing to increased start-up performances. Therefore, 15 research hypotheses are accepted.

B. Managerial Implications

Start-up firms need to focus on technological innovation to implement BMI and improve start-up performances. Some specific administrative implications are proposed:

- *Firstly, Start-Up Firms Need to Focus on Innovating Technology to Meet the Changing Environment:*

Start-up firms need to update technology resources; improved technical equipment compared to competitors and used new technological potentials to expand the product/service portfolio. Start-up firms proactively enhance management, technical and production technology investment capacity according to international standards to adapt to the industrial revolution 4.0.

➢ *Secondly, Start-Up Firms Need to Implement Renovation Some Components of Business Model:*

- *Capability Innovation*: start-up firms need to facilitate employees to be trained to gain knowledge, ability to update and develop new capacities, to consider new capabilities to adapt to changing market requirements.

- *Market Innovation*: start-up firms need to capture opportunities arising in new or developing markets, paying attention to market segments and finding customers for new products/services.

- *Cost Structure Innovation*: start-up firms consider pricing strategies, actively seek opportunities to save production costs, regularly check and adjust production costs to be more efficient.

- *Revenue Model Innovation:* start-up firms develop new revenue opportunities, provides more integrated services to receive long-term profit, supplement or replace one-time transaction revenue with fixed and long-term revenue model (e.g. leasing contract).

➢ *Limitations and Directions for Further Research*

This study was conducted in Ba Ria - Vung Tau province, so the representative is not high. Therefore, in order to improve representative, the further research needs to be investigated (repeated) in many other provinces/cities such as Ho Chi Minh City, Dong Nai, Binh Duong, and Can Tho where there are many start-up firms.

This study surveyed start-up firms in many different industries, so it is not possible to see the different characteristics and requirements of each industry. For better testing results, it is necessary to study a specific industry to see the role of technological innovation in conducting BMI and improving start-up performance.

There are also other factors that affect start-up performance such as quality of relationships with strategic partners, local start-up support organizations. These are issues raised for further researches in the future.

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