

A study on the effect of start-up companies' technological commercialization capabilities on the commercialization performance- Focusing on the moderating effect of transformational leadership

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Abstract

Background/Objectives: This study analyzes how the capabilities of technology commercialization and CEO's transformational leadership of start-ups plays a role in promoting the commercialization performance under uncertain and urgent circumstances.

Methods/Statistical analysis: Total 194 questionnaires were surveyed on venture companies belonging to the Korea Venture Business Association and start-up companies supported by start-up support groups of major universities. Among them, 143 valid questionnaires were analyzed, excluding 51 questionnaires beyond the requirements of start-ups. The statistical analysis was conducted using descriptive statistical analysis, exploratory factor analysis, reliability verification, correlation analysis, and multiple regression analysis using SPSS 22.0.

Findings: In terms of technological commercialization capability, marketing capability and technology development capability had a significant positive effect on commercialization performance, whereas manufacturing production capability and productization capability did not have a significant effect. When looking at the impact on commercialization performance, it was found that marketing capability had more influence than technology development capability. Also, it was found that transformational leadership (charisma, intellectual stimulation, individual consideration) mainly moderates the relationship between technology development capability and commercialization performance among technological commercialization capabilities. In the factors of transformational leadership, it was analyzed that the relationship between technology development ability and commercialization performance was shown to have a moderating effect in the order of charisma, intellectual stimulation, and individual consideration.

To successfully lead the technology commercialization of start-up companies, among technological commercialization capabilities, marketing capability and technology development capability are becoming more important to better understand customer needs and grow in a rapidly changing business environment amid the acceleration of the 4th industrial revolution.

Improvements/Applications: In a situation where the importance of technology is increasing, there is a growing need for the transformational leadership, which has a significant moderating effect on technology development capability.

Keywords: start-up companies, technological commercialization capabilities, technology development capability, transformational leadership, and commercialization performance

1. Introduction

The current business environment is facing major changes not only in the industrial structure but also in the socio-economic system with the wave of the fourth industrial revolution, and uncertainty has deepened more than ever, making it a time when rapid response is needed[1]. Moreover, as the paradigm of economic development shifts from industrial economy to knowledge-based economy, and the rapid spread of the COVID-19 crisis has accelerated the change, how quickly it responds to and transforms these changes has become the core of survival and growth.

In response, the current government of South Korea has already proposed "Start-up and Innovation Growth led by Small and Medium Ventures" as one of its state management strategies when it announced a "five-year plan for state administration" in July 2017. To effectively respond to changes in the paradigm of industrial structure following the acceleration of the fourth industrial revolution and increase the likelihood of success, we cannot help but put our expectations on technology-based start-up companies.

However, there are positive factors in terms of the share and contribution of small and medium-sized enterprises, including start-ups, it is a task to overcome the lack of excellent human resources and management systems because of the nature of small and medium-sized enterprises. Companies can only continue in the market by creating products and services that meet their customer needs through continuous technology development (R&D) and technology commercialization in a rapidly growing market environment such as the increasingly diversified and subdivided customer needs, shorter product life cycles, new product launches of innovative new technologies, and global competition.

In general, the success of technology commercialization varies depending on the growth stage of individual companies, the life cycle of the developed technology, and the intensity of competition. From the perspective of human resource development and competency development, it is necessary to review the frame for modeling the capabilities of top managements that dynamically act on technology commercialization, and to establish change-oriented goals such as the introduction or transfer of new technology or development of own technology. Transformational leadership will be urgently required as a common competency that must be possessed by companies subject to technology business.

This study analyzes how the capabilities of technology commercialization, which are important internal competencies in promoting technology commercialization of start-ups, reflecting the recent economic and policy situation, affects the commercialization performance, and how CEO's transformational leadership plays a role in promoting the technology commercialization and producing results under uncertain and urgent circumstances.

According to Article 2, Paragraph 1 "Definitions" of the Support for Start-ups of Small and Medium Enterprises Act, "Start-up refers to the establishment of a new small and medium enterprise. In this case, the scope of start-up is determined by Presidential Decree." According to Paragraph 2, "founder refers to a person who starts a small and medium-sized business and a person whose business has not passed 7 years since the start of business. Thus, it can be said that a start-up company is a company that has not passed 7 years since starting a small business.

Regarding the general status of start-up companies in Korea, the "2019 Start-up Companies Survey Report" by the Korea Institute of Startup & Entrepreneurship Development (2020) revealed that 88.0% of individual entrepreneurs and 12.0% of corporate entrepreneurs were found to be companies. As for the distribution of companies by business period, individual business owners were very high in the first to seventh years, and it was

found that the level of individual businesses maintained around 88%, and corporate businesses maintained around 12%.

However, manufacturing start-ups accounted for 68.9% of individual businesses and 31.1% of corporate businesses, about three times higher than other industries. Among the companies that started their businesses, the proportion of manufacturing companies is around 9.0 percent and that of non-manufacturing industries is around 91.0 percent as shown in Table 1.

Table 1. Business Period and Business Type of start-up companies

		Total (unit: N, %)		Individual	Corporate
Total		1,747,791	100.0	88.0	12.0
Business Period	1 yr	409,313	23.4	89.4	10.6
	2 yrs	369,751	21.2	88.4	11.6
	3 yrs	276,108	15.8	88.0	12.0
	4 yrs	220,662	12.6	87.8	12.2
	5 yrs	177,230	10.1	87.3	12.7
	6 yrs	155,095	8.9	85.6	14.4
	7 yrs	139,632	8.0	86.9	13.1
Business Type	Manufacturing	157,012	9.0	68.9	31.1
	Non-manufactg.	1,590,779	91.0	89.9	10.1

In a time of confusion in which the economic hegemony issue between countries increases and the movement of manpower and goods between countries is limited due to the COVID-19 outbreak, it will be of utmost importance to secure differentiated competitiveness that can dominate on the stage in which the international economy is experiencing rapid changes and fierce competition to continuously develop and create wealth. For this, R&D activities to develop excellent technologies are also important, but efforts to make the acquired technologies lead to practical economic results must also be strengthened. Through innovative technology development and commercialization, it is necessary to successfully enter the market by developing and providing products or services that can satisfy the new demands of changing customers, and to create high profits by expanding the market through continuous customer satisfaction.

For a company to provide products and services to the market and realize profits through technology commercialization, the proportion of R&D investment and the orientation of technology commercialization must complement each other. And the value of the company's technology assets is more affected by the orientation of technology commercialization than the investment for R&D[2,3].

According to Article 2 of the Act on Promotion of Technology Transfer and Commercialization, the definition of technology commercialization is defined as "using technology to develop, produce, or sell products, or to improve related technologies in the process". The Ministry of Commerce, Industry and Energy (2004) refers to technology commercialization as "a process in which a company produces product services using technology developed from

internal or external technology supply sources and generates profits by selling products and services produced in the market”, and the US Department of Commerce (2003) defines it as “the process of converting developed and transferred technologies into commercially successful products”.

A company's technology commercialization capability is defined as the ability to acquire and integrate technologies necessary to improve existing products or create new products, bring products to market quickly, and apply their technologies to various markets[4]. A study conducted on Chinese manufacturers suggested that there is a significant causal relationship between technological innovation capabilities and corporate business performance. Among the resources owned by companies, seven were strategic planning capability, research and development capability, resource allocation capability, organizational capability, production capability, and marketing capability[5].

Technology commercialization capability can be said to be the ability to develop or improve technology to perform various activities such as production and marketing that utilize technology. In the preceding research, mainly the factors of technology commercialization capability consist of manufacturing production capability, marketing capability, and productization capability, and in this study, as a broad concept, it is analyzed including technology development (R&D) capability, which is an essential factor for achieving continuous growth and development of a company.

Based on what many researchers have explained, the manufacturing production capacity of technology commercialization capacity is defined as the ability that the company has production facilities suitable for internal and external environmental changes and efficiently apply or improve existing production techniques within the scope of its original use and design.

Marketing capability is defined as the ability to figure out what customers want, how much and how large it is, to segment target markets before entering the market, to set up strategies for providing and selling products or services, and to execute them. This can contribute to strengthening the company's continuous competitiveness by collecting and delivering various information about customers and markets, also utilizing it.

Productization capability is a product development ability that can be put on the technology market before starting to produce or sell a product or service by applying technology. It can be said that it is a series of processes that apply and commercialize related technologies to processes and products to successfully enter the market.

Technology development capability refers to “the ability required for IT small and medium-sized venture companies to acquire, use, and execute technology or knowledge in order to develop innovative products”, and this requires manpower and development costs (R&D function) directly invested in R&D. To reinforce R&D activities, a learning function that can search, absorb, and embody technology and knowledge from outside is required, and it can be seen as important that an external networking function that promotes active technical cooperation with the outside world[6]. R&D capability can be described as a dynamic capability that includes knowledge creation and utilization that can strengthen a company's competence to maintain and acquire an organization's competitive advantage[7].

Leadership is defined as a process that affects all actions of individuals or groups to achieve a goal in given situation[8], and it is the process of transforming an organization into a new organizational form having a greater potential, by inducing the voluntary commitment of followers and energizing them through the presentation of a vision, and innovating organization[9]. In addition, leadership is defined as an influence process while presenting diversity in leadership research as a process that affects a member of a group or organization can interpret events,

select goals or strategies, organize work activities, motivate members to achieve goals, maintain cooperative relationships, develop skills and confidence of members, and secure support and cooperation of outsiders, etc.[10].

Transformational leadership theory emerged as a rebellion against traditional leadership that presupposes a stable environment. Transformative leadership is a more effective leadership concept in a system of challenging and high uncertainty, enabling members to activate higher-level desires and realizing their potential to achieve higher-than-expected performance[11,12]. This transformational leadership continued to evolve and was organized into four factors[13].

The first factor is the ideal influence, and it is related to the charisma that the subordinates follow the vision presented by the leader, and this is due to the high morality of the leader. Charisma is the most important factor in transformational leadership, and it allows subordinates to become engrossed in the duties assigned through charisma, inspire loyalty to the organization, earn respect from subordinates, and understand what is important to the organization. As a result, you can feel the mission of the organization, and the charismatic leader becomes a target of admiration and is regarded as a role model, so that the members become one with the vision established by the leader and the common purpose and mission[14].

The second factor is inspired motivation, which is the type of leadership that encourages and compliments the subordinates and constantly inspires them to realize a shared vision. Encouragement refers to the ability to set goals to be reached, to make members feel confident that they can achieve them, and to keep employees motivated. Leaders with the ability of inspired motivation, empower members of the organization with a passion for the future and give them the energy to develop toward the goals they need to reach. This inspired motivation is one of the sub-factors of charismatic behavior, and it is categorized as a leader's behavioral characteristics that energize or inspire members in the emotional aspect. It is said that inspirational motivation can occur even in the absence of charismatic leadership, which is not an emotional or intellectual basis, and is defined as appealing to senses and intuition. In this paper, the inspirational motivation that leads to a passionate and voluntary appearance in achieving the goal is integrated with the ideal influence to be included in the concept of charismatic leadership.

The third factor is intellectual stimulation, which is a leadership style that encourages members to recognize and solve problems in a new way, away from the practices or customs they have been doing[15]. Members voluntarily identify organizational problems and find innovative ways to solve them or come up with solutions. Leaders who have become accustomed to the traditional method have a strong consciousness to stick to the old method and practice it, but transformational leaders are forced to re-examine the validity of the one-sided method while breaking the stereotype in a new way. By doing so, the organization creates encouraging results, and when promoting technology commercialization, this intellectual stimulation leadership quickly dispels the internal resistance to the emergence of new technologies, allowing the members of the organization to maintain a creative and innovative attitude to perform their duties.

The fourth factor is individual consideration, which refers to an attempt by the CEO to understand and share the needs of members of an organization to satisfy individual needs and to maximize potential development by pursuing effective organizational goals. Individual consideration factors are largely composed of two factors. First, it is the consideration shown by the leader treating members equally with himself and making decisions based on agreement with them. Second, it is a factor that contributes to productivity improvement through the improvement of satisfaction with the leader and the self-efficacy of subordinates in the relationship between the leader and members.

Various measurement indicators are used to measure the commercialization performance of a start-up company. In addition to basic financial performance, there are customer satisfaction, quality level, and new product launches, etc. This study aims to analyze the commercialization performance by mixing financial performance and non-financial performance as an index that measures the performance of a start-up company's business.

2. Materials and Methods

2.1. Research Model

In this research, we analyze how the technological commercialization capability, an important internal competency when promoting technology commercialization, affects the performance of commercialization, and analyze how the moderating effect of the transformational leadership of the CEO affects in the relationship between technological commercialization capabilities and commercialization performance. To do this, we set up a research model as shown in Figure 1 below and analyze it empirically.

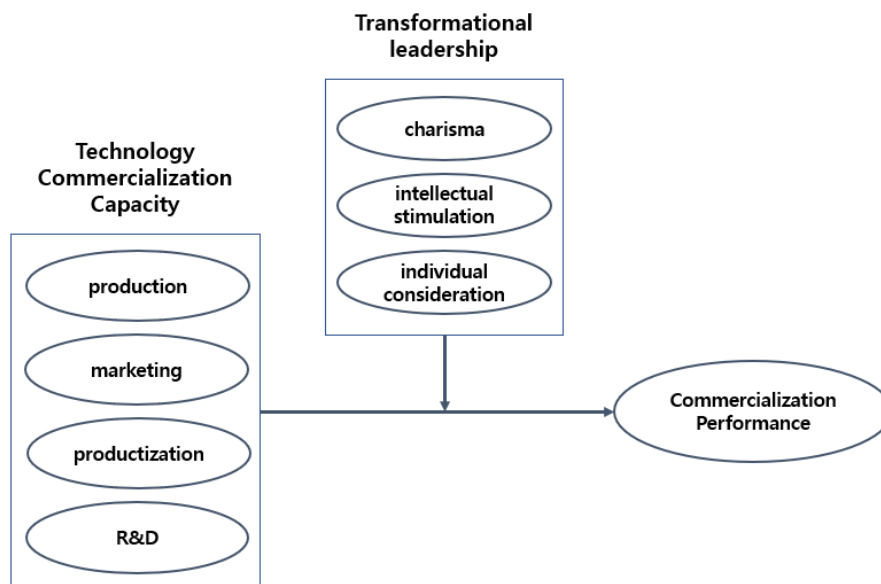


Figure 1. Research Model

2.2. Materials

The survey was conducted on venture companies affiliated with the Korea Venture Business Association and startup companies supported by start-up support groups of major universities, which are highly related to technology commercialization as it focuses on innovative technology projects. A total of 194 questionnaires were collected online, and 143 of them were used as analysis materials for this study, excluding a total of 51 such as questionnaires of companies that have passed 7 years due to the requirements of start-up companies and questionnaires that were answered unfaithfully.

2.3. Methods

In this study, we collected data using survey methods, and used the SPSS 22.0 statistical program for analysis of each factor and validation of the research model and hypothesis.

First, frequency analysis was carried out to identify the composition and demographic characteristics of

survey respondents, and descriptive statistical analysis was conducted to test the normality of data.

Second, we conducted an exploratory factor analysis for feasibility analysis to determine whether each variable in this study is a tool faithful to the concept under the research model, and an analysis using Cronbach's α to verify the reliability of the variables.

Third, the correlation analysis between the constituent factors used in this study was conducted to verify the relevance of each factor.

Fourth, multiple regression analysis was conducted to verify the hypothesis, analyzing the impact of a start-up's technology commercialization capabilities on commercialization performance, and verifying whether the CEO's transformational leadership had a moderating effect in the relationship between technology commercialization capabilities and commercialization performance.

3. Results and Discussion

Multiple regression analysis was conducted to verify the hypothesis (H1) that technological commercialization competency will have a significant positive effect on commercialization performance. The results of regression analysis for the sub-factors of the independent variable, technological commercialization capability, such as manufacturing production capability, marketing capability, productization capability, and technology development capability, and the dependent variable, commercialization performance are shown in Table 2.

Table 2. Multiple regression results of hypothesis H1

	<i>B</i>	<i>SE</i>	β	<i>t</i>	<i>P</i>	<i>VIF</i>
constant	.566	.338		1.677	.096	
production	.130	.100	.099	1.299	.196	1.526
marketing	.409	.077	.386	5.330	.000	1.383
productization	.079	.070	.093	1.138	.257	1.753
R&D	.260	.075	.292	3.461	.001	1.887
<i>adjR</i> ² = .463, <i>F</i> = 31.585 ^{***} (<i>p</i> < .001)						

Durbin-Watson's *d* = 2.398

* *P* < .05 ** *p* < .01 *** *p* < .001

As a result of conducting multiple regression analysis, it was found that marketing capability and technology development capability had significant probabilities of .000 and .001, which had a significant effect on commercialization performance, whereas manufacturing production capability and productization capability did not have a significant effect. The explanatory power of these variables to describe the commercialization performance, which is a dependent variable, was 46.3%, and among independent variables, marketing capability ($\beta=.386$) had more influence on the commercialization performance, which is a dependent variable than the technology development capability ($\beta=.292$).

Next, multiple regression analysis was also conducted to verify the hypothesis (H2) that transformational leadership (charisma, intellectual stimulation, individual consideration) will moderate the relationship between technological commercialization capabilities (manufacturing production capacity, marketing capacity,

productization capacity, technology development capacity) and commercialization performance.

First, the results of regression analysis to verify the hypothesis (H2-1) that charisma will moderate the relationship between technology commercialization capabilities (manufacturing production capability, marketing capability, productization capability, technology development capability) and commercialization performance are shown in Table 3.

Table 3. Hypothesis H2-1 analysis of the moderating effect of charisma

	Step1			Step2			Step3		
	B	β		B	β		B	β	
constant	3.937			3.937			3.944		
productionC	.130	.099		.101	.076		.084	.064	
marketingC	.409	.386	***	.416	.392	***	.595	.561	***
productizationC	.079	.093		.067	.079		.018	.021	
R&D_C	.260	.292	***	.137	.154		.122	.137	
charismaC				.241	.227	**	.223	.210	*
productionC.charismaC							-.243	-.101	
marketingC.charismaC							-.409	-.227	*
productizationC.charismaC							-.201	-.180	*
R&D_C.charismaC							.365	.378	***
$R^2 (\Delta R^2)$.478		.505	(.027)		.571	(.066)	
F		31.583	***	27.910	***		19.673	***	

* $p < .05$ ** $p < .01$ *** $p < .001$

To prevent the occurrence of multicollinearity, a three-stage hierarchical regression analysis was performed to test the moderation effect with newly created variables using the mean-centering calculation for the values of the independent variable and the moderating variable. As a result of the analysis, charisma was analyzed to show a significant moderating effect in the relationship between technology development capability and commercialization performance.

The results of regression analysis to verify the hypothesis (H2-2) that intellectual stimulation will moderate the relationship between technology commercialization capabilities (manufacturing production capability, marketing capability, productization capability, technology development capability) and commercialization performance are shown in Table 4.

Table 4. Hypothesis H2-2 analysis of the moderating effect of intellectual stimulation

	Step1			Step2			Step3		
	B	β		B	β		B	β	
constant	3.937			3.937			3.924		
productionC	.130	.099		.143	.108		.041	.031	
marketingC	.409	.386	***	.412	.388	***	.526	.496	***
productizationC	.079	.093		.083	.097		.042	.049	

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R&D_C	.260	.292 ***	.285	.320 ***	.405	.455 ***
IS_C			-.054	-.057	-.093	-.098
productionC.IS_C					-.282	-.128 *
marketingC.IS_C					-.037	-.028
productizationC.IS_C					-.131	-.112
R&D_C.IS_C					.301	.300 ***
$R^2 (\Delta R^2)$.478		.480 (.002)		.547 (.068)
F		31.583 ***		25.263 ***		17.879 ***

* $p < .05$ ** $p < .01$ *** $p < .001$

According to the result of the analysis, it was found that intellectual stimulation had a significant moderating effect in the relationship between technology development capability and commercialization performance.

The results of regression analysis to verify the hypothesis (H2-3) that individual consideration will moderate the relationship between technology commercialization capabilities (manufacturing production capability, marketing capability, productization capability, technology development capability) and commercialization performance are shown in Table 5.

Table 5. Hypothesis H2-3 analysis of the moderating effect of individual consideration

	Step1		Step2		Step3	
	B	β	B	β	B	β
constant	3.937		3.937		3.935	
productionC	.130	.099	.149	.113	.161	.122 *
marketingC	.409	.386 ***	.381	.360 ***	.508	.479 ***
productizationC	.079	.093	.071	.083	.026	.031
R&D_C	.260	.292 ***	.187	.210 *	.156	.175 *
IC_C			.197	.201 **	.141	.144 *
productionC.IC_C					-.050	-.022
marketingC.IC_C					-.268	-.203 *
productizationC.IC_C					.021	.017
R&D_C.IC_C					.146	.139 *
$R^2 (\Delta R^2)$.478		.509 (.031)		.539 (.030)
F		31.583 ***		28.441 ***		17.312 ***

* $p < .05$ ** $p < .01$ *** $p < .001$

As a result of the analysis, it was found that individual consideration had a significant moderating effect in the relationship between technology development capability and commercialization performance.

In the end, it was found that transformational leadership (charisma, intellectual stimulation, individual consideration) mainly moderates the relationship between technology development capability and commercialization performance among technological commercialization capabilities. The factors of transformational leadership were analyzed to show the moderating effect in the relationship between technology development capability and commercialization performance in the order of charisma ($\beta=.387$), intellectual stimulation ($\beta=.300$), and individual

consideration ($\beta=.139$).

4. Conclusion

To successfully lead the technology commercialization of start-up companies, the following implications can be drawn according to the results of the empirical analysis of this study.

First, among technological commercialization capabilities, marketing capability and technology development capability are becoming more important in the context of rapidly changing customer needs and business environment amid the acceleration of the Fourth Industrial Revolution. Relatively, manufacturing production capacity and productization capacity seem to be relatively insignificant due to changes in cooperation and operation with outsiders. In the end, it can be said that it is important to satisfy the needs of customers and continuously receive customer choices by enhancing technological competitiveness.

Second, in leadership, it is necessary to change to transformational leadership that considers intellectual stimulation and individual consideration to the existing charisma due to changes in various social factors such as a change in employees' consciousness toward the company and work-life balance, as well as increasing the uncertainty of the business environment. Particularly, in a situation where the importance of technology is increasing with the acceleration of the 4th industrial revolution, the need for transformational leadership that shows a significant moderating effect on technology development capability is increasing.

Third, using the results of correlation analysis and multiple regression analysis on technological commercialization capabilities, transformational leadership, and commercialization performance, it would be possible to figure out the main factors to increase the commercialization performance according to the situation of individual start-ups, and to strengthen execution power to achieve the target level.

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