

A Study on the Effect of Satisfaction with R&D Projects on R&D Performance Satisfaction -For SMEs in Jeollanamdo-

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Abstract

The purpose of this study is to check whether the satisfaction of the R&D (Research & Development) project directly affects the R&D performance, and to find out whether the satisfaction with regional connectivity and the satisfaction with the R&D operation management significantly mediate the relationship that the satisfaction with the R&D project has on the R&D performance. In order to verify the research hypothesis on this, a total of 51 companies located in Jeollanam-do that actually conducted R&D research projects were surveyed and analyzed.

In order to conduct an empirical study based on the collected questionnaire, a survey questionnaire related to the variables of the study model was composed based on a sample of 51 questionnaires. We used the SPSS program to verify the hypotheses in this study, and the hypotheses were verified by analyzing the validity, reliability, correlation, and deflection. As a result, there was a positive (+) significant relationship between R&D project satisfaction and R&D performance. In addition, it was found that the relationship between R&D project satisfaction and R&D performance was significantly mediated by the satisfaction with R&D regional connectivity and satisfaction with R&D project operation management.

Keywords: R&D Business, Satisfaction, R&D Performance, SME (Small and Medium Enterprise), R&D Operation Management

1. Introduction

Domestic companies are making a lot of efforts, such as investing in R&D and expanding research personnel to respond to the rapidly changing environment. In particular, SME (Small and Medium Enterprise) need technological innovation because their own technological prowess is their competitiveness. R&D and innovation are key elements of competitive advantage [5]. Innovation is a factor that determines a company's economic performance and can generate growth and profits [1].

SME companies lack finance for development, poor infrastructure, and poor market access [2]. Therefore, R&D of SMEs is the most important variable that determines competence through technological

innovation [3, 5]. Realizing immediate profits is also an important means, but R&D activities are essential for the continued survival and operation of companies. This study aims to examine whether satisfaction with such R&D projects has a positive effect on R&D performance, and what variables mediate the relationship between satisfaction with R&D projects and R&D performance.

2. Theoretical Backgrounds

2.1 R&D Definition

R&D refers to systematic activities that a company promotes internally or through an external organization in order to acquire natural scientific and engineering knowledge or to newly utilize the knowledge in products or production processes that are commercialized directly or indirectly by the company [4]. R&D is characterized by having very high novelty, complexity, and irregularity compared to other corporate activities, and aims to accumulate technical knowledge to solve corporate natural scientific and technical problems. Solving these problems can be transformed into new products, services, and processes that enable companies to have a competitive advantage, and indicators of R&D efforts appear as R&D resources, that is, R&D personnel and R&D investment [4]. R&D is to create technology, functionality, marketability, and ease of use. In addition, R&D refers to a creative activity as a method to include all knowledge in society and to apply and devise new perspectives on new objects and previously performed activities.

2.2 R&D Performance

If the concept of performance is expanded in detail, it is a concept that includes output, outcome, and impact. When viewed in a narrow range, it can be defined as an outcome, a result, or an impact excluding output. This means that the output generated in the execution process is an index for measuring the efficiency of the process, and only the outcome and impact are defined as performance. In addition, in a narrower range, only outcomes are regarded as outcomes. If this is expanded, outputs can be put into the range of outcomes as outputs derived from the execution process. Performance was classified into output and impact. 'Output' was regarded as 'goods and services' directly produced with financial support from the project' [10]. In addition, 'impact' was regarded as 'the social and economic changes brought about by the R&D projects. In the EU Framework Program, the achievement of the technical purpose of R&D as the primary achievement of R&D is defined as an indicator mainly related to R&D activities such as excellence of developed products and process technology, reduction of R&D period and cost reduction. In addition, it was defined as an indicator related to business activities such as profit margin, market share, sales, return on investment, and cost reduction as secondary achievements of R&D.

2.3 R&D Projects Operation Management

R&D operation management is an academic and practical field in which a number of fields such as engineering, science, management, etc. are linked, in which an organization plans, develops, and performs technological innovation to achieve strategic and management goals. This indicates that R&D management is not limited to R&D activities, but it is necessary to consider the creation of technology and knowledge acquired through R&D results, as well as the problem of diffusion [7].

Target setting is as one of the important tasks of R&D management, and defined effectiveness and efficiency as characteristics of R&D targets [7]. Effectiveness can be defined as the level of appropriate utilization of the resources that have been used to achieve the best goal as the higher goal among R&D goals, and accordingly, the effectiveness is expressed in the size or quality of the output. On the other hand,

efficiency can be seen as a lower goal of effectiveness, and can be expressed as a ratio of inputs to outputs, and it can be used as a measure of economics of resource utilization. In addition, R&D management was categorized into strategic tasks and operational tasks. The strategic tasks of R&D management were defined as those related to long-term planning, organization, execution, and control of R&D management. It is said that it has a lot to do with activities at the level of R&D projects for the purpose. As the importance of R&D management increases, R&D management is being discussed in many fields such as technology strategy, start-up, venture capital, and R&D management by industry. R&D management has different characteristics in the times, and its types are as follows.

As shown in <Table 1>, the types of R&D management can be divided into 4 generations and explained. In <Table 1>, the four visible types and main characteristics of R&D management were organized and explained with reference to Lee et al. (2005).

Table 1. Types of R&D Management

Division	Time	Main features
First generation	Industrial Revolution ~ 1950	Primitive R&D management led by scientists
Second generation	1950 ~ 1980	Aiming to streamline individual projects through project management techniques
Third generation	1980 ~ 1990 (mid)	Introduction and application of technology development, portfolio, and technology roadmap incorporating enterprise strategy
Fourth generation	After the mid-1990s	Development of value-creating technology through enterprise-wide corporate organization and external market integration to create discontinuous innovation

2.4 Local Connectivity

With the transition to a knowledge-based economy, interaction and co-learning at the regional level are more advantageous in creating competitiveness than at the national level. Regional Innovation System (RIS) was established as a result of synergistic reactions between various economic actors in the region, such as enterprises, universities, research institutes, and local governments, in the process of creating, introducing, and distributing new technologies in the region [11]. It was defined as a network and system within the region to maximize the innovation capacity of the country and to enhance regional competitiveness.

Regional connectivity means receiving various activities and services in the area without deviating from the environment in which the person grew up or stayed in a comprehensive range. In addition, regional connectivity can be rewritten as regional centrality.

The regional center is interpreted as having the characteristics of the region, and the characteristics can be regarded as regional characteristics and characteristics. The advantages of the service with regional connectivity are as follows.

First, it is easy to support by reflecting network sharing and field-oriented services.

Second, the level of participation is higher due to easy access.

Third, it is possible to facilitate supply activities by utilizing various resources derived from the region.

Fourth, it is easy to connect and solve difficulties.

Fifth, it can provide and accommodate the complex needs of consumers more comprehensively.

2.5 R&D Performance

Performance is classified as human resource performance, organizational performance, and financial performance. Human resource performance is used as a performance indicator by measuring the attitudes and behavioral aspects of organizational members. Organizational performance is evaluated in terms of productivity, satisfaction, cost reduction, and quality of products and services. Financial performance generally uses quantitative indicators such as sales volume, total asset net profit ratio, and sales net profit ratio [8]. Organization size, number of employees, and budget size can have a direct impact on performance [9].

3. Research Model and Hypotheses

3.1 Research Model & Hypothesis Setting

The main purpose of this study is to understand how R&D satisfaction of SMEs participating in R&D projects affects R&D performance, and what relationships are established for the process. R&D project satisfaction was set as an independent variable, and satisfaction with regional connectivity and satisfaction with R&D project operation management were set as mediating variables. The purpose of this study is to determine R&D performance as a dependent variable and to find out what correlations these variables have.

Figure 1 shows the model of this study. The model shows the relationships between variables (Satisfaction with R&D projects, Satisfaction with R&D regional connectivity, Satisfaction with R&D projects operation management, R&D performance).

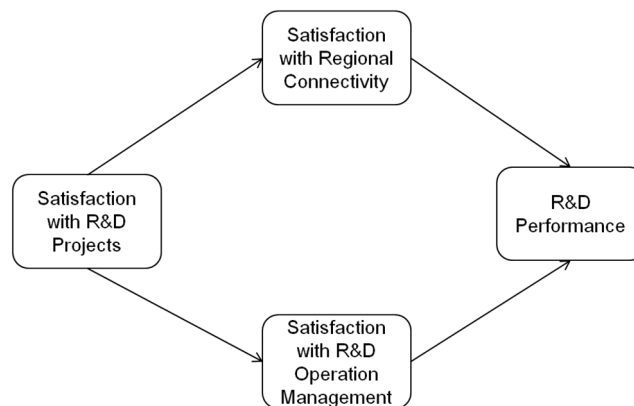


Figure 1. Research model

The hypotheses about specific relationships are as follows.

H1: Satisfaction with R&D projects will have a positive (+) significant effect on R&D performance.

H2: Satisfaction with R&D regional connectivity will mediate the relationship between R&D performance.

H3: Satisfaction with R&D operation management will mediate the relationship between R&D performance.

3.2 Definition of Variables

(1) Satisfaction with R&D Projects

Satisfaction with the R&D projects was defined by categorizing it into the size of the support fund, the period of support, the fund for responding to the project participation in-kind, and the appropriateness of the

support items.

(2) Satisfaction with Local Adherence

Regional adherence was defined as field-centered R&D support and local economy activation.

(3) Satisfaction with R&D projects Operation Management

Satisfaction with R&D projects operation management was defined as satisfaction with promotion, application method, procedure, and qualification criteria.

(4) R&D Performance

R&D performance was defined as the acquisition of new intellectual property rights of a company, product quality and price improvement, sales increase through exports and sales, and enhancement of corporate mindset for investment in R&D.

4. Experiment and Results

4.1 Collecting Data

In order to verify the research model and hypothesis, this study recruited companies through R&D projects centering on SMEs located in Jeollanam-do, and conducted a survey on selected companies. A total of 51 questionnaires were returned, and 51 questionnaires (100%) were used for analysis.

4.2 Composition of the Questionnaires

All questions were constructed using a 7-point Likert scale. The contents of the questionnaire are shown in Table 2 below.

Table 2. The contents of questionnaires

Variable	The Contents of the Questionnaires
Satisfaction with R&D Projects	I am satisfied with the amount of funding for the R&D projects. The support period for the R&D project is satisfactory The proportion of response funds participating in the R&D project is satisfactory. I am satisfied with the support items for the R&D projects.
Satisfaction with Local Connectivity	The R&D projects well reflected the situation of Jeollanam-do companies. The R&D projects is effective in supporting SMEs' on-site R&D. R&D projects are effective in understanding and supporting the needs of local sites. R&D projects have a great contribution to vitalization of the Jeollanam-do industry and local economy.
Satisfaction with R&D projects Operation Management	Introduction and application of technology development, portfolio, and technology roadmap incorporating enterprise strategy. R&D projects procedure is reasonable. The time it takes to process the R&D projects operation management is fast. Qualification criteria applicable to R&D projects are appropriate. R&D projects evaluation and performance management are systematic and professional. R&D projects strive to reflect recommendations in operation management.
R&D Performance	R&D projects contribute to the acquisition of new intellectual property rights. R&D projects improve corporate competitiveness (quality, price). R&D projects increases sales revenue. The R&D projects raises the corporate mindset for investment in R&D.

4.3 Empirical Analysis

(1) Reliability Analysis

The reliability value of each variable was found to be satisfactory. Satisfaction with R&D projects (.878), satisfaction with regional connectivity (.914), satisfaction with R&D operation management (.917), and Cronbach's α coefficient of R&D performance (.89) were more than 0.7, ensuring reliability.

(2) Validity Analysis

Factor analysis was performed to verify the validity of the variables used in this study. Factor analysis refers to a technique that identifies the shared structure between measurements by considering the correlation between variables or measurement items. Satisfaction with R&D projects (4 questions), satisfaction with regional connectivity (4 questions), satisfaction with R&D projects operation management (6 questions), and R&D performance (4 questions) all showed a factor of 0.5 or more, and all items were used as measurement items. As the commonality extraction value approaches 1, it is considered that each factor is well explained. Kaiser-Meyer-Olkin was 0.835 and Bartlett's sphericity test was 775.656 (significant probability 0.000). The cumulative explanatory power of the total variance appears to be 78.0165%.

4.4 Hypothesis Test Results

(1) Results of Hypothesis 1

As a result of simple regression analysis, the research hypothesis that satisfaction with R&D projects will have a positive (+) significant effect on R&D performance was found to be significant as shown in Table 3.

Table 3. Results of hypothesis 1

B	SE	beta	t	significance
2.887	.698		4.135	.000***
.525	.125	.518	4.197	.000***

R=0.518, R²=0.268, Adjusted R²=0.253, F value=17.618, P=0.000, *p < .05, **p < .01, ***p < .001

(2) Results of Hypothesis 2

The SPSS process macro technique in Hayes (2013) was used to verify the hypothesis that satisfaction with satisfaction with R&D regional connectivity mediates the relationship between satisfaction with R&D projects and R&D performance [6]. The lower and upper values of the mediation effects verified on the basis of 5000 and 95% confidence intervals are shown in Table 4. Table 4 shows the result values for mediation hypothesis 2.

Table 4. Results of hypothesis 2

Independent Variable	Dependent Variable	Co Efficeinent	S.E.	t	p	95% confidence	
						LLCI	ULCI
Satisfaction with R&D projects	Satisfaction with regional connectivity	.4305	.0821	5.2471	.0000	.2656	.5955
R ² =0.3645, F=27.5322(p=0.0000)							
Satisfaction with R&D projects	R&D performance	.1999	.1186	1.6848	.0987	-.0388	.4385

Satisfaction with regional connectivity		.7192	.1663	4.3235	.0001	.3846	1.0539
R ² =0.0999, F=5.3829(p=0.0061)							
Independent Variable	Dependent Variable	Mediator Variable	Indirect Effect	BootSE		Boot LLCI	Boot ULCI
Satisfaction with R&D projects	R&D performance	S.A.	.3096	.1084		.1279	.5485
			Direct Effect	t	p	Boot LLCI	Boot ULCI
			.1999	1.6848	.0987	-.0388	.4385

The mediation effect value of satisfaction with R&D regional connectivity was .3096, and the lower and upper values were shown to be (0.1279, 0.5485), indicating that H2 (not including a value of 0) was statistically significant. Meanwhile, it was not statistically significant because the direct effect value of satisfaction on R&D projects on R&D performance was .1999 and the lower and upper values were (-.3888, 0.4385) and contained a value of zero. Thus, satisfaction with R&D regional connectivity has been shown to completely mediate the relationship between satisfaction with R&D projects and R&D performance.

(3) Results of Hypothesis 3

The SPSS process macro technique in Hayes (2013) was used to verify the hypothesis that satisfaction with R&D projects operation management mediates the relationship between satisfaction with R&D projects and R&D performance. The lower and upper values of the mediation effects verified on the basis of 5000 and 95% confidence intervals are shown in Table 5. Table 5 shows the result values for mediation hypothesis 3.

Table 5. Results of hypothesis 3

Independent Variable	Dependent Variable	Co Efficeinent	S.E.	t	p	95% confidence	
						LLCI	ULCI
Satisfaction with R&D projects	Satisfaction with R&D projects operation management	.5005	.0935	5.2533	.0000	.3089	.6920
R ² =0.3651, F=27.5969(p=0.0000)							
Satisfaction with R&D projects		.2240	.1222	1.8329	.0732	-.0219	.4698
Satisfaction with R&D projects operation management	R&D performance	.5705	.1475	3.8668	.0003	.2737	.8673
R ² =0.0999, F=5.3829(p=0.0061)							
Independent Variable	Dependent Variable	Mediator Variable	Indirect Effect	BootSE		Boot LLCI	Boot ULCI
Satisfaction	R&D performance	Satisfaction	.2855	.0886		.1427	.4842

with R&D projects	with R&D projects operation management	Direct Effect	t	p	Boot LLCI	Boot ULCI
		.2240	1.8329	.0732	-.0219	.4689

The mediation effect value of satisfaction with R&D projects operation management was .2885, and the lower and upper values were shown to be (0.1427, 0.4842), indicating that H2 (not including a value of 0) was statistically significant. Meanwhile, it was not statistically significant because the direct effect value of satisfaction on R&D projects on R&D performance was .2240 and the lower and upper values were (-.0219, 0.4698) and contained a value of zero. Thus, satisfaction with R&D projects operation management has been shown to completely mediate the relationship between satisfaction with R&D projects and R&D performance.

5. Conclusion

R&D is the most important source for SMEs to increase competitiveness, generate profits, increase employment, and establish technological maturity. In Jeollanam-do, SMEs seek to strengthen their capabilities and create results through R&D projects. We verified the relationship among SMEs' satisfaction with R&D projects, satisfaction with regional connectivity, satisfaction with R&D operation management, and R&D performance.

As a result, all the research hypotheses were found to be significant. In particular, it was confirmed that satisfaction with regional connectivity and satisfaction with R&D operation management are important variables that mediate the relationship between satisfaction with R&D projects and R&D performance.

The implications through this study are as follows. First, it is necessary to expand R&D policies and R&D support projects for the establishment of a research organization, strengthening capabilities, and investing in research manpower development.

Second, it is important to understand the characteristics of the region for R&D projects conducted in the region, and it is necessary to consider the conditions such as the duration of the project, the setting of support funds, and the proportion of response funds.

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