

# **R&D Enhancement Strategy for Small and Medium Enterprises' Development in Korea\***

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## **Abstract**

The purpose of this study is to suggest the limitations of R&D support system for SMEs, and a policy plan for expanding performance. In order to accomplish the purpose, we investigate the way to expand performance through in-depth analysis and evaluation of the existing R&D support programs for SMEs. This paper examined the items of research expenses and the current condition of research misconduct. That is to say, the paper analyzed that the investment type of support expenses and scrutinized the R&D programs targeting SMEs. In addition, the paper verified whether there is an outflow of support expenses from government to SMEs.

The results of statistical analysis proved that the expenditure structure of personnel expenses in the support project of SME technology development is relatively small. The expenditure on personnel expenses is actually low on the support projects of the technology development. And the total number of unjustifiable execution sanctions is higher, such as a relatively larger number of restricted participation on the basis of the total number of organizations and figures compared to other ministries. This suggested that the wrong execution of the support projects of SME technology development are still pernicious, and it should need some efforts to politic supplementation. Policy implications can be suggested as follows by focusing on the systematization of the performance evaluation and management of the technology R&D support projects for SMEs.

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## **1. Introduction**

The support for R&D has grown in importance because it is directly connected to SMEs' growth and development. The innovation in SMEs through R&D is the only means and method of government support. As the role of SMEs for economic growth has been emphasized, SME R&D expenditure and support scale have steadily increased. Small and Medium Business Administration was reorganized and expanded into

the Ministry of SMEs and Startups in 2017. After JongHak Hong was appointed the Minister of SMEs and Startup in the same year, the first Ministry of SMEs and Startups(MSS) is a government organization whose objective is to strengthen competitiveness and support innovation of Small and Medium-sized Enterprises (SMEs) and Micro Enterprises (MEs). It shows that the Korean government recognizes the importance of SME policy by changing its name and expanding its scope of activates.

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The government invests about 14 trillion-won in R&D projects each year, and the subsidies for SME R&D have annually increased to nearly 3 trillion won. The R&D support scale for SMEs has steadily expanded, Korean support scale won the second place after the United States among OECD countries. According to the budget trends of the central and local governments for SME R&D (Lee, 2018), 46.5% grew from 1.96 trillion won in 2013 to 2.88 trillion won in 2017. The number of projects also increased by 17.5% over the last four years. The Ministry of SMEs and Startups provided approximately 3,857 billion won to a total of 34,064 projects between 2013 and 2017. In particular, after the launch of the new government, the size of R&D support fund organized by the Ministry of SMEs and Startups amounted 1.17 trillion won and increased by 62.2% from last year in 2017, as the Small and Medium Business Administration was upgraded to the Ministry of SMEs and Startups.

However, although national R&D investment in SMEs continues to increase in volume, its quality is not high. Although the success rate of the technology development is maintained at 90%, it is not leading to the actual commercialization because the commercialization rate is roughly 50%. In other words, about 50% of SMEs that received R&D support from the government are unable to promote the commercialization. Consequently, the R&D projects for SMEs, which cost about 1.2 trillion won in 2016, continue to be unused on a large scale or without its performance (Kim et al., 2017).

The low performance of the corresponding R&D support has shown manifold problems about the current R&D support system. The concerns have been raised, mainly including short-term performance-oriented R&D planning, selection and evaluation methods only biased in technology, R&D performance evaluation and management system without considering the characteristics of SMEs and their R&D ecosystems, supplier-oriented judgment, distorted taxation upon licensing fees, lack of

connection with private investment, etc. (Ministerial Committee on Economic Relations, 2018). In particular, with regard to the current R&D evaluation system, because R&D projects with different characteristics are evaluated with the identical evaluation indicators, there is the criticism that the large-scale projects for achieving formal and nominal results just to satisfy the numbers of the projects are indiscriminately produced. Since it consists mainly of the technical evaluation to check whether the technical-oriented targets are achieved and the evaluation committee with lack of experience about the market determines the R&D business possibility of R&D projects, the R&D judgment system is also criticized for not developing the results of the projects into technology transfer and commercialization, despite the high success rate of technology development. The proportion of tasks in which patents are linked to technology fees or commercialization is not only relatively small, but that of papers leading to commercialization is not very high (Hong, et al, 2018). According to Kim (2018), the failure of commercialization of national R&D projects is due to the lack of strategic consideration in the planning stage, insufficient system after successful commercialization, and outdated legal and institutional support system. Because the high technical success rate of government-funded R&D projects means that the projects with low technology orientation are mainly selected whether it could be a successful job creation or a contribution to society is open to doubt (Yoon and Yang, 2013)

Given This background, a variety of research questions can be answered. Why is SME R&D weak in performance creation and is performance management not organized? To be specific, is support expenses from the government systematically invested in SMEs, after analyzing the investment type of them and scrutinize the R&D programs that the government supports targeting SMEs? Is there any outflow of support expenses from the government to SMEs? Thus, the purpose of this study is to suggest the limitations of R&D support system for SMEs, and a policy plan for expanding performance.

**Table 1.** Success Rate and Commercialization Rate of SME Technology Development

Year	Technology Development			Commercialization		
	Projects Finally Evaluated (A)	Successful Projects (B)	Success Rate (A/B)	Projects Received (A)	Projects Commercialized (B)	Success Rate (A/B)
2014	4,157	3,973	95.60%	4,515	2,114	46.8%
2015	3,459	3,283	93.60%	13,054	6,732	51.6%
2016	4,160	3,841	92.30%	14,368	7,177	50.0%

Source: Database from the Ministry of SMEs and Startups

In order to accomplish the purpose, we investigate the way to expand performance through in-depth analysis and evaluation of the existing R&D support programs for SMEs. This paper examined the items of research expenses and the current condition of research misconduct. That is to say, the paper analyzed that the investment type of support expenses and scrutinized the R&D programs targeting SMEs. In addition, the paper verified whether there is an outflow of support expenses from government to SMEs.

## 2. Literature Review

### 2.1. *The Comparison of the Performance Evaluation and Management System of Korean R&D Projects with that of SME*

#### 2.1.1. *Performance Evaluation and Management System of Korean R&D Projects*

According to Act on The Performance Evaluation and Management of National Research and Development Projects, etc., the Performance evaluation and management of national R&D projects represents the details of the Establishment of Performance Objectives and Performance Indices, which systematizes how to create the great performance of national R&D projects. The Establishment of Performance Objectives and Performance Indices is expected to utilize the standard performance indices that reflect the characteristics of both the types of R&D and the technical fields

including basic research, applied research, development research, etc. After an objective of a national R&D project is established by detailed project unit, a mid- or long-term object is continuously set for the corresponding R&D project. The reasonable performance objectives are set by taking into account project types. The performance objective should be set to be challenging, creative or realistic in consideration of the type of projects, the deadline, the size of the fund, the capacity, and so on. When setting the performance objective, the performance evaluation and management system of Korean R&D projects should be specified after coming to an agreement with stakeholders including the related departments, the management agencies, researchers and evaluators, etc., which helps the feedback on accountability and evaluation results are being strengthened throughout the project life cycle. The national R&D projects allow both qualitative and quantitative performance indices to be established, and the indices should be set in consideration of the core content of each project's performance objectives to objectively measure their achievement. The integration of only quantitative indices such as the number of patents, the number of papers and so on should be basically avoided, and the performance indices are set to focus on the results of careful calculation based on the project level. The performance indices should have the principle of setting the indices suitable for the level of the project progress, taking into account the period project under the participation of the project's stakeholders.

The performance evaluation and management

system of national R&D projects is conducted throughout the logically established model by project as a basic framework (see Figure 1). The performance evaluation and management system for national R&D projects is conducted stage by stage. The first step is to decide the core elements of a project and the items of the performance evaluation and management such as resource input, project execution, calculation process, and expected performance. After the second step is to determine the type of the corresponding project, the third step is to set its performance objectives, and in this case, they should be considered as the type of the project and the characteristics of its technology sector. The last step is to set up performance indices for performance evaluation and management system. Here, the performance indices should be set in consideration of the relevance and core of the performance objectives and the target number that meet the performance objective.

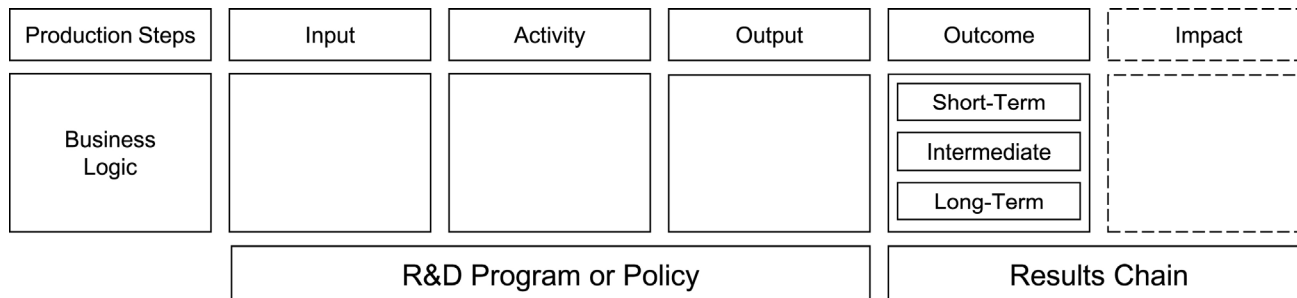
### 2.1.2. Problems of Performance Evaluation and Management System of Small and Medium Enterprises

Korean Management System of Performance Analysis for Small and Medium Enterprises has a legal force in a similar way to the performance evaluation and management system of national R&D projects. We extract the part of the performance analysis contents emphasized in the promotion of technology innovation of SMEs due to the similarity of the performance evaluation and management

system of national R&D projects. Thus, this paper is reconstituted based on Operation Guidelines for Technology Development Support Projects for Small and Medium Enterprises (Ministry of SMEs and Startups, 2018).

The technology development outcomes are in the property of the corresponding organization for the technology development and support projects for Small and Medium Enterprises like national R&D projects. In case of technology development support projects for SMEs, outcomes from the technology development are an exclusive possession of the corresponding organization, but if the outcomes are jointly developed, they are supposed to be owned communally after consultation under the operation guidelines, which is similar to the performance evaluation and management system of national R&D projects. Article 26 of the operation guidelines guarantees the above principle, but there could be severely conflicting claims of proprietorship between organizations because rather than its own technology, industry, university and institute collaboratively develop one technology. After the completion of a SME technology R&D support project, the company can apply for and register intellectual property rights based on the technology development support for SMEs. It is based on the following procedure. In case of applying for an intellectual property right, it can be in the name of a business, not a project manager or a participatory researcher.

**Figure 1.** Basic Form of Logic Model



Source: Standard Performance Indices for National R&D Projects (Ministry of Science and ICT, 2014)

In this context, the government tries to help SMEs to have the ownership of intellectual property rights as a main body of an act rather than as an individual. The head of an execution organization prevents the tangible and intangible outcomes from technology development support projects for SMEs from being disposed before the payment of the full technology fee. In regards to the technology development support projects for SME, the utilization and the follow-up management of the technology development outcomes are regulated for continuous performance management by submitting the proposal for how the outcomes could be applied.

The problems of the management system of performance analysis for SMEs concerning the technology development support projects have been continuously denounced in terms of the limitations of performance creation and the lack of performance management. The management system of the technology development support projects has been criticized for the low-efficiency of the operations because of its fragmentary and unconnected approach. According to a specific evaluation report of the technology development support projects for the commercialization of SMEs (KISTEP, 2013), since the top 5 accounted for more than 50% of the total purchases amount, the performance evaluation and management system came under criticism for a number of possible loopholes including the polarization of the performance within SMEs. It was confirmed that the performance evaluation and management system has been different from the original goal of improving technology competitiveness and promoting business stability of SMEs regarding the technology development support projects. Similarly, there are some cases of the lack of performance creation such as poor performance of R&D cooperation fund in making the cooperative investment in the technology development support projects through the public private partnership. In addition, according to a specific evaluation report of the technology R&D projects for

the commercialization of SMEs (KISTEP, 2014), the special projects for promoting the global small hidden champions in relation to such representative support projects were found to lack a systematic planning involved in the performance evaluation and management system. Although it is necessary to establish performance objectives, index development, and performance evaluation and management plan, there is a lack of the performance evaluation and management system in terms of the performance objectives and indices directly related to technology development, export commercialization of strategic items. It is the time to review the performance indices and the performance evaluation and management system for the entire R&D process including R&D project selection, management, performance creation, etc. of the technology development support projects for SMEs.

There are also criticisms on the government-and-supplier-oriented rigid research management system and the collective performance management system that do not reflect the characteristics of technology and market regarding the technology development support projects for SMEs. Based on the evaluation of the 3rd SME technology innovation promotion plan of National Science and Technology council (2014), the limitation of the supplier-oriented technology R&D support structure is criticized as a problem. Far from being just the carrying out of projects. Too many documents for submission are considered in applying and evaluating what they do and the standards for using the expenses for research are extremely severe. The method of selecting tasks by the evaluation committees composed of professors and researchers for the fair selection also did not discover the creative and challenging projects suitable for SMEs. Because there is the insufficient consideration of the demander (companies) and the market and the lack of reflection of the characteristics of SMEs like the evaluation of tracking the success or failure of the technology

development project goals, the performance evaluation and management system is stretched to its limit. The decision on the success or failure of the performance goals no relation to the marketability makes the corresponding projects to become a real business despite its highest rate of success in developing technology from them (92%). The performance evaluation and management system shows a limitation encouragement to cooperate with representative companies, universities and institutes. According to the Survey of the Descriptive Statistics of SMEs (Small and Medium Business Administration, 2013), they prefer to develop their own technologies (84.2%), while the joint development (or outsourced development with external agencies) is still lower (14%). Although 75% of the governments R&D budget is being spent on universities and public research institutes, there is little support for SMEs.

There are also questions about the overall performance evaluation and management system; establishing key indices, connecting performance objectives with the indices, monitoring performance achievements, etc. The research and analysis results of the middle and long term plan in the field of science and technology pointed the limitations, and recommend revising them on the performance evaluation and management system (Presidential Advisory Council on Science and Technology, 2017). The results represented that the technology R&D support projects should be revised to correct the policy direction, departmentalize the subjects, and set the objects and indices suitable for the characteristics of SMEs. It is necessary to select the indices that meet the objectives of the plan, and to set the reasonable targets based on the corresponding objectives (Ratio of R&D investment to sales, the number of globally innovative SMEs, etc.). It is also needed to select the performance indices that can show the policy effects of implementing the plan, and set the sensible targets on their objectives. In order to increase the

effectiveness of the technology development support projects for SMEs, it is essential to periodically check the performance of the projects and to monitor their implementation plan. The annual implementation plan for consistent policy implementation and performance monitoring should be systematically established and managed. A feedback process to collect the opinions of stakeholders and reflect them in the policy should be facilitated. The process should be prepared to collect the opinions of various policy, and reflect the collected opinions in the policy by strengthening the functions of support organizations such as the customer advisory groups for SEM technology development or politic exchange meeting like the annual project implementation plan. The efforts in human resource expansion and empowerment of specialized organizations involving Korea Technology and Information Promotion Agency for SMEs should be made to ensure timely performance management for the technology R&D support projects for SMEs. The specialized organizations need to strengthen their roles and functions in planning, management, and evaluation of R&D projects between the government and SMEs.

### *2.1.3 Implications of the Problems about the Performance Evaluation and Management of SME R&D Program*

This chapter analyzed the current status and the characteristics of the R&D management system of SMEs. Based on this analysis, the performance evaluation and management system of SMEs and the performance indices are summarized as follows. The technology R&D support projects of SMEs are operated within the scope and the principle of setting performance objectives and performance indices of national R&D projects. Based on the Act on the Performance Evaluation and Management of National Research and Development Projects, the technology development support projects of SMEs are running

with consistency. Although the principle is similar to that of other ministries, it has failed to establish the performance evaluation and management process such as specialized performance objectives and performance indices on technology, industry, business type of SMEs.

The national R&D projects and the technology development support projects have similarities but some differences in the performance evaluation and management system. The regulations related to technology development support projects for SMEs, unlike the autonomous and creative management system of national R&D projects, strictly emphasize the desirability of responsibility and research management. To be specific, the SME R&D innovation plan suggests strengthening responsibility and research management by securing fairness of SME R&D support, making up for the enforcement of the autonomous prevention of unjustifiable use, and tightening the sanctions against companies that use research expenses in April, 2018. It is for this reason that the direction of the regulations of the technology development support projects for SMEs would be focused on strengthening the management such as fair distribution, prevention of wrong use, and sanctions to compensate for its unfairness and inequality. In order to prevent a lopsided support for a certain company, the gradation system only by Ministry of SMEs and Startups is expanded to all departments and the number of times supposed is accumulated and managed. The public notice reporting function for whistleblowers has been implemented in the Online Assessment System SME Technology for Small and Medium Enterprises (SMTECH) by utilizing the Nudge method such as pop-ups, text messages, letters by authority of the Minister, and so on. The list of the malicious companies which use research expenses for an unjustifiable purpose and are limited to participate in the support projects is disclosed.

Unlike the national R&D projects, the technology

development support projects for SMEs are strengthening the support system such as labor costs to foster professional manpower. Since science and technology manpower is a factor that enables national competitiveness and economic growth, training the workforce can determine the standard of living of the people (Ryoo, 2004). According to Operation Guidelines for Technology Development Support Projects for Small and Medium Enterprises, a project execution organization has established a support system for stronger manpower by enacting a regulation that raises more than 30% of the project cost to the personal expense that can be cashed. In this way, the policy of increasing the labor cost is suggested to emphasize the connection of job expansion with the national keynote. If 30% of the 1 trillion won in a new R&D budget support for SMEs is used for new recruits, more than 10,000 jobs at a salary of 30 million won a year will be created. In accordance with the intention of enhancing the technology capacity through SMEs' professional personnel, new personnel expenses, external personnel expenses, fees for consultation of specialists, etc. are recognized as an item of expenditure.

There is an additional limitation of the performance evaluation and management system because the unique performance evaluation and management system of SMEs and its performance indices are not consistently established. According to the analysis results of the technology R&D support projects of SMEs at the ministry-wide level, the performance evaluation and management system is the limitation for unsystematic approach in the performance analysis framework and its performance indices based on the type of SMEs or their technological characteristics. The R&D projects targeted for SMEs may differ in the direction and characteristics of the performance analysis results depending on the type of SMEs, the form of cooperation, and the features of research. Moreover, although the projects are managed systematically, there is the need for

a general statement of the performance analysis and its performance indices that SMEs can easily understand. It is the time to review the performance evaluation and management system and its performance indices about the entire process of project selection, management and performance creation of SMEs R&D. Due to the overly rigid guidelines for execution and a lot of the documents in applying and evaluating a project, it has a hard time writing out them for submission, rather than consuming energy to complete it. The method to select the projects thought the committee members including professors and researchers based on fair selection has the limitation in finding creative and challenging projects, and a lack of the consideration for companies and market without reflecting the characteristics of SME R&D centered only on the success or failure of the project objectives. It was criticized that there is a lack of specificity and sustainability of establishing objectives and setting indices by type of SMEs. As a result, the R&D support by the government can be said to be the key to the company's innovative efforts and the expansion of its business ecosystem, the process of the evaluation and management of the research and its performance for the technology development support projects of SMEs should be established.

### **3. Methodology and Results**

This paper examined the items of research expenses and the current condition of research misconduct. That is to say, the paper analyzed that the investment type of support expenses and scrutinized the R&D programs targeting SMEs. In addition, the paper verified whether there is an outflow of support expenses from government to SMEs.

#### *3.1. The Ratio of Manpower Utilization of Technology Development Program for SMEs*

Despite the shortage of SME technical manpower, the utilization ratio of personnel expenses is not high in the support projects for technology development, resulting in a mismatch. SMEs which participated in the support projects are found to have a low rate of using personnel expenses to foster technical manpower. When it comes to the research expenses of the support projects for technology development, the average personnel expense is only 20% of the total research expenses (the equipment and material costs are up to 55% of it). Many existing reports and SMEs' requirements have suggested that the limitation of human resource development, but the results of the analysis proves that personal expenses are not properly utilized in the actual use of research expenses. This is because the SMEs which participated in the support projects have not systematically used the corresponding projects to foster new manpower. If the personnel expenses are divided into internal and external ones, the internal ones are higher. In the comparison between internal and external personnel expenses the ratio of internal personnel expenses is relatively higher than that of external ones, which means that SMEs are considered to lack the capability to take advantage of external experts, and expand collaborative research with other outsiders. In other words, since the characteristics of the support projects of SME technology development are too focused on solving SMEs own difficulties, the role of training, nurturing and maintaining professional manpower is lack. Thus, in considering that the current utilization rate of personnel expenses is around 20%, according to this revised 「Operation Guidelines for Technology Development Support Projects for Small and Medium Enterprises」 it would not be a big problem to raise the ratio of personnel expenses by up to 30% in case of more than 100 million won in research expenses. We analyzed the effective policing in the manpower utilization and the expansion of new recruitment now that SMEs which participated in the support projects are found to invest more in utilizing equipment and materials than inadequate manpower.



**Table 2.** Ratio of Items of Research Expenses by Technology Development Projects of SMEs

Name of Project	Direct Cost								Indirect Cost		
	Personnel Expense			Cost incurred in performing research task	Research allowances	Cost for research equipment and materials	Cost for research activities	Cost for commissioned research and development	Support expenses for utilization of performance	Research support expenses	Personnel support expenses
	Internal	External	Total								
WC300 R&D	8.6	0.0	8.6	1.1	0.0	52.3	31.2	6.0	0.4	0.3	0.0
Technological Fee Project	27.1	1.5	28.6	1.8	0.2	54.5	8.1	4.4	2.1	0.2	0.1
Support Project of Technology Development for Overcoming Trade Technical Barriers	0.9	0.0	0.9	1.7	0.0	71.8	23.0	1.4	1.1	0.0	0.0
Technology Development Project of Industry-University-Institute-Collaboration (TIPS)	66.9	3.8	70.6	0.9	0.0	23.3	3.8	0.0	1.2	0.0	0.0
Technology Development Project for Commercialization	13.7	0.5	14.2	1.2	0.0	72.5	4.7	6.3	1.0	0.1	0.0
Market Creation Type of Creative Technology Development Project	21.2	0.0	21.2	0.9	0.0	52.0	2.5	22.1	1.3	0.0	0.0
Technology Development Project of Product Process Improvement	5.7	0.3	6.0	1.7	0.0	84.6	4.0	1.0	2.7	0.1	0.0
Technology Innovation Development Project of SMEs	21.2	0.4	21.6	1.3	0.0	57.7	5.3	12.8	1.1	0.1	0.0
Technology Development Project of SME Conversion	12.4	0.5	12.9	1.2	0.0	75.1	4.1	5.6	1.1	0.0	0.0
Technology Competitiveness of Middle-Standing & SME	1.5	4.0	5.5	5.1	0.0	11.5	76.3	0.0	1.5	0.0	0.0
Technology Development Projects of Startup Growth	30.4	1.3	31.6	1.8	0.0	53.4	5.0	6.2	1.8	0.0	0.0
Mean	19.1	1.1	20.2	1.7	0.0	55.3	15.3	6.0	1.4	0.1	0.0

Source: Internal Data on Statistical Analysis on Technology Development Support Projects for SMEs(2018)

### 3.2. Status of Misconduct on the Part of the SMEs' Research Expenses

As a limitation of SME R&D promotion, misconduct in the support projects of SME technology Development is still not eradicated. After the national R&D project is commonly completed, the balance of the research expense and a sum of misconducted money are recovered. The support organization can even ask the corresponding company to calculate to a nicety again and conduct a spot inspection in order to recover a sum of money misconducted. According to Article 9 of Regulations on the Management, Etc. of National Research and

Development Projects, Standards for recovery of wrongfully executed amount is stated. Although the standards for recovery of wrongfully executed amount explicitly include adherence to the research period, execution based on the items of research expense, documents for executing the research expense, false payment and so on, the education and promotion on the standards for SMEs should be required in the future due to too many recovered cases by their misunderstanding. As the embezzlement of research expenses is continuously happening in addition to the inefficient use of research expenses, the government should evaluate and manage them. According to Regulations on the Management, Etc.

of National Research and Development Projects, the balance of research expenses and a sum of misconducted money are recovered after the support projects of the technology development are commonly completed, and a sum of misconducted money can be recovered though on-site inspections and resettlement in the national research and development projects. However, in the past five years from 2013 to 2017, the disclosure number of recovery of wrongful use in the support projects, investigated by Ministry of SMEs and Startups, was 476, and the amount of the retrieval was 359.9 billion won. The 56 cases of ‘Payment of Research Expenses without Product Supply or exaggeratedly’ were highest (8.8 billion won), and ‘Use of Materials and Parts for a Wrong Purpose (33 cases, 1.9 billion won)’, and ‘Withdrawal of Research Expenses without Permission (26 cases, 1.7 billion won)’ were ranked next.

Based on the current state of the restricted participation in national R&D projects by department (see Table 3) the number of the restricted participation declined from 2013 to 2017, which means the number of unjustifiable use tends to decrease, as well. In general, however, the total number of unjustifiable execution sanctions is higher, such as a relatively larger number of restricted participation on the basis of the total number of organizations and figures compared to other ministries. This suggested that the wrong execution of the support projects of SME technology development are still pernicious, and it

should need some efforts to politic supplementation.

The cases of wrong execution confirmed by the Ministry of Trade, Industry and Energy, and Ministry of SMEs and Startups indicated that the problem with the wrong execution is happening under the item of research expenses. There were the cases of the wrong execution of research expenses in terms of personnel expenses, costs for research activities, costs for research equipment and materials, support expenses for utilization of performance, and so on (see Table 4). These cases represented that the evaluation and management of research projects of technology development of SMEs compared with other ministries, although Ministry of SMEs and Startups’ sincere policies and efforts have continuously reduced the wrong execution of national R&D projects. Because SMEs often lack a dedicated department or have insufficient capability related the national R&D projects there would be many cases of misconduct on it. In particular, a lot of the wrong execution has occurred because of a lack of both management ability and full knowledge, rather than deliberate falsification. This minor execution should be accompanied by implementing various supportive policies such as continuous education and public relations, establishment of collaborated management system though joint research with Industry-University-Institute, research consultation, etc. These policies could reduce the number and the case of wrong execution, and push forward many different kinds of support projects of SME technology development.

**Table 3.** Recovery and Unpaid Amount of SMEs by Year

Unit (#, 100 million won)

Year	Recovery		Unpaid Amount							
			Closure		Deterioration		Revival		Under debt collection	
	Number	Amount	Number	Amount	Number	Amount	Number	Amount		
2013	48	58.4	12	19.2	4	5.3	1	0.08	5	16.7
2014	50	53.0	23	19.6	1	2.7	2	4.5	9	11.2
2015	229	98.6	29	34.1	8	6.2	1	1.2	11	14.3
2016	64	39.4	10	14.6	4	2.5	1	3.1	5	2.1
2017	85	110.4	23	34.2	4	5.2	3	5.4	27	45.0
Total	476	359.8	97	122.7	21	21.8	8	14.2	57	89.3

Source: Database from the Ministry of SMEs and Startups

**Table 4.** Restrictions on Participation in National R&D Projects by Department

Department	2012		2013		2014		2015		2016		Total	
	Fig	Org	Fig	Org	Fig	Org	Fig	Org	Fig	Org	Fig	Org
Ministry of Science and ICT	17	6	29	15	43	32	93	80	87	57	269	190
Ministry of Trade, Industry and Energy	584	597	662	559	353	311	277	219	394	272	2,180	1,868
Ministry of SMEs and Startups	1,266	1,164	850	758	744	645	213	171	319	306	3,392	3,044
Ministry of Environment	11	9	7	10	10	9	7	5	29	21	64	54
Total	2,007	1,791	1,584	1,367	1,203	1,025	664	502	814	688	6,272	5,373

Source: National Science and Technology Information System (2017)

#### 4. Conclusion and Implication

The results of statistical analysis proved that the expenditure structure of personnel expenses in the support project of SME technology development is relatively small. The literature review and the analysis results suggested that the lack of excellent manpower is the most important problem, but the expenditure on personnel expenses is actually low on the support projects of the technology development. Thus, the R&D support projects of SMEs should be revised to strengthen their technology development capacity by investing in outstanding human resources

In addition, Ministry of SMEs and Startups' institutional and politic efforts have continuously reduced the wrong execution of national R&D projects, but the number of the cases from its wrong execution of national R&D projects are relatively more than other ministries. Accordingly, we suggest that the continuous management of SME technology development research is essential to improve the current situation of the Korean small and medium enterprises. Because SMEs often lack a dedicated department or have insufficient capability related the national R&D projects there would be many cases of misconduct on it.

In spite of the necessity of the examination of the system, more detailed consideration should be needed about how it could be specifically improved

like the example of research misconduct. Overly segmentalized regulations on all of the sources in the research expenses can be expected to be a constraint factor in the creation of outcomes from the project by limiting the autonomy of the participating organizations. Project planning and implementation will need to be done by integrating the autonomy of the execution of project expenses. That is, administrative simplification and systematization of research management should be carried out by considering on-site difficulties of SMEs inversely with the inverse ratio of tight regulations to personnel expenses.

The results of the analysis show that major innovation in research programs is needed for small and medium-sized enterprises with huge support for technology development. Policy implications can be suggested as follows by focusing on the systematization of the performance evaluation and management of the technology R&D support projects for SMEs.

The systematization of the performance management and the research management of the support projects of SME technology development should be needed. First of all, the administrative procedures and the regulations of the support projects should be simplified and amended by considering bottleneck factors in a field of SMEs in the dimension of research management. The research management system should be continuously improved so that the support projects of the technology development can be

systematically carried out. Secondly, in order to systematize the performance management of the support projects of SME technology development, key indices (like HRD and commercialization performance) should be set and project objectives should be connected to the indices at the same time. Also, outcomes from the support should be regularly observed. To be specific, the indices that can meet the objectives of each support project of SME technology development should be selected and the targeted levels should be reasonably set up. In addition, the implementation performances and the implementation plans should be periodically inspected and consistently monitored for their higher effectiveness. Finally, a feedback process should be established to collect the opinions of stakeholders, and reflect them in the policy. The economic and social achievements of the support project of SME technology development should be continuously informed and promoted. The federal agencies and other public organizations should screen best practices and content guidelines, promote good outcomes from the support, and open them to the public by including the projects organized by Ministry of SMEs and Startups as well as the Korea Small Business Innovation Research Programs (KOSBIR) together.

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