Factors Affecting Decision to Select Government R&D Support Projects for SMEs

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Abstract. Nowadays, Thailand industry is still lacking technological and scientific application for making competitive capacity and value-added products. For this reason, the government needs to initiate special projects for supporting industrial research and development (R&D). In order to gain the highest benefit of the government budget, the process of selecting projects to be supported is considered important since it has an effect on the future prosperity of the country. Multiple evaluation factors, which may be conflicted by nature, are required for selecting suitable projects among several alternatives. The objective of this research is to study the factors that should be used in appraising the government R&D support projects for SMEs. Analytical Hierarchy Process (AHP) is applied to determine 3 main factors which consist of 9 sub-factors used for selecting suitable projects in order to receive funding from the government. The result shows that the important weight of the 3 main factors; entrepreneur, researcher, and project details are 0.565, 0.235, and 0.200 respectively.

1. Introduction

Understanding of the role of innovation in the process of small and medium-sized enterprises (SMEs) has initiated to attract research consideration over the last few years [1]. Scientific collaboration network is an academic network where hubs are researcher and spokes are co-authorships. This linkage is powerful participation that innovates research environment [2]. The triple helix model of research capacity development is based on the synergy between academia, industry, and governments for economic growth and social development [3]. Accordingly, SMEs has been an important mechanism of novel economies and many scholars mention that SMEs is a crucial factor of sustainable economic growth [4]. Nowadays, SMEs has shifted to a modern concept of “Innovative Entrepreneur” [5]. The Innovative Entrepreneur has become one of the key driving forces for the development and it is very crucial for the economic growth of any countries. The purpose of accomplishing circular economic, industrial development, provincial growth, employment creation, sustainable production, and advancement of new technology have regularly depended on entrepreneurial development [6].

In this regard, several countries like Thailand have initialized some policies to support innovative Entrepreneur. Thailand 4.0 policies is an economic model that aims to unlock the country from several economic challenges resulting from past economic development models. These challenges include “a middle-income trap”, “an inequality trap”, and “an imbalanced trap” [7]. Industrial Research and Technology Capacity Development Program (IRTC) is a Thai government funding program constructed to expedite the research and development projects for SMEs in Thailand. Entrepreneurs who are implementing and developing process improvements are the primary prospects to receive research
subsidies through IRTC, however, uplifting sociological and economic impact technology adoption projects that result in new potentialities are also considered.

Since the government must spend a lot of money on plenty of R&D projects; and, some projects need to disburse high investment, project selection will balance between risk and benefit which occur during the process of each project. At present, the selection of projects is expertly worked by an internal and external committee, however, the opinion of this expertise is not an evidence base and it is difficult to assess a variety of R&D projects without bias. Analytical Hierarchy Process (AHP) is an effective tool for dealing with complex decision making and may assist the decision maker to set priorities and make the best decision [8]. Many scholars used the AHP to choose R&D projects in the enterprise sector; nevertheless, the selection process of government-granted R&D project is less discussed [9].

This paper represents an AHP model for determining factors affecting government-funded project selection. Consideration of decision maker is applied to perform the pairwise comparisons of the qualitative performance data related to Project details, Entrepreneur, and Researcher that should be considered during Government R&D Support Projects for SMEs selection. Decision maker alike compared factors with each other to generate the hierarchical decision structure. The paper is organized as follows. Section 2 presents the literature on R&D project selection and the application of AHP in the classified decision factor. Section 3 discourses the methodology applied. Results are represented in Section 4. Section 5 concludes the research with the discussion section.

2. Literature review

2.1. Background: R&D project selection in Thailand

As a result of the available resource constraints, and the diversity of R&D project alternatives, funding the correct project is significant and spend a lot of time [10]. In Thailand, some funding government agencies such as regional science park have responsibility to subsidize projects for SMEs. The procedure for developing project is as follows. Firstly, funding agency visits the industrial sector to evaluate the information and problems needed to be solved or target to be achieved. In second step, funding agency selects the researcher from university or research institutes to deeply diagnose the technical problems. Lastly, industrial sector and researcher jointly develop project proposal according to problems and industrial demand. As previously mention that decision making in selection of R&D Projects that will be supported by government agencies is one of the most momentousness processes because R&D Projects is an activity that consumes large investment budget. For this reason, funding agencies have to give serious consideration and trade-off between benefits and risk that will arise from projects. The selection process is done by a panel of experts from inside and outside the funding agency. On the contrary diversity of expertise’s nomination committee and decision criteria that are used to consider cannot be clearly specified. It is difficult to evaluate without prejudice and risking unfairness in considering the project.

2.2. The AHP Method

The AHP has been acknowledged as one of the solid and elastic multi-criteria decision-making (MCDM) tools for dealing with complex problems [11]. The method demands the decision committee to contribute consideration regarding the interrelated emphasis of either criterion which is then employed in designation a preference for either selection alternative. The AHP method comprises of four processes include construction of the decision hierarchy, formulation of the pairwise comparison matrix, computation of the weights of criteria factor, and computation of the consistency ratio [12].

Process 1: Hierarchical decision making is constructed by analyzing the selection purpose, decision criteria and feasible alternatives. Each level consists of main criteria, sub-criteria, and alternatives could be expanded to the hierarchy for declare the selection objective in information.

Process 2: Pairwise comparison matrices are formed after constructing the decision hierarchy. Decision committees correlate the emphasis of the decision criteria in matches conforming to the objective of the selection goal adopting the nine-point rating score invented by Saaty [13].
Saaty’s rating score is described in Table 1. If there are various decision maker in the selection process, their considerations in the pairwise comparison matrices would be summarized applying the geometric mean.

Process 3: Following completing the pairwise comparison matrices, the model has been computed the weights of criteria factor. To calculate the weights, each factor in the pairwise comparison matrix is divided to summarize of its column. After that, the mathematics mean of each row is computed. The values achieved from this computation superseded the weights of the criteria factor.

Process 4: The final process in AHP model is to compute the Consistency Ratio (CR) in either pairwise comparison matrix. CR determines how invariably the considerations of decision committee are. If CR is underneath 0.1, accordingly the consideration of the decision makers can be approved as unvarying. In other words, if CR is more than 0.1, the decision makers are appealed to re-judgment the pairwise comparisons continuously the considerations turn into steady result [14].

3. Methodology
In the AHP hierarchy model for selecting government R&D support projects for SMEs, the objective should be to select the projects that have the capability for achievement by initiating worth. Entrepreneur characteristics, researcher characteristics, and project details factors are the three main criteria that are adopted in the selection of government R&D support projects for SMEs. These criteria are generally subdivided into individual sub-criteria. In this research, the entrepreneur characteristics criterion is segregated into budget, staff, and market. Budget grades are depended on the entrepreneur’s authorized capital. Staff grading is performed depending on in-house R&D staff that estimated in accordance with the organization diagram and the task appearances. Market are evaluated according to the availability in the targeted market. The researcher characteristics criterion is segregated into the experience, education level, and availability. Experience scores are depended on preceding research and experiences. Education scoring is performed depending on the degree of certificate that was enclosed to the proposal. Availability is evaluated according to their teaching and research workload. The project details factors criterion is subdivided into business impact, plan consistency and risk. Business impact criteria demonstrate the consequence and significance of an impact to the business if the disruption was to occur to a system, process, and other business operations. Plan consistency grades are based on reasonable of a work plan and actual time. The risk is evaluated by assessing probability and impact should consistently be performed. All these factors originate from literature review then the decision makers are interviewed for screening factors that affect the decision to select government R&D support projects for SMEs. Corresponding hierarchy is as represented in Figure 1.

Next process, sub-criteria beneath each main criterion are correlated to each pair of criteria by three decision makers. These decision makers have seen the project statistics from the information document that were provided to them. On that occasion, the comparison of the main factors has been achieved, and the AHP model has generated the local arrangement for these criteria.

Finally, these following steps are applied to score the criteria weights of three main criteria and nine sub criteria. Local and global weights are identified with the weighted score for the total selection problem. After that, the decision makers are interviewed for pairwise comparison to correlate the importance of the decision criteria. Table 2 demonstrates both the local and global weights for the whole criteria. Ranks column displays significant criteria among the whole criteria. The most significant criterion has been discovered as “market” and the least significant criterion is “risk”. Entrepreneur characteristics criteria are distinguished when correlating with researcher characteristics and project details factors. “Experience” is the most significant criterion amidst the researcher characteristics. “Plan Consistency” is the most important criterion among the project details factors.
Table 1. Saaty’s rating score.

| Level of importance | Definition                                                                 |
|---------------------|---------------------------------------------------------------------------|
| 1                   | Indicate the two factors are of same importance                           |
| 3                   | Indicate the two factors the early is slight important than the latter    |
| 5                   | Indicate the two factors the early is obviously important than the latter  |
| 7                   | Indicate the two factors the early is more important than the latter       |
| 9                   | Indicate the two factors the early is extreme important than the latter    |
| 2-4-6-8             | The median value of the above consideration                               |

Figure 1. The hierarchical structure of the decision problem.

4. Results
Government R&D support projects for SMEs should be completely investigated before receiving a support decision. In this regard, it is meaningful to characterize the construction of purposes that produce an innovative entrepreneur project outstanding. In this research, the results have presented that the most significant factors in government R&D support project selection are the entrepreneur characteristics criteria: “Market”, “Staff”, and “Budget”. The emphasis of the project details factors (Plan Consistency, Business Impact, Risk) do not importantly affect the whole score of the possible choice. The greatest values of these criteria factors enlarge the R&D project's potentiality of being profitable. “Market” criteria, the preceding criteria, is appraised according to opportunity in the prospect market. A threat of new entranced technologies and competitive rivalry are both discussed in the assessment. On this subject, it could be declared that the “market” that the project prospects are the paramount criteria that should be concerned. A dependable-constructed market diagnosis can be extremely dominant on the decision of decision committees. The parallel between the recommended technology and the market necessitates dexterity. In part of ranking the decision criteria, this paper uses the global weight of each criterion to prioritize the decision criteria that involve the government R&D funding projects selection.
### Table 2. Criteria weights.

| Criteria     | Local Weights | Sub-criteria | Local Weights | Global Weights | Rank |
|--------------|---------------|--------------|---------------|----------------|------|
| Entrepreneur | 0.565         | Budget       | 0.329         | 0.186          | 2    |
|              |               | Staff        | 0.214         | 0.121          | 3    |
|              |               | Market       | 0.457         | 0.258          |      |
| Researcher   | 0.235         | Experience   | 0.413         | 0.097          | 4    |
|              |               | Education Level | 0.345     | 0.081          | 6    |
|              |               | Availability | 0.242         | 0.057          | 8    |
| Project      | 0.200         | Business Impact | 0.328   | 0.066          | 7    |
|              |               | Plan Consistency | 0.441  | 0.088          | 5    |
|              |               | Risk         | 0.231         | 0.046          | 9    |

### 5. Discussion

In this paper, “Risk” is the least significant criterion from the entire of sub-criteria. Nevertheless, risk criterion should be concerned because the hardest part of developing a custom risk appraisal feature requires diagnosis of the potential and effect on the R&D project should a risk incidence occur. The feasibility of a risk occurring and its impact on a project are applied in an organization as decision assistance.

Although this paper points out the weight of the three main criteria and nine sub-criteria that affecting the decision to choose government R&D grant projects for SMEs, it does not state how to deal with alternative project selection. Future research should apply the model to test with real data of several R&D funding project proposals for SMEs. Subsequently, potentially projects will be subsidized. It will be of a benefit for academia, industry, and governments, for sustainable development in countries.

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