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Evaluation of Purchasing Process in Solar Energy Investment Projects via SIWEC Methodology

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ABSTRACT

Solar energy investments involve financial and technological commitments aimed at generating electricity or heat from sunlight. Direct electricity production is achieved through solar panels, while concentrated sunlight produces high-temperature energy. The importance of solar energy investments can be assessed from multiple perspectives. These projects reduce carbon emissions by decreasing reliance on fossil fuels. Solar energy investments are becoming increasingly vital, particularly in alignment with energy transition and sustainable development goals. In short, solar energy is a sustainable and environmentally friendly power source. It also enhances energy access in rural areas through off-grid energy production. To identify the critical factors influencing procurement performance in solar energy investments, a novel decision-making model is proposed, incorporating the SIWEC technique. The findings reveal that strategy definition is the most crucial aspect of the procurement process in solar energy investments. A common digital platform should be implemented across all company units to improve coordination in project and procurement processes. This platform enables real-time tracking of business plans, ensuring timely service delivery and more effective project risk management. Additionally, robust project management software should be utilized to monitor all stages of solar energy projects. Such tools help streamline supply processes, meet material requirements on time, and optimize costs. Potential disruptions in project planning can be identified early through digital systems, further reducing operational expenses. A transparent, data-driven supplier evaluation and selection process should be established to identify the most suitable suppliers for solar energy investments. Supplier performance must be monitored, evaluated, and reviewed periodically. Selecting the right supplier enhances project quality and overall efficiency.

1. Introduction

In today's developing world, technological studies are gaining momentum. With this developing technology, the features of the products produced are also changing and trying to adapt to the new market [1]. With this developing technology, it has become necessary for the development and

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planning structure of the purchasing processes of companies to change. For this reason, the purchasing processes of each company can be evaluated in a different structure. The rapid advancement of technology provides critical advantages in terms of economic growth, sustainable development and social welfare [2]. Technological innovation increases efficiency in the industrial and service sectors. Countries gain global competitive advantage by investing in technology. Technological developments are the cornerstone of global progress. However, it is of great importance that this progress takes place in a sustainable, inclusive and ethical framework. Therefore, states, companies and academic circles should carefully plan their technology investments [3].

When we look at the importance of purchasing strategy, for purchasing processes to be managed correctly, all units within the company must comply with the prepared procedures and instructions completely [4]. Companies that implement these instructions also follow the strategies correctly and systematically follow the purchasing processes without experiencing any disruptions as much as possible. Purchasing strategy is an approach that aims to optimize the goods and service supply processes of a business [5]. In this way, it is possible to reduce costs, increase quality and ensure sustainable growth. There are a number of advantages that effective purchasing strategies provide to businesses. Costs decrease with the right supplier selection. Unit costs can be reduced with large-scale purchasing agreements. This situation offers significant financial advantages to businesses [6]. On the other hand, working with quality suppliers reduces error rates in production processes. A reliable supply chain improves inventory management and ensures uninterrupted production.

For the company, when purchasing a product or service, it is necessary to care not only about making a purchase, but also about obtaining the highest benefit from the product or service, spreading it over a long period of time and making the activity sustainable together with the success of the transaction [7]. It is very important for all units of the institution to adopt this organizational chart and support the purchasing strategy with the right technical specifications at the right time for current demands [8]. The company has to analyze in a qualified manner how effective internal and external dynamics are in the product or service purchasing processes, which material or service will be provided by internal resources and in what way. At the same time, it is important to analyze in detail what the risks and threats are in the strategic thinking process of purchasing [9]. Evaluating the purchasing process in terms of performance in an institutional sense is an important form of information regarding the next stage of purchasing and the continuation of the interaction with the supplier [10].

Solar energy investments are financial, technological and infrastructural investments made to produce electricity or heat energy from sunlight. These investments can be made by individual consumers, businesses, public institutions and investors. These investments are critical to providing sustainable energy production, reducing dependence on fossil fuels and reducing carbon emissions [11]. Although the installation cost is high, it is profitable in the long term due to low maintenance and operating costs. Solar energy investments have become one of the cornerstones of the future energy transformation by offering great advantages in economic, environmental and technological terms [12]. It is necessary to follow technological developments to make these investments effective. Solar energy investments are of great importance [13]. Because these investments directly affect many critical factors such as sustainable development, energy security, environmental protection and economic growth. Solar energy is a carbon-free energy source. This contributes to being more successful in the fight against climate change [14].

The effectiveness of purchasing processes in solar energy investments is very important. The most basic reason for this is that this process is a critical factor that directly affects the total cost, efficiency, sustainability and long-term success of the investment [15]. Increasing the effectiveness of purchasing processes in solar energy investments provides cost efficiency. High-quality equipment can be selected at lower costs with an effective purchasing strategy [16]. Selection of suppliers, logistics management and delivery times ensure that the project is completed on time. Effective management of purchasing processes in solar energy investments ensures that the investment is sustainable in terms of cost, quality and time. While costs decrease with the right purchasing strategies, the return on investment is accelerated, and risks are minimized [17].

Solar energy investments are renewable energy projects that are becoming increasingly critical in line with sustainable development goals, reducing fossil fuel dependency and reducing carbon emissions [18]. However, the success of these projects is directly related not only to technological innovations but also to effective purchasing strategies [19]. Efficient management of purchasing processes is of vital importance in terms of reducing the costs of solar energy investments [20]. This study aims to determine the critical factors that increase the effectiveness of purchasing processes in solar energy investments. In line with this motivation, it is aimed to determine the most critical factors affecting purchasing processes in solar energy projects. To achieve this goal, a new decision-making model based on the SIWEC technique is being developed. In this process, the opinions of 5 different experts are consulted.

This study contributes to the literature in many ways. The study determines the important factors to make purchasing processes more efficient in solar energy investments. In this way, a new perspective is presented on the efficiency of purchasing processes for the solar energy sector. The effectiveness of purchasing processes is based on the harmonious work of all units of the company. In energy projects, the ability to foresee disruptions in the supply chain positively affects the profitability of this process. This study highlights the potential benefits of integrating digital systems into purchasing and supply chain management. These contributions can help develop strategies that will make purchasing processes in the solar energy sector more systematic and efficient. In addition, this study offers suggestions on how project management and material procurement can be made more effective in the solar energy sector.

2. Methodology

SIWEC is a criteria weighting method that encourages more realistic thinking by decision makers. The steps of the method are as follows [21].

First, experts evaluate the importance of the criteria. The initial decision-making matrix is constructed on the basis of expert grades. This matrix has dimensions of number of experts ×number of criteria. Next, this matrix is normalized by dividing the maximum element of the initial decision-making matrix.

$$n_{ij} = \frac{x_{ij}}{\max(x_{ij})} \tag{1}$$

After creating the normalized matrix, the standard deviations of the normalized expert grades are computed. This way, experts can be made to think more realistically.

$$v_{ij} = n_{ij} \times std\ dev_i \tag{2}$$

By multiplying the normalized grades with the standard deviation of the experts, the rating of the expert who gives the more diverse rating is highlighted. Next, all multiplied normalized grades are summed.

$$s_j = \sum_{i=1}^{k} v_{ij} \tag{3}$$

Finally, the sum for each criterion is divided by total sums, and thus the weights of criteria are obtained.

$$w_j = \frac{s_j}{\sum s_j} \tag{4}$$

3. Results

Purchasing processes in solar panel investments are Determining Strategy (DS), Making a Budget Plan (MBP), Choosing the Right Supplier (CRS), Placing an Order (PO), Storage Processes (SP), and Monitoring Performance (MP). These processes are graded by five experts. The grades are illustrated in Table 1.

Table 1
The grades

Experts	DS	MBP	CRS	PO	SP	MP
Expert1	10	9	7	9	8	9
Expert2	9	9	8	6	8	10
Expert3	10	7	10	7	7	6
Expert4	8	7	10	10	6	9
Expert5	10	7	5	5	9	10

Afterwards, the grades are normalized with Equation (1). Next, standard deviations are computed. The standard deviations of experts are .094, .125, .157, .149, and .213, respectively. Later, the normalized grades are multiplied by these standard deviation values using Equation (2), and the multiplied normalized grades for each process are summed by Equation (3). Finally, the weights of processes are obtained with the help of Equation (4). Table 2 shows sums and the weights of processes.

Table 2
The Weights of Processes

	DS	MBP	CRS	PO	SP	MP
s	.696	.561	.579	.526	.567	.652
w	.195	.157	.162	.147	.158	.182

According to weigh values in Table 2, the most important process is determining strategy. Because this is the process with the highest value.

4. Conclusions

Corporate companies want to comply with the regulation systematically when making decisions in purchasing processes. In this study, the determination of critical factors affecting the performance of purchasing processes in solar energy investments was examined. In line with this study, before conducting field research, theoretical research was conducted by determining the headings on energy and purchasing. Afterwards, face-to-face interviews were conducted with 5 people with at least 8 years of experience working in the energy field, and all processes were evaluated, and the difficulties experienced in these processes and performance tags were analyzed. In general, all employees in companies are familiar with the subject regarding the information on purchasing processes. According to this information, employees in the company know the following processes in order. Determining the needs, preparing the request form and technical specifications and submitting them for approval, obtaining budget plan approval, transferring the process to purchasing, collecting offers, selecting suppliers and products, completing purchasing approvals, placing the order, accepting the invoice and goods and submitting the invoice to accounting, and closing the file. The most basic issue in purchasing processes is the correct communication of product description and technical specifications by the units. Failure of the requesting officer to submit the correct technical specifications affects all processes from the beginning and leads to the failure to meet the purchases of goods and services in the purchasing processes. The most important of the critical factors affecting the performance in the purchasing process is that all units working in the company follow the work plans and projects systematically with each other. A project that cannot be planned correctly negatively affects the performance in the purchasing processes. The reason for this is the lack of sufficient time for market research, the increase in price due to the decrease in delivery time, the decrease in product/service quality, the disruption of project and business activities, etc.).

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Conflicts of Interest

The authors declare no conflicts of interest.

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