An Assessment Framework for Solar Cell Material Based on a Modified Fuzzy DEMATEL Approach

Chia-Chi Sun 1,* and Shih-Chi Chang 2,*

1 Department of International Business, Tamkang University, No.151, Yingzhuan Rd., New Taipei City 25137, Taiwan
2 Department of Business Administration, National Chang Hua University of Education, Bao-Shan Campus, No.2, Shi-Da Road, Changhua City 50007, Taiwan
* Correspondence: ccsun@mail.tku.edu.tw (C.-C.S.); 139866@gms.tku.edu.tw (S.-C.C.)

Abstract: We propose an evaluation system to choose appropriate materials for solar cells. A fuzzy DEMATEL information procedure was used for decision-making to gather information and analyze the causal relationship. These data acquired were partitioned into causal and impact bunches, empowering users to gather an improved understanding of the intelligent relationship among them, as well as making recommendations for changes to upgrade their general execution. The proposed approach can deliver a compelling fabric choice assessment with satisfactory criteria that fit the respondent’s discernment designs; particularly, these evaluation dimensions are interlaced. Recommendations are given to assist government authorities to plan a Taiwan solar cell industry approach and for industries to develop commerce techniques for improvement in the solar cell field.

Keywords: solar cell; material selection; evaluation system; fuzzy DEMATEL

1. Introduction

Innovation decision-making in technology-based endeavors must address four fundamental issues: What are the fundamental needs or client capacities that the firm will fulfill with its items and administrations? What innovation will be utilized to construct the items or convey the benefit? What is the source of that innovation? What dispersion instruments will be utilized to bring effectively created items to the commercial center? [1,2]. This paper presents material choice criteria for the permeable layer of thin-film solar cells utilizing an MCDM strategy, which incorporates a few procedures which permit rating of a run of criteria, positioning them with the suppositions of industry specialists [3,4].

The proposed modified fuzzy DEMATEL approach can analyze the basic variables for the solar cell industry in Taiwan. We offer a few preparatory experiences in the solar cell industry based on experimental data collected from the leading professionals in the solar cell industry. This strategy allows accumulating information to evaluate the basic variables and causal relationships between the sub-systems through a casual chart [5–8]. This assessment record framework for solar cell determination as a framework that incorporates causal connections between the influencing factors may be a better approach to illuminate that issue [9–15]. The components that impact solar cell determination are complicated, so the latent information is more robust than apparent information to create a choice [16–20]. The judgment of decision-makers is regularly given as crisp values, which lacks reflection of the dubiousness within the genuine world; subsequently, DEMATEL was created to address this issue [6,7]. The DEMATEL strategy can abuse latent information, such as master encounters and instinct [12,14], utilizing the slightest asset dedication and centers on the center driving calculation within the framework and the improvement direction, on which we will select the ideal solar cell material. Considering the effect of a causal relationship can more sensibly survey the significance of affecting variables and utilize the slightest asset commitment to illuminating a complicated issue when there are causal
connections between the influencing components, which viably and precisely give the organization the specified decision-making data. Hence, we illustrate that the DEMATEL different criteria assessment procedures are more suitable than the conventional strategy, giving professionals a profitable device to utilize in a fuzzy environment to illuminate material evaluation problems [18,20].

The Taiwan solar cell industry was selected as the case study, utilizing the connections between distinctive components to form a casual outline to distinguish the casual bunch and impact data, providing recommendations to Taiwan solar cell industry administrators.

2. Assessment Criteria Relevant to the Solar Cell Industry

This approach was designed to consider the basic variables in solar cell material selection to develop a coordinates plan and assessment strategy to select the ideal solar cell material.

2.1. Market Benefit

The first-level dimensions of market benefit are divided into four sub-dimensions: product life, competitive cost, market applications, market size.

*Product life:* Innovation is clearly in its lifecycle. This basis assesses the execution of solar cell innovation because it is imperative to know the probability of the innovation working persistently and unquestionably [21].

*Competitive price:* The viability of any component is decided by its supreme esteem, as well as by its relative esteem regarding the competition [22,23]. Estimating methodologies is a sometimes-overlooked portion of the showcasing blend, which can have an expansive effect on benefit, so it ought to be given the same consideration as advancement and publicizing techniques [24]. The next or lower cost can significantly alter net edges and deals volume, which by implication, influences other costs by diminishing capacity costs, for example, or creating openings for volume rebates with providers [22–24].

*Market applications:* Distinguish all partners for the application, that is, who should utilize it, how, where, and beneath what limitations the application will be utilized. What is imperative for them to work better, and how will the item help [25,26]? The client and subsequently, the industry demeanor or resistance toward item selection will depend upon items that require the client to alter their current mode of working, behavior, noteworthy learning or changing other current items or administrations [25,27,28]. Consequently, the appropriation will depend upon their characteristic reaction to these changes [26]. Acknowledgment is less demanding if the item complements the existing framework with extra benefits [26,29].

*Market size:* Market estimate conceivably plays a vital part in shaping and building an industry [30]. Numerous mechanical clients within the adjacent region can make an adequate request to empower providers to secure and use costly specialized apparatus [28,31].

2.2. Technological Ability

When evaluating a suitable material, various aspects must be considered: The superiority of technology, the possibility of acquiring the original technique, the reliability of the technique and technical personnel [32].

*Superiority of technology:* Does the solar cell material provide innovation inventively? Is the solar cell material associated innovation adequately troublesome to mimic by competitors? Is it possible for it to be a universal standard innovation [26,28,32]?

*Possibility of acquiring the original technique:* Does the residential innovation connected within the chosen system have competitive control? Might the localization rate of the associated advancement be higher in the near future [33–35]?

*Reliability of technique:* This premise surveys solar cell development, which may have been tried inside an inquire about an office or performed in pilot plants. Can it still be moved forward, or is it a cemented development [33]?
Technical personnel: Industries ought to endeavor to have more talented and specialized labor [36]. Instructors classify their programs by occupation, but the aptitudes utilized inside the work environment are characterized. Industry expertise centers are the lead substances for studying industry needs, creating an unused educational module, remaining in touch with industry boards, upgrading abilities benchmarks [36,37].

2.3. Government Policy

In the expansion of fulfilling desires related to the market benefit and innovative capacity to select the ideal solar cell material, government arrangements still must be tended to [27,32].

Training program: The program centers on updating the basic abilities of small and medium-sized undertakings (SMEs). Separate from catalyzing inter-firm systems and university-industry connections, industry forms may reinforce the motivating forces for SMEs to update their inner abilities [27].

Tax reduction: Assess the motivating forces that are routinely utilized to energize unused industry improvement. Solar cell arrangement dialogs are progressively concerned with the creation and rebuilding of assessing motivations [38,39], with assessing conclusions or credits advertised for a division of the costs of renewable vitality frameworks or gear introduced to homes and businesses [38–40].

Link with R&D programs: Might the chosen program exist in cooperation with the R&D program? Are there any clashes between the dispersal and the R&D programs? R&D collaboration is critical to complement the inquiry about assets of each institution, investigating establishing both basic and shared innovation improvement [41,42], colleges rule fundamental inquire about, and businesses commercialize the outcomes of R&D collaboration. R&D subsidizing comes from four sources, specifically, government, industry, private establishments, and abroad [43].

Consumer subsidy: The government gives a cost endowment straight to customers, which can impact the request, thereby progress the deals volume [44]. These are given in numerous ways, by really giving absent a great or benefit, utilizing government resources, property, or administrations at lower than the taken toll of arrangement, or by giving financial motivations to buy or utilize such products [44–50].

We construct the evaluation model using the literature review and interviews with specialists. We summarized and developed an assessment show with three measurements and twelve criteria that are most appropriate. Within the segments, this paper depicts the organizations where specialists are working and the interview topics that give essential data, summarizes the experts’ primary opinions about all subjects and after that classifies these conclusions into three measurements and twelve criteria that can be received as the auxiliary system for the consequent survey. In expansion to answering to the survey in building this assessment, the specialists have moreover given their proficient information and encounter. After interviewing the experts and reviewing the literature, the framework of this research includes three dimensions and twelve criteria evaluation criteria.

In common, these models contribute to show a set of conceivably critical components for solar industry materials evaluation [51–55].

3. Research Method

The solar cell business is anticipated to decrease due to the COVID-19 pandemic, whereby major choices regarding modern apparatus within the solar cell industry are likely to stop until the end of the year. After lockdown, numerous producers will confront issues in assembly due to supply chain disturbances caused by a period of stagnation amid the pandemic. Asian providers, especially, will face challenges in sloping up generation due to bottlenecks within the supply of a few key components and delays in conveyance. In this section, we outline this novel half breed assessment and determination using the Taiwanese solar cell industry as a case study.
(1) Define the quality factor characteristics and establish an evaluation scale

The assessment scale for causal relations and a pair-wise comparison of the quality variables is at that point built [54], according to the scale by Tzeng et al. [54], Matić et al. [55].

(2) Obtain interdependent data for all factors using an expert opinion method

These pair-wise comparisons between any two components are indicated by and given a number of 0–4: “No influence (0),” “Low influence (1),” “Medium influence (2),” “High influence (3),” “Very high influence (4),” separately [56–58].

(3) Calculate the arithmetic mean matrix

Let us use that the number of factors is \( n \), and the value is from \( K \) professionals who judge the factors based on the 0, 1, 2, 3, 4 five-level evaluation scale: \( Z_{ij}^{(k)} \) and \( X_{ij}^{(k)} \) represents this influence level of factor \( i \) to factor \( j \). Then, sum up and average all \( X_{ij}^{(k)} \) from \( K \) experts [56–58]. The formula is given below to calculate the arithmetic mean matrix.

(4) Calculate the casual matrix

The casual connection network and the total-relation lattice outline the interrelated effect on each calculation, as in the equation below [59]. The normalized direct-relation lattice could be obtained as \( \mathbf{X}^{(k)} \).

(5) Utilize the casual matrix

Let \( \mathbf{X}^{(k)} \) the quality of the given \( y \) calculate for the direct/indirect network \( T \), and \( i, j = 1, 2, \ldots, n \) [59]. Sum the columns and the columns of the casual matrix (\( T \)), as in the equation below. It incorporates the coordinate and the roundabout effect, which is the degree of the coordinate or the circuitous effect on the other variables. Once the normalized direct-relation \( \mathbf{X}^{(k)} \) is obtained, the total-relation matrix \( T \) can be calculated, guaranteeing the convergence of \( \lim_{w \to \infty} \mathbf{X}^w = 0 \). The casual matrix is as following Formulas (2) and (3) [60–62].

(6) Causal diagram

The causal graph is delineated in two dimensions, where the full \((\bar{R}_i + \bar{C}_j)\) is the level pivot, and the contrast \((\bar{R}_i - \bar{C}_j)\) is the vertical pivot, thereby rearranging the complex causal relation into an effectively justifiable visual structure to consider all the issues [62]. When \((\bar{R}_i - \bar{C}_j)\) is positive and over the x hub, the quality calculate \( m \) has a place to the sort of cause, but when \((\bar{R}_i - \bar{C}_j)\) is negative and underneath the x pivot, the quality figure has a place to the sort of result.
4. Research Results and Discussion

Twelve material selection variables for the solar cell industry in Taiwan. The primary stage included distinguishing how numerous qualities or criteria are included in solar cell material determination. The assessment constructed in segment 2 employing a writing survey and interviews with specialists in Taiwan’s solar cell industry distinguished three measurements and twelve criteria to assess solar cell material determination.

Fourteen specialists were invited to assess the criteria. This investigation was conducted by collecting observational information from several key specialists, including completely different businesses. The industry representation was ideal as all pertinent industry divisions and scholarly analysts (solar cell, electronic and mechanical investigator) were included. A fuzzy DEMATEL strategy was connected to capture the complex connections among these assessment criteria is shown in Figure 1.

Figure 1. Research evaluation framework.

| Goal               | Dimensions                  | Sub-Criteria                     |
|--------------------|-----------------------------|----------------------------------|
| Market Benefit     |                             | Product life                     |
|                    |                             | Competitive Price                |
|                    |                             | Various Applications             |
|                    | Technological Ability       | Market Size                      |
|                    |                             | Supervinity of technique         |
|                    |                             | Possibility of acquiring new/old technique |
|                    |                             | Reliability of technique         |
|                    |                             | Technical Personnel              |
|                    | Government Policy           | Training Programs                |
|                    |                             | Tax Reduction                    |
|                    |                             | Linkage with R&D programs        |
|                    |                             | Consumer Subsidy                 |

Step 1: Calculate the arithmetic mean matrix

This is also called the initial average matrix that utilizes data from the collected questionnaire to calculate the arithmetic mean matrix. By separately adding up all the interrelated factors for every aspect and then averaging their sum, we obtained the arithmetic mean matrix. Assume that the number of factors is \( n \), and the value is from \( K \) professionals who judge the factors based on the 0, 1, 2, 3, 4 five-level evaluation scale: \( X_{ij}^{(k)} \) and \( Z_{ij}^{(k)} \) \((i = 1, 2, 3, \ldots, n; j = 1, 2, 3, \ldots, n)\) represents the influence degree of factor \( i \) to factor \( j \). Then, sum up and average all \( X_{ij}^{(k)} \) from \( k \) experts. The calculation formula is given below
to calculate the \( n \times n \) arithmetic mean matrix. The arithmetic mean matrix framework was obtained for the first-level measurement:

\[
\tilde{Z}^1 = \begin{pmatrix}
(0,0,0) & (0.25,0.5,0.75) & (0.5,0.75,1) \\
(0.025,0.5) & (0,0) & (0.25,0.5) \\
(0.5,0.75,1) & (0.025,0.5) & (0,0)
\end{pmatrix}
\]

**Step 2: Normalizing the casual fuzzy matrix**

The linear scale change is utilized to convert the criteria scale into comparable scales. The normalizing the casual fuzzy matrix can be gotten as \( \tilde{X}^{(1)} \). It is expected that at slightest one \( i \) exists. The normalized arithmetic mean matrix was as follows:

\[
\tilde{X}^{(1)} = \begin{pmatrix}
(0.000,0.000,0.000) & (0.095,0.228,0.380) & (0.204,0.318,0.469) \\
(0.082,0.200,0.352) & (0.000,0.000,0.000) & (0.137,0.274,0.426) \\
(0.187,0.339,0.490) & (0.074,0.199,0.336) & (0.000,0.000,0.000)
\end{pmatrix}
\]

**Step 3: Establish and analyze the casual model**

After calculating normalizing the casual fuzzy matrix, the total-relation framework \( \tilde{T} \) can be got. The casual matrix could be ensured that the convergence of \( \lim_{w \to \infty} \tilde{X}^w = 0 \). Let \( X^{(k)}(k) \) be calculated for the direct/indirect network \( T \), and \( i, j = 1, 2, \ldots, n \). Add up the columns of the direct/indirect matrix \( \tilde{T} \).

\[
\tilde{T} = \begin{pmatrix}
(0.030,0.207,1.345) & (0.128,0.383,1.549) & (0.111,0.377,1.562) \\
(0.154,0.460,1.755) & (0.027,0.197,1.336) & (0.145,0.417,1.671) \\
(0.134,0.379,1.551) & (0.081,0.315,1.438) & (0.023,0.169,1.210)
\end{pmatrix}
\]

**Step 4: Utilize the causal matrix**

Table 1 portrays the coordinate and circuitous impacts of the three first-level measurements, and their casual connections are shown in the digraph in Figure 2. Table 2 shows that government policy is the net cause, while technological capacity and market benefit are the net recipients. Figure 2 demonstrates that government policy may be the foremost basic measurement, with technological capacity and market benefit influencing each other as well as being influenced by the innovative measurement. Figure 2 shows that "Government policy" was the most important factor that positively impacted the other dimensions.

Table 1. Sum of \( \tilde{R}_i \) value, \( \tilde{C}_i \) value, \( \tilde{R}_i + \tilde{C}_i \) value and \( \tilde{R}_i - \tilde{C}_i \) value impacts of the three measurements.

| Measurement          | \( \tilde{R}_i \) Value     | \( \tilde{C}_i \) Value     | \( \tilde{R}_i + \tilde{C}_i \) Value | \( \tilde{R}_i - \tilde{C}_i \) Value |
|----------------------|----------------------------|----------------------------|--------------------------------------|--------------------------------------|
| Market benefit       | (0.401,1.134,4.655)         | (0.373,1.134,4.655)         | (0.774,2.268,9.310)                  | (0.027,0.000,−0.001)                 |
| Technological ability| (0.302,1.010,4.363)         | (0.237,0.927,4.109)         | (0.539,1.937,8.472)                  | (0.064,0.083,0.255)                  |
| Government policy    | (0.359,1.124,4.576)         | (0.450,1.207,4.830)         | (0.809,2.331,9.407)                  | (−0.091,−0.084,−0.254)               |

Table 2. The sum \( \tilde{R}_i + \tilde{C}_i \) value and \( \tilde{R}_i - \tilde{C}_i \) value of the impacts of the three measurements.

| Measurement          | \( \tilde{R}_i + \tilde{C}_i \) Value | \( \tilde{R}_i - \tilde{C}_i \) Value |
|----------------------|--------------------------------------|--------------------------------------|
| Market benefit       | 3.376                                 | 0.006                                |
| Technological ability| 3.002                                 | 0.111                                |
| Government policy    | 3.456                                 | 5.684                                |
The causal associations among the three market benefit criteria are portrayed in Tables 3 and 4 and Figure 3. The causal associations among the three technological abilities appear in Tables 5 and 6 and Figure 4, with Tables 7 and 8 and Figure 5 summarizing the causal associations among the three government policy criteria.

The causal connections among the three second-level criteria of the market benefit are delineated in Tables 3 and 4 and Figure 3. The causal connections among the three second-level criteria of technological ability are shown in Tables 5 and 6 and Figure 4, with Tables 7 and 8 and Figure 5 summarizing the causal connections among the three second-level criteria of government policy.

Tables 3 and 4 delineate that different applications and market size measures are the net causes, though product life and competitive cost are the net recipients. Figure 3 shows that the market size measure may be the foremost basic measurement, with product life and competitive cost influenced by each other as well as by different applications and market sizes. Figure 3 shows that “Various applications” and “Market size” impacted “Product life” and “Competitive price”, respectively. In this analysis, “Market size” was the most important factor that positively impacted the other factors. Accordingly, it showed that in the market benefit sub-aspects, “Market size” was the key factor that impacted the other factors the most.

Table 3. The sum $\tilde{R}_i$ value, $\tilde{C}_i$ value, $\tilde{R}_i + \tilde{C}_i$ value and $\tilde{R}_i - \tilde{C}_i$ value impacts of the second-level criteria of the market benefit.

|                      | $\tilde{R}_i$ Value | $\tilde{C}_i$ Value | $\tilde{R}_i + \tilde{C}_i$ Value | $\tilde{R}_i - \tilde{C}_i$ Value |
|----------------------|---------------------|---------------------|-----------------------------------|-----------------------------------|
| Product life         | (0.230,0.785,4.782) | (0.223,0.776,5.048) | (0.453,1.561,9.830)               | (−0.008,0.010,−0.265)           |
| Competitive price    | (0.318,1.066,5.965) | (0.362,1.130,5.999) | (0.679,2.196,11.964)              | (−0.044,−0.064,−0.034)          |
| Various applications | (0.238,0.892,5.377) | (0.258,0.950,5.544) | (0.496,1.842,10.921)              | (−0.020,−0.058,−0.167)          |
| Market size          | (0.412,1.240,6.495) | (0.355,1.128,6.029) | (0.767,2.368,12.524)              | (0.056,0.112,0.466)            |
Table 4. The sum \((\bar{R}_i + \bar{C}_i)^{def} \) value and \((\bar{R}_i - \bar{C}_i)^{def} \) value of the impacts of the four criteria of the market benefit.

|                      | \(\bar{R}_i + \bar{C}_i \) Value | \(\bar{R}_i - \bar{C}_i \) Value |
|----------------------|----------------------------------|----------------------------------|
| Product life         | 2.991                            | -10.398                          |
| Competitive price    | 3.816                            | -0.065                           |
| Various applications | 3.383                            | 0.001                            |
| Market size          | 4.027                            | 0.169                            |

Figure 3. Graph of appearing causal relationship of the market benefit criteria.

Tables 5 and 6 show that the superiority of the technique, the possibility of acquiring an original technique, and reliability of the technique belong to net causes, though technical personnel belong to a net collector. Figure 4 shows that the reliability of the technique may be the foremost basic measurement. Figure 4 shows that “Reliability of technique”, “Possibility of acquiring original technique”, and “Superiority of technique” impacted “Technical personnel”, respectively. In this analysis, “Reliability of technique” was the most important factor that positively impacted the other factors. Accordingly, it showed that in the technological ability sub-aspects, “Reliability of technique” was the key factor that impacted the other factors the most.

Table 5. The sum of \(\bar{R}_i \) value, \(\bar{C}_i \) value, \(\bar{R}_i + \bar{C}_i \) value and \(\bar{R}_i - \bar{C}_i \) value impacts of the second-level criteria of the technological ability.

|                | \(\bar{R}_i \) Value | \(\bar{C}_i \) Value | \(\bar{R}_i + \bar{C}_i \) Value | \(\bar{R}_i - \bar{C}_i \) Value |
|----------------|----------------------|----------------------|----------------------------------|----------------------------------|
| Superiority of technique | (0.346,1.282,7.984) | (0.353,1.324,8.134) | (0.699,2.605,16.117) | (-0.006, -0.042, -0.150) |
| Possibility of acquiring original technique | (0.430,1.408,8.438) | (0.393,1.359,8.264) | (0.823,2.767,16.702) | (0.036,0.048,0.174) |
| Reliability of technique | (0.396,1.390,8.373) | (0.363,1.274,7.957) | (0.760,2.664,16.330) | (0.033,0.115,0.416) |
| Technical personnel | (0.341,1.242,7.841) | (0.405,1.364,8.281) | (0.746,2.606,16.122) | (-0.063, -0.122, -0.440) |
Table 6. The sum \((\tilde{R}_i + \tilde{C}_i)\) and \((\tilde{R}_i - \tilde{C}_i)\) of impacts of the three criteria of the technological ability.

|                          | \(\tilde{R}_i + \tilde{C}_i\) Value | \(\tilde{R}_i - \tilde{C}_i\) Value |
|--------------------------|--------------------------------------|-------------------------------------|
| Superiority of technique | 4.858                                | 0.004                               |
| Possibility of acquiring original technique | 5.070                                | 0.072                               |
| Reliability of technique | 4.937                                | 0.156                               |
| Technical personnel     | 4.863                                | 2.184                               |

Figure 4. Graph of appearing causal relationship of the technological ability criteria.

Tables 7 and 8 portray that training programs, tax reduction, and linkage with R&D programs are the net causes, though consumer subsidy could be a net recipient. Figure 5 indicates that training programs may be the foremost basic measurement. Figure 5 shows that “Training programs”, “Linkage with R&D programs”, and “Tax reduction Meet future mission” impacted “Consumer subsidy”, respectively. In this analysis, “Training programs” was the most important factor that positively impacted the other factors. Accordingly, it showed that in the government policy sub-aspects, “Training programs” was the key factor that impacted the other factors the most.

Table 7. The sum \(\tilde{R}_i\) value, \(\tilde{C}_i\) value, \(\tilde{R}_i + \tilde{C}_i\) value and \(\tilde{R}_i - \tilde{C}_i\) value impacts of the second-level criteria of the government policy.

|                          | \(\tilde{R}_i\) Value | \(\tilde{C}_i\) Value | \(\tilde{R}_i + \tilde{C}_i\) Value | \(\tilde{R}_i - \tilde{C}_i\) Value |
|--------------------------|------------------------|------------------------|------------------------------------|------------------------------------|
| Training programs        | (0.132,0.678,5.313)     | (0.180,0.669,4.898)     | (0.312,1.347,10.211)               | (−0.048,0.009,0.415)              |
| Tax reduction            | (0.203,0.687,5.083)     | (0.169,0.678,5.182)     | (0.372,1.366,10.265)               | (0.034,0.009,−0.100)              |
| Linkage with R&D programs| (0.201,0.755,5.428)     | (0.192,0.744,5.311)     | (0.393,1.500,10.739)               | (0.009,0.011,0.117)               |
| Consumer subsidy         | (0.162,0.588,4.586)     | (0.157,0.617,5.019)     | (0.319,1.204,9.605)                | (0.005,−0.029,−0.432)             |
Table 8. The sum $(\tilde{R}_i + \tilde{C}_i)$ value and $(\tilde{R}_i - \tilde{C}_i)$ value of impacts of the three criteria of the government policy.

|                          | $\tilde{R}_i + \tilde{C}_i$ Value | $\tilde{R}_i - \tilde{C}_i$ Value |
|--------------------------|----------------------------------|----------------------------------|
| Training programs        | 2.844                            | 0.076                            |
| Tax reduction            | 2.869                            | 0.037                            |
| Linkage with R&D programs| 3.041                            | 0.030                            |
| Consumer subsidy         | 2.643                            | -3.524                           |

Figure 5. Graph of appearing causal relationship of the government policy criteria.

This experimental approach endeavored to distinguish the major components for material selection within the solar cell industry utilizing the Taiwan solar cell industry as the case study. The investigation determined that the major causal measurement is government policy (D3); that is, the two measurements involve more improvement room for enhancement and comparison to other strengths, permitting businesses to create more distinctively and successfully. The committee determined that “market size” is the most causal measurement for solar cell material determination within the market benefit measurement (D1). Porter (1998) contended that an advanced domestic market is a vital component for competitive advantages, as companies that confront modern market applications offer prevalent items since the domestic market requests quality and the vicinity to such shoppers, empowering the firm to better meet clients’ needs. The reliability of the technique is the foremost basic factor for solar cell material determination within the technological ability measurement (D2). The quality of the gear, its upkeep, the solar cell framework plan, and how it is worked play major roles in reliability quality. The reliability quality of the solar cell framework is a basic measure for assessment. The specialists also demonstrated that the training program might be a significant and determinative component for solar cell industry material determination. Effective human asset capability is vital for a high-tech industry; hence, the training arrangement may be a productive arrangement device to move forward proficient abilities and capabilities.

5. Conclusions and Remarks

We take solar cell materials for our case purposes. Photovoltaics (PV) comprise the technology to convert sunlight directly into electricity. The term “photo” means light and “voltaic,” electricity. A photovoltaic (PV) cell, also known as a “solar cell,” generates electricity.
This study presents a solar cell material assessment for the solar cell industry. The DEMATEL technique can abuse latent information to the total, such as master encounters and instinctual. This thinks about too recognized the key calculate for deciding the ultimate sun oriented cell fabric choice both from strategy and reality information. The proposed technique employs the least resource dedication, centers on the center driving calculation within the framework, and recognizes the course of change for the determination of the ideal solar cell material. The components that impact solar cell material choice are complicated, so passive information is more solid than evident information in decision-making. The above-mentioned hypothetical models contribute to our understanding of material choice components. According to the interaction between major competencies of the fuzzy DEMATEL method, the managers can effectively manage in a cost-saving way, thereby increasing the competitive advantage of the solar cell industry.

The solar cell industry material determination comprises numerous connection components. This study showed that the government policy impact is of most concern, confirming the solar cell material determination system [57–60]. Future inquiries should apply this crossover to confirm its appropriateness to other rising advances. The proposed approach is appropriate for managing complicated choice issues with material determination criteria. With respect to the solar cell industry, policymakers must consider the key variables and their impacts on the other circuitous measurements. For the most part, enacting powerful components can more effortlessly result in enhancement, but circuitous components restrict commitments to ceaseless invigorating development. In this case, “government policy” is the most causal measurement which unequivocally coordinates influencers in all other measurements.

The results show that “Government policy” was the most important factor that positively impacted the other dimensions. The government ought to act as a catalyst, enabling companies to raise their objectives and move to higher levels of competitive execution [61]. They should energize companies to develop their execution, fortify early requests for progressed items, center on specialized calculate creation, and invigorate nearby competitions by constraining coordinate participation and implementing anti-trust directions. They should also provide the desired infrastructural needs for improvement [62,63], executing broker arrangements and preparing approaches. Broker approaches can back the foundation of relations between firms through the creation of stages for discourse [64–66], which promotes knowledge-enhancing organization relations through public-private associations, such as incubators, venture capital exercises, college research facilities, and other inquiry about research insertions. The presence of innovation incubators makes it simpler for scholarly staff to misuse knowledge-based commerce thoughts, hence overcoming the barriers that repress commercial coordinate application of scholarly investigation [67–71]. Incubators, regularly found between an inquiry about colleges and industry, progressively intercede development, and their representatives from academia and industry, and combine hones and proficient standards from both perspectives in their day-to-day work [72,73]. Rothschild and Darr [72] offer a complex show of the part of hatcheries to make strides eminent progress, proposing that the incubators serve as a bridge meddle the founded and industry, as well as a portion of a more extensive arrangement of advancement. Incubator laborers and supervisors exchange information and know-how between industry and colleges.

College research facilities and other investigation centers give firms with simpler get to logical skill and research, in this way, encouraging the exchange of information into commercial applications [74–76]. The role of colleges has progressively been considered, and they are imperative since their common mission is instruction and inquiry, as well as their potential to serve as hubs for business and science-industry exchange [77–79]. Venture capital can aid to overcome office and data issues among businesses, trailblazers, and agents. Venture capitalists enter a company as it were against a stake in proprietorship and an understanding to require a dynamic portion in administration [80,81]. Kou and Wu [74] contended that within the early arrangement of inventive firm improvement, potential
financial specialists contend with issues surveying the quality of a thought, which tends to depend on particular intangible resources (e.g., brand names, licenses, the brain or the stamina of the business visionary) or ventures (R&D, program or organizational alter), and the capacity of the venture to procure a finishing first-mover advantage relative to competing performing artists and items. Commerce victory at this organization may be doable with the engagement of dynamic and understanding speculators, who bring monetary value as well as non-financial resources such as significant encounters, business-related abilities, complementary systems, and observing capacity. Kou and Wu [74] highlight that venture capitalists can support the energetic organization by empowering the fast development of promising, high-risk youthful firms. In contrast, industrial systems can serve as a stage for the advancement of wander capital markets by making an environment in which numerous performing artists with complementary abilities can attempt modern thoughts and recognize unused accomplices. For the venture capital firm, the arrangement may frame prolific ground for obtaining or sending data and progressing business visionaries inside their field of specialization. Venture capital stores give administration rather than capital help. Once the undertaking is successful, they offer their holding within the company to create a benefit. Taiwan has built up a creative capital and bring forth environment, comprising a culture of entrepreneurial capacity [82,83]. Moreover, Taiwan’s entrepreneurial brooding education has effectively backed and hatched various solar cell companies.

The brokers are masters, but, in most cases, brokers work for workplaces presently serving small and medium sizes companies. Broker approaches point to enable value-enhancing trade and collaboration that would have been finished inside the nonappearance of exercises. The broker courses of action join the creation of stages, security of intellectual property rights, and back of knowledge-enhancing organizational linkage. The stage can cultivate industry improvement, not as it were, empowering and encouraging the development of mechanical systems but also underpins outside associations. In expansion, mental property changes may be changed to supply both the teacher and person analysts with a motivation to collaborate. The linkages of the industrial cluster give discharge time, as well as making potential learning and benchmarking openings within the industry.

Moreover, training programs are a critical part, and fruitful human asset capability is vital for the sun-oriented cell industry. Subsequently, the training arrangement may be a proficient arrangement apparatus for progressing proficient abilities and capabilities. Training arrangement centers update the abilities and competencies basic for compelling SME clusters. Government organizations need to make human resources, making a more talented and specialized labor oblige, and construct cluster aptitudes centers. Cluster aptitudes centers might end up as the lead substances for looking over industry needs, making unused educational programs, remaining in touch with cluster committees, overhauling aptitudes benchmarks, sharpening benchmarking in other places, and collecting information around cluster occupations and programs.

In this analysis, “Market size” was the most important factor that positively impacted the other factors. Accordingly, it showed that in the market benefit sub-aspects, “Market size” was the key factor that impacted the other factors the most. Market estimate conceivably plays the foremost critical part in shaping and building a solar cell industry. The market measure points to extend openness to modern thoughts and imaginative arrangements. One instrument for the market-side approach is open procurement. The government ought to increment the current cash stream of imaginative firms by buying more at higher costs, while to invigorate R&D and advancement in sectors that effortlessly raise outside capital, the government ought to commit to an arrangement that increments the imaginative firms’ future anticipated benefits, for illustration, by promising to purchase future imaginative products at higher costs. Government procurement ought to make costs, and amounts requested responsive to quality positioning alterations: top-quality items ought to be ensured prompt benefits while, for out of date products, the open buyer ought to deal for exceptionally competitive costs. Government consumption ought to diminish
anticipated profit. Market size conceivably plays the foremost critical part in shaping and building a solar cell industry. The market measure points to extend openness to unused thoughts and inventive arrangements. One instrument for the market-side approach is an open acquirement. Vaidogas and Šakienaitė [75] list a few perspectives that ought to be considered when building up an arrangement for acquirement for the industry’s development. To fortify R&D and advancement in financially obliged portions, the government has to increase the current cash stream of creative firms by buying more at higher costs, whereas to brace R&D and progression in portions that viably raise exterior capital, the government ought to commit to a course of action that increases the creative firms’ future expected benefits, for illustration, by promising to buy future innovative merchandise at higher costs. Government acquirement ought to make costs and sums asked responsive to quality situating modifications: top-quality things should be guaranteed speedy benefits whereas, for out of date merchandise, the open buyer ought to bargain for uncommonly competitive costs.

The solar cell material determination handle is composed of numerous connection components. A case considers of Taiwan selecting the foremost reasonable materials was actualized to illustrate the proposed crossbreed strategy. It can give enlightening and commonsense recommendations to the solar cell industry for assessing and selecting materials. A case study of the Taiwan solar cell industry selecting the most suitable materials was implemented to demonstrate the proposed hybrid method. It can give commonsense recommendations to the solar cell industry for assessing and selecting materials.

Different applications have noteworthy impacts on sun based cell materials evaluation. This appears that firms ought to center on whether the sun-powered cell fabric is congruous with their current esteem framework, past involvement and reliability with the degree of potential buyers. Compatibility has been recognized as a critical indicator for modern innovation acknowledgment. The dye-sensitized solar cells provide a technically and economically credible alternative concept to present-day p–n junction photovoltaic devices. Dye-sensitized solar cells have attracted a lot of interest in recent years. Dye-sensitized solar cells have the advantages of lower costs and lower energy consumption in production processes than poly-silicon solar cells.

Microcrystalline silicon (µc-Si:H) stored at moo temperatures (<250 °C) is an alluring fabric for sun-powered cell applications. Microcrystalline silicon (µc-Si:H) can be stored utilizing the same statement procedures utilized for shapeless silicon, but, compared to the last mentioned, it offers upgraded infrared retention and a moved forward solidness against light drenching. In any case, depending on the stated conditions and sort of substrates, microcrystalline silicon (µc-Si:H) may display different morphologies (grain estimate, shape, surface morphology, etc.). Careful fabric development control is hence required for ideal gadget execution.

GaAs features a precious structure comparable to that of silicon. An advantage of GaAs is that it has light assimilation. GaAs has higher vitality change effectiveness than crystal silicon, coming to almost 25 to 30%. GaAs is additionally prevalent in space applications where solid resistance to radiation harm and effectiveness are required.

Our research was collected in one industry, and there are outstanding contrasts between businesses, and the inquiry about discoveries may subsequently shift between nations. The proposed approach presents impediments in terms of the little test estimate, so future investigation should be conducted to test the appropriation variables displayed considering diverse strategies and larger test sizes.

Author Contributions: Conceptualization, C.-C.S.; methodology, C.-C.S.; software, C.-C.S.; validation, C.-C.S.; formal analysis, C.-C.S.; investigation, C.-C.S. and S.-C.C.; resources, C.-C.S. and S.-C.C.; data curation, C.-C.S. and S.-C.C.; writing—original draft preparation, C.-C.S.; writing—review and editing, C.-C.S.; visualization, C.-C.S.; supervision, C.-C.S.; project administration, C.-C.S. All authors have read and agreed to the published version of the manuscript.
Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

References
1. Miles, R.W.; Hynes, K.M.; Forbes, I. Photovoltaic solar cells: An overview of state-of-the-art cell development and environmental issues. Prog. Cryst. Growth Charact. Mater. 2005, 51, 1–42. [CrossRef]
2. Schimper, H.J.; Kollonitsch, Z.; Möller, K.; Seidel, U.; Bloech, U.; Schwarzburg, K.; Willig, F.; Hannappel, T. Material studies regarding InP-based high-efficiency solar cells. J. Cryst. Growth. 2006, 287, 642–646. [CrossRef]
3. Juang, W.S. A Practical Anonymous Payment Scheme for Electronic Commerce. Comput. Math. Appl. 2003, 46, 1787–1798. [CrossRef]
4. Kebede, K.Y.; Mitsufuji, T. Technological innovation system building for diffusion of renewable energy technology: A case of solar PV systems in Ethiopia. Technol. Forecast. Soc. Chang. 2017, 114, 242–253. [CrossRef]
5. Wu, W.W.; Lee, Y.T. Developing global managers' competencies using the fuzzy DEMATEL method. Expert Syst. Appl. 2007, 32, 499–507. [CrossRef]
6. Kuo, M.S. Optimal location selection for an international distribution center by using a hybrid method. Expert Syst. Appl. 2011, 38, 7208–7221. [CrossRef]
7. Hille, E.; Althammer, W.; Diederich, H. Environmental regulation and innovation in renewable energy technologies: Does the policy instrument matter. Technol. Forecast. Soc. Chang. 2020, 153, 119. [CrossRef]
8. Li, H.; Wang, W.; Fan, L.; Li, Q.; Chen, X. A novel hybrid MCDM model for machine tool selection using fuzzy DEMATEL, entropy weighting and later defuzzification VIKOR. Appl. Soft Comput. 2020, 91, 106207. [CrossRef]
9. Yu, X.B.; Lu, Y.Q.; Yu, X. Evaluating Multiobjective Evolutionary Algorithms Using MCDM Methods. Math. Probl. Eng. 2018, 2018, 9751783. [CrossRef]
10. Ding, X.F.; Liu, H.C. A 2-dimension uncertain linguistic DEMATEL method for identifying critical success factors in emergency management. Appl. Soft Comput. 2018, 71, 386–395. [CrossRef]
11. Jiang, S.; Shi, H.; Lin, W.; Liu, H.C. A large group linguistic Z-DEMATEL approach for identifying key performance indicators in hospital performance management. Appl. Soft Comput. 2020, 86, 105900. [CrossRef]
12. Chen, C.H.; Tzeng, G.H. Creating the aspired intelligent assessment systems for teaching materials. Expert Syst. Appl. 2011, 38, 12168–12179. [CrossRef]
13. Chen, F.H.; Hsu, T.S.; Tzeng, G.H. A balanced scorecard approach to establish a performance evaluation and relationship model for hot spring hotels based on a hybrid MCDM model combining DEMATEL and ANP. Int. J. Hosp. Manag. 2011, 30, 908–932. [CrossRef]
14. Rostamzadeh, R.; Govindan, K.; Esmaeili, A.; Sabaghi, M. Application of fuzzy VIKOR for evaluation of green supply chain management practices. Ecol. Indic. 2015, 49, 188–203. [CrossRef]
15. Wang, F.K.; Hsu, C.H.; Tzeng, G.H. Applying a Hybrid MCDM Model for Six Sigma Project Selection. Math. Probl. Eng. 2014, 2014, 730934. [CrossRef]
16. Hu, H.Y.; Chiu, S.I.; Cheng, C.C.; Yen, T.M. Applying the IPA and DEMATEL models to improve the order-winner criteria: A case study of Taiwan’s network communication equipment manufacturing industry. Expert Syst. Appl. 2011, 38, 9674–9683. [CrossRef]
17. Ho, W.R.J.; Tsai, C.L.; Tzeng, G.H.; Fang, S.K. Combined DEMATEL technique with a novel MCDM model for exploring portfolio selection based on CAPM. Expert Syst. Appl. 2011, 38, 16–25.
18. Govindan, K.; Paam, P.; Ahtub, A. A fuzzy multi-objective optimization model for sustainable reverse logistics network design. Ecol. Indic. 2016, 67, 753–768. [CrossRef]
19. Chen, Z. Evaluating Sustainable Liveable City via Multi-MCDM and Hopfield Neural Network. Math. Probl. Eng. 2020, 4189527. [CrossRef]
20. Kalbar, P.P.; Birkved, M.; Karmakar, S.; Nygaard, S.E.; Hauschild, M. Can carbon footprint serve as proxy of the environmental burden from urban consumption patterns. Ecol. Indic. 2017, 74, 109–118. [CrossRef]
21. Chen, W.C.; Lin, Y.F.; Liu, K.P.; Chang, H.P.; Wang, L.Y.; Tai, P.H. A Complete MCDM Model for NPD Performance Assessment in an LED-Based Lighting Plant Factory. Math. Probl. Eng. 2018, 2018, 7049208. [CrossRef]
22. Charters, W.W.S. Solar energy: Current status and future prospects. Energy Policy 1991, 19, 738–741. [CrossRef]
23. Malhotra, A.; Schmidt, T.S.; Huenteler, J. The role of inter-sectoral learning in knowledge development and diffusion: Case studies on three clean energy technologies. Technol. Forecast. Soc. Chang. 2019, 146, 464–487. [CrossRef]
24. Sovacool, B.K.; D’Agostino, A.L.; Bambawale, M.J. The socio-technical barriers to Solar Home Systems (SHS) in Papua New Guinea: “Choosing pigs, prostitutes, and poker chips over panels. Energy Policy 2011, 39, 1532–1542. [CrossRef]
25. Frondel, M.; Ritter, N.; Schmidt, C.M. Germany’s solar cell promotion: Dark clouds on the horizon. Energy Policy 2008, 36, 4198–4204. [CrossRef]
26. Smestad, G.P.; Krebs, F.C.; Granqvist, C.G.; Chopra, K.L.; Mathew, X.; Gordon, I.; Lampert, C.M. Priority publishing in Solar Energy Materials and Solar Cells. Sol. Energy Mater. Sol. Cells. 2010, 94, 1187–1190. [CrossRef]
27. Kolodinski, S.; Werner, J.H.; Queisser, H.J. Quantum efficiencies exceeding unity in silicon leading to novel selection principles for solar cell materials. Sol. Energy Mater. Solid Cells. 1994, 33, 275–285. [CrossRef]
28. Takeda, Y.; Wakahara, A.; Sasaki, A. Calculation of photovoltaic characteristics and materials selection for low-band-gap cells of multi-structure solar cell system. Sol. Energy Mater. Sol. Cells. 1992, 26, 85–98. [CrossRef]
29. Liu, R.X.; Xie, S.M. Innovation Management and Industrial Engineering. In Proceedings of the 2009 International Conference on Information Management, Washington, DC, USA, 26–27 December 2010; pp. 375–379.
30. Jacobsson, S.; Lauber, V. The politics and policy of energy system transformation-explaining the German diffusion of renewable energy technology. Energy Policy 2006, 34, 256–276. [CrossRef]
31. Fernandez, A.I.; Martinez, M.; Segarra, M.; Martorell, I.; Cabeza, L.F. Selection of materials with potential in sensible thermal energy storage. Sol. Energy Mater. Sol. Cells. 2010, 94, 1723–1729. [CrossRef]
32. Gupta, N. Material selection for thin-film solar cells using multiple attribute decision making approach. Mater. Des. 2011, 32, 1667–1671. [CrossRef]
33. Hillhouse, H.W.; Beard, M.C. Solar cells from colloidal nanocrystals: Fundamentals, materials, devices, and economics. Curr. Opin. Colloid Interface Sci. 2009, 14, 245–259. [CrossRef]
34. Rahm, D. US public policy and emerging technologies: The case of solar energy. Energy Policy 1993, 21, 374–384. [CrossRef]
35. Schoijet, M. Possibilities of new materials for solar photovoltaic cells. Solar Energy Mater. 1979, 1, 43–57. [CrossRef]
36. Kadir, M.Z.A.A.; Rafeeu, Y.; Adam, N.M. Prospective scenarios for the full solar energy development in Malaysia. Renew. Sustain. Energy Rev. 2010, 14, 3023–3031. [CrossRef]
37. Matin, M.A.; Aliyu, M.M.; Quadery, A.H.; Amin, N. Prospects of novel front and back contacts for high efficiency cadmium telluride thin film solar cells from numerical analysis. Sol. Energy Mater. Sol. Cells 2010, 94, 1496–1500. [CrossRef]
38. Azzopardi, B.; Mutale, J. Life cycle analysis for future photovoltaic systems using hybrid solar cells. Renew. Sustain. Energy Rev. 2010, 14, 1130–1134. [CrossRef]
39. Huang, Y.; Porter, A.L.; Zhang, Y.; Lian, X.; Guo, Y. An assessment of technology forecasting: Revisiting earlier analyses on dye-sensitized solar cells (DSSCs). Technol. Forecast. Soc. Chang. 2019, 146, 831–843. [CrossRef]
40. Baker, E.; Chon, H.; Keisler, J. Advanced solar R&D: Combining economic analysis with expert elicitation to inform climate policy. Energy Econ. 2009, 31, 37–49.
41. Laleman, R.; Albrecht, J.; Dewulf, J. Life Cycle Analysis to estimate the environmental impact of residential photovoltaic systems in regions with a low solar irradiation. Renew. Sustain. Energy Rev. 2011, 15, 267–281. [CrossRef]
42. Li, X.; Xie, Q.; Jiang, J.; Zhou, Y.; Huang, L. Identifying and monitoring the development trends of emerging technologies using patent analysis and Twitter data mining: The case of perovskite solar cell technology. Technol. Forecast. Soc. Chang. 2019, 146, 687–705. [CrossRef]
43. Parida, B.; Injyan, S.; Goic, R. A review of solar photovoltaic technologies. Renew. Sustain. Energy Rev. 2011, 15, 1625–1636. [CrossRef]
44. Delucchi, M.A.; Jacobson, M.Z. Providing all global energy with wind, water, and solar power, Part II: Reliability, system and transmission costs, and policies. Energy Policy 2011, 39, 1170–1190. [CrossRef]
45. Huang, Y.H.; Wu, J.H. Technological system and renewable energy policy: A case study of solar photovoltaic in Taiwan. Renew. Sustain. Energy Rev. 2007, 11, 345–356. [CrossRef]
46. Sarkar, B.; Omair, M.; Choi, S.B. A Multi-Objective Optimization of Energy, Economic, and Carbon Emission in a Production Model under Sustainable Supply Chain Management. Appl. Sci. 2018, 8, 1744. [CrossRef]
47. Turskis, Z.; Urbonas, K.; Daniunas, A. A Hybrid Fuzzy Group Multi-Criteria Assessment of Structural Solutions of the Symmetric Frame Alternatives. Symmetry 2019, 11, 261. [CrossRef]
48. Chen, H.M.W.; Chou, S.Y.; Luu, Q.D.; Yu, T.H.K. A Fuzzy MCDM Approach for Green Supplier Selection from the Economic and Environmental Aspect. Math. Probl. Eng. 2016, 2016, 809786.
49. Wu, W.W. Choosing knowledge management strategies by using a combined ANP and DEMATEL approach. Expert Syst. Appl. 2008, 35, 828–835. [CrossRef]
50. Lin, Y.T.; Yang, Y.H.; Kang, J.S.; Yu, H.C. Using DEMATEL method to explore the core competences and causal effect of the IC design service company: An empirical case study. Expert Syst. Appl. 2011, 38, 6262–6268. [CrossRef]
51. Falqi, I.I.; Ahmed, M.; Mallick, J. Silicate Concrete Materials Management for Sustainability Using Fuzzy-TOPSIS Approch. Appl. Sci. 2019, 9, 3457. [CrossRef]
52. Wang, P.; Li, Y.; Wang, Y.H.; Zhu, Z.Q. A New Method Based on TOPSIS and Response Surface Method for MCDM Problems with Interval Numbers. Math. Probl. Eng. 2015, 2015, 938535. [CrossRef]
53. Lu, Y.; Jin, C.; Qiu, J.; Jiang, P. Using a Hybrid Multiple-Criteria Decision-Making Technique to Identify Key Factors Influencing Microblog Users’ Diffusion Behaviors in Emergencies: Evidence from Generations Born after 2000. Symmetry 2019, 11, 265. [CrossRef]
54. Tseng, G.H.; Chiang, C.H.; Li, C.W. Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL. Expert Syst. Appl. 2007, 32, 1028–1044. [CrossRef]
55. Matić, B.; Jovanović, S.; Das, D.K.; Zavadskas, E.K.; Stević, Ž.; Sremac, S.; Marinković, M. A New Hybrid MCDM Model: Sustainable Supplier Selection in a Construction Company. Symmetry 2019, 11, 353. [CrossRef]
56. Wang, C.Y.; Tsai, P.H.; Zheng, H. Constructing Taipei City Sports Centre Performance Evaluation Model with Fuzzy MCDM Approach Based on Views of Managers. Math. Probl. Eng. 2013, 2013, 138546. [CrossRef]
57. Wu, H.H.; Tsai, N. A DEMATEL method to evaluate the causal relations among the criteria in auto spare parts industry. *Appl. Math. Comput.* 2011, 218, 2334–2342. [CrossRef]
58. Wu, H.H.; Chen, H.K.; Shieh, J.I. Evaluating performance criteria of Employment Service Outreach Program personnel by DEMATEL method. *Expert Syst. Appl.* 2010, 37, 5219–5223. [CrossRef]
59. Nie, R.X.; Wang, J.Q.; Zhang, H.Y. Solving Solar-Wind Power Station Location Problem Using an Extended Weighted Aggregated Sum Product Assessment (WASPAS) Technique with Interval Neutrosophic Sets. *Symmetry* 2017, 9, 106. [CrossRef]
60. Zhou, Q.; Huang, W.; Zhang, Y. Identifying critical success factors in emergency management using a fuzzy DEMATEL method. *Saf. Sci.* 2010, 49, 243–252. [CrossRef]
61. Bausys, R.; Kazakeviciute-Januskeviciene, G. Qualitative Rating of Lossy Compression for Aerial Imagery by Neutrosophic WASPAS Method. *Symmetry* 2021, 13, 273. [CrossRef]
62. Mishima, T.; Taguchi, M.; Sakata, H.; Maruyama, E. Development status of high-efficiency HIT solar cells. *Sol. Energy Mater. Sol. Cells.* 2011, 95, 18–21. [CrossRef]
63. Mohamed, A.R.; Lee, K.T. Energy for sustainable development in Malaysia: Energy policy and alternative energy. *Energy Policy* 2006, 34, 2388–2397. [CrossRef]
64. Rehman, A.; Shekhovtsov, A.; Rehman, N.; Faizi, S.; Salabun, W. On the Analytic Hierarchy Process Structure in Group Decision-Making Using Incomplete Fuzzy Information with Applications. *Symmetry* 2021, 13, 609. [CrossRef]
65. Mian, S.A. Assessing value-added contributions of university technology business incubators to tenant firms. *Res. Policy* 1996, 25, 325–335. [CrossRef]
66. Mian, S.A. Assessing and managing the university technology business incubator: An integrative framework. *J. Bus. Ventur.* 1997, 12, 251–285. [CrossRef]
67. Colombo, M.G.; Delmastro, M. How effective are technology incubators? Evidence from Italy. *Res. Policy.* 2002, 31, 1103–1122. [CrossRef]
68. Chou, C.C.; Ding, J.F. Application of an Integrated Model with MCDM and IPA to Evaluate the Service Quality of Transshipment Port. *Math. Probl. Eng.* 2013, 2013, 657657. [CrossRef]
69. Mahmood, T.; Ahmmed, J.; Ali, Z.; Pamucar, D.; Marinkovic, D. Interval Valued T-Spherical Fuzzy Soft Average Aggregation Operators and Their Applications in Multiple-Criteria Decision Making. *Symmetry* 2021, 13, 829. [CrossRef]
70. Lumpkin, J.R.; Ireland, D.R. Screening practices of new business incubators: The evaluation of critical success factors. *Am. J. Small Bus.* 1988, 12, 59–81. [CrossRef]
71. Liu, L.Q.; Wang, Z.X.; Zhang, H.Q.; Xue, Y.C. Solar energy development in China-A review. *Renew. Sustain. Energy Rev.* 2010, 14, 301–311. [CrossRef]
72. Rothschild, L.; Darr, A. Technological incubators and the social construction of innovation networks: An Israeli case study. *Technovation* 2005, 25, 59–67. [CrossRef]
73. Pearce, J.M. Expanding photovoltaic penetration with residential distributed generation from hybrid solar photovoltaic and combined heat and power systems. *Energy* 2009, 34, 1947–1954. [CrossRef]
74. Kou, G.; Wu, W. An Analytic Hierarchy Model for Classification Algorithms Selection in Credit Risk Analysis. *Math. Probl. Eng.* 2014, 2014, 297563. [CrossRef]
75. Vaidogas, E.R.; Šakėnaitė, J. Solving the Problem of Multiple-Criteria Building Design Decisions with respect to the Fire Safety of Occupants: An Approach Based on Probabilistic Modelling. *Math. Probl. Eng.* 2015, 2015, 792658. [CrossRef]
76. Carpenter, R.; Petersen, B. Capital Market Imperfections, High-Tech Investment, and New Equity Financing. *Econ. J.* 2002, 477, 54–72. [CrossRef]
77. Chang, P.L.; Shih, H.Y. The innovation systems of Taiwan and China: A comparative analysis. *Technovation* 2004, 24, 529–539. [CrossRef]
78. Gul, M.; Guneri, A.F. Hospital Location Selection: A Systematic Literature Review on Methodologies and Applications. *Math. Probl. Eng.* 2021, 2021, 6682958. [CrossRef]
79. Admati, A.; Pfleiderer, P. Robust Financial Contracting and the Role of Venture Capitalists. *J. Financ.* 1994, 49, 371–402. [CrossRef]
80. Ye, J.; Du, S.; Yong, R. Similarity Measures between Intuitionistic Fuzzy Credibility Sets and Their Multicriteria Decision-Making Method for the Performance Evaluation of Industrial Robots. *Math. Probl. Eng.* 2021, 2021, 6630898. [CrossRef]
81. Huang, C.Y.; Shyu, J.Z.; Tzeng, G.H. Reconfiguring the innovation policy portfolios for Taiwan’s SIP Mall industry. *Technovation* 2007, 27, 744–765. [CrossRef]
82. Kumar, R.; Rosen, M.A. Performance evaluation of a double pass PV/T solar air heater with and without fins. *Appl. Therm. Eng.* 2011, 31, 1402–1410. [CrossRef]
83. Viana, T.S.; Rüther, R.; Martins, F.R.; Pereira, E.B. Assessing the potential of concentrating solar photovoltaic generation in Brazil with satellite-derived direct normal irradiation. *Sol. Energy* 2011, 85, 486–495. [CrossRef]