Decision-Making Method for the Evaluation of Success Factors of ABET Accreditation

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Abstract: - ABET (Accreditation Board for Engineering and Technology), formerly known as the Accreditation Board for Engineering and Technology, accredits university programs in computers, engineering, and engineering technology. Although ABET accreditation is optional, graduates of programs with this accreditation are regarded as having knowledge, attitudes, and behaviours that are comparable to those of other countries. The ABET Accreditation process has always been quite structured and methodical. It has helped identify and fix any inadequacies by comparing different engineering and computer programs to worldwide standards. The Decision Making Trial and Evaluation Laboratory (DEMATEL) approach was used in this study to ascertain the relative value of the ABET process's success elements. An application case study, conducted at a Turkish institution, serves as an illustration.

Key-Words: - ABET, Accreditation, Decision Making, Decision Support Systems, DEMATEL, Success Factors.

1 Introduction

A review process called accreditation is used to ascertain whether educational programs are up to certain quality criteria. Accreditation is not permanent after it has been obtained; it must be renewed on a regular basis to guarantee that the educational program's quality is upheld. A team of qualified professionals from academia or industry traditionally conducts an external quality evaluation as the process of academic accreditation's conclusion. These professionals give of their time, expertise, and professional knowledge to this process of quality control and constant improvement of education in their respective fields.

There are many types of accreditations that audit institutions, individuals, departments, and organizations in a certain framework and determine their eligibility. Some of these are; ABET (Accreditation Board for Engineering and Technology), ASIIN (Accreditation Agency for Degree Programs in Engineering, Informatics, Natural Sciences and Mathematics), FIBAA (Foundation for International Business Administration Accreditation), AQAS (Agency for Quality Assurance through Accreditation of Study Programs).

University programs in applied and natural sciences, computers, engineering, and engineering technology are accredited by ABET, formerly known as the Accreditation Board for Engineering and Technology. ABET is a nonprofit organization with ISO 9001 certification and it is not a form of ranking. It is regarded as proof that a program complies with the requirements established by its technical profession on a global scale and it only provides program accreditation while being invalid for degrees, departments, colleges, organizations, or individuals. They additionally offer customized accreditation for post-secondary programs within degree-granting institutions that have been granted international, national, or provincial institutional accreditation, [1]. ABET provides assurance that a university program meets the quality standards of the profession for which that program prepares graduates. The key points about ABET accreditation are as follows. Global Recognition: While ABET is based in the United States, its accreditation is recognized globally. Programs in countries outside of the U.S. seek ABET accreditation to signify that their programs meet international standards of quality. Program-Specific Accreditation: ABET accredits specific programs within an institution, rather than accrediting the institution as a whole, which means that in a university, some of the programs can be ABET-accredited while the others cannot. Peer Review Process: The accreditation process involves a rigorous review by professionals and academics in the relevant disciplines. They assess program curricula, faculty, facilities, and institutional support against established

criteria. Continuous Improvement: Programs seeking ABET accreditation must demonstrate that they continuously make improvements to their curriculum and resources to ensure students are receiving an education that meets the evolving standards of the profession. Benefits to Graduates: Graduating from an ABET-accredited program can enhance employment opportunities since many employers require or prefer graduates from accredited programs. It also ensures a certain level of education quality and readiness for professional practice. Periodic Review: Accreditation is not permanent; programs must periodically seek re-accreditation to ensure they continue to meet quality standards, [2].

The ABET Accreditation process has always been quite structured and methodical. It has helped identify and fix any inadequacies by comparing different engineering and computer programs to worldwide standards. The Decision Making Trial and Evaluation Laboratory (DEMATEL) technique is introduced in this work to ascertain the relative value of the ABET process's success elements. The study's following sections are arranged as follows. In Section 2, DEMATEL is described. The case study is illustrated in Section 3. In the concluding section, there are conclusions.

2 Dematel Method

The DEMATEL technique was developed in 1972–1976 in Geneva by the Science and Human Affairs Program at the Battelle Memorial Institute, [3]. The DEMATEL method allows the decision-maker to understand the relationships among different criteria via a network relationship map, [4].

The DEMATEL is a systematic methodology that is utilized in management and operations research to model, analyze, and solve difficult problems. It's a useful method in many domains, including project management, decision-making, risk assessment, and environmental management. The DEMATEL method handles and makes sense of complex, interrelated systems, which makes it an invaluable tool in strategic planning and systemic analysis.

The steps of the DEMATEL method are as follows, [4]:
1. Problem Definition and Criteria Selection
   Initially, the decision-making problem is clearly defined, and the criteria or factors that affect the decision are identified. These criteria can be challenges, objectives, or any variables that have a significant impact on the problem.
2. Evaluation and Interaction
   Decision-makers evaluate the degree to which each criterion influences or is influenced by other

criteria. This is usually achieved through surveys or expert assessments where decision-makers rate the influence on a scale (e.g., 0 to 4, where 0 means no influence and 4 means very high influence).
3. Creating the Direct-Relation Matrix
   The evaluations are compiled into a direct-relation matrix A. This matrix represents the direct influences among all pairs of criteria. The elements a_{ij} of the matrix A show how each factor i directly affects each factor j, as determined by a decision-maker.
4. Normalization
   The direct-relation matrix is normalized to ensure that the sum of its elements does not exceed a certain threshold, typically 1. This step is crucial for maintaining the consistency of the analysis. By using (1) to normalize the matrix A, the matrix D is created, [5].

$$D = s.A, \qquad (1)$$

where

$$s = min\left[\frac{1}{max_{1 \le i \le n}\sum_{j=1}^{n}|a_{ij}|}, \frac{1}{max_{1 \le i \le n}\sum_{i=1}^{n}|a_{ij}|}\right] \qquad (2)$$

5. Calculating the Total-Relation Matrix
   Through matrix operations, the total-relation matrix is calculated from the normalized direct-relation matrix. This matrix shows not only the direct but also the indirect influences among the criteria. The total relation matrix T is defined as $T = D(I - D)^{-1}$ where I is the identity matrix.
   Define r and c as the complete relation matrix T's row and column sums, respectively, as n x 1 and 1 x n vectors. In matrix T, if r_i is the sum of the ith row, then r_i displays the direct and indirect impacts that factor i has on the other factors. When the symbol c_j represents the total of the jth column in matrix T, it indicates that component j has both direct and indirect effects on c_j from the other factors, [6].
6. Analysis
   The total-relation matrix is analyzed to derive the prominence and relation of criteria. Criteria are then classified into two groups: those that mostly influence other criteria (called "cause" group) and those that are mostly influenced by other criteria (called "effect" group).
7. Decision Making
   Based on the analysis, decision-makers can identify key drivers and barriers within the system, allowing them to prioritize interventions, allocate resources efficiently, and make informed decisions to address the problem.

Using the DEMATEL technique to solve a decision-making problem gives the decision-maker access to the relevance weights of the criteria as well as the opportunity to see how they interact.

3 Case Study

The DEMATEL approach for assessing the ABET process's success elements is presented in this paper. The case study is carried out using the perspectives of three professors at a Turkish institution. First, success factors that are determined by discussing the decision makers are explained in Table 1, [7].

Table 1. Success Factors of ABET, [6]

Label	Factor	Explication
C_1	Students	Creating admissions, advancement, and graduation policies and ensuring their effective implementation are all part of student management.
C_2	Program educational objectives	Program educational objectives must be stated in writing and aligned with the institution's mission, the needs of the program's diverse constituents, and these standards.
C_3	Continuous quality improvement	ABET accreditation requires programs to continuously assess and improve their quality. This process ensures that the programs evolve with advancements in the field and maintain relevance to current and future technical challenges.
C_4	Quality steering team and leader	A quality steering team is required for each program to guarantee the long-term adoption of quality, as evidenced by the literature.
C_5	Document orientation and knowledge-sharing culture	The purpose of documentation should be to enable many agencies and stakeholders to have a sufficient level of common understanding.
C_6	Academic and research excellence	Ensuring academic quality is the program's most essential component. To address the need for outcome-based learning, effective synergy between program design and delivery is necessary.
C_7	Top management support	Adoption of innovation, quality, and sustainability initiatives requires a huge amount of effort and resources. Endorsements and full-hearted support from top management become essential to accommodate required organizational changes and commitment of resources.

To employ the DEMATEL method, a group of four experts reached a consensus and they provided

the influence of each criterion i exerts on each factor j of the others, using an integer scale shown in Table 2.

Table 2. Influence Degrees

No influence	0
Very low influence	1
Low influence	2
High influence	3
Very high influence	4

The initial direct influence matrix is represented in Table 3.

Table 3. Initial Direct Influence Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7
C_1	0	0	4	0	0	0	0
C_2	4	0	3	0	0	0	0
C_3	0	2	0	2	0	0	0
C_4	1	0	0	0	1	0	2
C_5	0	1	0	0	0	0	0
C_6	0	0	0	0	0	0	0
C_7	0	0	0	4	0	0	2

ABET success factors' importance degrees are determined in Table 4.

Table 3. ABET Success Factors' Importance Degrees

Success Factor	Importance Degree
C_1	0.17
C_2	0.20
C_3	0.22
C_4	0.15
C_5	0.04
C_6	0.03
C_7	0.19

The results show that continuous quality improvement is the most important success factor. Document orientation and knowledge sharing culture and academic and research excellence factors have lower effects on the success of the ABET process.

4 Conclusions

The managerial implications of ABET (Accreditation Board for Engineering and Technology) accreditation extend beyond the academic realm, affecting various aspects of university administration, departmental management, and broader educational policy. ABET's rigorous standards and continuous improvement criteria have significant impacts on how programs are designed, delivered, and evaluated. Some key managerial implications of ABET accreditation are as follows:

Resource Allocation: ABET accreditation often requires programs to invest in high-quality facilities, laboratory equipment, and information resources. In view of these requirements and the need to address

other institutional priorities, managers and administrators have to be cost-effective in the use of resources, [8].

Faculty Development: ABET standards on the other hand and particularly those pertaining to the enhancement of the educational processes will necessitate such institutions providing for the training and motivation of staff. This is not only helping the teacher in professional enhancement about the subject which is their specialization only but also in effective teaching strategies that will result in desirable child outcomes, [9].

Assessment and Evaluation: An important component of ABET accreditation is the proposition of a systematic approach to assessing and evaluating student outcomes and using the results for continuous improvement. This requires significant managerial effort to develop and maintain an effective assessment process, collect and analyze data, and implement changes based on findings.

Strategic Planning: ABET accreditation aligns with the strategic planning of the institution, specifying quality, relevance, and continuous improvement. Managers must integrate accreditation goals with strategic objectives to ensure that the program not only meets accreditation standards but also contributes to the institution's overall mission and vision, [10].

Transparency and Communication: Managing ABET accreditation requires transparent communication with all stakeholders. This includes clearly articulating the value of ABET accreditation, the standards and expectations for faculty and students, and the benefits of continuous improvement efforts.

Overall, ABET accreditation has broad managerial implications, requiring a proactive and strategic approach to leadership, resource management, and stakeholder engagement.

In this study, the criteria that affect the success of achieving the accreditation are determined through a literature survey and the importance weights of these success factors are computed DEMATEL method. "Continuous quality improvement" and "Program educational objectives" are specified as the most important ABET criteria. "Document orientation and knowledge sharing culture" and "academic and research excellence" are the least influential criteria. Developing a multi-criteria decision-making based selection process for determining whether a university may achieve ABET or not will be the subject of future research.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process
During the preparation of this work the authors used Chat GPT in order to edit English language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

The authors equally contributed to the present research, at all stages from the formulation of the problem to the final findings and solution.

Conflict of Interest

The authors have no conflicts of interest to declare.