

## Presenting a Model of Factors Influencing Business Competitiveness in the Petrochemical Industry

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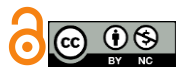
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### ABSTRACT

**Objective:** Competitiveness at the organizational level is a concept that numerous theories have addressed, each proposed by different researchers from diverse perspectives. In a market-based economy, firms compete with each other to attract more customers, continually monitoring each other's behaviors and adopting various strategies to achieve success. Consequently, competition drives firms to perform optimally, produce high-quality goods, and provide services at the lowest possible cost. This study aims to examine and identify the components of a competitiveness model in the petrochemical industry and ultimately design and present a relevant model to foster growth in this sector.

**Methodology:** By using an integrated approach to implement the DEMATEL and ISM methods for constructing the reachability matrix instead of using the SSIM matrix, the outputs of the DEMATEL method (T matrix) were relied upon.

**Findings:** For forming the reachability matrix, values smaller than the threshold in the T matrix were considered insignificant relationships (equivalent to zero), and values larger than the threshold (significant relationships) were considered equivalent to one. Based on the results obtained from implementing the ISM method, the model of interrelationships among the components was depicted.

**Conclusion:** The resulting model illustrates the significant relationships of elements at each level to elements at the subsequent level, as well as significant relationships among elements within each row. Additionally, this model considers the meaningful reciprocal and feedback relationships obtained from the DEMATEL method.

**Keywords:** Competitiveness, Petrochemical Industry, Business Model, Validation.

## 1 Introduction

The prerequisite for any strategic decision-making and planning is to understand the current situation through examining environmental factors. The role of environmental analysts is to identify opportunities and threats and to precisely evaluate the effects of environmental variables on all aspects of the organization, including its inputs and outputs. Environmental factors, as parameters influencing competitiveness, have a significant presence in various economic and political dimensions. Typically, environmental factors are considered on three levels: international macro, micro, and national. Among these, macro-environmental factors refer to a set of factors that affect the firm but are beyond its control (such as political and economic factors, etc.). National environmental factors pursue these objectives on a smaller scale and at the national level. Micro-environmental factors address the immediate environment of the organization, essentially the market, and these factors have a close connection with the firm and its activities, such as market dynamics, technology, customers, competition, and ultimately the dynamics related to the firm itself (Coskun-Setirek & Tanrikulu, 2021; Nelson, 2017; Oh & Shong, 2017; Wiesböck & Hess, 2020; Wong, 2013).

Accordingly, the international macro environment acts as the infrastructure for the national environment. If developments in the international political, economic, social, and technological spheres can have positive effects on the four domestic domains, the national environment can also lead to dynamism in the areas of market, technology, customers, and competitors, thereby bringing dynamism to the firm itself. Otherwise, if changes in the international macro environment do not align with the national environment, assuming stability in the national environment, achieving a sustainable competitive advantage will not be possible, and this will negatively impact the dynamics of the microenvironment in the medium term (Mannani et al., 2021; Miller et al., 2008; Mogashoa, 2021; Mohajerani et al., 2019).

Given the aforementioned issues, the petrochemical industry has also become competitive, and companies need to gain a competitive advantage. Additionally, the way

businesses interact with customers has become more important than ever. These interactions can occur in physical or virtual spaces. Given the environmental changes and the market dynamics and further changes anticipated, companies in the petrochemical industry must proactively update their processes and technologies, identify customer needs and expectations, and pay attention to market conditions to succeed. Competitiveness of companies is often studied from a strategic management perspective and rarely analyzed from an operational viewpoint. Therefore, this study aims to present a competitiveness model in the petrochemical industry to address existing gaps. The main question of this research is: What is the competitiveness model for businesses in the petrochemical industry?

## 2 Methods and Materials

This study aims to examine and identify the components of a competitiveness model in the petrochemical industry and ultimately design and present a relevant model to foster growth in this sector. Considering the research objective, the study was conducted using a structural-interpretive method. Initially, the key influencing factors were identified, and then, using the proposed method, the relationships between these factors and the pathways to progress were presented. Typically, in the ISM method, after identifying the model elements, the researcher forms the Structural Self-Interaction Matrix (SSIM) based on expert opinions to establish the internal relationships among the variables.

## 3 Findings and Results

In this research, an integrated approach was used to implement the DEMATEL and ISM methods for constructing the reachability matrix instead of using the SSIM matrix, relying on the outputs of the DEMATEL method (T matrix). Thus, for forming the reachability matrix, values smaller than the threshold in the T matrix were considered insignificant relationships (equivalent to zero), and values larger than the threshold (significant relationships) were considered equivalent to one. Table 1 shows the reachability matrix considering secondary relationships.

Table 1

Reachability Matrix of Research Variables

	C 1	C 2	C 3	C 4	C 5	C 6	C 7	C 8	C 9	C1 0	C1 1	C1 2	C1 3	C1 4	C1 5	C1 6	C1 7	C1 8	C1 9	C2 0	C2 1	C2 2	C2 3	C2 4
C1	1	0	0	0	1	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
C2	0	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0
C3	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
C4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
C5	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1
C6	0	1	1	0	1	1	0	0	1	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
C7	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	1	0	0	0	1	1
C8	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0	0	0	0	0	1
C9	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
C1 0	1	0	1	1	1	0	1	0	1	1	1	0	0	0	0	0	0	0	1	0	0	1	0	0
C1 1	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	0
C1 2	0	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	1	1	0	0	0	0	1
C1 3	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	1	0
C1 4	0	0	0	1	0	0	1	1	0	0	0	1	0	1	1	0	0	1	0	0	1	1	0	1
C1 5	1	0	1	0	0	0	0	1	0	0	1	0	0	1	1	0	1	0	0	1	0	0	0	0
C1 6	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	1	1	0	1	1	0	0	1	0
C1 7	0	1	0	0	0	1	0	0	0	1	1	0	0	0	0	1	1	0	0	0	0	1	0	0
C1 8	1	1	0	1	1	0	0	0	0	1	0	0	0	1	0	0	0	1	0	1	0	0	0	0
C1 9	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0
C2 0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	0	1	0	1	0	0	1	0
C2 1	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0
C2 2	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1	1	0	0	1	1	1	1	1
C2 3	0	0	1	0	0	0	1	0	1	1	0	0	1	0	1	1	0	1	0	1	0	1	1	0
C2 4	0	1	0	0	1	0	1	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	0	1

To determine relationships and hierarchies of components, the set of outputs and inputs related to each component were extracted from the received matrix (Table 2).

Table 2

Inputs and Outputs Set for Determining the First Level in ISM Hierarchy

Code	Inputs	Outputs	Common Set	Level
C1	1, 5, 9, 10, 22	1, 5, 9, 10, 15, 18, 22	1, 5, 9, 10, 22	1
C2	2, 3, 10, 12, 17	2, 3, 6, 8, 12, 17, 18, 24	2, 3, 12, 17	
C3	2, 3, 6, 15, 16, 23	2, 3, 6, 8, 10, 13, 15, 16, 23	2, 3, 6, 15, 16, 23	1
C4	4, 18	4, 10, 14, 18	4, 18	1
C5	1, 5, 6, 13, 21, 24	1, 5, 6, 10, 13, 17, 21, 24	1, 5, 6, 13, 21, 24	1
C6	2, 3, 5, 6, 9, 10	3, 5, 6, 9, 17	3, 5, 6, 9	
C7	7, 11, 12, 16, 23, 24	7, 10, 11, 12, 14, 16, 19, 23, 24	7, 11, 12, 16, 23, 24	1
C8	3, 8, 9, 14, 15, 24	8, 9, 19, 15, 24	8, 9, 15, 24	
C9	1, 6, 8, 9, 21, 23	1, 6, 8, 9, 10, 13, 21, 23	1, 6, 8, 9, 21, 23	1

C10	1, 3, 4, 5, 7, 9, 10, 11, 22	2, 6, 8, 10, 11, 17, 18, 21, 20, 22	10, 11, 22
C11	7, 10, 11, 15, 20, 21	7, 13, 10, 15, 11, 18, 20, 21	7, 10, 15, 11, 20, 21
C12	2, 7, 8, 18, 12, 24	2, 7, 8, 12, 13, 18, 24	2, 7, 8, 12, 18, 24
C13	3, 5, 11, 13, 12, 17, 23	5, 21, 12, 13, 23	12, 13, 23
C14	4, 7, 8, 14, 22, 24	5, 14, 17, 19, 22, 24	14, 22, 24
C15	1, 3, 8, 17, 15, 20, 21	4, 11, 23, 17, 15, 20, 21	20, 15, 21
C16	3, 7, 13, 16, 19, 23	11, 15, 16, 19, 23	19, 16, 23
C17	2, 6, 10, 11, 16, 17	6, 11, 13, 14, 16, 17	6, 11, 16, 17
C18	1, 2, 4, 5, 10, 14, 18, 20	6, 11, 14, 18, 20	14, 18, 20
C19	7, 10, 12, 19	2, 7, 10, 19, 24	7, 10, 12, 19
C20	9, 10, 15, 16, 18, 20, 23	11, 15, 16, 20, 22, 23	15, 16, 20, 23
C21	5, 13, 21	13, 20, 21	21
C22	1, 11, 13, 16, 22, 23, 24	2, 7, 15, 17, 22, 23, 24	22, 23, 24
C23	3, 9, 10, 14, 22, 23	4, 9, 11, 18, 22, 23	9, 22, 23
C24	12, 5, 7, 8, 19, 22, 24	4, 5, 7, 8, 18, 22, 24	5, 7, 8, 22, 24

1

Next, to rank the components, the priorities were determined based on the common set of inputs and outputs of each component. Components whose common set of inputs and antecedents (outputs) was equal to their input set were placed at the highest level in the ISM hierarchy. To determine the level of other components, the components whose level was known were removed from the set, and the input and output sets were recalculated, identifying the components for the subsequent levels. Based on the calculations, seven components, including profit margin,

personality factors, quality, organization mission, public relations, pricing, advertising, and awareness, were identified as first-level components. To identify the second-level components, first-level components were removed from the set, and the input and output sets were recalculated without considering the first-level variables. Based on the output of these calculations, one component, the phenomenon of business factors based on competitiveness, was identified as the second-level component. Table 3 shows the second-level components in the ISM hierarchy.

**Table 3**

*Determining the Second Level of the ISM Hierarchy*

Code	Inputs	Outputs	Common Set	Level
C2	2, 10, 12, 17	2, 6, 8, 12, 17, 18, 24	2, 12, 17	2
C6	2, 6, 10	2, 6, 17	2, 6	2
C8	8, 10, 15, 24	8, 15, 24	8, 15, 24	2
C10	10, 11, 22	2, 6, 8, 10, 11, 17, 18, 21, 20, 22	10, 11, 22	2
C11	10, 11, 15, 20, 21	13, 11, 10, 15, 18, 20, 21	10, 15, 11, 20, 21	2
C12	2, 8, 12, 18, 24	2, 8, 12, 13, 18, 24	2, 12, 8, 18, 24	2
C13	11, 12, 13, 17, 23	21, 12, 13, 23	12, 13, 23	2
C14	8, 14, 22, 24	14, 17, 19, 22, 24	14, 22, 24	2
C15	8, 15, 17, 20, 21	11, 23, 15, 17, 20, 21	20, 15, 21	2
C16	13, 16, 19, 23	11, 15, 16, 19, 23	19, 16, 23	2
C17	2, 6, 10, 11, 16, 17	6, 11, 13, 14, 16, 17	6, 11, 16, 17	2
C18	2, 10, 14, 18, 20	6, 11, 14, 18, 20	14, 18, 20	2
C20	10, 15, 16, 18, 20, 23	11, 15, 16, 20, 22, 23	15, 20, 16, 23	2
C21	13, 21	13, 20, 21	21	2
C22	11, 13, 16, 22, 23, 24	2, 15, 17, 22, 23, 24	22, 23, 24	2
C23	10, 14, 22, 23	11, 18, 22, 23	9, 22, 23	2
C24	12, 8, 22, 24	8, 18, 22, 24	8, 22, 24	2

To determine the third level elements, second-level components were removed, and the input and output sets were recalculated without considering these components (Table 4). Based on the output of these calculations, seven

components—structure, economic factors, individual factors in the project, increased competition, creativity and innovation, access constraints, and increased costs—were placed at the third level.

**Table 4**

*Calculations for Determining the Third-Level Elements*

Code	Inputs	Outputs	Common Set	Level
C2	2, 12, 10, 17	2, 6, 8, 10, 12, 17, 18, 24	2, 12, 17	3
C6	2, 10, 6	2, 6, 10, 13, 17	2, 10, 6	3
C8	8, 15, 10, 24	8, 10, 15, 24	8, 10, 15, 24	3
C11	15, 11, 20, 21	13, 15, 18, 11, 21	15, 11, 21	
C12	2, 8, 12, 18, 24	2, 8, 12, 13, 18, 24	2, 12, 8, 18, 24	
C13	11, 12, 13, 17, 23	21, 12, 13, 23	12, 13, 23	
C14	8, 14, 22, 24	14, 17, 19, 22, 24	14, 22, 24	
C15	8, 17, 15, 20, 21	11, 23, 17, 15, 20, 21	20, 15, 21	
C16	8, 16, 23	11, 15, 16, 23	16, 23	
C17	2, 6, 11, 10, 16, 17	6, 10, 11, 13, 14, 16, 17	6, 10, 11, 16, 17	3
C18	2, 14, 10, 18, 20	6, 11, 10, 14, 18, 20	14, 10, 18, 20	3
C20	15, 16, 10, 20, 18, 23	11, 10, 15, 16, 20, 22, 23	15, 10, 20, 16, 23	3
C21	13, 10, 21	13, 10, 20, 21	13, 10, 21	3
C22	11, 13, 16, 22, 23, 24	2, 15, 17, 22, 23, 24	22, 23, 24	
C23	14, 22, 23	11, 18, 22, 23	22, 23	
C24	12, 8, 22, 24	8, 18, 22, 24	8, 22, 24	

The fourth-level elements were determined based on similar calculations. Accordingly, six components—reactive measures, incentive schemes, feedback, planning,

technology, and training—were identified as fourth-level elements (Table 5).

**Table 5**

*Calculations for Determining the Fourth-Level Elements*

Code	Inputs	Outputs	Common Set	Level
C11	11, 15	11, 22, 15	11, 15	4
C12	12, 24	12, 13, 24	12, 24	4
C13	11, 12, 13, 23	21, 12, 13, 23	12, 13, 23	4
C14	14, 22, 24	14, 22, 24	14, 22, 24	4
C15	15	15, 23	15	4
C16	16, 23	11, 15, 16, 23	16, 23	4
C22	11, 13, 16, 22, 23, 24	15, 22, 23, 24	22, 23, 24	4
C23	14, 22, 23	11, 22, 23	22, 23	4
C24	12, 22, 24	8, 18, 22, 24	22, 24	4

Finally, three variables—financial outcomes, structural outcomes, and cultural outcomes—were identified as fifth-level variables (Table 6).

**Table 6**

*Calculations for Determining the Fifth-Level Elements*

Code	Inputs	Outputs	Common Set	Level
C22	22, 23, 24	22, 23, 24	22, 23, 24	5
C23	23	22, 23	23	5
C24	22, 24	22, 23, 24	22, 24	5

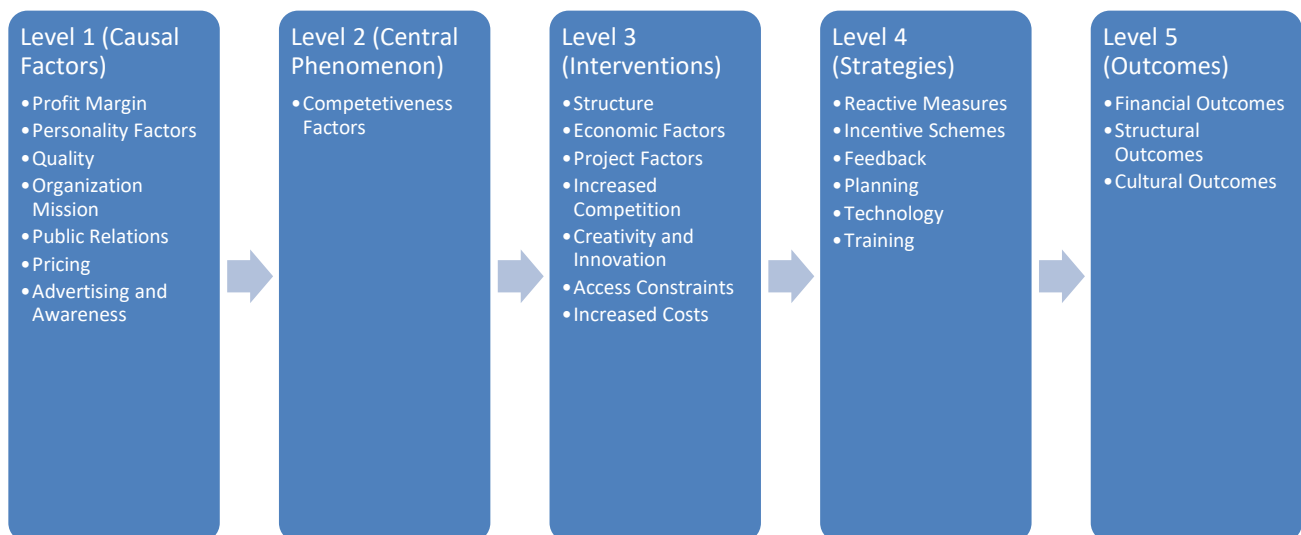
**Table 7**

*Summary of Component Levels with ISM Method*

Component	Level
Profit Margin, Personality Factors, Quality, Organization Mission, Public Relations, Pricing, Advertising, Awareness	1
Phenomenon of Business Factors Based on Competitiveness	2
Structure, Economic Factors, Individual Factors in the Project, Increased Competition, Creativity and Innovation, Access Constraints, Increased Costs	3
Reactive Measures, Incentive Schemes, Feedback, Planning, Technology, Training	4
Financial Outcomes, Structural Outcomes, Cultural Outcomes	5

**Figure 1**

*Final Model*



The most significant outcome of the quantitative data analysis phase is the determination of causal relationships (influencing and being influenced) among the set of studied elements and organizing these relationships within a structural model. In this structural model, elements at each level affect elements at the subsequent levels and are influenced by elements at the previous levels. Additionally, there is a horizontal relationship among elements at each level. Thus, in the final step of implementing the ISM method, based on the established hierarchy, the position of

each element in relation to other elements (in terms of influencing and being influenced) can be determined, and based on this, the relationship model among elements can be depicted; a model that shows the factors influencing business competitiveness.

Based on the results obtained from the ISM method, the relationship model among components is depicted in Figure 1. This figure shows the significant relationships of elements at each level on elements at the subsequent level and also significant relationships among elements at each row.

Additionally, this figure considers the meaningful reciprocal and feedback relationships obtained from the DEMATEL method.

#### 4 Discussion and Conclusion

In the context of a business model based on competitiveness in the petrochemical industry, there was no sample among the reviewed sources that looked at this issue from a macro perspective, and the presented framework represents a new viewpoint on this subject. However, studies highlighted the informational resources aspect in integrating business processes and, considering the specified indicators, shows that if informational resources are integrated at levels of availability, transparency, timeliness, and the level of detail, business processes will be highly integrated. The above-mentioned study introduces a tool for measuring process integration as a recommendation for other researchers (Azmsaha et al., 2023; Mogashoa, 2021). The framework provided by the present study considers more comprehensive and complete indicators compared to this study.

The results indicate a low level of integration in input/output, time, technology, and stakeholders in the hardware unit. Therefore, to enhance the integration level of these aspects at the organizational unit level, the company should focus on topics such as aligning process outputs for use in subsequent processes, reducing implementation time, changing and establishing communication between processes, reducing process start-up time after errors, and factors such as further automating processes, paying more attention to technology management integration, and

focusing more on stakeholder communication by increasing information sharing among stakeholders, streamlining processes when stakeholders need it, increasing communication among stakeholders, and enhancing trust and cultural commonalities among stakeholders involved in project matters.

The results of evaluating the integration of business process components in the administrative and financial unit indicate a low level of goal integration in this unit. Therefore, it is recommended that the company focus on the goals, policies, and strategies of the respective unit with an approach to creating alignment with organizational goals, policies, and strategies.

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#### Declaration of Interest

The authors of this article declared no conflict of interest.

#### Authors Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

#### Ethics principles

In this research, ethical standards including obtaining informed consent, ensuring privacy and confidentiality were observed.

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