

# The Development of a Cleaner Production Model and Applied Management Solutions for the Pharmaceutical Industry

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## ABSTRACT

The present study aimed to develop a cleaner production model and applied management solutions for the pharmaceutical industry. The research methodology was basic-applied in terms of purpose, and descriptive-exploratory in terms of implementation method. The statistical population included the companies operating in the pharmaceutical industry. Experts and managers working in these companies were selected as the statistical analysis unit. Using Cochran's formula for a finite population, 341 individuals, including 9 experts, were selected as the sample. Interpretive structural modeling technique was used to design the interpretive structural model of cleaner production, and rough set theory was used to prioritize cleaner production indicators. Finally, SWOT matrix was used to provide operational and strategic solutions for cleaner production. The results showed that 15 variables of "cleaner policies and regulations", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner processes", "cleaner suppliers", "cleaner employee", "cleaner partnership", "cleaner culture", "cleaner design", "cleaner environmental management", "cleaner resource management", "cleaner innovation", "cleaner purchasing management", "cleaner technology", "risk perception and cleaner protection indicators" are respectively the most important factors in achieving cleaner production. In the present study, a cleaner production assessment model was proposed for the pharmaceutical industry by identifying the key performance indicators involved in cleaner production using reliable techniques.

**Keywords:** cleaner production, factor analysis, interpretive structural modeling, rough set theory, SWOT matrix

## INTRODUCTION

In recent years, with the rapid industrialization of many developed countries, much attention has been paid to environmental degradation and governments around the world have begun to execute environmental protection laws [1]. To this end, business firms have focused on applying pollution prevention techniques and minimizing wastes in their business models and processes emphasizing the strategy of gaining economic benefits along with environmental improvements (e.g. dilution, end-line filtration, recycling and reuse) [2]. Hence, environmental protection was one of the most important factors in the creation and activation of development, sustainability, success and excellence strategies in business firms [3]. Nowadays, customers and stakeholders mainly encourage or force business firms to comply with environmental laws and to implement sustainable environmental management systems and green business [4]. Environmental sustainability is based on the concepts such as cleaner production, green production, green productivity, green and sustainable design, and takes a preventive approach with emphasis on productivity [5]. Using the cleaner production approach, a business firm can reduce environmental protection costs, protect the environment, and increase green economic profitability by reducing resource consumption through waste reduction and pollution prevention [6]. Here, it is better to define cleaner production at first. Cleaner production examines all decisions, activities and actions to improve environmental

performance by reducing negative environmental impact and it is not limited to pollution control activities in a production process [7]. Ortolano et al. defined cleaner production as an attempt to prevent undesirable environmental impacts throughout the product life cycle (raw material extraction, product design, production and use, and final disposal). Official definition of “cleaner production” will help us organize interesting ideas in this area [8]. The United Nations Environment Program (UNEP) defines cleaner production as a continuous application of an integrated preventive environmental strategy to processes, products, and services so as to increase overall efficiency and to reduce the risks to humans and the environment [9].

Now, the following questions arise: What are the key performance indicators involved cleaner production assessment in the pharmaceutical industry? How effective are these indicators? What is the interpretative structural model of cleaner production? What are the weights allocated to these indicators? What are the strategic and applied solutions for cleaner production-based management in the pharmaceutical industry?

## CLEANER PRODUCTION

Promotion of cleaner production processes is crucial for improving companies’ environmental performance, their supply chain and wider community. Identifying the factors affecting cleaner production will lead to promotion of cleaner production. The previous studies examined the effects of certain factors, e.g. green product and process innovations, the use of international standards, and environmentally-friendly regulations and culture, on cleaner production. In particular, green product innovation minimizes energy consumption, reduces the amount of materials, and prevents pollution [10]. Green production process reduces the amount of materials as well as energy and water consumption, and generates less waste by improving productivity [11].

According to the United Nations Environment Program (UNEP), cleaner production is a continuous application of an integrated preventive environmental strategy to processes, products, and services so as to increase overall efficiency and to reduce the risks to humans and the environment [12].

Cleaner production specifies at which stages of production resources are wasted or not optimally consumed. This information helps us minimize this waste in the best way possible. Cleaner production is a tool to find out where and why resources are wasted and pollution is generated, and how can we minimize it [13].

A cleaner production team should always remember that not generating waste is better than recycling and reusing it. Therefore, cleaner production team should only consider the second option, i.e. prevention of waste generation. In fact, many options considered by a team are resulted from combination of the above categories to create cost-effective and sustainable results. For example, every new technology option should be followed before and after improving management and education [12].

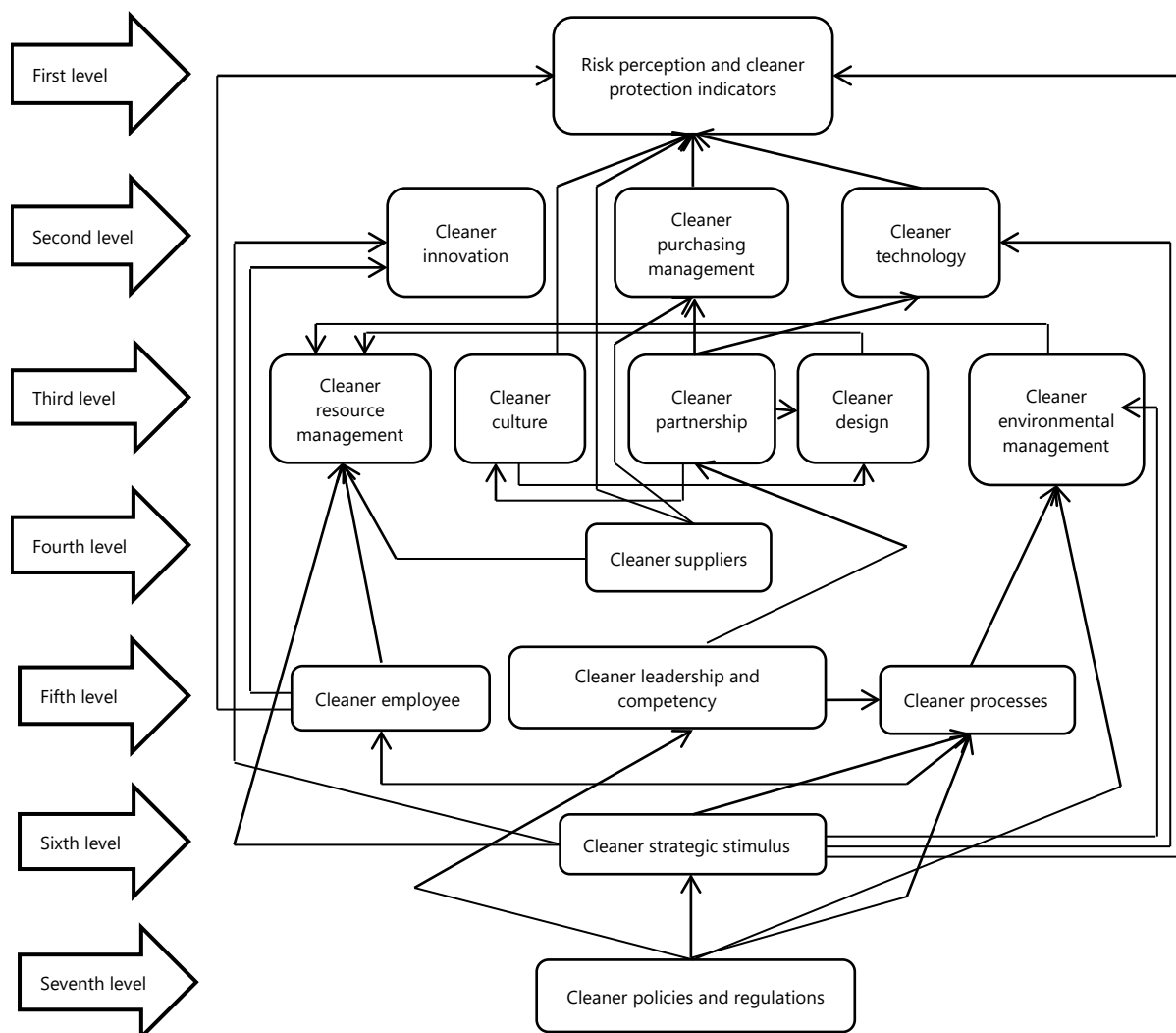
It should be remembered that some selected options may require major changes to processes, equipment or products. This dramatically reduces waste generation or increases productivity, but often requires significant investment. Finally, it should be noted that some selected options require laboratory studies to ensure that the product, as a result of the program, is of acceptable quality in the market [12].

There is no process in which raw materials are completely transformed into a product and some waste will always be generated. Cleaner production aims to minimize this waste and loss of raw materials by manipulating and modifying production processes.

Correct implementation of cleaner production usually leads to the following benefits for industrial units and other units implementing cleaner production [14-15]:

- Increased profitability and efficiency of processes
- Reduced costs of production and non-compliance with regulations
- Improved product quality
- Minimizing costs of filtration and final disposal
- Providing a quick return on capital or operational investments
- Improved productivity and increased economic benefits
- More efficient use of energy and raw materials
- Enhanced employee motivation and engagement of active workers in the production and implementation of ideas
- Reduced risks to consumers and the environment

Ozturk et al., in a study entitled “Sustainable textile production: Cleaner production assessment/eco-efficiency analysis study in a textile mill” stated that cleaner production assessment is useful for prevention and control of pollution in the Turkish textile industry. They collected material flow and energy consumption at all stages and listed 92 of the best techniques. 22 of these techniques were selected based on technical and economic application. Environmental and technical performance, good management practices, optimization techniques, water and energy consumption, chemical consumption, sewage flow, gases produced from waste, solid waste generation,



**Figure 1.** Interpretative structural model of cleaner production in the pharmaceutical industry

optimization of chemical consumption, and replacement were identified as the best techniques for cleaner production assessment [12].

Guimaraes et al. conducted a study entitled “Cleaner production, project management and strategic stimulus” and concluded that cleaner production is an important systematic tool for reducing waste. To successfully implement cleaner production, it is necessary to ensure the effectiveness of factors affecting this process, e.g. identifying decision making factors and an effective method for project management and implementation of strategies to achieve the expected results [16]. The present study aimed to measure correlations between the structures such as strategic management, project management maturity, and cleaner production success, considering the moderator effect of business. 238 manufacturing companies were used for this study. Data analysis was performed using structural equation modeling. The results showed strong correlation between cleaner production structures encouraging managers to make decisive decisions. The results also showed that there is a close relationship between strategic stimulus, project management maturity, and cleaner production success.

## RESEARCH OBJECTIVES

- 1) Identification of the key performance indicators involved in cleaner production assessment in the pharmaceutical industry
- 2) Determination of effectiveness of every key performance indicator involved in cleaner production assessment in the pharmaceutical industry
- 3) Design of an interpretative structural model for cleaner production in the pharmaceutical industry
- 4) Prioritizing the key performance indicators involved in cleaner production assessment in the pharmaceutical industry

- 5) Proposing strategic and applied solutions for cleaner production-based management in the pharmaceutical industry

## MATERIAL AND METHODS

To identify the key performance indicators involved in cleaner production assessment in the pharmaceutical industry and to determine their effectiveness (the first and second questions), exploratory and confirmatory factor analysis, Statistical Package for Social Science (SPSS) and Smart Partial Least Squares (Smart PLS) were used. Moreover, interpretive structural modeling (ISM) was used to design an interpretive structural model for cleaner production in the pharmaceutical industry (the third question). Rough set theory (RST) was used to prioritize the key performance indicators involved in cleaner production assessment (the fourth question). Finally, SWOT (Strengths, Weaknesses Opportunities, Threats) analysis was used to analyzed strengths and weaknesses and to propose strategic and applied solutions (the fifth question).

## DATA ANALYSIS

### **First question: What are the key performance indicators involved in cleaner production assessment in the pharmaceutical industry?**

The first factor consisted of ten variables and accounted for 9.153% of the total variance. Content analysis of these variables indicated that they all focus on pollution management and environmental cleanliness. Hence, this factor was named "Cleaner environmental management". The second factor had seven variables and accounted for 9.108% of the total variance. Content of these variables was associated with cleanliness of various processes. So, this factor was called "Cleaner processes". The third factor included six variables and named "Cleaner policies and regulations". This factor accounted for about 8.422% of the total variance. The fourth factor consisted of six variables and accounted for 5.145% of the total variance. Content analysis of these variables showed that they all focus on clean actions in the resource area. Therefore, this factor was called "Cleaner resource management". The fifth factor included five variables and accounted for 4.331% of the total variance. Content analysis of these variables showed that they all focus on employee related issues. Hence, this factor was called "Cleaner employee". The sixth factor had five variables and accounted for 4.023% of the total variance. Content of these variables was related to clean strategic actions. Therefore, this factor was named "Cleaner strategic stimulus". The seventh factor with four variables was called "Cleaner leadership and competency". This factor accounted for about 3.963% of the total variance. The eighth factor had four variables and accounted for 3.755% of the total variance. Content analysis of these variables indicated that they all focus on supplier-related issues. So, this factor was called "Cleaner suppliers". The ninth factor consisted of three variables and accounted for 3.718% of the total variance. Content analysis of these variables showed that they all focus on purchasing raw materials. Hence, this factor was named "Cleaner purchasing management". The tenth factor included three variables and accounted for 3.702% of the total variance. Content analysis of these variables indicated that they all focus on the issues related to innovation in the company. So, this factor was named "Cleaner innovation".

The eleventh factor with two variables accounted for 2.575% of the total variance. Content analysis of these variables showed that they all focus on employee related issues. Therefore, this factor was called "risk perception and cleaner protection indicators". The twelfth factor included two variables and accounted for 2.368% of the total variance. Content analysis of these variables showed that they all focus on cleaner production culture. Hence, this factor was called "Cleaner culture". The thirteenth factor with two variables accounted for 2.083% of the total variance. Content these variables was associated with participating in organizations and clean actions. Therefore, this factor was called "Cleaner partnership". The fourteenth factor with two variables was named "Cleaner design". This factor accounted for about 1.922% of the total variance. The fifteenth factor consisted of two variables and accounted for 1.813% of the total variance. Content analysis of these variables showed that they all focus on cleaner production technology. So, this factor was called "Cleaner technology".

### **Second question: How effective are the key performance indicators involved in cleaner production assessment in the pharmaceutical industry?**

The test results showed that all key performance indicators involved in cleaner production assessment in the pharmaceutical industry were confirmed. **Table 1** presents factor loadings coefficients, adjusted coefficient of determination, significance number, and the results for each indicator.

### **Third question: What is the interpretive structural model of cleaner production in the pharmaceutical industry?**

### **Fourth question: What are the weights allocated to the key performance indicators involved cleaner production assessment in the pharmaceutical industry?**

**Table 1.** The results obtained from assessment of indicators

The key performance indicators	Factor Loadings Coefficients	Adjusted coefficient of determination R Square Adjust	Significance (t-value)	Result
Cleaner environmental management (CEM)	0.636	0.405	7.080	Confirmed
Cleaner processes (CP)	0.732	0.536	11.031	Confirmed
Cleaner policies and regulations (CPR)	0.734	0.552	11.282	Confirmed
Cleaner resource management (CRM)	0.878	0.636	12.982	Confirmed
Cleaner employee (CE)	0.884	0.639	13.107	Confirmed
Cleaner strategic stimulus (CSS)	0.671	0.450	8.097	Confirmed
Cleaner leadership and competency (CLC)	0.801	0.582	12.055	Confirmed
Cleaner suppliers (CS)	0.896	0.649	13.329	Confirmed
Cleaner purchasing management (CPM)	0.864	0.629	12.901	Confirmed
Cleaner innovation (CI)	0.859	0.608	12.837	Confirmed
Risk perception and cleaner protection indicators (RPCPI)	0.821	0.593	12.263	Confirmed
Cleaner culture (CC)	0.836	0.599	12.524	Confirmed
Cleaner partnership (CPA)	0.792	0.561	11.986	Confirmed
Cleaner design (CD)	0.829	0.597	12.307	Confirmed
Cleaner technology (CT)	0.708	0.501	9.0876	Confirmed

**Table 2.** Normalized weights and prioritization of indicators

Indicator	Indicator name	Normalized weights	Rank
C <sub>1</sub>	Cleaner environmental management	0.0502	10
C <sub>2</sub>	Cleaner processes	0.0947	4
C <sub>3</sub>	Cleaner policies and regulations	0.1110	1
C <sub>4</sub>	Cleaner resource management	0.0466	11
C <sub>5</sub>	Cleaner employee	0.0790	6
C <sub>6</sub>	Cleaner strategic stimulus	0.1096	2
C <sub>7</sub>	Cleaner leadership and competency	0.0957	3
C <sub>8</sub>	Cleaner suppliers	0.0917	5
C <sub>9</sub>	Cleaner purchasing management	0.0294	13
C <sub>10</sub>	Cleaner innovation	0.0438	12
C <sub>11</sub>	Risk perception and cleaner protection indicators	0.0200	15
C <sub>12</sub>	Cleaner culture	0.0678	8
C <sub>13</sub>	Cleaner partnership	0.0733	7
C <sub>14</sub>	Cleaner design	0.0605	9
C <sub>15</sub>	Cleaner technology	0.0268	14

The normalized weights and prioritization of the indicators involved in cleaner production model in the pharmaceutical industry are shown in **Table 2** and **Figure 2**.

**Fifth question 5: What are the strategic and applied solutions for cleaner production-based management in the pharmaceutical industry?**

**Table 3** shows the quantitative strategic planning matrix of the company in which three selected aggressive strategies were examined.

According to the total scores of the aggressive cleaner production strategies in the quantitative strategic planning matrix, strategy 3, i.e. "Establishing a cleaner production team to educate and promote cleaner production culture in the organization" was selected as the best strategy to gain competitive advantages of cleaner production.

## FINDINGS

### First question

In the present study, an analytical method was proposed to identify the key performance indicators involved in cleaner production assessment in the pharmaceutical industry. According to the results obtained from the first question, 15 indicators of "cleaner environmental management", "cleaner processes", "cleaner policies and regulations", "cleaner resource management", "cleaner employee", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner suppliers", "cleaner purchasing management", "cleaner innovation", "risk perception and

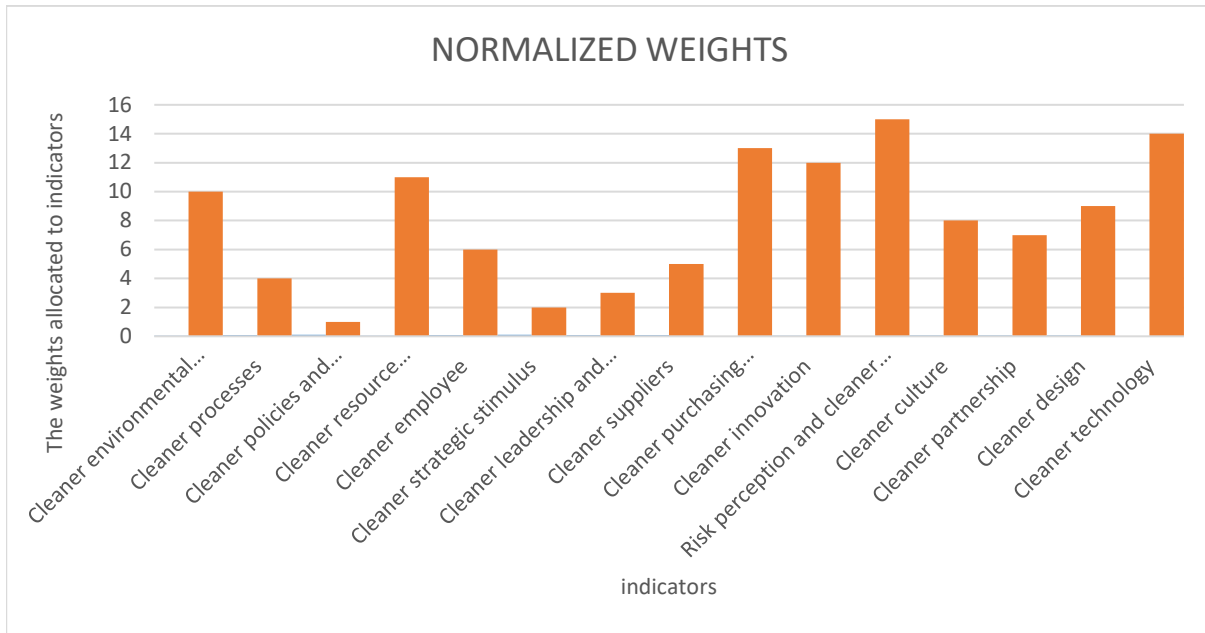


Figure 2. The normalized weights allocated to the key performance indicators involved in cleaner production

Table 3. Quantitative Strategic Planning Matrix (QSPM)

Strategy	Coefficient of importance	Strategy 1 A continuous, integrated, and preventive program for products, processes and services to enhance eco-efficiency		Strategy 2 Promoting sustainable consumption techniques		Strategy 3 Establishing a cleaner production team to educate and promote cleaner production culture in the organization	
		Coefficient of attractiveness	Score	Coefficient of attractiveness	Score	Coefficient of attractiveness	Score
Strengths (S)							
S <sub>1</sub>	15%	6	0.9	4	0.6	7	1.05
S <sub>2</sub>	25%	1	0.25	1	0.25	7	1.75
S <sub>3</sub>	20%	7	1.4	6	1.2	8	1.6
Total	60%	---	2.55	---	2.05	---	4
Weaknesses (W)							
W <sub>1</sub>	15%	1	0.15	1	0.15	1	0.15
W <sub>2</sub>	10%	7	0.7	7	0.7	6	0.6
W <sub>3</sub>	15%	5	0.75	1	0.15	3	0.45
Total	40%	---	1.6	---	1	---	1.2
Total (Strengths and Weaknesses)	100%	---	4.15	---	3.05	---	5.6
Opportunities (O)							
O <sub>1</sub>	20%	7	1.4	7	1.4	7	1.4
O <sub>2</sub>	40%	4	1.6	5	2	6	2.4
O <sub>3</sub>	5%	5	0.25	4	0.2	5	0.25
Total	65%	---	3.25	---	3.6	---	4.05
Threats (T)							
T <sub>1</sub>	15%	1	0.15	1	0.15	1	0.15
T <sub>2</sub>	15%	3	0.45	5	0.75	7	1.05
T <sub>3</sub>	5%	2	0.1	5	0.25	6	0.3
Total	35%	---	0.7	---	1.15	---	1.5
Total (Opportunities and Threats)	100%	---	3.95	---	4.75	---	5.55
Total attractiveness score	---	---	8.1	---	7.8	---	11.15

cleaner protection indicators", "cleaner culture", "cleaner partnership", "cleaner design", and "cleaner technology" were identified as the key performance indicators involved in cleaner production assessment.

### Second question

The results indicated that all indicators of "cleaner environmental management", "cleaner processes", "cleaner policies and regulations", "cleaner resource management", "cleaner employee", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner suppliers", "cleaner purchasing management", "cleaner innovation", "risk perception and cleaner protection indicators", "cleaner culture", "cleaner partnership", "cleaner design", and "cleaner technology" were effective and respectively accounted for 0.405, 0.536, 0.552, 0.636, 0.639, 0.450, 0.582, 0.649, 0.629, 0.608, 0.593, 0.599, 0.561, 0.597, and 0.501 of the performance changes in cleaner production. Also, the effectiveness of these indicators on cleaner production were respectively equal to 0.636, 0.732, 0.743, 0.878, 0.844, 0.667, 0.801, 0.896, 0.884, 0.859, 0.821, 0.836, 0.792, 0.829 and 0.708. Finally, according to the results, 15 indicators were identified and confirmed as the key performance indicators involved in cleaner production assessment.

### Third question

In the present study, a soft method was proposed for partitioning an interpretive structural model for the key performance indicators involved in cleaner production assessment in the pharmaceutical industry. In the interpretive structural model, 15 indicators of "cleaner environmental management", "cleaner processes", "cleaner policies and regulations", "cleaner resource management", "cleaner employee", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner suppliers", "cleaner purchasing management", "cleaner innovation", "risk perception and cleaner protection indicators", "cleaner culture", "cleaner partnership", "cleaner design", and "cleaner technology" were examined as the key performance indicators involved in cleaner production assessment in the pharmaceutical industry. The results led to a partitioned model for the key performance indicators involved in cleaner production assessment. Among these variables, more attention should be paid to "cleaner policies and regulations", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner processes" and "cleaner employee", respectively. In other words, these indicators are important and one cannot ensure cleaner production without paying special attention to them. Moreover, these indicators were considered as the basis of the interpretive structural model and can facilitate the achievement of other indicators.

### Fourth question

According to the results obtained from rough set theory, the following weights were allocated to "cleaner policies and regulations", "cleaner strategic stimulus", "cleaner leadership and competency", "cleaner processes", "cleaner suppliers", "cleaner employee", "cleaner partnership", "cleaner culture", "cleaner design", "cleaner environmental management", "cleaner resource management", "cleaner innovation", "cleaner purchasing management", "cleaner technology", and "risk perception and cleaner protection indicators", respectively: 0.1110, 0.1096, 0.0957, 0.0947, 0.0917, 0.0790, 0.0733, 0.0678, 0.0605, 0.0502, 0.0466, 0.0438, 0.0294, 0.0268 and 0.02. Accordingly, much attention has been paid to "cleaner policies and regulations" aspect of cleaner production assessment in the pharmaceutical industry. In other words, paying attention to cleaner policies and regulations and compliance with these regulations are indisputable, and this indicator is of great importance to cleaner production.

### Fifth question

Based on the results obtained from the fifth question, Pars Darou Co. was selected as the sample and the cleaner production strategies were developed for this company. In this regard, the strategic and applied solutions for cleaner production-based management developed for Pars Darou Co. were as follows:

- Enhancing awareness and education through workshops, national and international seminars and conferences on cleaner production.
- Establishing and organizing small cleaner production groups and stimulating the groups for more efficiency
- Coordinating environmental policy incentives and cleaner production programs
- Minimizing the use of hazardous raw materials through a classification system for raw materials
- Planning for sustainable consumption of materials, water and energy, and developing a system for resource performance assessment
- Preparing production process map, controlling input changes, processing, and obtaining output of each process

## DISCUSSION AND CONCLUSION

Today, cleaner production is a critical issue for organizations, as environmental protection has been considerably interested by organizational stakeholders, shareholders, officials, customers, employees, competitors, and communities. In this regard, steady growing firms widely apply programs like experiential design, lifecycle analysis, environmental quality management, green supply chain management, cleaner production, as well as ISO 14000 standard. With rigid governmental laws and increased public knowledge, it is inevitably impossible to ignore environmental issues. Manufacturing companies must voluntarily follow eco-friendly and environmental protection standards in manufacturing. Therefore, organizations are not presently allowed to disregard governmental laws.

In the present century, coherence and harmony between environment, economics, and community is a critical challenge to attain sustained development; in addition, it is also increasingly interested through increased global knowledge of environmental issues by states and industries. In this case, some rules and regulations have been imposed by states limiting greenhouse gases, energy consumption, and environmental pollutants. In the industry, companies must undergo strict environmental protection pressure in order to release social and environmental concern, and associated companies, throughout the world, are complied with these rules and regulations.

Garvin expresses that anything that may not be measured and assessed would be impossibly managed [17]. Thus, performance evaluation is considered a critical part of strategic management system in organizations influencing the whole system. Hence, studying performance key factors in cleaner production evaluation of pharmaceutical industry significantly contributes in identifying requirements, enhancing motivations, and improving cleaner production communication. Therefore, it is critically significant to precisely determine the factors.

The research applied reliable methodologies for proposing cleaner production model. The results show that 15 critically significant factors contribute in attaining cleaner production as follows (in order), which must be considered: 'cleaner policies and regulations', 'cleaner strategic drivers', 'cleaner leadership and competency', 'cleaner processes', 'cleaner suppliers', 'cleaner employees', 'cleaner participation', 'cleaner culture', 'cleaner design', 'cleaner environmental management', 'cleaner resource management', 'cleaner innovation', 'cleaner purchase management', 'cleaner technology', 'cleaner perceived risk and protection criteria'.

## REFERENCES

1. Yu F, Chen J, Sun F, Zeng S, Wang C. Trend of technology innovation in China's coal-fired electricity industry under resource and environmental constraints. *Energy Policy*. 2001;39(3):1586-99.
2. Wang J. China's national cleaner production strategy. *Environmental Impact Assessment Review*. 1999;19(5):437-456.
3. Thomas R. A Greater Understanding of Environmental Ethics and Need for Inculcating Environment-friendly Culture. *International Review of Sociology*. *Revue Internationale de Sociologie*. 2002;12(1):77-87.
4. Romli A, Prickett P, Setchi R, Soe S. (2015). Integrated eco-design decision-making for sustainable product development. *International Journal of Production Research*. 2015;53(2):549-571.
5. Ren T. Barriers and drivers for process innovation in the petrochemical industry: A case study. *Journal of Engineering and Technology Management*. 2009;26(4):285-304.
6. Qi G, Zeng S, Tam CM, Yin H, Wu J, Dai Z. Diffusion of ISO 14001 environmental management systems in China: rethinking on stakeholders' roles. *Journal of Cleaner Production*. 2011;19(11):1250-6.
7. Stone L. When case studies are not enough: the influence of corporate culture and employee attitudes on the success of cleaner production initiatives. *Journal of Cleaner Production*. 2000;8(5):353-9.
8. Zhang L, Yu H, Cai M, LVZ. Cleaner production in China. *Ecol Econ*. 2012;8:46-9.
9. Searcy C, Morali O, Karapetrovic S, Wichuk K, McCartney D, McLeod S. Challenges in implementing a functional ISO 14001 environmental management system. *International Journal of Quality & Reliability Management*. 2012;29(7):779-96.
10. Dangelico RM, Pujari D. Mainstreaming green product innovation: Why and how companies integrate environmental sustainability. *Journal of Business Ethics*. 2010;95(3):471-86.
11. Chowdary BV, George D. Improvement of manufacturing operations at a pharmaceutical company: a lean manufacturing approach. *Journal of Manufacturing Technology Management*. 2011;23(1):56-75.
12. United Nations Industrial Development Organization (UNIDO). *Guidance Manual: How to Establish and Operate Cleaner Production Centers*. 2008.
13. Molina-Azorín JF, Claver-Cortés E, Pereira-Moliner J, Tari JJ. Environmental practices and firm performance: an empirical analysis in the Spanish hotel industry. *Journal of Cleaner Production*. 2009;17(5):516-24.



14. Hong J, Li X. Speeding up cleaner production in China through the improvement of cleaner production audit. *Journal of cleaner production*. 2013;129:35-40.
15. Khan Z. Cleaner production: an economical option for ISO certification in developing countries. *Journal of cleaner production*. 2008;16(1):22-135.
16. de Guimarães JCF, Severo EA, Vieira PS. Cleaner production, project management and Strategic Drivers: An empirical study. *Journal of Cleaner Production*. 2017;141:881-90.
17. Garvin D. (1993). Building a learning organization. *Harvard Business Review*. 1993;71(4):78-91.

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