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Analysis of factors affecting entrepreneurship, market, knowledge management in clean production and sustainable competitive advantage

R. Tayyebirad¹, Y. Vakil Alroaia^{2*}

¹Department of Management, Semnan Branch, Islamic Azad University, Semnan, Iran.

²Entrepreneurship and Commercialization Research Center, Department of Management, Semnan Branch, Islamic Azad University, Semnan, Iran

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ABSTRACT

BACKGROUND AND OBJECTIVES: An emerging type of innovation that leads to dramatic improvement in management processes and methods, and at the same time promotes innovation, is entrepreneurship for preserving cleaner production. However, few studies have been conducted to examine the impact of entrepreneurial orientation, knowledge management, and market orientation on sustainable competitive advantage and cleaner production that indicates the necessity and importance of conducting such research. Therefore, the present study aimed to determine the impact of entrepreneurship, market, and knowledge management on sustainable competitive advantage and cleaner production.

METHODS: The study is a descriptive research based on the method and an applied one in terms of the purpose. The statistical sample includes 289 senior executives of small and medium enterprises which are selected by random stratified method. The Structural Equation Model was used for inferential analysis and Analytic Network Process was used for prioritization.

FINDINGS: According to the obtained results, entrepreneurial orientation, market orientation, and knowledge management affect cleaner production with the 0.75, 0.85, and 0.51 scores, respectively, and also, cleaner production leads to improvement of competitive advantage. As a result, companies operate more successfully when using a set of strategic guidelines for cleaner production and achieve the significant development, which produce a sustainable competitive advantage over competitors. The Analytic Network Process output also indicates that the knowledge orientation got first rank with the weight of 0.307, followed by entrepreneurial orientation and market orientation with the weight of 0.229 in the second rank, and cleaner production (0.141) and sustainable competitive advantage (0.095) ranked third and fourth, respectively.

CONCLUSION: It seems that the existing knowledge of manufacturing operations is insufficient at this level to cover the rapid growth of this field, and many small and medium enterprises are still lagging behind in taking advantage of these new opportunities.

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*Corresponding Author:

Email: y.vakil@semnaniau.ac.ir

Phone: +989122316247

Fax: +982333654231

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INTRODUCTION

Concerns related to problems facing environment encourage citizens and companies to reduce waste, and recycle, reuse, or rebuild commodities. To this end, the environmental sustainability approach is utilized through environmental practices in organizations (Li *et al.*, 2017). Cleaner production (CP) is one of the environmental practices with the aim of rational use of natural resources, innovative organizational processes, and minimizing waste generation by companies for a Sustainable Competitive Advantage (SCA) in an advanced society. On the other hand, due to lack of natural resources, developing countries are under pressure to grow entrepreneurial activities to achieve rapid growth while reducing its negative effects on natural resources (Silajdzic *et al.*, 2015). The Green Revolution in 2010 has led to entrepreneurship through competitive, proactive, and sustainable innovations in a world moving towards globalization (Tan *et al.*, 2015). Initiatives are essential to promote and direct creativity. According to Hart (1995), and Saha and Darnton (2005), Green producers are committed to broad and long-term evaluation of the effect of their activities and thus they can affect the quality and well-being, protection, and security of society as well as the economic growth, and social and economic justice. As several studies show including Brandt (2007), Corbett and Klassen (2006), Dills and Stone (2007), the importance of green production is growing rapidly. Huge challenges facing the planet's ecosystem and resources due to population growth and emerging economic development (Kleindorfer *et al.*, 2005; Esty and Winston, 2009; Hart, 1995; Industry Today, 2010). Satisfying growing demand for goods by manufacturing systems is associated with devastating environmental impacts (Frosch and Gallopolous, 1989). Entrepreneurship for sustained cleaner production, is a kind of innovation that leads to dramatic improvement in management techniques and processes and promotes innovation. In order to minimize the effects of economic activity, by reducing residuals, reducing natural resource consumption, or using alternative energy sources, many companies encourage sustainability by providing some public policy motivations (De Oliveira *et al.*, 2016). Determining the variables driving the entrepreneurial activities is difficult due to the existence of related factors, such as socio-cultural, economic, and environmental factors (Castano *et al.*, 2015). On the

one hand, unique collaborate is difficult in using specific resources that creates sustainable innovations. In this regard, Cleaner production (CP), aimed at increasing the firm's sustainable competitive advantage, as well as superior performance than competitors, can be developed by strategic approaches such as Marketing Orientation (MO), Entrepreneurial Orientation (EO), and Knowledge Management (KM). When social and businesses networks are developed, EO and MO will lead to improved business performance and its resulted advantages is better reflected (Boso *et al.*, 2013). Supply chain structures in integration with environmental initiative for cleaner production will benefit companies in emerging markets in this way (Hoof and Thiell, 2015). However, few studies have been conducted on interrelationships between entrepreneurship, marketing approach, knowledge management approach, and cleaner production, which will be addressed in the present study (Kim *et al.*, 2012). However, little is known about the relationships among EO, MO, KM, CP and SCA, for they are the same actions to guarantee a high business performance. Consequently, in this study based on the literature that there is a causal effect between the constructs (EO, MO, KM) which come before Cleaner Production and Sustainable Competitive Advantage.

Theoretical framework

Entrepreneurship

As a relatively new concept in economics, entrepreneurship plays an important role in the countries' economic growth and development in the competitive and market-based economy of the new age. Entrepreneurship makes it possible to adapt to the new conditions of a dynamic economy in which ideas, products, and services are rapidly changing. Accordingly, in general, all economic participants including consumers, producers, and investors, must be entrepreneurs and, in turn, participate in entrepreneurial activities (Birkinshaw, 2000).

Competitive Advantage definition and concept

"Competitive advantage is defined as the superiority in market competitive position due to the better performance compared to competitors (Porter, 1985)." The competitive advantage causes distinction in the features or dimensions of company that enables it to provide better services (better value) to its customers compared to its competitors. The above

mentioned and other definitions of competitive advantage indicate a direct relationship between the customer's desired values, the company's proposed values and the values proposed by competitors of the company with the requirements and dimensions of competitive advantage. In case that comparing the values of the company with the values proposed by competitors is more consistent and closer to the customer's values and expectations, it can be said that the company has competitive advantage over its competitors in one or more indicators so that outperforms competitors and thus, captures the customers' hearts ([Guimaraes et al., 2016](#)).

Knowledge Management

Based on the literature review in this area, knowledge management is of fundamental importance in the global economy and plays an important role in the competitiveness improvement in large companies, as well as SMEs. Based on recent evidence, the knowledge management approach has been adopted by companies to promote innovation in business, social justice and the environment ([Centobelli et al., 2017](#)). The purpose of knowledge management is to identify, collect, categorize and organize, store and share, disseminate and make available knowledge at the organization level ([Yaghoubi et al., 2011](#)). Research and development in organizations, due to its valuable and effective nature, has led many researchers to consider knowledge management as a key factor for nurturing and the emergence of creativity in organizations and, consequently, the prosperity and viability of the organization. [Myrtle Beach \(2003\)](#) suggests that knowledge management is the extension of knowledge, insight, understanding, know-how and usage, technology and traditions with a combination of modern science. Finding, selecting, organizing, and disseminating important information is possible through the knowledge management process. For more complex activities such as problem solving, dynamic learning, planning, decision making and strategy, professional knowledge management is required ([Spector, 2004](#)). The American Productivity and Quality Center define knowledge as the extensive process of deploying, organizing, transferring and using information in the organization ([Qasri, 2013](#)). According to [Tsekhoveroy et al., \(2019\)](#), knowledge digitalization technology, which encourages the creation of domestic robots,

helps CEOs in the field of machine intelligence improve R&D activities.

Cleaner production

The macro-environmental forces caused by the natural environment create environmental issues that have increasingly been addressed over the past two decades. The 1990s was called the Earth Decade and experts suggest that the natural environment has become a main issue for global companies and people. By increasing the pollution of water and air to a dangerous level, the Ozone layer is pierced and the earth becomes warmer. Many fear the land buried under the rubbish. Concerns about the environment have led to a movement called the Green Movement, and the far-sighted companies have gone beyond state regulation and adopted strategies to create a sustainable environment and tried to create an economic system that governs the world to ensure the survival and durability of the planet ([Salehi Amiri, 2008](#)). There are very complex relations between humans and nature. Traditionally, nature was considered a stronger force than human; however, today there are machines that can move mountains and available technology has the potential to penetrate in nature and destroy the environment. Examining consumers' willingness to use green products indicated that more than 92% of European multinational companies have turned to environmentally friendly products, and 85% have changed their product line. Also, green products grew more than doubled to 11.4 percent of all home products in the United States from the 1980's to 90's., although this growth rate remained constant in the 1990s. Nature or environment is a capital with many non-renewable components, and recycling the renewable ones is so long that can actually be considered non-renewable. On the other hand, any natural phenomenon is so interconnected with other components that any change in each of the components cause change even to the farthest points of the world ([Nakhai, 2011](#)). Cleaner production is an environmental initiative, focused on systematically reducing production costs by restoring consumer resources, and minimizing the production of industrial waste ([Severo et al., 2015; Neto et al., 2015](#)) as well as the reuse of materials and recycling them to minimize environmental damage ([Guimaraes et al., 2017](#)). The present study aimed to investigate the

impact of entrepreneurship, market, and knowledge management on cleaner production and sustainable competitive advantage that each of these issues has been explained below:

Entrepreneurial Orientation (EO)

Entrepreneurial orientation, according to researchers, relies on the encouragement of change and innovation, risk-taking, and competitive aggressiveness in the organization (Wiklund and Shepherd, 2005; George and Marino, 2011). However, entrepreneurial orientation can also be defined as the company's ability to engage in activities related to innovation, risk-taking, and leadership in innovative activities (Engelen et al., 2015). Entrepreneurial orientation is a decision-making process that influences a company's willingness to innovate, overcome competitors through reactivity and aggressiveness, and take risks (Miller and Friesen, 1983). Overall, the entrepreneurial orientation includes exploring, evaluating, and exploiting opportunities to provide the market with new products and services (Ribeiro-Soriano and Huarng, 2013). Entrepreneurial orientation is also a set of corporate features that lead companies to innovate in business, products and services based on management decisions (Birkinshaw, 2000). EO includes identifying behavior and creating market opportunities, emerging and developing organizations, creativity in forming teams, creating healthy disruptive innovation, and organizational transformation that can take place in individual, team, organizational, industries, and the community levels (Shane and Venkataraman, 2000).

Market Orientation

Market orientation in terms of Dobni and Luffman (2003) is a behavioral culture to determine the direction of employees' thoughts and actions. The market orientation approach highlights the customers by understanding their requirements, proposing value to them, and creating a high level of customer satisfaction. Also, great attention is paid to responding to competitive threats and continuous discussion about the strengths and weaknesses of competitors and coordination between their performances through the integration of all members of the company in meeting customer's requirements. In this regard, maximizing long-term profit (Narver and

Slater, 1990) and sustainable competitive advantage (Kumar et al., 1998) is possible through providing superior value to customers. Market orientation is a continuous searching for customer data to identify market demands and quickly and satisfactorily provide solutions to customers by creating and communicating value of services and products to ultimately lead to improved organizational performance (Baker and Sinkula, 2005; Hult et al., 2003).

Knowledge Management Orientation

Knowledge Management Orientation refers to having infrastructures and information technologies to save and supply the produced knowledge in addition to structural and cultural facilitators (Kim and Lee, 2001). Since it is created by individuals based on collective work during the daily activities, knowledge is the result of constant interaction between people inside and outside the organization (Prieto et al., 2009).

Sustainable Competitive Advantage (SCA)

As one of the operational results and management decisions, SCA leads to organization superior performance compared to the competitors (Guimaraes et al., 2016), and Tan et al., (2015) mentioned quality improvement, innovation, costs reduction strategies, and social and environmental regulations as some factors influencing the organizational performance improvement.

Literature review

Hemmat and Qorbani (2017) conducted a research entitled "examining the relationship between strategic entrepreneurship and the competitive advantage of knowledge-based service companies: companies founded in Isfahan Scientific and Research Town". The research was conducted by structural equation method using SmartPLS software on a statistical sample including 134 companies from Isfahan research and development town. According to the obtained results, the five dimensions of strategic entrepreneurship derived from the Ireland model including entrepreneurial mentality, entrepreneurial culture, entrepreneurial leadership, strategic resource management and the use of creativity and the innovation development, have a positive impact on competitive advantage and thus, can improve competitive advantage. Supporting

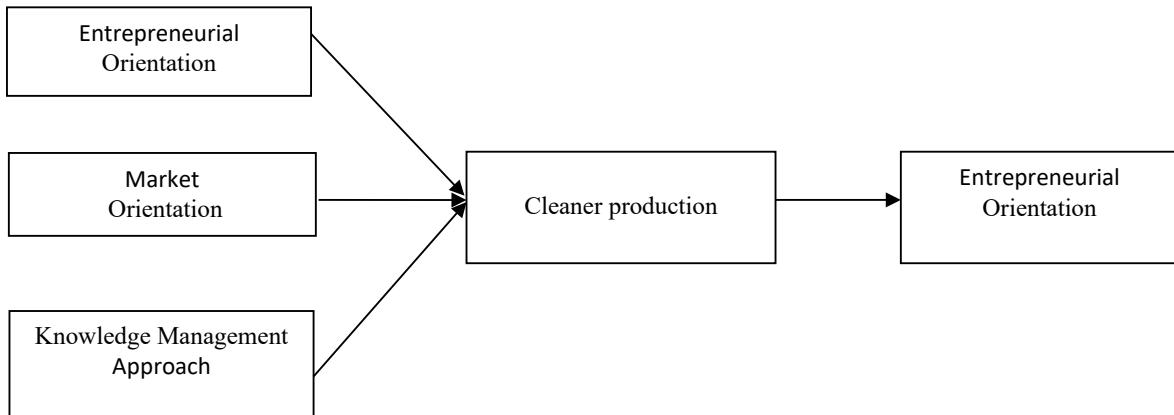


Fig. 1: Research Conceptual Model ([Guimaraes et al., 2018](#))

ideas from employee and accepting potential risks, applying training programs to strengthen entrepreneurial culture, creating and developing networking with other companies, attracting investors, reducing external controls, and using self-assessment and participatory systems and focusing on customer-oriented culture in an organization also contributes improving the effectiveness of strategic entrepreneurship and competitive advantage. In their study entitled "green marketing as a competitive advantage against non-responsible companies", [FakhrAbadi and Baqai \(2017\)](#) found that new concepts like clean technology, green consumer, competitive advantage, and sustainability are emerging in the environmental green marketing era. For instance, clean technology includes the innovative design of new products and the production system, so that waste and contamination are eliminated during the design phase. Today, green consumers do not use consume goods that could endanger the consumers' or the others' health or cause damage to the environment during production, cause unnecessary waste through packaging, harm animals or have a negative impact on other countries. Issues such as sustainable development in economy have had an important impact on marketing science and have proceeded the third century to sustainable green marketing. Looking ahead, equity and fairness, and emphasis on needs can be mentioned as the apparent challenges of this era. In such conditions, if there were a lot of consumers worried about the

environment, companies are distinguished from the others by adapting their products to the environment. This is a win-win relationship that causes both welfare and needs fulfillment for the consumer, as well as reducing costs through the proper activities and waste reduction for the company. In the research conducted by [Guimaraes et al., \(2018\)](#), the effect of entrepreneurship, market, and knowledge management were investigated on cleaner production and sustainable competitive advantage. Their study, conducted in a sample of 1,774 SMEs operating in the transformation industries, trade and services sectors in South of Brazil and using structural equation modeling, has been analyzed as a descriptive quantitative research. According to their results, strategic drivers have an intensive impact on cleaner production, which indicates the strong correlation between the three previous ones and also, research companies that use strategic orientation tend to have a greater impact on cleaner production. The current study have been carried out in the applications of small and medium enterprises In Iran during during the years 2015-2019.

Conceptual model

According to the theoretical framework and literature review, the research conceptual model, extracted from [Guimaraes et al., \(2018\)](#), is shown in Fig. 1.

Evidence and documents of conceptual model variables are given in [Table 1](#).

Table 1. Evidence of Conceptual Model Variables

Variable	Researcher
Entrepreneurial orientation	Hernández-Perlines and Rung-Hoch (2017); Engelen <i>et al.</i> , (2015);; George and Marino (2013)
Market orientation	Dobin and Luffman (2003); Narver and Slater (1990); Kumar <i>et al.</i> , (2002)
Knowledge Management Approach	Yaghoubi <i>et al.</i> , 2011; Centobelli <i>et al.</i> , (2017)
Cleaner production	Tsekhouvoy <i>et al.</i> , (2019); Prieto <i>et al.</i> , (2009)
Sustainable competitive advantage	Guimaraes <i>et al.</i> , (2016)

MATERIALS AND METHODS

The present study is a correlative survey and an applied research. The statistical sample of this research includes the senior managers of small and medium enterprises that are 289 managers using the $5Q \leq n \leq 15Q$ rule. The Guimaraes *et al.*, (2018) standard questionnaire was used with 22 items for the purpose of this research. The Cronbach's alpha coefficient is also used to measure the reliability which is obtained higher than 0.7, that shows a high reliability. For the reliability analysis, 50 questionnaires were pretested in an initial sample. Then Cronbach's alpha technique was employed to calculate the reliability coefficient based on the data obtained from questionnaires. Cronbach's alpha was calculated at 0.90 for variables; confirming the questionnaire's reliability. The confirmatory factor analysis along with the structural equations has been used to analyze the information. The following assumptions hold respectively in this method:

- Expressing the model
- Estimating the model
- Testing hypotheses
- Interpreting the model

LISREL software has been used for this purpose. The ANP technique with the following assumptions is also used to rank the factors:

- Comparing the main criterion with the goal
- Paired comparison of the other criteria to each criterion separately
- Paired comparison of sub criteria of each criterion to that criterion
- Paired comparison of sub criteria to each sub criteria separately
- Paired comparison of alternatives based on sub criteria

Table 2 is a presentation of the most frequently mentioned sustainable competitive advantage in the reviewed literature and Delphi method.

Table 2 Study indicators and semantic code

Indicator	Semantic code
Cleaner production	(CP)
Sustainable Competitive Advantage	(SCA)
Entrepreneurial orientation	(EO)
Marketing Orientation	(MO)
Knowledge Management	(KM)
Cleaner production	(CP)
Priority based on Target (special vector)	(W21)

RESULTS AND DISCUSSIONS

Descriptive statistics indexes have been used to categorize data related to gender, educational level, and history in order to describe the demographic characteristics of the studied population.

A total of 289 respondents were selected among which, the most frequency is related to male with 224 people which constitutes of the sample 77.50%, followed by the number of 65 female which constitutes 22.49% of the sample size. Among the 289 respondents, 56 have the associate degree which constitutes 19.37% and the most frequency was related to bachelor degree with 154 (53.28%) followed by master degree with 79 people 79% of the sample. 33 out of 289 respondents or 11.44% of the sample size had the working experience from 1 to 5 years. 165 respondents or 57.09 % of sample had working experience of 6 to 10 years; also, 165 individuals or 57.09 % had 6 to 10 years of experience and 62 respondents or 21.45 percent in the range of 11-15 years. Finally, 29 people or 10.3 % of the sample had over 16 years of experience.

Explaining hypotheses was firstly performed by the confirmatory factor analysis and then, by the structural equation model.

Confirmatory Factor Analysis

The validity of the scale used should be confirmed at first in order to verify the research hypotheses based on this scale. Therefore, confirmatory factor

analysis has been used to measure the relationship between latent variables and their measurement items. Confirmatory factor analysis examines the relationship of the items (the same questionnaire questions) with the structures. In fact, the research hypotheses cannot be used based on questionnaire data until it is demonstrated that the latent variables are well measured by the questionnaire questions. Therefore, the accurate data measurement is proved utilizing the confirmatory factor analysis. The relationship power between the factor (latent variable) and the observed variable is determined by the factor loading. The factor loading is ranged from zero and one. According to [Kline \(2010\)](#), the relationship is a weak one and can be ignored if the factor loading is less than 0.3.

The confirmatory factor analysis results

The factor analysis results are presented in [Table 3](#).

3. The factor loading is greater than 0.3 in all cases, indicating the acceptable correlation between the latent variables and the observed variables.

The structural equations results

The power of relationship between the research variables is measured by the structural equation modeling. The research hypotheses analysis was also performed using structural equation model. The final model is presented to analyze the research hypotheses in [Table 4](#). This model is drawn using the LISREL software output and its interpretations are as follows:

The Entrepreneurial Orientation has a positive relationship with cleaner production

According to [Table 4](#), the power of the relationship between entrepreneurial orientation and cleaner production is calculated at 0.75, which indicates a

Table 3. Factor loading coefficients and T value

construct	Item	Factor loadings coefficient	t-statistic
Entrepreneurial Orientation (EO)	EO1	0.31	7.12
	EO2	0.51	5.22
	EO3	0.75	7.15
	EO4	0.61	2.26
Market Trending (MT)	MT1	0.45	3.14
	MT2	0.78	4.14
	MT3	0.31	5.11
	MT4	0.39	5.23
	MT5	0.52	6.23
Knowledge Management (KM)	KM1	0.68	3.14
	KM2	0.52	4.15
	KM3	0.81	9.15
	KM4	0.52	3.25
	CP1	0.63	2.14
Cleaner production (CP)	CP2	0.51	2.16
	CP3	0.87	3.15
	CP4	0.72	3.29
	SCA1	0.89	3.56
Sustainable Competitive Advantage (SCA)	SCA2	0.74	5.16
	SCA3	0.53	7.12
	SCA4	0.68	5.89
	SCA5	0.73	6.49

Table4; Hypotheses Testing Results

Hypothesis	Correlation value	t-statistic	Hypothesis results
Entrepreneurship orientation - Cleaner production	0.75	2.75	confirmed
Market orientation - cleaner production	0.51	3.62	confirmed
Knowledge Management Approach - Cleaner production	0.85	3.59	confirmed
Cleaner production - Sustainable competitive advantage	0.87	5.04	confirmed

desirable correlation. Therefore, the above hypothesis is confirmed and it can be said that entrepreneurial orientation affects the cleaner production in the manufacturing companies in Iran.

The Market Orientation has a positive relationship with cleaner production

According to [Table 4](#), the relationship power for market orientation and lean production is 0.51, which indicates the desirable correlation. Therefore, the above hypothesis is confirmed and it can be said that the market orientation affects the cleaner production in the manufacturing companies in Iran.

Knowledge Management approach has a positive relationship with cleaner production

According to [Table 4](#), the power of the relationship between the KM approach and the cleaner production is calculated at 0.85, which indicates the desirable correlation. Therefore, the above hypothesis is confirmed and it can be said that the knowledge management approach affects the cleaner production in the manufacturing companies located in Iran.

Cleaner production has a positive relationship with the sustainable competitive advantage

According to [Table 4](#), the power of the relationship between cleaner production and sustainable competitive advantage has been calculated at 0.78, which indicates the desirable correlation. Therefore, the above hypothesis is confirmed, and it can be said that cleaner production has a positive effect on the competitive advantage of the manufacturing

companies located in Iran. Goodness of fit indicators has also been used to fit the structural model of the main research model. The regular χ^2 index is one of the main indicators to calculate the free parameters of fit indices, obtained by dividing the simple division of χ^2 to the model's degree of freedom ([Eq. 1](#)). If this value is between 1 and 5, it is considered to be desirable ([Kline, 2010](#)).

$$\frac{\chi^2}{df} = \frac{201.56}{74} = 2.724 \quad (1)$$

The model also has good fit because the Root Mean Square Error of Approximation (RMSEA) score is 0.033. Based on the sample size, all the fit indices of the model show significant differences. [Table 5](#) shows a summary of the model fit indices based on the p-value.

Priority based on Target (W21)

The main criteria are compared on a paired basis to perform the first analysis. For this purpose, a group of experts has been used and the Eigenvector has been calculated using the geometric mean and normalization techniques. The numbers obtained show the importance of each of the main criteria. The calculations performed in [Table 6](#) are presented and the Eigenvector is displayed as W21.

According to the obtained Eigenvector:

- The “knowledge orientation” criterion is in the first rank with a normalized weight of 0.307.
- The “entrepreneurial orientation” and “market orientation” criteria with a normalized weight of 0.229 are in the second priority.

Table 5: Goodness of Fit Indicators for the structural model of the research main hypotheses

Fitness Index	RMSEA	GFI	AGFI	NFI	NNFI	IFI
Acceptable values	<0.1	>0.9	>0.9	>0.9	>0.9	1 – 0
Calculated values	0.033	0.95	0.97	0.93	0.92	0.98

Table 6: Ranking the main criteria

Norms	EO	MO	KM	CP	SCA	Geometric mean	Eigenvector
EO	1	1.259	1.259	1.729	1.569	1.240	0.229
MO	1.166	1	0.546	1.901	2.404	1.238	0.229
KM	0.794	1.832	1	2.972	2.931	1.662	0.307
CP	0.578	0.337	0.526	1	2.492	0.761	0.141
SCA	0.637	0.341	0.416	0.401	1	0.515	0.095

- The “cleaner production” criterion with a normalized weight of 0.141 is in the fourth priority.
- The “Sustainable Competitive Advantage” criterion is in the fifth priority with a normalized weight of 0.095.

The inconsistency rate of the performed comparisons is 0.044, which is less than 0.1, and therefore, the comparisons accuracy was confirmed.

Determining the priority of entrepreneurial orientation sub-criteria

The calculations performed to determine the priority of sub-criteria for entrepreneurial orientation are presented in [Table 6](#). As this criterion is composed of 4 indicators, 7 paired comparisons have been made.

According to the obtained Eigenvector:

- The sub-criterion of “The Company develops market measures earlier than its competitors” is in the first rank with a weighted average of 0.440.
- The sub-criterion of “The Company encourages investment in high-risk, high-yield projects”, with a normalized weight of 0.323, is in the second priority.
- The sub-criterion of “The Company emphasizes the R & D activities, technological leadership and innovation in processes and products/services” is in the third priority with a normalized weight of 0.134.
- The sub-criterion of “Changes in the range of products or services has been very significant”,

with a normalized weight of 0.103, is in the last priority.

The inconsistency rate of the comparisons is 0.707, which is less than 0.1, and the comparisons accuracy was confirmed.

Determining the priority of Market Orientation (OM) sub-criteria

The calculations performed to determine the priority of Market Orientation sub-criteria are presented in [Table 8](#). Since this criterion is composed of 5 indicators, 10 paired comparisons have been made.

According to the obtained Eigenvector:

- The sub-criterion of “This Company prioritizes projects and response measures in relation to market orientation.” is in the first rank with a weighted average of 0.263.
- The sub-criterion of “The Company considers response measures to be one of the most important market demand information.” is in the second priority with a normalized weight of 0.260.
- The sub-criterion of “There is a cultural unit in the company that continuously provides customers with higher values”, with a normalized weight of 0.230 is in the third priority.
- The sub-criterion of “The company has special departments or staff to collect and manage market data to transform them into the market information”, with a normalized weight of 0.154 is in the fourth priority.

Table 7: Determining the priority of entrepreneurial orientation sub-criteria

	EO1	EO2	EO3	EO4	Geometric mean	Eigenvector
EO1	1	0.538	3.356	3.090	1.537	0.323
EO2	1.858	1	5.866	1.750	2.090	0.440
EO3	0.298	0.170	1	1.127	0.489	0.103
EO4	0.324	0.571	0.887	1	0.636	0.134

Table 8: Determining the priority of Market Orientation sub-criteria

	MO1	MO2	MO3	MO4	MO5	Geometric mean	Eigenvector
MO1	1	0.646	0.587	2.443	3.084	1.234	0.230
MO2	1.547	1	0.627	1.712	3.169	1.394	0.260
MO3	1.702	1.594	1	1.104	1.876	1.412	0.263
MO4	0.409	0.584	0.905	1	1.757	0.824	0.154
MO5	0.324	0.316	0.533	0.569	1	0.499	0.093

- The sub-criterion of “product/service innovations and process include market information”, with a normalized weight of 0.093 is in the fifth priority.

The inconsistency rate of the comparisons is 0.052, which is less than 0.1 and therefore, the comparisons accuracy was confirmed.

Determining the Priority of Knowledge Management (KM) sub-criteria

The calculations performed to determine the priority of knowledge management sub-criteria are presented in [Table 9](#). Since this criterion is composed of 4 indicators, 6 paired comparisons have been made.

According to the obtained Eigenvector:

- The sub-criterion of “formal procedures and systems influencing the processes of new products/services development, encourage employees to seek new knowledge regardless of organizational structure.” is in the first priority with a normalized weight of 0.350.
- The sub-criterion of “Managers welcome new offers and creativity from employees of new

product and process teams”, with a normalized weight of 0.315 is in the second priority.

- The sub-criterion of “formal procedures and systems influencing the processes of new products/services development are considered to enhance team behavior rather than individual behavior”, with a normalized weight of 0.216 is in the third priority.
- The sub-criterion of “formal procedures and systems influencing the processes of new products/services development are designed to help exchange knowledge with administrative boundaries.” is in the fourth priority with a normalized weight of 0.119.

The inconsistency rate of the comparisons is 0.707, which is less than 0.1, and therefore the comparisons accuracy was confirmed.

Determining the priority of the Cleaner production (CP) sub-criteria

The calculations performed to determine the priority of cleaner production sub-criteria are presented in [Table 10](#). Since this criterion is composed of 4 indicators, therefore, 6 paired comparisons have been made.

Table 9: Determining the priority of Knowledge Management sub-criteria

	KM1	KM2	KM3	KM4	Geometric mean	Eigenvector
KM1	1	0.671	2.488	2.094	1.367	0.315
KM2	1.491	1	3.975	0.899	1.515	0.350
KM3	0.402	0.252	1	0.695	0.515	0.119
KM4	0.478	1.125	1.439	1	0.938	0.216

Table 10: Determining the Priority of Cleaner production sub-criteria

	CP1	CP2	CP3	CP4	Geometric mean	Eigenvector
CP1	1	1.632	4.048	2.865	2.091	0.452
CP2	0.613	1	3.284	1.551	11.329	0.287
CP3	0.245	0.305	1	2.458	0.654	0.142
CP4	0.349	0.645	0.407	1	0.550	0.119

Table 11: Determining the priority of sustainable Competitive Advantage sub-criteria

	SCA1	SCA2	SCA3	SCA4	SCA5	Geometric mean	Eigenvector
SCA1	1	0.646	0.820	2.443	2.763	1.290	0.234
SCA2	1.547	1	1.025	2.285	3.169	1.629	0.296
SCA3	1.220	0.976	1	1.457	2.685	1.360	0.247
SCA4	0.409	0.438	0.686	1	2.514	0.719	0.143
SCA5	0.362	0.316	0.373	0.398	1	0.719	0.080

According to the obtained Eigenvector:

- The sub-criterion of "CP measures caused decrease the use of raw materials, water, or electricity in organizational processes." is in the first priority with a normalized weight of 0.452.
- The sub-criterion of "CP operations improve the production/service provision process", with a normalized weight of 0.287 is in the second priority.
- The sub-criterion of "The Company encourages its staff to propose new ways for CP and sustainable innovations." is in the third priority with a normalized weight of 0.142.
- The sub-criterion of "Use of CP measures leads to products/services of higher quality than competitors", with a normalized weight of 0.119 is in the last priority.

The inconsistency rate of the comparisons is 0.707, which is less than 0.1, and therefore the comparisons accuracy was confirmed.

Determining the priority of Sustainable Competitive Advantage (SCA) sub-criteria

The calculations performed to determine the priority of the sustained competitive advantage sub-criteria are presented in [Table 11](#). Because this criterion is composed of 5 indicators, 10 paired comparisons have been made.

According to the obtained Eigenvector:

- The sub-criterion of "our operating procurement costs is less than our competitors during production/service delivery", with a normalized weight of 0.296 is in the first priority.
- The sub-criterion of "our profit from new products/services is much better compared to our competitors", with a normalized weight of 0.247 is in the second priority.
- The sub-criterion of "Our income from new products/services is superior to our competitors", is in the third priority with a normalized weight of 0.234.
- The sub-criterion of "Our new products/services include sustainable environmental knowledge and concepts", is in the fourth priority with a normalized weight of 0.143.
- The sub-criterion of "Our new products/services are produced with respect for entrepreneurship

social responsibility guidelines", with the normal weight of 0.080 is in the last priority.

The inconsistency rate of the comparisons is 0.052, which is less than 0.1 and therefore, the comparisons accuracy was confirmed.

CONCLUSION

Regardless of the economic sector in which they operate, companies have a key task of promoting sustainable development in their region. Since companies' environmental actions determine the direct effects of environmental sustainability, hence, small and medium producers, like other companies, are responsible for reducing the natural resources use and nuclear materials, and also the systematic increase of emissions of pollutants and waste. Therefore, there is a need to use strategic guides before using cleaner production, which led companies to achieve a sustainable competitive edge ahead of their competitors. The results of the tests show that Knowledge Management (KM) has the greatest impact on the cleaner production (CP). Therefore, it is very important for companies to create formal promotion and management structures. In this regard, the knowledge created by the organization is a tool to wise use of resources and to develop competitive innovations in business as well as environmental, economic and social sustainability. Companies use cleaner production to benefit from a set of strategic guidelines, resulting in significant developmental improvements that produce a sustainable competitive advantage in comparison with competitors. New results from this research include: "What effect do regional economic factors have on the relationship between constructs? What are the company's main measures? Using research to determine market demands and meet them by sustainable ways; what are CP measures that companies use to create sustainable competitive advantage?" Such questions can help understand the dynamics between them. These constructs have been investigated and so managers can emphasize the measures that maximize CP utilization and cause improved organizational performance. The results of this research are consistent with [Hemmat and Ghorbani \(2017\)](#). They also stated in their research that entrepreneurship has a positive impact on competitive advantage and can therefore improve

their competitive advantage. The results are also consistent with Fakhr Abadi and Baqai (2017) in emphasizing the emergence of new concepts including cleaner technology, sustainability, green consumerism, and competitive advantage in the green environmental marketing era. They also found that cleaner production lead to competitive advantage. Since the existing knowledge base is somewhat fragmented, it has been difficult to investigate this subject. As the term cleaner production is widely used in popular publications, SMEs can claim to use cleaner production in a variety of ways. Different values are also assigned to cleaner production in a competitive strategy. Therefore, it seems that the existing knowledge of manufacturing operations is insufficient at this level to cover the rapid growth of this field, and many SMEs are still lagging behind in taking advantage of these new opportunities.

Also according to the findings, small and medium manufacturing companies are recommended to apply the following items:

1. Identifying and implementing formal procedures and systems affecting the processes of new products/services development.
2. Managers are advised to welcome the suggestions and creativity of their employees.
3. Companies should focus on R&D activities, technology leadership and innovation in processes and products/services.
4. Creating a cultural unit within companies that consistently provides customers with higher values.

AUTHOR CONTRIBUTIONS

Y. Vakil Alroaia performed conceptualization, methodology, software, and literature review and manuscript preparation. R. Tayyebirad and Y. Vakil Alroaia performed data correction, writing original draft preparation, writing reviewing and editing references.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

ABBREVIATION

CP	Cleaner production
SCA	Sustainable Competitive Advantage
EO	Entrepreneurial Orientation
MO	Marketing Orientation
KM	knowledge Management
CP	Cleaner production

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