

Kenari, Naghmeh Khabazi; Farahmand, Naser Feghhi; Iranzadeh, Soleyman

Article

A comprehensive model for energy management strategies in coordination with manufacturing and organization strategies and its effect on energy management performance

Cogent Business & Management

Provided in Cooperation with:

Taylor & Francis Group

Suggested Citation: Kenari, Naghmeh Khabazi; Farahmand, Naser Feghhi; Iranzadeh, Soleyman (2018) : A comprehensive model for energy management strategies in coordination with manufacturing and organization strategies and its effect on energy management performance, Cogent Business & Management, ISSN 2331-1975, Taylor & Francis, Abingdon, Vol. 5,
<https://doi.org/10.1080/23311975.2018.1463605>

This Version is available at:

<https://hdl.handle.net/10419/206061>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



<https://creativecommons.org/licenses/by/4.0/>



Received: 06 December 2017
Accepted: 08 April 2018
First Published: 11 April 2018

*Corresponding author: Naser Feghhi Farahmand, Department of Industrial Management, Tabriz Branch, Islamic Azad University, Tabriz, Iran
E-mail: farahmand@iaut.ac.ir

Reviewing editor:
Tamer Elshandidy, University of Bradford, UK

Additional information is available at the end of the article

MANAGEMENT | RESEARCH ARTICLE

A comprehensive model for energy management strategies in coordination with manufacturing and organization strategies and its effect on energy management performance

Naghmeh Khabazi Kenari¹, Naser Feghhi Farahmand^{1*} and Soleyman Iranzadeh¹

Abstract: Today, energy management is an important tool for organizations to achieve their key goals, but only by considering the role of energy management strategies, we cannot achieve scientific and precise results from energy management system. So this research aims to propose a comprehensive model of energy management strategies that is in line with organization and manufacturing strategies and increases performance of energy management. In this research, we collect information from the petrochemical companies and refineries, whose energy intensity is determined by hydrocarbon balance sheet of the country and examine them. Results show that organizations in which the type of their energy management, manufacturing, and organization strategies are coordinated have better energy management performance.

Subjects: Environmental Psychology; Economics; Environmental Economics; Finance; Business, Management and Accounting; Industry & Industrial Studies; Manufacturing Industries; Chemical Industries; Distributive Industries; Information Technology

Keywords: energy management; energy management strategies; manufacturing strategies; organization strategy; strategy coordination; energy management performance

ABOUT THE AUTHORS

Naghmeh khabazi kenari is a PhD candidate in industrial management at Tabriz Islamic Azad University. Her research interests include energy management strategy, manufacturing strategy, and strategy coordination.

Naser Feghhi Farahmand is an associate professor of industrial management at Tabriz Islamic Azad University. His research interests include strategy management, supply chain management, and human resource management. His articles have been published in International journals. He has run a lot of projects in Iranian companies in the field of strategic management.

Solyiman Iranzadeh is an associate professor of industrial management at Tabriz Islamic Azad University. His research interests include knowledge management, organizational culture, and cost management. His articles have been published in International journals. He has run a lot of projects in Iranian companies in the field of knowledge management.

PUBLIC INTEREST STATEMENT

The main purpose of the present study is to describe how the coordination between important influential factors such as energy management strategies, Organization and manufacturing strategies will increase the energy management performance. Based on the strategic reference points model we integrated two criteria of “focus” and “organizational control” in the form of matrix, which from this interaction of points four types of strategy were achieved in all three domains. So energy management strategies are; Case-based improvement, Focus-based, Comprehensive improvement and Leading. Manufacturing strategies categories are; Caretakers, Lean competition, Technology-driven innovation and Mass customization and also organization strategies are; Leadership in minimizing the cost, relatively cost minimizing, Fairly differentiated and completely differentiated. This paper is applicable for senior managers of the organizations to achieve sustainable strategies and also can be useful for the companies that want to have a suitable performance of energy management system.

1. Introduction

Today in the world, sources of fossil fuels are decreasing and consequently, costs of providing them are increasing. On the other hand, technologies of renewable energy are often in the stage of introduction and early growth and are not still properly developed and their investment volume is high. In Iran, limitation of fossil resources and oil export from the end of the present century, and hence, the cessation of revenues from oil exports causes that in the absence of required planning and forecasting, the development process of the country will be seriously affected.

According to this, organizations that have an inactive approach to energy, given global routine changes are faced with significant risk and little regard to the energy issue can lead to problems for the future of business activities and their management (Ralston, 2008).

Energy intensity in accordance with the definition of International Energy Agency is rate of the energy consumption to the GDP. On the one hand, Iran Energy Efficiency Organization (SABA) declared that energy intensity of internal industries is more than the global average so that intensity of energy in the country based on current rates in 2014 is 3.6 times more than average energy intensity of the world.

Considering high consumption of energy in Iranian industries and in line with implementation of the law of the second economic development program and also in accordance with approval of the cabinet of ministers, industries such as petrochemicals and refineries from many years ago have started the energy management activities, but most organizations that are active in other industries because of the cheapness of energy in Iran have not considered the strategic energy planning and reducing its consumption seriously (Shams, 2014).

In fact, energy management is considered a combination of energy efficiency activities, techniques, and management of related processes which result in lower energy cost (Ates & Durakbasa, 2012, p. 81).

Energy strategies are one of the requirements listed in energy management standards such as EN16001 and ISO50001. According to previous studies, strategic planning as well as energy management strategies are necessary for the implementation and establishment of the energy management system and affect the performance of energy management. However, one of the criticisms that can be made on this research is the lack of considering energy management system from a systematic perspective. In other words, only considering the role of energy management strategies, one cannot achieve comprehensive results of energy management system's performance, because there are other important influential factors that should be taken into consideration.

According to statistics published in the country's hydrocarbon balance sheet in 2014 (Institute of Iran International Energy Studies), industrial sector after the household sector and transportation is the third largest consumer energy sector in the country. On the other hand Energy is consumed in the industrial sector by a diverse group of industries including manufacturing, agriculture, mining and construction and for a wide range of activities such as processing and assembly, space conditioning, and lighting (Abdeaziz, Saidur, & Mekhilef, 2011).

In fact, decisions about manufacturing, manufacturing method, organization's size, organization's location, type of machinery and equipment, type of equipment, inventory level, inventory control, quality control, use of resources and high-energy equipment, planning and design, selection and purchase of equipment and workplaces can reduce energy consumption. In other words, they can have severe effects on increasing energy consumption efficiency (Fred, 2011).

Thus, it can be concluded that control of all parameters that affect energy consumption in industry, including role of the manufacturing sector that is the most important part of each organization and in which processes related to the production of products and the organization's services are carried out, are very important. So considering the role of manufacturing strategies along with energy management strategies and organization strategies and its impact on energy management performance can produce more accurate and far more scientific results.

Ralston (2008) finds that the process to develop a new energy strategy addresses the prospects that the way an organization manages its energy and environmental threats and opportunities over the next 15 years could invigorate or cripple it. Shams (2014) in her PhD thesis conducted in Iran brought out the models of energy management strategies and its sub-systems with grounded theory methods and the information gathered from the knowledgeable specialists in Energy Management. However, in this research, due to small size of sample, examining the relationship between coordination of organization's strategies with energy management strategies and strategies of energy management sub-systems and energy management performance was not possible and also the researcher was unable to examine horizontal coordination of strategies of energy management subsystems with energy management performance.

Although past researchers have highlighted the importance of manufacturing strategy towards attaining higher performance (Kim & Arnold, 1992; Leong, Snyder, & Ward, 1990; Ward & Duray, 2000). Amoaka-Gyampah and Acquah (2008) argued that there is a direct relationship between manufacturing strategy and firm's performance. Miltenburg (2008) suggested that firms that apply manufacturing strategy are most likely to achieve higher return on sales and better profit before tax to sales ratio. Corporate performance is positively related to role of manufacturer managers in strategic decision-making (Swamidass & Newell, 1987). Anderson, Cleveland, and Schroeder (1989) findings indicated that production competence is a measurable function of production and related to firms competence. Quality assurance and the firm's capabilities to deliver their products and services were also found to be significantly related to the firms performance (Williams, D'Souza, Rosenfeldt, & Kassae, 1995). Advanced operating procedures and firm capabilities tend to build efficient delivery process; low operation cost generates competitive advantage and increase firm performance (Day, 1994). According to Butt (2012) lack of co-alignment of manufacturing strategies and marketing strategies leads to negative impact on both financial and non-financial performance.

As you see there are numerous researches performed on the manufacturing strategy but one of the highlights of this study, and a major contribution is its systematic view and incorporating the element of energy management strategy as a functional strategy in coordination with manufacturing strategies and also organization strategy. Ours is the first study to take a different perspective on this aspect, by empirically trying to understand how coordinated, medium-coordinated and uncoordinated companies have significant difference in performance level. Our findings confirm certain assumptions of the previous studies but also provide new insights, giving us a better understanding of coordination between different functional and business strategies such as energy management, manufacturing, and organization strategies and evaluate its effect in energy management performance.

2. Theoretical foundations and research background

For the concept of strategy, there are many definitions. Daft believes that strategy is a plan for building an interactive relationship with environmental factors, which are usually contradictory, in order to meet the organization's goals. Some managers see target synonym with strategy, but from Daft's view, it is goal that determines where does the organization go? And strategy determines how to reach it? (Afjeh & Sepahvand, 2009).

Most organizations rather than having a single and comprehensive strategy use a set of related strategies that each one is designed at different levels (Walker et al., 2014). There are three general levels of strategy in most organizations, including corporate strategy, business strategy and functional strategy (Daft, 2006, pp. 30 and 117; Harrison & John, 2007, p. 196; Wheelen & Hunger, 2010, pp. 28–29). The corporate strategy refers to the attractiveness of the industry (Grant, 2002). A main responsibility of corporate strategy is identifying industries in which business units of organization compete and resources of company are allocated to these divisions (Bowman & Helfat, 2001). Business strategies focus on creating competitive advantage over competitors in an industry, in other words, how a company should compete (Grant, 2002; Hambrick, 1980). Functional strategies focus on improving effectiveness of organization's operations so the result of these strategies is to increase efficiency, quality, innovation and responding the needs of customers. In fact, if functional strategies are determined in a smart manner would lead to improving distinctive competencies of organization (Hill & Jones, 2010).

With regard to the above concepts, it can be said that energy management today is one of the strategic issues of Iranian organizations, which can be considered as one of the programs and tasks of organization that needs strategic planning (Bryson & Alston, 2009, pp. 9–10).

In fact industrial companies have seemed to realize that energy management can be an effective lever for enhancing their production systems and operations towards improved energy efficiency and thereby reducing energy use and related energy costs. The ISO 50001 standard, released in June 2011 by the international Organization of Standardization, additionally enforces energy management activities of companies and other organizations globally as it provides practical guidance and specifies minimum requirements for implementing a formal energy management system (German Federal Environment Agency, 2014).

Energy management strategy is getting important day by day due to the increased cost for energy supply and enhanced environmental awareness. Energy management strategy is the strategy of meeting energy demand when and where it is needed. This can be achieved by optimizing energy usage by the systems in order to reduce the total production cost of these systems (Abdeaziz et al., 2011).

In the other hand, Wenerfelt (1984) referred manufacturing strategy formulation as “what a firm wants is to create a situation where its own resource position directly and indirectly makes it difficult for others to catch up”. Based on the previous studies related to the topic of this article, manufacturing strategy among three strategies of corporate, business and functional, is a functional strategy (Daft, 2006; Harrison & John, 2007; Wheelen & Hunger, 2010). And also building on the study of Shams (2014), energy management strategy is a functional strategy, which wants to optimize efficacy of energy resources that organization uses to help realization of the goals and strategies of the firm and business.

In order to determine type of energy management strategy, manufacturing and organization strategies based on strategic reference points model, two criteria of “focus” and “organizational control” were integrated in the form of matrix, which from this interaction of points, four types of strategy were achieved in all three domains. So energy management strategies are; case-based improvement, focus-based, comprehensive improvement and Leading (Shams, 2014). Manufacturing strategies categories are; caretakers, lean competition, technology-driven innovation, and mass customization (Mostafavi, 2012) and also organization strategies are; leadership in minimizing the cost, relatively cost minimizing, Fairly differentiated and completely differentiated (Dehghan, 2000).

3. Conceptual model of the research

Based on the three concepts of “corporate strategy”, “business strategy” and “functional strategy” discussed in the previous section, the initial model of this study is presented. This model is shown in Figure 1, which is a proper basis for the conceptual model of this article.

4. The main question and hypothesis of the research

In present study, considering that organizations can choose their strategies in these three areas from several options, a major question arises that what are the dominant strategies in each of the three domains in the statistical population?

According to this main question, the following hypothesis is presented:

Coordination between energy management strategy, manufacturing strategy and organization strategy leads to higher energy management performance.

5. The methodology

5.1. Population and sample

In order to collect quantitative data to test the research hypotheses, the population includes petrochemical companies and oil and gas refineries, which their energy intensity is determined by the hydrocarbon balance sheet of the country published by the international institute for energy studies. The total number of petrochemical companies and refineries is 56 organizations and sampling is of the census type. The selection of this sample is due to the fact that we can use the intensity of energy published in the country’s hydrocarbon balance sheet as an energy management function in analyses. Table 1 shows the statistical sample of the research.

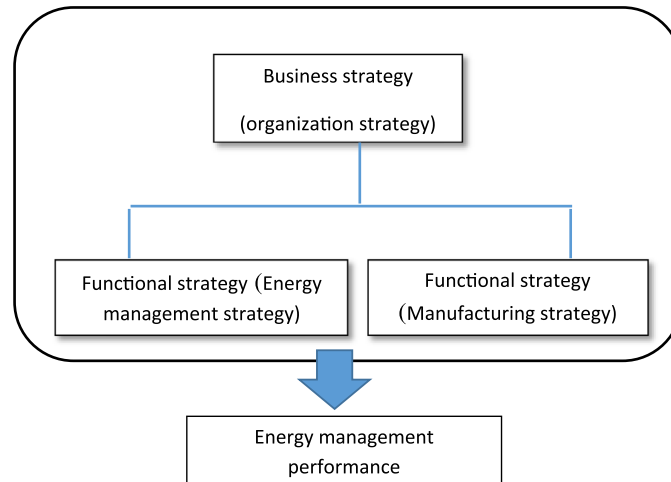
5.2. Data collection method

Part of information and data are collected by the international institute for energy studies from reports published in the state hydrocarbon balance sheet. In addition, the questionnaire tool was also used to measure the independent variable. This questionnaire contains 56 questions with closed answers in the form of Likert spectrum. The questionnaire has 16 questions on energy management strategy, 20 questions related to manufacturing strategies and 20 questions to identify organization’s strategy. After evaluating validation (content and formality) and reliability (Cronbach’s alpha coefficient for energy management strategy, manufacturing and organization strategy is 0.887, 0.901 and 0.869, respectively) five copies from each questionnaire was sent to each company in order that people who are familiar with strategic issues of energy and production of company to complete it.

Table 1. The research sample

Oil refineries	Abadan, Isfahan, Shahid Tondgoyan Tehran, Tabriz, Shiraz, Kermanshah, Lavan, Imam Khomeini, Shazand, Bandar Abbas
Gas refineries	Bidboland 1, South Pars Phase 1, South Pars Phases 2 and 3, South Pars phases 4 and 5, South Pars phases 6, 7 and 8, South Pars phases 9 and 10, South Pars phase 12, South Pars phases 15 and 16, South Pars phases 17 and 18, Persian, Hasheminejad, Fajr Jam, Masjed Soleiman, Sarkhoon and Qeshm, Ilam
Petro-chemical	Bandar Imam, Arak, Tabriz, Isfahan, Khorasan, Shiraz, Razi, Khark, Fanavar, Bisotun, Kermanshah, Maroon, Pars, Borzouye, Urmia, Iran, Khuzestan, Pardis 1 and 2, Zagros 1 and 2, Arya Sasol, Jam, Ghadir, Kermanshah Polymer, Kavian, Ahvaz Karoon, Arvand, Baft Shimi, Jamshid Takht, Rejal, Arya Tex, Abadan, Ilam, Iran Carbon, Morvarid

Figure 1. Initial model of the research.



5.3. Research variables

In order to determine the level of energy management performance of sample companies (dependent variable), the energy intensity index or the intensity of energy consumption is used. To this purpose, statistics published in the hydrocarbon balance sheet of the country during the years 2013–2015 was used. Energy intensity index in petrochemical companies based on the ratio of fuel consumption to the produced product and in oil refineries based on the amount of energy consumed per refinery per barrel of crude oil and in gas refineries based on the amount of fuel consumed per each million cubic meters of the light gas is calculated.

In this study, the coordination between three strategies (energy management, manufacturing and organization strategies) is assumed as independent variable. Determining different types of energy management strategy, manufacturing and organization strategies based on strategic reference points model is explained in the previous sections.

5.4. Information analysis

In the present study and in the descriptive statistics section, statistical indices such as frequency, percentage and the mean and in the section of inferential statistics, parametric statistics was used. In this research, after extraction of information, statistical data was summarized and classified in frequency distribution tables in software such as SPSS and SMARTPLS.

6. Evaluation of the measurement model

Considering the small size of sample and complex structure of the model, in order to confirm the model we used confirmatory factor analysis technique and the partial least squares method. Before entering the phase of testing hypotheses and conceptual model of the research, it is necessary to ensure accuracy of the measurement models of exogenous and endogenous variables.

6.1. Factor analysis

This is done through first-, second-, and third-order factor analysis. The model actually tests all the first-, second- and third-order measurement equations (factor loadings) using the t statistic. All numbers of this model are obtained from the t test and are used as the coefficients and they are significance at 95% confidence level, since the absolute value of t statistic is greater than 1.96 (Appendix 1).

6.2. Convergent validity

In order to measure convergent validity, three scales are considered: factor loadings, average variance extracted and composite reliability (CR). To this purpose, average variance extracted should be higher than 0.5 so as one of the convergent criteria to be credible (Fornell, 1981). Table 2 shows that

all the first-order factor loadings have a value greater than 0.5 and convergent validity for all the latent variables confirms.

Internal consistency is the same as reliability in which both the Cronbach’s Alpha and the composite reliability are used. According to Fornell (1981), the composite reliability should be equal to or greater than 0.7, which indicates adequacy of internal convergence. According to Table 2, average variance extracted is calculated for each structure and factor loadings and or external loadings for each agent is measured. Composite reliability indices and Cronbach’s alpha are used to examine reliability of the questionnaire.

6.3. Quality of the measurement model

Another test for evaluation of the measurement model is Quality of the measurement model. By this index, in fact, tests ability of the route model in prediction of observed variables through values of their respective latent variables. Three values of are 0.02, 0.15 and 0.35 for Cv Com index imply low, medium and high quality for the measurement model, respectively. According to the results of Table 3, the total average of the index is 0.73, which indicates the optimal and high quality of the model.

6.4. Discriminant validity

A kind of relationship between latent variables in a structural equation model is based on association. Association is a relationship between two variables in a model that is non-directional and nature of this kind of relationship is evaluated by means of correlation analysis. Table 4 presents Pearson Correlation Coefficients for assessment of the relationship between latent variables two by two.

The greater the correlation coefficient, the greater and more powerful would be intensity of relationship between two or more variables. In addition, the last column of this table presents the second root of average variance explained (AVE). As specified in the table, value of second root of AVE for all variables is more than correlation of that variable with other variables, so divergent validity is confirmed (Table 2).

Table 2. Validity, reliability indices, and fitting the model							
Hidden variables	AVE	CR	R ²	Cronbach’s alpha	\sqrt{AVE}	$\sqrt{R^2}$	GOF
Leadership in minimizing the cost	0.714	0.926	0.609	0.899	0.834	0.677	0.564
Relatively cost minimizing	0.721	0.928	0.34	0.903			
Fairly differentiated	0.775	0.945	0.573	0.927			
Completely differentiated	0.738	0.934	0.205	0.912			
Case-based Improvement	0.779	0.934	0.478	0.905			
Focus-based	0.675	0.892	0.158	0.844			
Comprehensive Improvement	0.703	0.904	0.2	0.864			
Leading	0.815	0.946	0.581	0.924			
Caretakers	0.634	0.896	0.121	0.856			
Lean competition	0.746	0.936	0.448	0.915			
Technology-driven innovation	0.734	0.933	0.466	0.91			
Mass customization	0.721	0.928	0.488	0.903			
Energy management strategy	0.547	0.897	0.778	0.88			
Business strategy	0.577	0.839	0.607	0.802			
Manufacturing strategy	0.581	0.875	0.813	0.852			
Total	0.677	0.934	0	0.927			

6.5. Cross-loadings

If the highest factor loadings for each index is related to the structure of that index and for the rest of structures to show a lower factors loadings or if any construct or variable takes most of its factor loadings from indices related to itself, it can be said that variables of the model are sufficiently distinctive. To this purpose, table of cross loadings (Table A2) is used that shows the factor loadings of each item have the highest correlation with the corresponding variable (Appendix 2)

Goodness of fit index shows the relation between quality of the structural model and the measurement model so that if its values exceeded 0.4 suggests very good fitness of the designed model. In this research, the fit index is equal to 0.564, which is greater than 0.4 and in turn indicates consistency of the questions with the theoretical constructs.

Figure 2. Final conceptual model of the research.

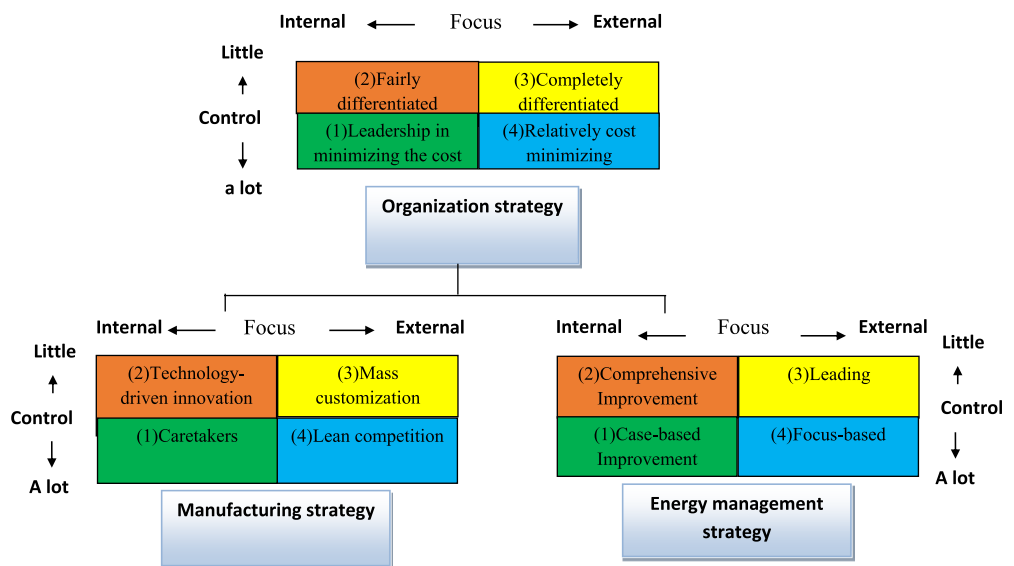


Table 3. Results of testing quality of the measurement model

Hidden variables	Quality of the measurement model (cv com)	Result
Leadership in minimizing the cost	0.714	Strong
Relatively cost minimizing	0.721	Strong
Fairly differentiated	0.774	Strong
Completely differentiated	0.738	Strong
Case-based improvement	0.779	Strong
Focus-based	0.675	Strong
Comprehensive improvement	0.703	Strong
Leading	0.815	Strong
Caretakers	0.634	Strong
Lean competition	0.746	Strong
Technology-driven innovation	0.734	Strong
Mass customization	0.721	Strong
Total mean	0.73	Strong

Table 4. Correlation coefficients and divergent validity index

Hidden variables	1	2	3	4	5	6	7	8	9	10	11	12	\sqrt{AVE}
(1) Leadership in minimizing the cost	1												0.845
(2) Relatively cost minimizing	0.316	1											0.849
(3) Fairly differentiated	0.351	0.282	1										0.88
(4) Completely differentiated	0.28	-0.034	0.186	1									0.859
(5) Case-based improvement	0.433	0.095	0.354	-0.02	1								0.883
(6) Focus-based	0.105	0.024	0.272	0.122	0.157	1							0.822
(7) Comprehensive improvement	0.161	0.238	0.11	-0.191	0.024	0.125	1						0.838
(8) Leading	0.301	0.15	0.339	0.195	0.273	0.036	0.203	1					0.903
(9) Caretakers	0.221	0.139	0.191	0.08	0.133	0.203	0.182	0.154	1				0.796
(10) Lean competition	0.373	0.332	0.294	0.221	0.315	0.246	0.289	0.216	0.237	1			0.864
(11) Technology-driven innovation	0.395	0.054	0.498	0.448	0.131	0.375	0.077	0.289	-0.022	0.189	1		0.857
(12) Mass customization	0.328	0.301	0.259	0.075	0.231	0.223	0.32	0.349	0.095	0.181	0.324	1	0.849

Table 5. Descriptive outcomes including mean and standard deviation

Coordination of strategy	Average	Standard deviation	Sample size
Complete coordination	0.601	0.500	13
Medium coordination	0.194	0.102	25
Uncoordinated	0.021	0.014	18
Total	0.233	0.326	56

7. Hypothesis testing

In this section, to investigate the main hypothesis of the research, companies are divided into three clusters. First cluster includes companies that all three types of their strategy are consistent, which are considered as the first cluster companies that are in full harmony. Second cluster includes companies that two strategies of them are in line with each other, they are considered as secondary cluster companies with moderate consistency. If none of the strategy types are in line with each other, they are considered as inconsistent companies.

Given that the independent variable (complete-weak and moderate coordination) is qualitative (at least three groups) and the dependent variable (energy management performance) is quantitative, the variance analysis is used (Tables 5 – 7).

$$\begin{cases} H_0: \mu_1 = \mu_2 = \mu_3 \\ H_1: \mu_1 \neq \mu_2 \neq \mu_3 \end{cases}$$

8. Results

The results obtained from the analysis of variance shows that if *F* statistic is of the table is larger and significant level of error (5%) is lower, it means that coordinated companies, with medium-coordination and uncoordinated companies have significant differences in performance level. The effect size shows that difference between three groups was about 45%. Considering that coordination effect is significant (there is a significant difference between at least two types of coordination), Turkey test was used to for pairwise comparisons.

Performance of company among companies in which coordination of energy management strategies, manufacturing strategy and organization strategy is complete (13 companies) at the confidence level of 95% with medium-coordination companies (25 companies) and uncoordinated companies (18 companies) have significant differences and average of companies with complete coordination (0.6868) is more than that in medium-coordination (0.1944) and uncoordinated companies (0.0207). As a result, the researcher's hypothesis is confirmed at 95% confidence level and we can say that coordination between energy management strategy, manufacturing strategy and organization strategy leads to higher performance of energy management. Also, results of Tukey test show that at the confidence level of 95%, average of medium companies (0.1944) and uncoordinated firms (0.0207) have no significant difference (Graph 1).

Graph 1. Average performance of companies of different groups.

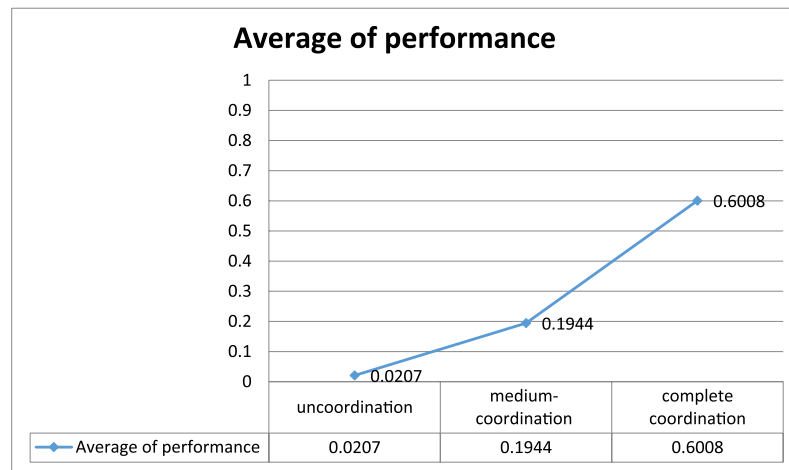


Table 6. Two-variable analysis of variance

Source of variations	Sum of squares	Degrees of freedom	Averages of squares	F statistics	Significance level	Effect size
Coordination	2.607	2	1.304	21.26	0	0.445
Error	3.25	53	0.061			
Total	5.857	55				

Table 7. Tukey test results

Coordination strategy	Count	Collection	
		1	2
Uncoordinated	18	0.0207	
Medium coordination	25	0.1944	
Complete coordination	13		0.6008
Significance level		0.106	1.000

Finally, after conducted investigations, the research hypothesis was confirmed. Therefore, the conceptual framework of the research can be used as a theoretical model that has scientific validity. This theoretical model is depicted in Figure 2.

Results show that energy management performance in organizations with coordinated and uncoordinated combinations of strategies is not the same and higher energy management performance relates to organizations with more coordinated combinations of strategies and lower energy management performance relates to organizations with uncoordinated strategy combinations. In fact, combinations 111, 222, 333, and 444 (combination of cells with the same color in Figure 2) are coordinated combinations, which lead to higher performance. These combinations are resulted from companies which had, in order, high control and internal focus, high control and external focus, low control and internal focus, low control and external focus, and their focus was on outcome efficiency and internal resources, outcome efficiency and external resources, creating new values and internal resources, creation of new values and external resources.

So it is recommended that organizations select their energy management strategies in the way that be coordinated with the manufacturing strategies and organizations strategies because coordination of these three strategies will cause the better energy performance.

9. Conclusion

- (1) Energy management in with the meaning of how to use energy resources to produce products and services for organizations has attracted attention from countries and organizations for a while. Major researches done have been often focused on defining the process of developing energy management strategies.
- (2) In this research to identify the dominant strategies in three areas of energy management, manufacturing and organization, pattern of strategic reference points was used and focus of attention and amount of control are two main bases for ranking strategies.
- (3) According to the analyses made, company’s performance in companies with complete coordination between energy management strategies, manufacturing strategy and organization strategy (13 companies) at 95% confidence level, with medium-coordination companies (25 companies) and uncoordinated companies (18 companies) have significant difference and average of companies with complete coordination (0.6868) is more than that of medium coordination companies (0.1944) and uncoordinated companies (0.0207). As a result, the

researcher's hypothesis is confirmed at 95% confidence level and it can be said that coordination between energy management strategy, manufacturing strategy and organization strategy leads to higher performance of energy management.

Funding

The authors received no direct funding for this research.

Author details

Naghmeh Khabazi Kenari¹

E-mail: naghmehkhabazi@gmail.com

Naser Feghhi Farahmand¹

E-mail: farahmand@iaut.ac.ir

ORCID ID: <http://orcid.org/0000-0002-4936-2374>

Soleyman Iranzadeh¹

E-mail: Iranzadeh@iaut.ac.ir

ORCID ID: <http://orcid.org/0000-0001-8533-2810>

¹ Department of Industrial Management, Tabriz Branch, Islamic Azad University, Tabriz, Iran.

Citation information

Cite this article as: A comprehensive model for energy management strategies in coordination with manufacturing and organization strategies and its effect on energy management performance, Naghmeh Khabazi Kenari, Naser Feghhi Farahmand & Soleyman Iranzadeh, *Cogent Business & Management* (2018), 5: 1463605.

References

- Abdeaziz, E. A., Saidur, R., & Mekhilef, S. (2011). A review on energy saving strategies in industrial sector. *Renewable and Sustainable Energy Reviews*, 15(1), 150–168. <https://doi.org/10.1016/j.rser.2010.09.003>
- Afjeh, S. A., & Sepahvand, R. (2009). Effect of strategic coordination between strategies, human resources, human capital and organizational performance in organizational behavior, human resource management of the oil industry. *Journal of Industrial Management Researches*, 6(15), 87–113.
- Amoaka-Gyampah, K., & Acquah, M. (2008). Manufacturing strategy, competitive strategy and firm performance: An empirical study in a developing economy environment. *International Journal of Production Economics*, 111(2), 575–592. <https://doi.org/10.1016/j.ijpe.2007.02.030>
- Anderson, J. C., Cleveland, G., & Schroeder, R. G. (1989). Operations Strategy: A Literature Review. *Journal of Operations Management*, 8(2), 133–158. [https://doi.org/10.1016/0272-6963\(89\)90016-8](https://doi.org/10.1016/0272-6963(89)90016-8)
- Ates, S. A., & Durakbasa, N. M. (2012). Evaluation of corporate energy management practices of energy intensive industries in Turkey. *Energy*, 45(1), 81–91. <https://doi.org/10.1016/j.energy.2012.03.032>
- Bowman, E. H., & Helfat, C. E. (2001). Does corporate strategy matter. *Strategic Management Journal*, 22(1), 1–23. [https://doi.org/10.1002/\(ISSN\)1097-0266](https://doi.org/10.1002/(ISSN)1097-0266)
- Bryson, J. M., & Alston, F. K. (2005). *Creating and implementing your strategic plan: A workbook for public and nonprofit organizations* (2nd ed.). San Francisco: Jossey-Bass.
- Bryson, J. M., & Alston, F. K. (2009). *Creating and implementing your strategic plan*. (S. M. Arabi & M. T. Z. Ghomi, Trans.). (1st ed.). Tehran: Mahkameh Publication.
- Butt, I. (2012). *The Impact of product positioning strategy, manufacturing strategy and their co-alignment on firm' performance* (A thesis submitted to the faculty and Graduate Studies and Research in Partial Fulfillment of the Requirements, for the degree of Doctor of Philosophy in Management, p. 51).
- Daft, R. (2006). *Theory and design of organization*. (A. Persian & S. M. Arabi, Trans.). (7th ed.). Tehran: Publications Office of Cultural Studies.
- Day, G. S. (1994). The capabilities of market-driven organizations. *Journal of Marketing*, 58(4), 37. <https://doi.org/10.2307/1251915>
- Dehghan, N. (2000). *Provide a pattern for improving export performance: Emphasizing the strategic fit between the international marketing strategy and the organization's environmental dimensions and international marketing subsystems on export performance Case: Technical Services Engineering* (Doctoral dissertation). Allameh Tabatabaee University.
- Fornell, L. D. (1981). Structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.2307/3151312>
- Fred, R. D. (2011). *Strategic management*. (A. Parsian, S. M. Arabi, Trans.). (19th ed.). Tehran: Publications Office of Cultural Studies.
- German Federal Environment Agency. (2014). *Number of ISO 50001 certified sites worldwide*. Retrieved May 15, 2015, from www.nagus.din.de/sixcms-upload/media/2612/2014-05-30%20chart%20ISO%2050001%20worldwide.pdf
- Grant, R. M. (2002). *Contemporary strategy analysis: Concepts, techniques, applications* (4th ed.). Oxford: Blackwell.
- Hambrick, D. C. (1980). Operationalising the concept of business-level strategy in research. *Academy of Management Journal*, 26(4), 687–707.
- Harrison, G., & John, K. (2007). *Strategic management* (Ghasemi, Trans.). (4th printing). Tehran: Hey'at Publication.
- Hill, C. W. L., & Jones, G. R. (2010). *Strategic management theory: An integrated approach*. South-Western Cengage Learning, 3.
- Institute of Iran International Energy Studies. (2014). *Hydrocarbon balance sheet of the country*. Tehran: Andishe Third Millennium publication.
- Kim, J. S., & Arnold, P. (1992). Manufacturing competence and business performance: A framework and empirical analysis. *Operations and Production Management*, 13(10), 4–25.
- Leong, G. K., Snyder, D., & Ward, P. T. (1990). Research in the process and content of manufacturing strategy. *Omega*, 18, 109–122. [https://doi.org/10.1016/0305-0483\(90\)90058-H](https://doi.org/10.1016/0305-0483(90)90058-H)
- Miltenburg, J. (2008). Setting manufacturing strategy for a factory within a factory. *International Journal of Production Economics*, 113(1), 307–323. <https://doi.org/10.1016/j.ijpe.2007.09.001>
- Mostafavi, A. (2012). *Explaining the integrated pattern of production strategies in line with marketing strategies and business strategies and their effect on the performance of the organization* (Doctoral dissertation). Allameh Tabatabaee University.
- Ralston. (2008). How to develop a customized corporate energy strategy. *Strategy and Leadership Journal*, 36(2), 30–39. <https://doi.org/10.1108/10878570810858194>
- Shams, H. (2014). *Toward the model for typology of energy management strategies* (The case of companies in down stream section of Iranian oil industry) (Doctoral dissertation). Allameh Tabatabaee University.
- Swamidass, P. M., & Newell, W. T. (1987). Manufacturing strategy, environmental uncertainty and performance: A path analytic model. *Management Science*, 33(4), 509–524. <https://doi.org/10.1287/mnsc.33.4.509>

Walker, O. C., Harper, C. B., Malinz, J., & Laresh, J. (2014). *Marketing strategy: A decision-focused approach*. (S. M. Arabi, Trans.). Davoud Izadi, Tehran: Publications Office of Cultural Studies.

Ward, P. T., & Duray, R. (2000). Manufacturing strategy in context: Environment, competitive strategy and manufacturing strategy. *Journal of Operations Management*, 18(2), 123–138.
[https://doi.org/10.1016/S0272-6963\(99\)00021-2](https://doi.org/10.1016/S0272-6963(99)00021-2)

Wenerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171–180.
[https://doi.org/10.1002/\(ISSN\)1097-0266](https://doi.org/10.1002/(ISSN)1097-0266)

Wheelen, T. L., & Hunger, J. D. (2010). *Strategic management and business policy: Achieving sustainability*. Upper Saddle River, NJ: Prentice Hall.

Williams, F. P., D'Souza, D. E., Rosenfeldt, M. E., & Kassae, M. (1995). Manufacturing strategy, business strategy and firm performance in a mature industry. *Journal of Operations Management*, 13(1), 19–33.
[https://doi.org/10.1016/0272-6963\(95\)00006-E](https://doi.org/10.1016/0272-6963(95)00006-E)

Appendix 1.

Table A1. Results of first-, second-, and third-order factor loadings

Order of factor loading	Hidden variables	Item	Factor loading	t Statistics	Significance level	Validity result
First	Business strategy/ leadership in minimizing the cost	A1	0.863	56.880	0.001	Valid
		A2	0.860	43.892	0.001	Valid
		A3	0.860	43.637	0.001	Valid
		A4	0.754	24.374	0.001	Valid
		A5	0.882	71.073	0.001	Valid
	Business strategy/ relatively cost minimizing	B1	0.795	30.901	0.001	Valid
		B2	0.843	38.147	0.001	Valid
		B3	0.901	85.296	0.001	Valid
		B4	0.831	26.628	0.001	Valid
		B5	0.871	42.834	0.001	Valid
	Business strategy/ fairly differentiated	C1	0.881	52.553	0.001	Valid
		C2	0.856	37.006	0.001	Valid
		C3	0.910	71.605	0.001	Valid
		C4	0.918	72.818	0.001	Valid
		C5	0.833	41.475	0.001	Valid
	Business strategy/ completely differentiated	D1	0.898	62.072	0.001	Valid
		D2	0.870	38.064	0.001	Valid
		D3	0.892	54.204	0.001	Valid
		D4	0.816	21.681	0.001	Valid
		D5	0.817	20.604	0.001	Valid
Energy management strategy/case-based Improvement	E1	0.897	65.933	0.001	Valid	
	E2	0.864	35.627	0.001	Valid	
	E3	0.897	62.750	0.001	Valid	
	E4	0.872	44.443	0.001	Valid	
Energy management strategy/focus-based	F1	0.764	2.439	0.001	Valid	
	F2	0.835	2.632	0.001	Valid	
	F3	0.816	2.788	0.001	Valid	
	F4	0.868	3.254	0.001	Valid	

Table A1. (Continued)

Order of factor loading	Hidden variables	Item	Factor loading	t Statistics	Significance level	Validity result
	Energy management strategy/comprehensive Improvement	G1	0.891	45.423	0.001	Valid
		G2	0.836	27.386	0.001	Valid
		G3	0.870	19.946	0.001	Valid
		G4	0.751	9.773	0.001	Valid
	Energy management strategy/leading	H1	0.907	75.555	0.001	Valid
		H2	0.910	70.811	0.001	Valid
		H3	0.907	103.959	0.001	Valid
		H4	0.886	53.784	0.001	Valid
	Manufacturing strategy/caretakers	I1	0.728	3.392	0.001	Valid
		I2	0.854	4.674	0.001	Valid
		I3	0.732	3.583	0.001	Valid
		I4	0.869	3.867	0.001	Valid
		I5	0.786	4.099	0.001	Valid
	Manufacturing strategy/lean competition	J1	0.896	91.435	0.001	Valid
		J2	0.853	47.700	0.001	Valid
		J3	0.877	43.652	0.001	Valid
		J4	0.846	43.733	0.001	Valid
		J5	0.846	36.474	0.001	Valid
	Manufacturing strategy/technology-driven innovation	K1	0.840	33.353	0.001	Valid
		K2	0.881	40.938	0.001	Valid
		K3	0.862	40.299	0.001	Valid
		K4	0.875	32.591	0.001	Valid
		K5	0.827	25.794	0.001	Valid
	Manufacturing strategy/mass customization	L1	0.877	34.793	0.001	Valid
		L2	0.732	20.857	0.001	Valid
L3		0.877	49.635	0.001	Valid	
L4		0.942	124.876	0.001	Valid	
L5		0.914	59.486	0.001	Valid	
Second	Manufacturing strategy	Lean competition	0.669	9.016	0.001	Valid
		Mass customization	0.699	10.010	0.001	Valid
		Caretakers	0.347	3.451	0.001	Valid
		Technology-driven innovation	0.683	7.239	0.001	Valid
	Energy management strategy	Comprehensive Improvement	0.447	5.017	0.001	Valid
		Case-based	0.692	10.312	0.001	Valid
		Focus-based	0.398	3.964	0.001	Valid
		Leading	0.762	13.853	0.001	Valid
	Business strategy	Leadership in minimizing the cost	0.780	16.331	0.001	Valid
		Fairly differentiated	0.757	20.201	0.001	Valid
		Relatively cost minimizing	0.583	8.127	0.001	Valid
		Completely differentiated	0.453	5.268	0.001	Valid
	Third	Firms' strategies	Manufacturing strategy	0.902	45.221	0.001
Energy management strategy			0.779	15.711	0.001	Valid
Business strategy			0.882	52.736	0.001	Valid

Appendix 2.

Table A2. Crossover loads

	Leadership in minimizing the cost	Relatively cost minimizing	Fairly differentiated	Completely differentiated	Case-based improvement	Focus-based	Comprehensive improvement	Leading	Caretakers	Lean competition	Technology-driven innovation	Mass customization
A1	0.863	0.377	0.332	0.219	0.341	0.148	0.069	0.284	0.242	0.340	0.361	0.163
A2	0.860	0.303	0.271	0.188	0.384	0.108	0.263	0.291	0.158	0.377	0.354	0.376
A3	0.860	0.168	0.291	0.202	0.429	0.138	0.137	0.267	0.192	0.297	0.402	0.268
A4	0.754	0.133	0.157	0.316	0.337	-0.068	0.176	0.209	0.203	0.253	0.199	0.179
A5	0.882	0.312	0.395	0.272	0.349	0.087	0.064	0.219	0.146	0.305	0.337	0.383
B1	0.284	0.795	0.243	-0.001	0.019	-0.043	0.187	0.048	0.005	0.237	0.168	0.362
B2	0.258	0.843	0.215	0.039	0.148	0.138	0.233	0.231	0.161	0.321	0.042	0.209
B3	0.299	0.901	0.375	-0.011	0.122	0.123	0.066	0.178	0.168	0.303	0.131	0.297
B4	0.220	0.831	0.132	-0.079	0.026	-0.119	0.264	0.123	0.020	0.310	-0.124	0.229
B5	0.266	0.871	0.182	-0.113	0.067	-0.048	0.309	0.038	0.218	0.237	-0.042	0.162
C1	0.345	0.180	0.881	0.272	0.347	0.190	0.003	0.353	0.155	0.254	0.500	0.096
C2	0.313	0.253	0.856	0.147	0.291	0.163	0.144	0.168	0.253	0.277	0.361	0.266
C3	0.306	0.248	0.910	0.115	0.430	0.281	0.106	0.325	0.181	0.301	0.444	0.265
C4	0.276	0.199	0.918	0.147	0.311	0.304	0.070	0.316	0.106	0.223	0.531	0.217
C5	0.302	0.359	0.833	0.135	0.179	0.259	0.164	0.327	0.148	0.237	0.352	0.298
D1	0.338	0.000	0.226	0.898	-0.024	0.115	-0.178	0.134	0.086	0.259	0.392	0.004
D2	0.159	-0.141	0.093	0.870	-0.130	0.144	-0.082	0.181	0.125	0.191	0.339	0.075
D3	0.250	0.067	0.234	0.892	0.045	0.164	-0.203	0.154	0.148	0.198	0.441	0.125
D4	0.202	0.014	0.033	0.816	-0.067	0.021	-0.141	0.163	0.046	0.070	0.349	0.131
D5	0.201	-0.159	0.145	0.817	0.054	0.056	-0.189	0.237	-0.104	0.197	0.383	-0.005
E1	0.344	0.050	0.326	0.051	0.897	0.033	-0.015	0.270	0.068	0.340	0.017	0.113
E2	0.407	0.057	0.299	0.018	0.864	0.271	-0.096	0.262	0.079	0.389	0.191	0.170
E3	0.411	0.142	0.368	-0.029	0.897	0.166	0.124	0.195	0.179	0.277	0.173	0.294
E4	0.365	0.082	0.256	-0.111	0.872	0.078	0.067	0.240	0.141	0.103	0.077	0.235
F1	0.096	0.023	0.137	0.063	0.130	0.764	-0.026	0.004	0.073	0.257	0.317	0.135
F2	0.001	-0.011	0.273	0.048	0.112	0.835	0.063	-0.069	0.163	0.081	0.261	0.201
F3	-0.045	0.002	0.141	0.007	0.038	0.816	0.118	0.010	0.195	0.041	0.218	0.087
F4	0.211	0.046	0.300	0.211	0.196	0.868	0.193	0.113	0.210	0.342	0.392	0.264
G1	0.194	0.087	0.040	-0.236	0.133	0.122	0.891	0.257	0.149	0.248	0.086	0.331
G2	0.113	0.206	0.104	0.001	-0.030	0.196	0.836	0.110	0.172	0.239	0.070	0.245
G3	0.095	0.313	0.143	-0.192	0.012	0.057	0.870	0.162	0.155	0.259	0.067	0.222
G4	0.116	0.293	0.121	-0.212	-0.172	-0.002	0.751	0.089	0.143	0.232	-0.002	0.268
H1	0.276	0.190	0.358	0.049	0.250	-0.013	0.154	0.907	0.170	0.148	0.216	0.374
H2	0.278	0.042	0.230	0.211	0.176	-0.005	0.221	0.910	0.114	0.058	0.284	0.284
H3	0.320	0.166	0.335	0.309	0.282	0.080	0.186	0.907	0.141	0.239	0.348	0.412
H4	0.211	0.139	0.299	0.127	0.274	0.062	0.174	0.886	0.130	0.325	0.193	0.187

(Continued)

Table A2. (Continued)

	Leadership in minimizing the cost	Relatively cost minimizing	Fairly differentiated	Completely differentiated	Case-based improvement	Focus-based	Comprehensive improvement	Leading	Caretakers	Lean competition	Technology-driven innovation	Mass customization
I1	0.138	0.235	0.113	-0.057	0.007	0.151	0.257	0.063	0.728	0.262	-0.100	0.060
I2	0.156	0.213	0.212	-0.028	0.130	0.228	0.186	0.001	0.854	0.239	-0.037	0.228
I3	0.239	-0.107	0.025	0.158	0.097	0.091	-0.009	0.296	0.732	0.035	0.023	0.031
I4	0.204	-0.022	0.124	0.034	0.186	0.226	0.072	0.085	0.869	0.105	0.010	0.007
I5	0.173	0.129	0.227	0.255	0.104	0.082	0.162	0.252	0.786	0.238	0.032	-0.021
J1	0.376	0.316	0.222	0.244	0.236	0.203	0.150	0.131	0.248	0.896	0.147	0.234
J2	0.301	0.268	0.240	0.208	0.346	0.302	0.276	0.203	0.368	0.853	0.129	0.159
J3	0.259	0.214	0.345	0.137	0.336	0.172	0.294	0.138	0.080	0.877	0.154	0.111
J4	0.307	0.285	0.182	0.262	0.172	0.213	0.301	0.210	0.172	0.846	0.253	0.164
J5	0.367	0.350	0.299	0.078	0.282	0.165	0.236	0.261	0.132	0.846	0.126	0.098
K1	0.286	0.105	0.444	0.386	0.044	0.334	0.165	0.263	0.088	0.241	0.840	0.294
K2	0.387	0.062	0.476	0.309	0.089	0.280	0.099	0.340	0.019	0.119	0.881	0.262
K3	0.333	-0.116	0.388	0.425	0.182	0.291	0.067	0.292	-0.116	0.216	0.862	0.297
K4	0.305	0.039	0.394	0.404	0.089	0.351	-0.100	0.127	-0.145	0.119	0.875	0.218
K5	0.386	0.144	0.426	0.394	0.160	0.354	0.069	0.200	0.042	0.097	0.827	0.306
L1	0.240	0.223	0.235	0.066	0.295	0.192	0.252	0.309	0.116	0.122	0.161	0.877
L2	0.382	0.278	0.188	0.116	0.145	0.148	0.313	0.239	0.060	0.123	0.350	0.835
L3	0.284	0.346	0.109	-0.045	0.176	0.087	0.326	0.350	0.022	0.189	0.165	0.810
L4	0.272	0.267	0.314	0.053	0.191	0.200	0.193	0.230	0.144	0.162	0.286	0.894
L5	0.215	0.174	0.235	0.115	0.184	0.303	0.282	0.362	0.056	0.173	0.382	0.826



© 2018 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.

You are free to:

Share — copy and redistribute the material in any medium or format

Adapt — remix, transform, and build upon the material for any purpose, even commercially.

The licensor cannot revoke these freedoms as long as you follow the license terms.

Under the following terms:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made.

You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

No additional restrictions

You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.



***Cogent Business & Management* (ISSN: 2331-1975) is published by Cogent OA, part of Taylor & Francis Group.**

Publishing with Cogent OA ensures:

- Immediate, universal access to your article on publication
- High visibility and discoverability via the Cogent OA website as well as Taylor & Francis Online
- Download and citation statistics for your article
- Rapid online publication
- Input from, and dialog with, expert editors and editorial boards
- Retention of full copyright of your article
- Guaranteed legacy preservation of your article
- Discounts and waivers for authors in developing regions

Submit your manuscript to a Cogent OA journal at www.CogentOA.com

