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Studying the effect of human role on green product development

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ABSTRACT

The aim of this paper is to study the effects of human role and technical aspects on green product development and performance in industrial and service supplying companies of Esfahan provinces. The research statistical population was green industries includes Esfahan province green choice industries and green service supplying units in 2004- 2011, for which 31 questionnaires were obtained and the questionnaires results were analyzed using SPSS software. The research results showed that beside technical aspects, technical and organizational aspects also deserve due attention while they have often been ignored by companies. The other results were that the adoption of green product development is not only specific to large companies and that any company influenced by green performance environmental pressures can apply it. Green product development can be adopted and vastly influence performance. For future research it is much better to obtain more understanding of relation between human factors and green product development. Besides, strategies should be implemented to strengthen the importance of this relation between newly established companies to found industrial and service supplying units at the very beginning aiming at green product development and environmental principles.

1. Introduction

The issue of the importance of organizations environmental management receives more attention, then ever before. Therefore, companies adopting sustainable environmental management. Greening their organizations is dependent on technical, human and organizational aspects. They influence the adoption of environmental methods and look for better performance on social and technical grounds. Both human and organizational aspects are required for organizations changes when most environmental management advanced methods have been adopted and significantly appeared in recent debates in environmental issues (Berry and Rondinelli, 1998).

Environmental management organizational aspects include changes which should be made in products and production practices to optimize organizations environmental performance. One of the most relevant theories in technical aspects is environmental reconstruction stating that cooperation between industrial development and environmental performance optimization can be actualized by emphasis on technical aspects through organizations investment in technology and innovation (Zhu et al., 2011).

Shareholders put pressure on companies to develop environmental friendly products. Observations show that there is a relation between ISO 9001 certificate and efforts for the new product development innovation. These issues are important variables when studying green products development. As an example, the size of a company influences its inclination to have a green prospect in its development. The ISO 14001 environment management system is also more inclined towards supply chain methods in which environmental product development is very important. Companies which are in environments under pressure by environmental laws are much more inclined towards environmental methods, and as a result, there is more inclination towards green product development methods in them. Company size, ISO14001 certificate and environmental laws pressure all affect green product production (Lai and Wong, 2012).

Based on studies, in order to obtain and maintain competitive advantages, companies should produce high quality/ low price products in the greatest diversity at the shortest time. The product development process is one of the most significant processes in companies to increase profit and competition. In order to assess the success of this process, performance assessment is also required as

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the basic factor in organizational planning and activities control just like the product development process. The appropriate understanding of market performance and indigenous performance indices is very important to determine products optimization environmental development (Driva et al., 2001).

Within recent decades, concern about the environment has changed into, not only an important general issue, but also a critical subject in academic research. Environmental pollutions generated as the result of human production and consumption are among matters which have been recognized for times by organizations active in this field as threats for human beings. For this reason, green performance development is inevitable as a solution under these critical conditions. This study thus aims to investigate the human role and technical aspects for investigation in to green performance development in industrial and service supplying companies.

2. Literature review

2.1. Green product

The term "green" is applied to a product when its environmental and social performance in production, application and disposal has been significantly optimized compared with competitive goods. In another word, a green product is a product which does not harm the environmental and which contains constituents that are not potentially detrimental to the environment. According to another definition, a green product is a product which enjoys the following criteria: it is so designed to enjoy applicability, assembly and reproduction and contains constituents which are recyclable. Regarding energy consumption, it should have efficiency and produce lower environmental pollution compared with other products. Generally speaking, a green product can be defined as producing less environmental pollutions. In some studies classified green goods into some classes including general green goods, recyclable paper products, products not tested on animals, environmentally compatible products, gases compatible with the ozone layer and products which are efficient regarding energy consumption. Concerning what preceded, a green product can be studied in connection with the criteria in Table 1.

Table 1: Green product assessment criteria

	Assessment criteria
Green product	1. Contains constituents not detrimental to the environmental 2. Has efficiency in terms of energy consumption 3. Is made of materials which provide it with recyclability 4. Enjoys an environmental friendly production process 5. Generates less environmental pollution

2.2. Behavior

Research on the green consumer behavior emerged as an important subject for marketing planners during the years of 1791. Around 1771, there was a progress in research and many publications conducted studies on environmental attitudes and their effects on consumers behavior such as the effect of marketing variables on environmental conscious purchase decision, decision to consume with energy conservation and internal recycling methods (Hartman, 2006). This change in consumer's behavior assisted the start of green revolution to prevent more damages to the environment.

2.3. Green management

Green management is a set of comprehensive, objective- based and continuous studies and actions so performed at different levels of governmental systems to promote and stabilize an organization status due to accomplish the green state status.

This system is applicable to any organization which is inclined to apply the following cases:

A. Implementation, maintenance and optimization of an environmental management system.

B. Assurance of compliance with the environmental policy (made by itself).

C. Proof of this compliance to others.

D. Application for certificate and registration of its environmental management by an external organization.

E. Determination of compliance with this standard and its statement by the organization itself.

2.4. Industry and green marketing

Data acquired from ministry of industries and mines, the small industries organization and industrial towns in Iran showed that the combination of green marketing and the industrial cluster leads the industrial cluster to green utilization, and by accomplishing green industrial cluster to exit from environmental crises. By being generated in industry, green utilization reduces industries environmental pollutions, decreases energy and raw material consumption, increases intra-industrial cooperation and relation, decreases production wastes and provides competitive advantage to industry through accomplishing green utilization. Green utilization generally provides the ground for the green industry cluster and causes environmental crises decrease in the country (Fig. 1) (Kordshouli et al., 2012).

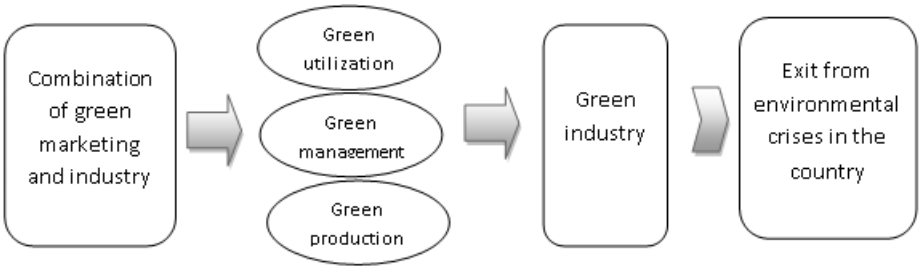

Fig. 1: Relation between green industry and environmental problems

2.5. Industry and green innovation

Nowadays, industry efforts for environmental performance optimization from the production cycle have increased and converted into the main objective in many fields. Innovations which have partially or totally made improvements in environmental performance or have appropriately or mildly influenced investment have been compiled. Based on strict international laws for the environment, environmental conservation treaty and environmental commonly available information, consumers affect industry models and laws in the world industries (Chen et al., 2006; Chen, 2008). Nowadays, environmental large companies will thus play on important role in the trade cycle.

Based on studies, in order to obtain and maintain competitive advantage, companies should produce high quality/ low price products in the greatest diversity at the shortest time. According to wong et al. the product development process is one of the most significant processes in companies to increase profit and competition. In order to assess the success of this process, performance assessment is also required as the basic factor in organizational planning and activities control, just like the product development process. The appropriate understanding of market performance and indigenous performance indices is very important to determine products optimization environmental development (Driva et al., 2001).

3. Research hypotheses

H1.There is a relation between technical factors and green products development methods adoption.
H2. There is a relation between organizational/ human factors and green products development methods adoption.
H3. There is a relation between green performance and green products development methods adoption.
H4. There is a relation between operational performance and green products development methods adoption.
H5. There is a relation between market performance and green products development methods adoption.

4. Research methodology

This study searches for the effects of the human role and technical aspects on product development and company's performance and is intended to provide guides for being as greener as possible. It is thus reckoned an applied study in which a standard questionnaire has been used for data gathering (Jabbour, 2015).

34 questionnaires were then distributed to the green units selected from Esfahan province environmental organization report. 31 questionnaires were eventually collected and analyzed.

For data analysis, Kolmogorov- Smirnov test was initially applied to obtain data normality. Coefficient of correlation (spearman's method) was then applied for hypotheses test.

When data are collected on a ranking basis or converted into ranks, spearman rank order correlation coefficient or spearman ρ can be applied. Regarding the research hypotheses in all the cases, relation between 2 variables is studied. This test is thus one of the best methods to investigate the hypotheses significance. In order to explain the level of green product development as the intermediary factor in the relation between variables, regression model estimation is used. In this method, a variable is selected as the response variable which should examine a linear or nonlinear relation between independent and dependent variables. This variable will be fruitful in the better examination of the relation between variables.

5. Research model, variables and mode of measurement

Regarding the conceptual model resulted from the literature and interview; the following variables have been considered (Table 2).

A. Questionnaire validity: The original questionnaire was given to relevant specialists and the final questionnaire was designed using their common opinions.

B. Questionnaire reliability: The research reliability was calculated by the questionnaire distribution and using Cranbach alpha coefficient. Its high reliability was then approved (Fig. 2).

Technical aspects are changes which should be made in production processes and products to lead to organizations environmental performance optimization (Jabbour, 2015).

Human/ organizational aspects**:** Environmental management organizational aspects include changes which should be made in products and production methods for organizations environmental performance optimization.

One of the most relevant theories in technical aspects is environmental reconstruction stating that cooperation between industrial development and environmental performance optimization can be actualized by emphasis on technical aspects through organizations investment in technology and innovation (Zhu et al., 2011).

Green product development can be a set of activities aiming to access a product with new specifications or optimize the existing products based on market requirements and opportunities and technical and technological opportunities and limitations considering a competitive strategy (Crawford and Di Benedetto, 2006).

Table 2: Research variables

Variable	Alpha
Technical aspects	90%
Human/ organizational aspects	89%
Green product development	96%
Green product	93%
Operational performance	86%
Market	84%

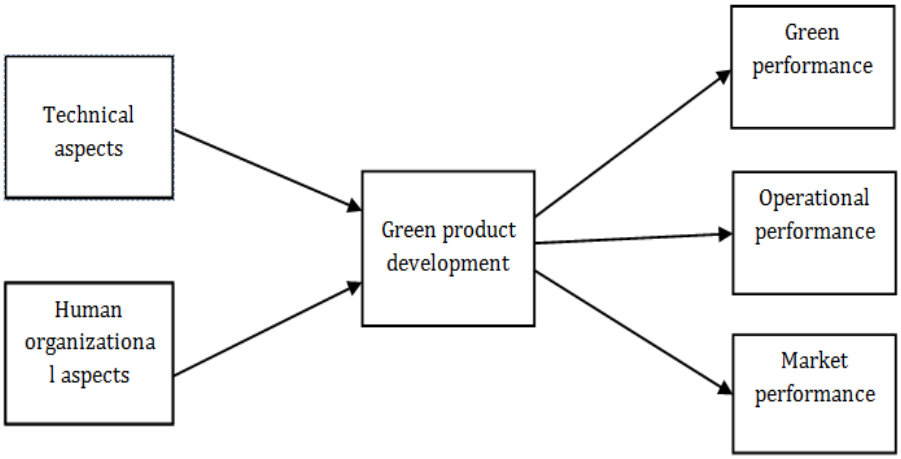

Fig. 2: Research conceptual model (Jabbour, 2015)

Green performance is the set of actions taken to achieve stability and decrease in risks and damages to the environment. Green performance is also called ecological performance (Tomasin et al., 2013).

Operational performance is the company performance versus a standard index or the administration of environmental effectiveness, utility and responsibility such as the cycle time, utility, wastes reduction and compliance with regulations (Tomasin et al., 2013).

Market performance is the security behavior or asset in the market, Market performance committee is one part of the market which supervises specialist's effective mode of providing a regular market (Business Dictionary, 2015).

6. Analysis

Inferential statistics and hypotheses test upon the description of variables in this section, the examination of the presented hypotheses and the statistical test applied in the study are dealt with for statistical investigation into the hypotheses verification by the findings analysis.

6.1. Review of data normality using Kolmogorov - Smirnov test

For applying a statistical technique, it should be initially specified that collected data enjoy normal or subnormal distribution. If they have normal distribution, the hypotheses can be tested using parametric tests. If they have a subnormal distribution, nonparametric tests should be applied. In this step, we will deal with the review of the results from the above mentioned test for each of the dependent and independent variables, and based on the results, we will choose the appropriate test to verify the research hypotheses (Table 3).

Regarding the above mentioned Table 3 results, because the level of significance for all the variables is lower than the error value of 0.05, the frequency of the variables type in question enjoys a subnormal distribution.

6.2. Research hypotheses test

A) H_1: There is a significant relation between technical factors and green products development methods adoption.

$$H_0: P = 0$$

There is a significant relation between technical factors and green products development methods adoption.

$$H_1: P \neq 0$$

There is not a significant relation between technical factors and green products development methods adoption.

Regarding the following Table 4 results, if the level of significance is higher than the error value, the zero hypotheses (Ho) will be assumed. If it is lower than the error value, H_1 will be assumed.

Spearman's significance test was used to test this hypothesis, relevant results of which are described as follows: there is a significant relation between technical factors and green products development

methods adoption, for the obtained level of significance equals 0.000 which is lower than the research alpha of 0.05. The general conclusion is thus that there is a significant relation between the specifications of green products development methods and technical factors at the %99 level. Correlation between the above mentioned 2 variables is of the linear type. That is both of them simultaneously increase or decrease. Correlation intensity between the 2 variables is relatively at a high level. The research 1st hypothesis is thus confirmed. That is, green products development methods adoption will cause the dependent variable (technical factors) to fluctuate.

Table 3: Result of relevant variables normality/ sub normality test

	Technical factors	Organizational/ human factors	Green product development	Green product	Operational factors	Technical factors
N	31	31	31	31	31	31
Normal Mean	3.87902	3.82795	4.24195	3.9597	3.78064	4.0967
Parameters a, b Std. Deviation	0.80758	0.86686	0.60604	0.73581	0.911496	0.53548
Kolomogorov-Sminow Z	1.72075	1.6736	1.93025	1.7505	1.9558	2.14325
Asymp. Sig.(2-tailed)	0.045	0.034	0.002	0.006	0.001	0.000

Table 4: Coefficient of correlation between technical factors specifications and green products development methods adoption (spearman's method)

Technical factors	Dependent variable	Independent variable
0.282	Intensity	Green products development methods adoption
0.000	Significance	
31	Number	

B) H_2: There is a significant relation between organizational/ human factors and green products development methods adoption.

$$H_0: P = 0$$

There is a significant relation between organizational/ human factors and green products development methods adoption

$$H_2: P \neq 0$$

There is not a significant relation between organizational/ human factors and green products development methods adoption.

Regarding the following Table 5 results, if the level of significance is higher than the error value, the zero hypotheses (Ho) will be assumed. If it is lower than the error value, H_2 will be assumed.

Table 5: Coefficient of correlation between organizational/ human factors specifications and green products development methods adoption (spearman's method)

organizational/ human factors	Dependent variable	Independent variable
0.503	Intensity	Green products development methods adoption
0.004	Significance	
31	Number	

Spearman's significance test was used to test this hypothesis, relevant results of which are described as follows: there is a significant relation between organizational/ human factors and green products methods adoption, for the obtained level of significance equals 0.004 which is lower than the research alpha of 0.05. The general conclusion is thus that there is a significant relation between the specifications of green products development methods and organizational/ human factors at the %99 level. Correlation between the above mentioned 2 variables is of the linear type. That is both of them simultaneously increase or decrease. Correlation intensity between the 2 variables is relatively at a high level. The research 2nd hypothesis is thus confirmed. That is, green products development methods adoption will cause the dependent variable (organizational/ human factors) to fluctuate.

C) H_3: There is a significant relation between green products development methods adoption and green performance.

$$H_0: P = 0$$

There is a significant relation between green products development methods adoption and green performance**.**

$$H_3: P \neq 0$$

There is not a significant relation between green products development methods adoption factors and green performance.

Regarding the following Table 6 results, if the level of significance is higher than the error value, the zero hypotheses (H_0) will be assumed. If it is smaller than the error value, H_3 will be assumed.

Table 6: Coefficient of correlation between green products specifications and green products development methods adoption (spearman's method)

Green performance	Dependent variable	Independent variable
0.448	Intensity	Green products development methods adoption
0.011	Significance	
31	Number	

Spearman's significance test was used to test this hypothesis, relevant results of which are described as follows: there is a significant relation between green products factors and green products development methods adoption, for the obtained level of significance equals 0.011 which is lower than the research alpha of 0.05. The general conclusion is thus that there is a significant relation between green products development methods specifications and green products at the 99% level. Correlation between the above mentioned 2 variables is of the

linear type. That is, both of them simultaneously increase or decrease. Correlation intensity between the two variables is relatively high. The research 3rd hypothesis is thus verified. That is, green products development methods adoption will cause the dependent variable (green performance) to fluctuate.

E) H_4: There is a significant relation between green development methods adoption and operational performance.

$$H_0: P = 0$$

There is a significant relation between green products development methods adoption factors and operational performance**.**

$$H_4: P \neq 0$$

There is not a significant relation between green products development methods adoption factors and operational performance.

Regarding the following Table 7 results, if the level of significance is higher than the error value, the zero hypotheses (H_0) will be assumed. If it is smaller than the error value, H_4 will be assumed.

Table 7: Coefficient of correlation between green products development methods adoption specifications and operational performance (spearman's method)

operational performance	Dependent variable	Independent variable
0.474	Intensity	Green products development methods adoption
0.007	Significance	
31	Number	

Spearman's significance test was used to test this hypothesis, relevant results of which are described as follows: there is a significant relation between green products development methods adoption and operational performance, for the obtained level of significance equals 0.007 which is lower than the research alpha of 0.05. The general conclusion is thus that there is a significant, relation between green products development methods specifications and operational performance. Correlation between the 2 variables is of the linear type. That is, both (of them) simultaneously increase or decrease. Intensity of correlation between the 2 variables is relatively at a high level. The research 4th hypothesis is thus confirmed. That is, green products development methods adoption will cause the dependent variable (operational performance factors) to fluctuate.

E) H_5: There is a significant relation between green development methods adoption and market performance.

$$H_0: P = 0$$

There is a significant relation between green products development methods adoption factors and market performance.

$$H_5: P \neq 0$$

There is not a significant relation between green products methods adoption factors and market performance.

Regarding the following Table 8 results, if the level of significance is higher than the error value, the zero hypotheses will be assumed. If it is lower than the error value hypothesis5 will be assumed.

Table 8: Coefficient of correlation between green products development methods adoption specifications and market performance (spearman's method)

market performance	Dependent variable	Independent variable
0.474	Intensity	Green products development methods adoption
0.007	Significance	
31	Number	

Spearman's significance test was used to test this hypothesis, relevant results of which are described as follows: there is a significant relation between green products development methods adoption and market performance, for the obtained level of significance equals 0.001 which is lower than the research alpha of 0.05. The general conclusion is thus that there is a significant, relation between green products development methods specifications and relevant market performance. Correlation between the above mentioned 2 variables is of the linear type. That is both simultaneously increase or decrease. Intensity of correlation between the 2 variables is at a relatively high level. The research fifth hypothesis is thus confirmed. That is, green products development methods adoption will cause the dependent variable (market performance factors) to fluctuate.

7. Conclusion

This study aims to present experimental results for a conceptual model which is suggestive of relation between technical aspects and organizational/ human factors to adopt green products development methods and the effect of these methods on company's performance, the environment, and market performance and conditions. The conceptual frame work was studied in a group of Esfahan province industrial and service supplying units as a case sample.

Surveys showed that man and technical aspects directly influence product development and green performance. Regarding the studies conducted in this research, lack of domestic sources and studies in this domain was completely tangible. Concerning the importance of environmental aspects in the existing environmental crises, this research has taken a step towards increasing theoretical literature and offers a general framework for relevant researchers and enthusiasts. Regarding the performed tests, the following results were obtained:

1. Green products development methods adoption will cause the dependent variable (technical factors) to fluctuate.
2. Green products development methods adoption will cause the dependent variable (organizational and human factors) to fluctuate.
3. Green products development methods adoption will cause the dependent variable (green performance) to fluctuate.

4. Green products development methods adoption will cause the dependent variable (operational performance factors) to fluctuate.

5. Green products development methods adoption will cause the dependent variable (market performance factors) to fluctuate.

The obtained results confirm the collected literature to some extent and show a relation between technical aspects for green product development and generally show environmental management. The results also confirmed evidences of the possibility in environmental management being competitive.

The results are indicative of this fact for company's managers that company performance, including marketing, efficiency and environmental performance, maybe influenced by environmental management and green development methods adoption. When managers seek for a better performance, green product development will thus gain importance. The research results showed that beside technical aspects, technical and organizational aspects also deserve due attention while they have often been ignored by companies. The other points perceived from this research were that green product development adoption is not only specific to large companies and that any company influenced by green performance environmental pressures can apply it. Green product development can be adopted and vastly influence performance.

For future research, it is much better to obtain more understanding of relation between human factors and green product development. Besides, strategies should be implanted to strengthen the importance of this relation between newly established companies to found industrial and service supplying units at the very beginning aiming at green product development and environmental principles.

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