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Original Research

Why do Services and Manufacturing Firms Envision Environmental Innovation Differently? A Path-Model Comparison

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Abstract

Innovation and environmental awareness are crucial issues that actually build a firm's competitive advantages. In terms of manufacturing industries, several studies have been carried out to disentangle the variables that help companies to orientate more effectively their innovations toward sustainability. In comparison, although the service industry is increasing its economic weight, little research has been carried out in this domain. In the present paper, we analyze the differences of eco-innovative behavior between Service and Manufacturing industries. We retrieved 6,253 firms' data from the Spanish panel of innovative activities (PITEC database) and deployed a structured equations model (EQS) for each group to compare what variables are influencing the willingness to be eco-innovative for each type of industry. Results show the differences in impact that product orientation has on eco-orientation. The relationship between product-orientation and eco-orientation in service firms is significantly different to that in manufacturing firms. In fact, product-orientation impact is lower in service firms. Thus, while manufacturing firms show a similar impact of product and process orientation on eco-orientation, process-orientation in service firms almost doubled the relative impact of product-orientation on eco-innovation. These results may allow both policy makers and managers to make the correct decisions regarding national, industrial and company strategy.

Keywords: environmental innovation, manufacturing and service industry, product innovation, process innovation

Introduction

Any innovation that reduces environmental damage is an eco-innovation [1-3]. Nowadays, the aspects related to sustainable development, environmental management, and eco-innovation are considered crucial as building competitive advantages on them is feasible [4-8].

To date, the environmental implications of the manufacturing industry have been analyzed in detail [8-14], but service industries have been given less attention, in spite of their rapid growth and higher importance in overall economic activities [15].

We stress the need to analyze the differences between industry and service firms in terms of eco-innovative activities in line with our previous studies [16, 17]. The importance of product and process-innovations, of market information sources, and the former introduction of commercial and organizational innovations for service firms was empirically tested, but the direction of the relationships between constructs or their indirect effects between constructs and

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Table 1. Select variables from PITEC* database.

PITEC Variables	Function type	Explanation
$FUENTE_i$	Cat.	Importance of information sources “i” while innovating (2 – Suppliers, 3 – Clients, 4 – Competitors)
$OBJET_i$	Cat.	Importance of objective “i” while innovating (1 – Increase range of products or services, 2 – Replace outdated product or processes, 3 – Enter new markets, 4 – Increase market share, 5 – Increase quality of products or services, 6 – Increase flexibility for producing goods and services, 7 – Increase capacity for producing goods and services, 8 – Reduce labour costs per unit output 9 – Reduce materials costs per unit output, 10 – Reduce energy costs per unit output, 11 – Reduce environmental impacts, 12 – Improve health and safety, 13 – Meet environmental and health and safety regulations)

*www.fecyt.es

Categorical variables: 1 – High; 2 – Medium; 3 – Low; 4 – Not considered or not important.

$FUENTE_2$-$FUENTE_4$ are defined as market information sources. $OBJET_1$-$OBJET_5$ are defined as product-oriented objectives, $OBJET_6$-$OBJET_{10}$ as process-oriented objectives, $OBJET_{11}$-$OBJET_{13}$ as other types of objectives

environmental orientation have not been tested yet, neither the differences, nor the similarities among services and manufacturing industries.

State of the Art: Definitions and Characteristics Regarding Eco-Innovation

The general determinants of eco-innovation as firms' R&D investment or the importance of following a continuous innovative-basis pattern [12], the moderating effect of size, the importance of the international orientation of [19], regulations [20], or how previous innovative levels positively affect the environmental focus of companies [11, 17, 19], have been studied in detail.

However, although those aspects which act as enhancers of the eco-innovative companies' behavior, such as the maturity of the firm [19, 20] or the effect of an industry's technological level on environmental orientation when innovating [21], have been highlighted, studies focused on the specific actions directly affecting eco-innovative actions and their relative weights, and whether there are different patterns between manufacturing and service industries, are still scarce. Some authors, for example, Forsman [22] and Sirilli and Evangelista [23], compared manufacturing and services innovative activities without finding any significant differences.

Regarding eco-innovation determinants, Segarra-Oña et al. studied, on the one hand, different manufacturing industries such as the Spanish automobile [24] and the Spanish tile industry [25], finding in both cases that process-innovation, product-innovation, and market information sources have been key in the eco-innovative behavior of companies. On the other hand, the same authors studied the determinants of the eco-innovative orientation of service industries [15] finding similar patterns; service companies that innovate through the improvement of products and processes are more likely to be environmentally oriented, that previous innovation activity affects in a direct way the consideration of the environmental aspects when innovating and that those companies that rely on the information from competitors, suppliers, and customers are also more sensitive to introducing environmental innovations.

Our previous work [16] indicated that manufacturing firms show higher orientation toward the environment than service firms supporting theories that state that the manufacturing industry is leading the green revolution [10, 26, 27]. Furthermore, we confirmed highly polarized positions in environmental aspects. Finally, the analysis pointed out that service and manufacturing firms classified as environmentally orientated did not differ that much from each other in terms of their operational objectives and priorities. However, there is still no research comparing both groups regarding their eco-innovative orientation, whose specific actions improve the sustainable orientation when innovating and the different characteristics dependent on their belonging to the manufacturing or service industries. This is what we address in this paper, with the following research question:

RQ1: What are the Differences between Manufacturing and Services Firms Regarding Eco-Innovation Drivers?

The importance of this study is based on the need for managers to improve their sustainable attitude. It is also due to the interest that national and supranational organizations such as the EU have in improving sustainable development and the economic growth strategies of their associate countries [28-30].

Research Methods

In this study we used the Technological Innovation Panel (PITEC) for 2011 to test the differences in the eco-innovative behavior between manufacturing and service industries. PITEC is a statistical instrument for studying the innovation activities of Spanish firms over time. We based our study on the simplest and more explanatory model identified by Peiro et al. [16]. We applied multi-group comparison of PLS models checking the differences in path

Table 2. Reliability measurements.

	AVE	Composite Reliability	R^2	Cronbach's Alpha
Services				
Eco-orientation	0.849	0.944	0.336	0.911
MK inf. sources	0.645	0.844		0.723
Process-orientation	0.630	0.895	0.202	0.854
Product-orientation	0.662	0.907	0.349	0.871
Manufacturing				
Eco-orientation	0.859	0.948	0.479	0.918
MK inf. sources	0.651	0.848		0.731
Process-orientation	0.727	0.930	0.207	0.906
Product-orientation	0.663	0.907	0.320	0.872

estimates for manufacturing and services industries. The PITEC survey has more than 200 variables related to the innovative capacity and orientation of the firms. We have chosen, in relation to the paper´s objectives, 16 variables (Table 1) to conduct our analysis.

To measure orientation by introducing products' innovation variables, Objects 1-5 and Objects 6-10 were used to measure orientation by introducing process innovation variables.

We used a partial least squares (PLS) approach with SmartPLS 2.0.M3 by Ringle et al. [31] to analyze the data. This approach is appropriate because:

(1) SmartPLS is able to evaluate the reliability and validity of the instrument simultaneously
(2) It is recommended over maximum likelihood techniques in studies in which the theory is not firmly established [32-36]
(3) PLS does not rely on distribution.

As we were dealing with latent constructs, covariance structure analysis needed to be undertaken with the use of structural equation modeling in which a priori theoretical knowledge was incorporated into empirical analysis [37]. Then, we estimated the same structural model for the two subsamples (manufacturing vs. services) using partial least squares. We used item reliability, internal consistency and discriminant validity [36] to test the reliability and validity of the research instrument. We used individual item loadings firms to evaluate individual item reliability. According to [36], individual items with loadings greater than 0.7 are considered acceptable, meaning that the item explained about 50% of the variance in a specific measure and ensured that the items in the measurement model measured the same construct. All the items exceeded the suggested threshold for item reliability, indicating that the survey instrument was enough for measuring each construct individually. Second, we used Cronbach's α and Composite Reliability to evaluate the internal consistency for each construct. The minimum acceptable α or composite reliability level is 0.7 for each item loading [38]. Results show that the constructs had values greater than the minimum threshold of 0.7 (Table 2).

Finally, we tested discriminant validity using the average variance extracted (AVE), which measures the variance captured by the indicators relative to the measurement error (Table 2). Discriminant validity is the lack of a relationship between measures which theoretically should not be related. The AVE should be greater than 0.5 in order to justify the use of a construct [36, 39]. Furthermore, the squared inter-correlations among the latent variables should not exceed the AVE to justify the discriminant validity. As squared inter-correlations did not exceed the AVE (Table 3), discriminant validity was demonstrated and the structural model was assessed with confidence for both subsamples.

Structural Model Assessment

The structural model proposed was estimated by the partial least squares method, using the application

Table 3. Matrix of correlation between latent variables.

	Eco-orientation	MK inf. sources	Process-orientation	Product-orientation
Services				
Eco-orientation	**0.922**			
MK inf. sources	0.386	**0.803**		
Process-orientation	0.562	0.450	**0.794**	
Product-orientation	0.400	0.591	0.491	**0.814**
Manufacturing				
Eco-orientation	**0.927**			
MK inf. sources	0.444	**0.807**		
Process-orientation	0.641	0.455	**0.853**	
Product-orientation	0.548	0.565	0.502	**0.814**

Square root of AVE on diagonals in bold.

SmartPLS. Results for each subsample are shown in Figs. 1 and 2. The figures show (observable) questionnaire items from PITEC database in rectangles and unobservable latent factors with circles. The arrows indicate regression relationships, showing the relationships of items with latent factors (measurement model) and between latent factors (structural model). Corresponding partial regression coefficients are indicated next to the arrows and, inside the circles corresponding to endogenous variables, the coefficient of determination (R^2) for the corresponding regression.

The results indicate how well the structural models predicted the hypothesized relationships. Firstly, path coefficients (standardized β) denote the strength of the causal relationships between two constructs [40]. Figures support positive relationships for the proposed hypotheses.

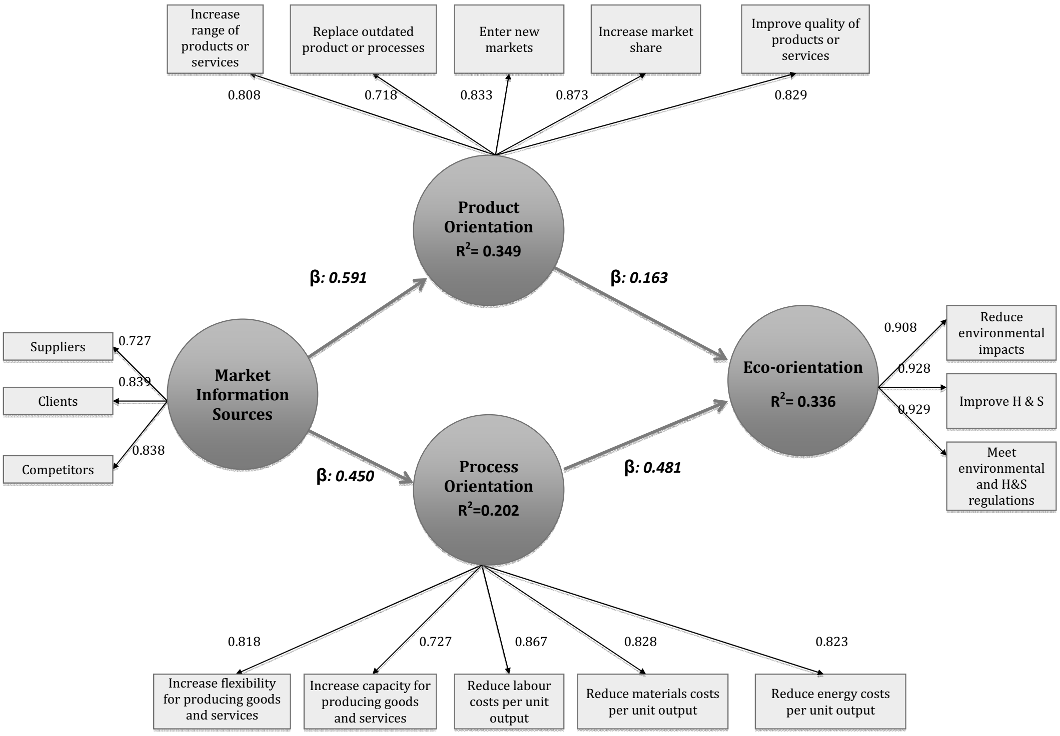

Fig. 1. Estimated structural equation model for service industries.

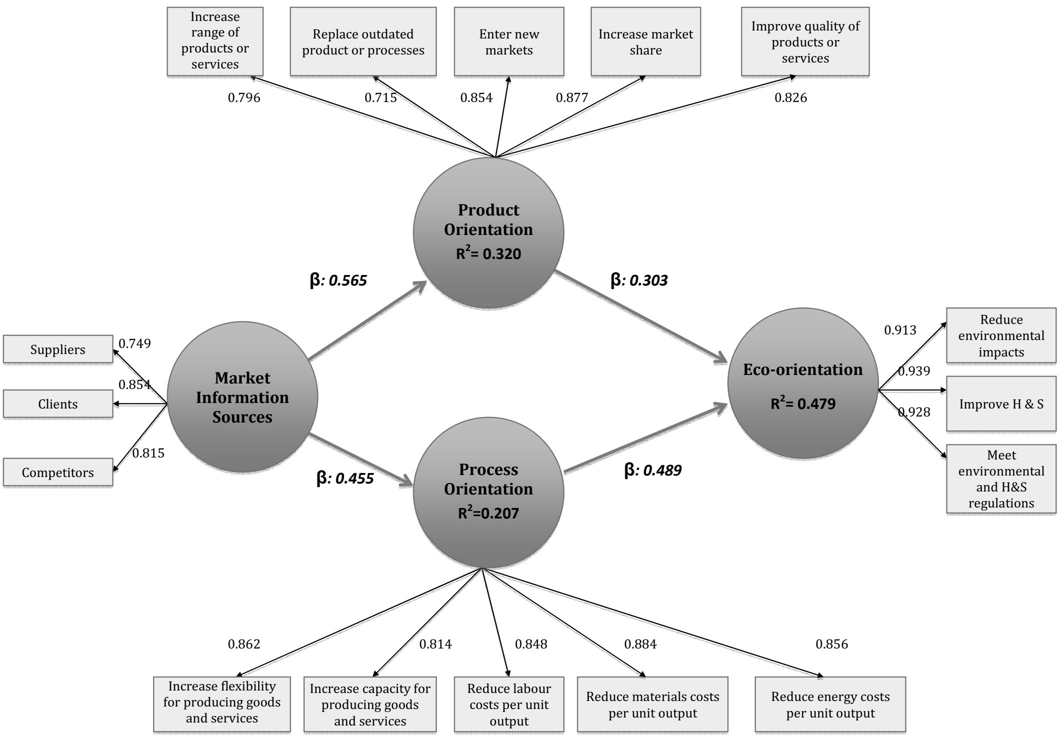

Fig. 2. Estimated structural equation model for manufacturing industries.

Table 4. Tests of hypotheses for direct effects between latent variables.

	Services			Manufacturing		
	$\beta^{(1)}$	Standard Error	T Statistics	$\beta^{(2)}$	Standard Error	T Statistics
MK inf. sources -> Process-orientation	0.450	0.017	26.81***	0.455	0.015	29.54***
MK inf. sources -> Product-orientation	0.591	0.013	43.81***	0.565	0.013	44.03***
Process-orientation -> Eco-orientation	0.481	0.019	25.46***	0.489	0.016	30.64***
Product-orient -> Eco-orientation	0.163	0.019	8.43***	0.303	0.016	19.04***

*** Significant at $p<0.001$. $\beta^{(i)}$ Standardized betas for group i

To confirm the theoretical assumptions, Table 4 shows the regression coefficients between latent factors, their t-statistics and p-values, estimated by bootstrapping with 500 samples. The four proposed relationships have significant values, confirming hypotheses.

Results indicate that process-orientation and product-orientation had a positive effect on eco-orientation. The path coefficients for service and manufacturing groups between process-orientation and eco-orientation were, respectively, 0.481 and 0.489 (both significant at $p<0.001$). Additionally, product-orientation was significantly related to eco-orientation ($\beta^{(1)} = 0.163$, $p<0.001$ and $\beta^{(2)} = 0.303$, $p<0.001$ β). Regarding the market information sources construct, results show that this variable contributed to a significant positive effect on both product-orientation and process-orientation. In other words, the importance of the information from suppliers, competitors and clients in the innovation process has a significantly positive effect on product-orientation ($\beta^{(1)} = 0.591$, $p<0.001$ and $\beta^{(2)} = 0.565$, $p<0.001$) and on process-orientation ($\beta^{(1)} = 0.450$, $p<0.001$ and $\beta^{(2)} = 0.455$, $p<0.001$) of services and manufacturing firms, respectively, while innovating.

Moreover, squared multiple correlation (R^2) for each endogenous variable measures the percent of variance explained by each construct in the model. R^2 coefficients associated with latent variable regressions are significant, with values greater than those suggested by Falk and Miller [41].

Finally, following the propositions of Barclay et al. [34], Tenenhaus et al. [37], and Henseler et al. [42], we consider that this analysis should be strengthened with the cross-validated redundancy index (Q^2) or Stone-Geisser test [43, 44]. The Stone-Geisser test gives us a measure of goodness with which the values observed are reconstructed by the model and its parameters [36]; it is generally accepted that a model has predictive relevance when Q^2 is greater than zero [42]. The Stone-Geisser test (Q^2) can be measured utilizing procedures of the blindfolding type [37] and it is only applicable to latent variables that are incorporated in a reflective measurement model [42], as in our model. Table 5 shows the Stone-Geisser test (Q^2) utilizing blindfolding procedure. Results show that the model has predicted relevance, as Q^2 results for each construct are greater than zero.

However, the question that emerges is whether numeric differences between path coefficients are statistically significant. To address this issue, we performed multigroup analysis. The comparison of group-specific effects entails consideration of how a categorical moderator variable (group membership) affects the direction and/or strength of the relationship between two latent variables [42]. To approach multigroup analysis, we dismissed the parametrical approach, because it relies on distributional assumptions which constitute a major shortcoming and did not fit our data. Thus, we decided to apply the approach by Henseler [45] and Henseler et al. [42] and nonparametric confidence set approach [46] with percentile method [47], which do not build on any distributional assumptions, are simple to apply and require low computational demand.

Table 5. Q^2 results for each construct

Q^2	Services	Manufacturing
Eco-orientation	0.655	0.672
MK inf. sources	0.299	0.308
Process-orientation	0.445	0.585
Product-orientation	0.471	0.474

Results are presented in Table 6. As shown, the three methods lead to the same results. The path coefficients between product-orientation and eco-orientation for service and manufacturing firms differ significantly. Thus, this path coefficient in manufacturing firms is significantly greater than in service firms. Product-orientation, which is the orientation to increase the quality or the number of products, to penetrate new markets or to increase market share while innovating, affects more the environmental orientation of manufacturing firms than service firms.

Discussion, Conclusions, Limitations, and Further Research

The objective of this paper was to disentangle empirically the differences in eco-innovative behaviour between services and manufacturing industries. While Segarra-Oña et al. [17] indicated that concern about environmental aspects when innovating is higher in manufacturing industries than in service industries, the patterns that drive this orientation might not be the same because of the differences between services and manufacturing businesses.

This study of over 6000+ firms provides several interesting insights that should be taken into consideration in

Table 6. Multigroup comparison test results.

	Path coefficients			$p_{\text{Henseler (2007)}}$	$p_{\text{Henseler et al. (2009)}}$	Confidence intervals		
	Services	Manufacturing	diff			Serv.	Manuf.	Sig.
MK inf. sources -> process-orientation	0.450	0.455	0.005	0.418	0.453	[0.416 . 0.482]	[0.428 . 0.487]	n.s.
MK inf. sources -> product-orientation	0.591	0.565	0.025	0.085	0.085	[0.564 . 0.619]	[0.541 . 0.591]	n.s.
Process-orientation -> Eco-orientation	0.481	0.489	0.007	0.376	0.369	[0.447 . 0.521]	[0.456 . 0.517]	n.s.
Product-orientation -> Eco-orientation	0.163	0.303	0.139	**0.000**	**0.000**	[0.125 . 0.203]	[0.269 . 0.335]	**sig**

Results for Henseler (2007) [45] and Henseler et al. (2009) [42] eligible for a one-sided test.

order to improve firms' environmental orientation. The first conclusion of this paper is that services firms adjusted well to the model explaining environmental orientation drivers proposed by Segarra-Oña et al. [16].

On the other hand, probably the most interesting result is the differentiated impact that product-orientation has on eco-orientation. We have proven that the relationship between product-orientation and eco-orientation in service firms is significantly different from the one in manufacturing firms. In fact, product-orientation impact is lower in services firms. Thus, while manufacturing firms show a similar impact of product and process-orientation on eco-orientation, in service firms process-orientation almost doubled the relative impact of product-orientation on eco-orientation.

These results strengthen our previous findings [16, 17, 24, 25] and clarify the variables that influence firms' behavior regarding eco-innovation depending on industry type.

These results may enhance internal decisions as well as public policy strategies as regards greener industries, in line with the last eco-innovation EU programs (http://ec.europa.eu/environment/eco-innovation/),

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References

1. BLISCHWITZ R., GILJUN S., KUHNDT M., SCMIDT, B. Eco-innovation: Putting the EU on the path to a resource and energy efficient economy. Wuppertal Institute. Brussels. **2009**.
2. KEMP R. Eco-innovation: Definition, Measurement and Open Research Issues. Economia Politica. **3**, (97), 420, **2010**.
3. KEMP R., OLTRA V. Research Insights and Challenges on Eco-Innovation Dynamics. Industry and Innovation. **18**, (3), 249, **2011**.
4. SULLIVAN R. Being sustainable...be specific, Eng. Manage. J., **12**, (5), 220, **2002**.
5. ESTY D.C., WINSTON A.S. Green to Gold, How smart companies use environmental strategy to innovate, create value, and build competitive advantage. John Wiley & Sons, Hokoben, New Jersey. **2006**.
6. NIDUMOLU R., PRAHALAD C., RANGASWAMI M. Why Sustainability Is Now the Key Driver of Innovation. Harvard Bus Rev. **87**, 57, **2009**.
7. POHORYLES R J. Europe in the making – what role environmentalism; and, why should sustainable development be less than environmentalism? Innovation. **23**, 319, **2010**.
8. KONECZNA R., KULCZYCKA J. Export Competitiveness of Polish Environmental Products in Select Manufacturing Sectors. Pol. J. Environ. Stud. **20**, (6), 1531, **2011**.
9. MONDÉJAR-JIMÉNEZ J., VARGAS-VARGAS M., MONDÉJAR-JIMÉNEZ J.A. Measuring environmental evolution using synthetic indicators. Environ. Eng. Manage. J. **9**, 1145, **2010**.
10. BENGOETXEA-USATEGI C. Sustainable development: An integrated visión. DYNA. **82**, (7), 342, **2007** [In Spanish].

11. TENDERO R., GARCÍA DE VIEDMA M. Building process for sustainable development: a modal activity. Inf. Constr. **63**, (521), doi:10.3989/ic.09.034, **2011** [In Spanish].
12. WAGNER M. Empirical influence of environmental management on innovation: Evidence from Europe. Ecol. Econ. **66**, 392, **2008**.
13. DE MARCHI V. Environmental innovation and R&D cooperation: Empirical evidence from Spanish manufacturing firms. Res. Policy. **41**, (3), 614, **2012**.
14. DEL RÍO P., TARANCÓN M., CALLEJAS F. Analysing the determinants of environmental technology investments. A panel-data study of Spanish industrial sectors. J. Clean. Prod. **19**, (11), 1170, **2011**.
15. LAY G., COPANI G., JAGER A., BIEGE S. The relevance of service in European manufacturing industries. Journal of Service Management. **21**, (5), 715, **2010**.
16. SEGARRA-OÑA M., PEIRÓ-SIGNES A. Eco-innovation determinants in service industries. Dirección y Organización. **50**, 5, **2013**.
17. SEGARRA-OÑA M., PEIRÓ-SIGNES A., MONDÉJAR-JIMÉNEZ J., VARGAS-VARGAS M. Service vs. manufacturing: how to better address eco-innovation, public policies by disentangling the different characteristics of industries. Innovation. DOI: 10.1080/13511610.2013.863705, **27**, (2), 134, **2014**.
18. SEGARRA-OÑA M., PEIRÓ-SIGNES A., ALBORS-GARRIGÓS J., MIRET-PASTOR L. Impact of Innovative Practices in Environmentally Focused Firms: Moderating Factors. Int. J. Environ. Res. **5**, (2), 425, **2011**.
19. KESIDOU E., DEMIREL P. On the drivers of eco-innovations: Empirical evidence from the UK. Res. Policy. **41**, (5), 862, **2012**.
20. JAFFE A.B., PALMER K. Environmental regulation and innovation: a panel data survey, Rev. Econ. Stat. **79**, 610, **1997**.
21. PEIRÓ-SIGNES A., SEGARRA-OÑA M., MIRET-PASTOR L., VERMA R. Eco-innovation attitude and industry's technological level. An important key for promoting efficient vertical policies. Environ. Eng. Manage. J. **10**, (12), 1893, **2011**.
22. FORSMAN H. Innovation capacity and innovation development in small enterprises. A comparison between the manufacturing and service sectors. Res. Policy. **40**, (5), 739, **2011**.
23. SIRILLI G., EVANGELISTA R. Technological innovation in services and manufacturing: results from Italian surveys. Res. Policy, **27**, 881, **1998**.
24. SEGARRA-OÑA M., PEIRÓ-SIGNES A., PAYÁ-MARTÍNEZ A. Factors influencing automobile firms' eco-innovation orientation. Eng. Manage. J. **26**, (1), 52, **2014**.
25. SEGARRA-OÑA M., PEIRÓ-SIGNES A. Determinants of the eco-innovation orientation at the Spanish tile industry. DYNA. **89**, (1), **2014** [In Spanish].
26. JOVANE J., YOSHIKAWA H., ALTING L., BOËR C.R., WESTKAMPER E., WILLIAMS D., TSENG M., SELIGER G., PACI A.M. The incoming global technological and industrial revolution towards competitive sustainable manufacturing, CIRP Annals – Manufacturing Technology. **57**, (2), 641, **2008**.
27. JOHNSTONE N., LABONNE J. Why do manufacturing facilities introduce environmental management systems? Improving and/or signaling performance. Ecol. Econ. **68**, (3), 719, **2009**.
28. BURCIU A., BOSTAN I., CONDREA P., GROSU V. Financing the environmental policies in the communitarian space. Environ. Eng. Manage. J. **9**, (9), 1179, **2010**.
29. POHORYLES R.J. Sustainable Development, Innovation and Democracy: What role for the regions? Innovation: The European Journal of Social Science Research. **20**, (3), 183, **2007**.
30. PIRANI E., SECONDI L. Eco-Friendly Attitudes: What European citizens say and what they do. Int. J. Environ. Res. **5**, 425, **2011**.
31. RINGLE C.M., WENDE S., WILL A. SmartPLS 2.0 (beta). www.smartpls.de, Hamburg. **2005**.
32. ANDERSON J.C., GERBING D.W. Structural Equation Modeling in Practice: A Review and Recommended Two-Step Approach. Psychol. Bull. **103**, 411, **1988**.
33. BAGOZZI R., YI Y. On the evaluation of structural equation Models. J. Acad. Market. Sci. **18**, (1), 74, **1988**.
34. BARCLAY D., HIGGINS C., THOMPSON, R. The Partial Least Square (PLS). Approach to causal modeling: Personal computer adoption and use as an illustration. Technol. Stud. **2**, (2), 2 85, **1995**.
35. CHIN W.W., MARCOLIN B.L., NEWSTED P.R. A partial least squares latent variable modeling approach for measuring interaction effects: results from a Monte Carlo simulation study and an electronic mail emotion/adoption study. Inform. Syst. Res. **14**, (2), 189, **2003**.
36. CHIN W.W. The partial least squares approach to structural equation modeling. In: G. A. Marcoulides (Ed.), Modern Methods for Business Research. 295, **1998**.
37. TENENHAUS M., VINZI V., CHATELIN J., LAURO C. PLS path modeling. Comput. Stat. Data An. **48**, (1), 159, **2005**.
38. NUNNALLY J., BERNSTEIN I. Psychometric Theory (3th Ed). New York: McGraw Hill. **1994**.
39. FORNELL C., LARCKER D. Evaluating structural equations models with unobservable variables and measurement error. J. Marketing Res. **18**, 39, **1981**.
40. WIXOM B., WATSON H. An empirical investigation of the factors affecting data warehousing success. MIS Quarterly, **25**, 17, **2001**.
41. FALK R., MILLER N. A primer on soft modelling. (Ed.) The University of Akron Press, Akron, **1992**.
42. HENSELER J., RINGLE C.M., SINKOVICS R.R. The use of partial least squares path modeling in international marketing. Advances in International Marketing. **20**, 277, **2009**.
43. STONE M. Cross-validatory choice and assessment of statistical predictions. J. Roy. Stat. So.c B Met. **36**, 111, **1974**.
44. GEISSER S. A predictive approach to the random effect model. Biometrika. **61**, (1), 101, **1975**.
45. HENSELER J. A new and simple approach to multi-group analysis in partial least squares path modeling. In: H. Martens, T. Næs & M. Martens (Eds), PLS'07 international symposium on PLS and related methods – causalities explored by indirect observation. Oslo. **2007**.
46. SARSTEDT M., HENSELER J., RINGLE C.M. Multigroup analysis in partial least squares (PLS) path modeling: Alternative methods and empirical results. Advances in International Marketing, 22, **2011**.
47. EFRON B. Nonparametric estimates of standard error: the jackknife, the bootstrap and other methods. Biometrika. **68**, (3), 589, **1981**.