

Business Strategies and Competitive Advantage through Green Entrepreneurship and Sustainable Environmental Management

Michalis Skordoulis¹, Spyros Galatsidas¹, Garyfallos Arabatzis¹

¹Democritus University of Thrace, Orestiada, Greece, e-mails: msrkodoulis@gmail.com; sgalatsi@fimenr.duth.gr; garamp@fimenr.duth.gr

Abstract. Both environmental sustainability and the production of green products are strategies that are dictated by the need for environmental protection and modern business management practices, but still they are not widely applied. Adopting such strategies gives businesses the ability to operate more efficiently and develop a competitive advantage. This article proposes the theoretical development of a strategic framework using operations research models and business management tools aiming to develop a competitive advantage through sustainable environmental management.

Keywords: Environmental sustainability, competitive advantage, green products, operations research, green entrepreneurship.

1 Introduction

Worrying phenomena such as the climate change, the increase in average temperatures and the greenhouse gases emissions lead to increasingly negative environmental and economic impacts, which need to be treated effectively (Papageorgiou et al., 2015). This relationship between economic development, energy consumption, gas emissions and their negative implications is analyzed in several studies (Chalikias & Ntanos, 2015; Ntanos et al., 2015). In recent decades, businesses have been faced with a set of new challenges in environmental management. In addition, the need for environmentally friendly products becomes increasingly imperative as consumers' exhibit increased awareness towards environmental issues and renewable energy sources (Chalikias et al., 2010a, b; Kolovos et al., 2011; Ntanos et al., 2016).

Thus, from the beginning of the 1990s, the goal is to create a sustainable future (Hutchinson, 1992). A number of researchers (Nidumolu et al., 2009; Arabatzis et al., 2015; Ojo et al., 2015) state that the inclusion of sustainable environmental management in a business's strategy can be an core source for developing a competitive advantage which is the ultimate goal of each business (Wheelen & Hunger, 2012).

Copyright © 2017 for this paper by its authors. Copying permitted for private and academic purposes.

Proceedings of the 8th International Conference on Information and Communication Technologies in Agriculture, Food and Environment (HAICTA 2017), Chania, Greece, 21-24 September, 2017.

The current environment in which businesses are required to operate is very dynamic, similar to the environment of a battle. For the analysis of such environments, operations research models have been developed and can be applied in the case of enterprises (Chalikias & Skordoulis, 2014; Chalikias & Skordoulis, 2016).

The purpose of this paper is to propose the theoretical basis for the development of a framework analyzing business competition by using operations research models and aiming to create competitive advantage by using modern management tools.

2 Sustainable environmental management and competitive advantage

In recent years, more and more businesses are turning to practices aiming at environmental protection and sustainability. On the one hand, this trend stems from the increasing pressure from stakeholders, such as environmental organizations, consumers and regulators. In this sense, environmental sustainability could be the most important challenge of corporate social responsibility. On the other hand, the trend towards integrating sustainable management of the environment into business strategy has to do with its contribution to competitive advantage creation.

Corporate social responsibility is inseparably linked to environmental protection. Corporate social responsibility contributes to corporate image strengthening, to favorable taxation promotion, to relations with the stakeholders strengthening as well as to better risk management and security (Urip, 2010). Consequently, actions related to environmental protection and can be expressed through corporate social responsibility framework can lead to higher economic returns and as far as it is concerned to the establishment of a competitive advantage (Urip, 2010; Skordoulis et al. 2013).

According to Danjelico and Pujari (2010), sustainable environmental management is linked to the competitive advantage of a business by reducing the use of energy, raw materials and pollutants. According to them, the production of green products, i.e. products produced by methods that minimize the burden on the environment (Ottman et al., 2006).

Wu and Lin (2016) report that green product production contributes to minimizing the environmental impact of products throughout their lifetime, including purchasing raw materials, manufacturing, selling, consumption and disposal after use.

According to a framework proposed by Rohm and Montgomery (2010), revenue growth, risk reduction and cost reduction will increase business profitability and lead to a sustainable competitive advantage.

More specifically, a strong emphasis on sustainability leads to the development of more eco-efficient products, strengthens co-operation with environmental regulators and reduces the environmental impact of business operations.

In addition, new technological capabilities are created to help measure and analyze environmental impacts more effectively.

Furthermore, by producing more eco-efficient products, higher value can be provided to an increasing number of green consumers, which will lead to increased sales.

Moreover, a better and more efficient co-operation with environment regulators will be archived through the production of green products. This will reduce business risk, since eco-friendly and safe products will reduce the potential risk of environmental liability and consumers. This reduced risk will have a positive impact on capital costs. In turn, actions to reduce production processes impact on the environment will lead to direct cost savings of fuel, water, electricity and waste disposal (Berry & Rondinelly, 1998).

It is a fact that the cost of organizing a business to operate with a focus on sustainable environmental management can be considered quite high. However, businesses should not perceive the adoption of sustainable environmental management practices as unnecessary costs; they should perceive them as long-term investments that eventually lead to the development of a competitive advantage (Becker-Olsen et al., 2006).

3 Business competition analysis with operations research models and strategy formulation

During the World Wars, mathematical models were widely used in combats. These models aimed at solving various optimization problems related to the ongoing war operations. By the end of the wars, these models were applied with to business cases, since business competition is very similar to battlefields combats.

Such models based on differential equations have been applied in business cases such as marketing strategy analysis (Taoka, 1997), oligopoly competition strategies (Fruchter & Kalish, 1997), products development based on customers' needs (Fehlmann, 2008), advertising costs (Chintagunta & Vilcassim, 1992; Chalikias & Skordoulis, 2014; Chalikias et al. 2016) and supply chains (Chalikias & Skordoulis, 2016).

Unlike traditional static models that can only explain competition in a market, operations research models such as Lanchester's combat model can not only be used in the multidimensional analysis of a market but also in the prediction of tis future sizes based on competition data (Fehlmann, 2008).

In such a case, the competition between two businesses could be analyzed by a system of differential equations as the following one:

$$\begin{cases} \frac{dx}{dt} = -ay + f(t) \\ \frac{dy}{dt} = -bx + g(t) \end{cases} \quad (1)$$

Where $x(t)$ and $y(t)$ would be the operating income for each one of the two competitors, $f(t)$ and $g(t)$ the rate at which they increase or decrease affected by one

or more variables in each model. Such variables would be advertising costs, supplies at points of sale, or environmental investments.

Having analyzed the competition with an operations research model it is possible to point out the strengths and weaknesses of a business against competition as well as the points that need to be improved (Fehlmann, 2008).

Once the strengths, weaknesses and the points to be improved have been recorded, the next step is to develop the appropriate business strategy. For this purpose, tools of modern business administration can be used.

Such a tool is the Quality Function Deployment (QFD) method, which aims to integrate customers' needs and requirements at the development of a product (Fehlmann, 2008; Chaudha et al., 2011). The QFD method can indicate to a business where and how to focus as well as the impacts on competition (Salari & Bhuiyan, 2016).

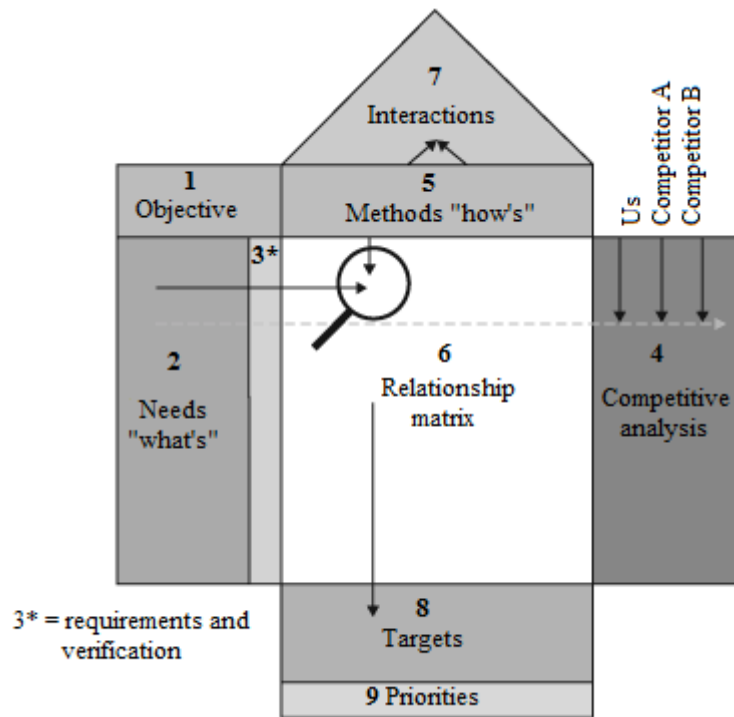


Fig. 1. Quality Function Deployment framework.

Environmental sustainability through the QFD method means that a business should operate environmentally responsible (Dai & Blackhurst, 2012) and should therefore translate environmental requirements into processes; this strategy would possibly result in the potential development of a competitive advantage as already discussed.

Another tool that could be used to achieve environmental sustainability is the Balanced Scorecard (BSC), the basic idea of which is that the effective use of investment funds is no longer the only determinant of developing a competitive advantage, but there are other factors as well such as human capital, knowledge creation and customer orientation (Kaplan & Norton, 2005).

In order to apply BSC method to an environmental sustainability strategy, the proper business units should be selected, the environmental aspects must identified, and the relationship between the environmental aspects and the business strategy should be analyzed (Figgie Et al., 2002).

By adding the environmental dimension to BSC, in addition to its existing ones, a business can translate its environmental strategy into a set of performance and requirements measures (Sidiropoulos et al., 2004). The elements that may include the environmental dimension of a BSC are presented in the table below.

Table 1. Proposed BSC framework for the environmental dimension (Sidiropoulos et al., 2004).

Processes		Products
Resources	Wastes	
<ul style="list-style-type: none"> • Energy • Water • Raw material 	<ul style="list-style-type: none"> • Gas emission • Liquid wastes • Solid wastes • Dangerous wastes 	<ul style="list-style-type: none"> • Recyclable parts percent • Non-recyclable parts life cycle • Products life cycle • Substitutes number

Based on the above framework, the environmental dimension of BSC can be used to model different events to provide the ability to run, analyze and evaluate different scenarios (Sidiropoulos et al., 2004).

4 Conclusions

The fact that many businesses do not yet consider environmental sustainability as a priority (Kaebernick et al., 2003) gives to those who integer it into their strategies the chance to develop a competitive advantage. This will be the results of both the benefits provided by an environmental sustainability strategy (Kim & Mauborgne, 2005) and, a so-called “blue ocean” strategy which is an innovative approach that enables development in new fields of a market where there are still few potential competitors (Nidumolu et al., 2009).

From the above analysis, it is obvious that integrating environmental requirements into business strategy leads to a sustainability framework that can be reflected by the development of a competitive advantage by improving efficiency, reducing costs and risks and increasing compatibility with customers’ and regulations’ requirements.

Developing an environmental sustainability strategy through operations research models and business management tools is more effective than traditional ways since it takes into account all possible variables and it is possible to predict the results by

creating, running and evaluating different scenarios (White & Lee, 2009; Paucar-Caceres & Espinosa, 2011).

Therefore, a business strategy that includes environmental sustainability will be more effective when it is based on operations research model and business tools such as the QFD method, as this will provide a better understanding of the competition and the requirements. Moreover, the analysis of as many scenarios as possible including different variables will become feasible.

A strategic approach as described above will result in significant changes in the structure, the mission, the vision and the purpose of any business that will adopt it. Such a strategy can ultimately enhance the reputation and results of a business in a constantly changing market that creates new challenges.

References

1. Arabatzis, G., Galatsidas, S., Intze, C., Chalikias, M., Tsiantikoudis, S. & Mamalis, S. (2015). *Green Entrepreneurship and Green Products: Consumers' Views and Attitudes in Regional Unit of Evros*. In: Proceedings of the 7th International Conference on ICT in Agriculture, Food and Environment (HAICTA 2015). Kavala, September 2015. Athens: HAICTA, pp. 291-297.
2. Becker-Olsen, L., Cudmore, A., & Hill, P. (2006). The impact of perceived corporate social responsibility on consumer behaviour. *Journal of Business Research*. 59(1): 46-53.
3. Berry, M.A., & Rondinelli, D.A. (1998). Proactive corporate environmental management: A new industrial revolution. *The Academy of Management Executive*. 12(2): 38-50.
4. Chalikias, M., Kalaitzidis, I., Karasavvidis, G., Pechlivanis, E.F. (2010a). Relationship between sustainable farming and agricultural training: The case of Pella prefecture (Northern Greece). *Journal of Food, Agriculture and Environment*. 8(3-4 Part 2): 1388-1393.
5. Chalikias, M., Kyriakopoulos, G. & Kolovos, K.G. (2010b). Environmental sustainability and financial feasibility evaluation of woodfuel biomass used for a potential replacement of conventional space heating sources. Part I: A Greek case study. *Operational Research*. 10(1): 43-56.
6. Chalikias M. & Ntanos S. (2015). *Countries clustering with respect to carbon dioxide emissions by using the IEA database*, In: Proceedings of the 7th International Conference on ICT in Agriculture, Food and Environment (HAICTA 2015). Kavala, September 2015. Athens: HAICTA, pp. 347-351.
7. Chalikias, M. & Skordoulis, M. (2014). Implementation of Richardson's arms race model in advertising expenditure of two competitive firms. *Applied Mathematical Sciences*. 8(81): 4013-4023.
8. Chalikias, M. & Skordoulis, M. (2016). Implementation of FW Lanchester's combat model in a supply chain in duopoly: the case of Coca-Cola and Pepsi in

Greece. *Operational Research an International Journal*. doi:10.1007/s12351-016-0226-0.

9. Chalikias, M., Lalou, P. & Skordoulis, M. (2016). Modeling advertising expenditures using differential equations: the case of an oligopoly data set. *International Journal of Applied Mathematics and Statistics*. 55(2): 23-31.
10. Chaudha, A., Jain, R., Singh, A.R. & Mishra, P.K. (2011). Integration of Kano's Model into quality function deployment (QFD). *The International Journal of Advanced Manufacturing Technology*. 53(5-8): 689-698.
11. Chen, Y.S., Lai, S.B. & Wen, C.T. (2006). The influence of green innovation performance on corporate advantage in Taiwan. *Journal of Business Ethics*. 67(4): 331-339.
12. Chintagunta, P.K., & Vilcassim, N.J. (1992). An empirical investigation of advertising strategies in a dynamic duopoly. *Management science*. 38(9): 1230-1244.
13. Dai, J., & Blackhurst, J. (2012). A four-phase AHP-QFD approach for supplier assessment: a sustainability perspective. *International Journal of Production Research*, 50(19), 5474-5490.
14. Dangelico, R. M. & Pujari, D. (2010). Mainstreaming green product innovation: Why and how companies integrate environmental sustainability. *Journal of Business Ethics*. 95(3): 471-486.
15. Fehlmann, T. (2008). *New Lanchester theory for requirements prioritization*. In: Proceedings of the Second International Workshop on Software Product Management. Barcelona, September 2008. Baelona: I.E.E.E, pp. 35-40.
16. Figge, F., Hahn, T., Schaltegger, S. & Wagner, M. (2002). The sustainability balanced scorecard-linking sustainability management to business strategy. *Business Strategy and the Environment*. 11(5): 269-284.
17. Fruchter, G. & Kalish, S. (1997). Closed-loop advertising strategies in a duopoly. *Management Science*. 43(1): 54-63.
18. Hutchinson, C. (1992). Corporate strategy and the environment. *Long Range Planning*. 25(4): 9-21.
19. Kaebernick, H., Kara, S. & Sun, M. (2003). Sustainable product development and manufacturing by considering environmental requirements. *Robotics and Computer-Integrated Manufacturing*. 19(6): 461-468.
20. Kaplan, R.S. & Norton, D.P. (2005). The balanced scorecard: measures that drive performance. *Harvard Business Review*. 83(7): 172.
21. Kim, W.C. & Mauborgne, R. (2005). Blue ocean strategy: from theory to practice. *California Management Review*. 47(3): 105-121.
22. Kolovos, K.G., Kyriakopoulos, G.L. & Chalikias, M. (2011). Co-evaluation of basic woodfuel types used as alternative heating sources to existing energy network, *Journal of Environmental Protection and Ecology*. 12 (2):733-742.
23. Kyriakopoulos G.L, Arabatzis G. & Chalikias, M. (2016). Renewables exploitation for energy production and biomass use for electricity generation. A multi-parametric literature-based review. *AIMS Energy*, 4(5): 762-803.

24. Lin, Y., Cheng, H.P., Tseng, M.L. & Tsai, J.C. (2010). Using QFD and ANP to analyze the environmental production requirements in linguistic preferences. *Expert Systems with Applications*. 37(3): 2186-2196.
25. Nidumolu, R., Prahalad, C.K. & Rangaswami, M.R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review*. 87(9): 56-64.
26. Ntanos S., Arabatzis G., Milioris K., Chalikias M. & Lalou P., (2015). *Energy Consumption and CO₂ Emissions on a Global Level*. In: Proceedings of the 4th International Conference: Quantitative and Qualitative Methodologies in the Economic & Administrative Sciences (I.C.Q.Q.M.E.A.S. 2015). Athens, Technological Education Institute of Athens, pp.251-260.
27. Ntanos S., Ntanos A., Salmon I. & Ziatas T., (2016). *Public awareness on Renewable Energy Sources: a case study for the Piraeus University of Applied Sciences*. In: Proceedings of the 5th International Symposium and 27th National Conference on Operational Research (EEEE2016). Athens, Piraeus University of Applied Sciences, pp. 18-23.
28. Ojo, E., Mbohwa, C. & Akinlabi, E. (2015). *Sustainability - competitive advantage?* In: Proceedings of the 2015 International Conference on Operations Excellence and Service Engineering. Florida, September 2015. Canton, MI: IEOM Society, pp. 592-600.
29. Ottman, J.A., Stafford, E.R. & Hartman, C.L. (2006). Green marketing myopia. *Environment*. 48(5): 22-36.
30. Papageorgiou, A., Skordoulis, M., Trichias, C., Georgakellos, D. & Koniordos, M. (2015). *Emissions trading scheme: evidence from the European Union countries*. In: Communications in Computer and Information Science. 535: Proceedings of Creativity in Intelligent Technologies & Data Science Conference, Eds., Kravets et al. Volgograd, September 2015. Switzerland: Springer International Publishing, pp. 222-233.
31. Paucar-Caceres, A. & Espinosa, A. (2011). Management science methodologies in environmental management and sustainability: Discourses and applications. *Journal of the Operational Research Society*. 62(9): 1601-1620.
32. Rohm, H. & Montgomery, D. (2010). *Link sustainability to corporate strategy using the balanced scorecard*. Cary, NC: Balanced Scorecard Institute.
33. Salari, M., & Bhuiyan, N. (2016). A proposed approach to improve current sustainable product development. *Journal of Industrial and Production Engineering*, 33(5), 297-307.
34. Sidiropoulos, M., Mouzakitis, Y., Adamides, E. & Goutsos, S. (2004). Applying sustainable indicators to corporate strategy: the eco-balanced scorecard. *Environmental Research, Engineering and Management*. 1(27): 28-33.
35. Skordoulis, M., Tsoufas, A., Kornelaki, E. & Samanta, I. (2013). *The effect of corporate social responsibility (CSR) actions on consumers' behaviour*. In: Proceedings of eRA-8 International Scientific Conference. Economy Session. Piraeus, September 2013. Piraeus: T.E.I. of Piraeus, pp. 47-58.
36. Taoka, N. (1997). *Lanchester strategy: an introduction*. London: Lanchester Press.

37. Urip, S. (2010). *CSR strategies for a competitive edge in emerging markets*. Toronto: Jon Wiley & Sons.
38. Wheelen, L.T. & Hunger, J.D. (2012). *Strategic management and business policy toward global sustainability. 13th edition*. Upper Saddle River, NJ: Prentice Hall.
39. White, L. & Lee, G.J. (2009). Operational research and sustainable development: Tackling the social dimension. *European Journal of Operational Research*. 193(3): 683-692.
40. Wu, S.I. & Lin, S.R. (2016). The effect of green marketing strategy on business performance: a study of organic farms in Taiwan. *Total Quality Management & Business Excellence*. 27(1-2): 141-156.
41. Yazdani, M., Hashemkhani Zolfani, S. & Zavadskas, E.K. (2016). New integration of MCDM methods and QFD in the selection of green suppliers. *Journal of Business Economics and Management*. 17(6): 1-17.