

**007-0312**

**How Green is Green?**

**A Framework for Environmental Performance Assessment in Operations**

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**POMS 18th Annual Conference**

**Dallas, Texas, U.S.A**

**May 4 to May 7, 2007**

## **ABSTRACT**

This paper presents a framework based upon a relationship between environmental benefits and the investments and costs needed to implement and run company operations. As the results of environmental management become more evident it is proposed that the benefits rather than the environmental impacts are measured in the analysis of environmental performance. Four categories, or stages, are defined in this paper: “creative-green”, “expensive-green”, “inefficient-green or beginner”, and finally, the “complacent” stage. The paper describes the characteristics of each category and provides examples of indicators that could be used to measure environmental benefits. Qualitative and quantitative methods are necessary to classify companies according to the framework. It is believed that this paper can assist companies and public organisations to assess operations and projects considering their level of sustainability. The proposed framework can impact FDI and environmental policies in the public arena, and foster innovation on environmental practices within the private sector.

*Key words: Environmental Management, Operations Management, Sustainability, Environmental Performance*

## **INTRODUCTION**

Assessing environmental performance of organisations is not a straightforward task. Quality performance can be communicated by level of customer or stakeholder satisfaction or tangible measures of a product. On the other hand, environmental performance permeates regulatory compliance, level of emissions and consumption, product and process characteristics, among other variables. Whereas financial assessment can be expressed by one number reflecting, for example, tangible assets, level of stakeholders’ trust or even predicted value of intangible assets,

environmental assessment or the level of sustainability of a company can not be fairly represented by a single number.

Nevertheless, once environmental management is highlighted as vital a competence for companies to compete in the future, their level of sustainability or environmental performance needs to be measured in a practical way by managers, investors and government decision makers.

In fact, the universally known concept of sustainability is not easy to transform into numbers. For example, in the report “*Our Common Future*”, it is stated that sustainable development is development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1989).

Ehrenfeld (1999) suggested the following working definition for sustainability:

*“a possible way of living or being in which individuals, firms, governments, and other institutions are responsible for taking care of the future as if it belonged to them today, for equitably sharing the ecological resources on which the survival of human and other species depends, and for assuring that all who live today and in the future will be able to satisfy their needs and human aspiration”.*

Nowadays, the concept of sustainable development becomes simpler and more practical to understand, referring to the equilibrium of economic, social and environmental goals. In other words, it means that companies need to pursue environmentally-friendly products and methods, as well as being social responsible through economically viable processes.

Indeed, there are some attempts to measure sustainability level, such as Dow Jones’s sustainability index. Dow Jones Sustainability World Index (DJSI World) covers the top 10% of the biggest 2,500 companies in the Dow Jones World Index in terms of economic, environmental and social criteria (Dow Jones, 2007). In the ISO 14000 International Standard Series, the standard ISO 14031:1999 gives guidance on the design and use of environmental performance evaluation within an organisation. The document defines “Environmental Performance” as the results of an organisation’s management of its environmental aspects. Moreover, “Environmental Performance

Evaluation” is defined as an internal management process that uses indicators to provide information that compares an organisation’s past and present environmental performance using environmental performance criteria (ISO 14031, 1999).

Several authors have discussed the role of an organisation’s operations function within its environmental performance. Since the operations function is one of the main contributors towards sustainable development, this paper presents a framework based on a matrix, which takes into account the environmental benefits, investments and costs to implement and run company operations.

## **GREEN OPERATIONS AND ENVIRONMENTAL PERFORMANCE**

There is a strong relationship between business and operations strategies and sustainability. Business and operations strategies define what, where, when and how to produce goods or services. Thus, sustainability needs to be considered as part of the business and operations strategy. Environmental issues permeate these questions (what, where, when and how) in terms of choosing more environmental-friendly products, and more sustainable production sites, in appropriate rates and through environmentally-sound processes.

The operations function of a company encounters environmental protection issues directly because it is the main source of harmful emissions, and therefore, environmental management programmes and policies should be carefully developed to strengthen its operations strategy (Gupta, 1995).

Gupta and Sharma (1996) define “Environmental Operations Management” (EOM) as the integration of Environmental Management principles with the decision-making process for converting resources into usable products. They believe that EOM is a strategic level of operations management since it primarily concerns product and process design. In fact, defining the strategic

operations objectives (cost, quality, speed, flexibility and reliability) is strongly connected to environmental issues.

The Canadian Department of Foreign Affairs and International Trade – DAIFT - conceptualise the aim of Green Operations as the integration of environmental considerations into day-to-day operations (DAIFT, 2006). This ensures that operations are conducted in a manner consistent with good environmental stewardship principles and practices while taking into account competing demands on financial and human resources. Sarkis (2001) has designed the concept of greener manufacturing and operations through the use of environmental tools such as: design for environment, green supply chains, total quality environmental management and reverse logistics. Furthermore, Kleindorfer, Singhal and Wassenhove (2005) has identified that the evolution towards sustainable Operations Management is clear in three areas that integrate the three Ps (People, Profit and the Planet) of sustainable operations management: (1) Green product and process development, (2) Lean and green OM and (3) Remanufacturing and closed-loop supply chains.

Elliott (2001) points out operations management as a key player to achieve a sustainable future and examines the factors of the operations function (plant, place, process, programmes, people and product) and their natural involvement with social and environmental care.

Porter and Van Der Linde (1995) discuss the role of regulation in stimulating innovation and therefore, increasing competitiveness within economic sectors. For them, innovation offsets can be broadly divided into product offsets and process offsets. Products offsets refer to better performing or higher quality products, safer goods and lower costs. On the other hand, process offsets embrace higher resource productivity, material savings, better utilization of by-products, lower energy consumption, reduced material storage and waste disposal costs, and finally create a safer workplace. In short, both product and process innovation can lead companies to mitigate against pollution, which is understood as inefficiency in the process. Thus, companies must improve their measurement and assessment methods to detect environmental costs and benefits (Porter and Van Der Linde, 1995).

Placet, Anderson and Fowler (2005) listed the economic, social and environmental benefits of sustainable development. Regarding the economic benefits, they cite cost savings and revenue generation. Social and environmental benefits include improved quality of life for employees and society as a whole, resource conservation, environmental protection on local, regional and global scale.

Funk (2003) highlights the connection between sustainability and performance. A company expanding its operations worldwide would be wise to tie sustainability considerations to its strategic management of social, political and economic factors (Funk, 2003). Otherwise, potential negative impacts can affect the company. The author also mentions famous episodes of Shell's conflict in Nigeria and Nike's labour practices, demonstrating how sustainability should be considered as an opportunity to avoid future costs and loss of competitiveness.

In summary, sustainability in operations management means pursuing high environmental and social benefits in a cost-effective manner.

## **RESEARCH METHODOLOGY**

The major objectives of this paper are to present the environmental performance matrix and the relationship between the stages of sustainability and the product and process level of sustainability. A literature review on the topics of sustainable (green or environmental) production and environmental performance assessment was conducted in order to achieve these objectives. Pieces of research on strategy, sustainability and operations management were also covered aiming at the development of a framework to assess environmental performance in operations.

The environmental performance matrix is a framework that shows the stages of sustainability and helps to classify companies' operations function according to their environmental benefits and investments or operational costs to run their activities.

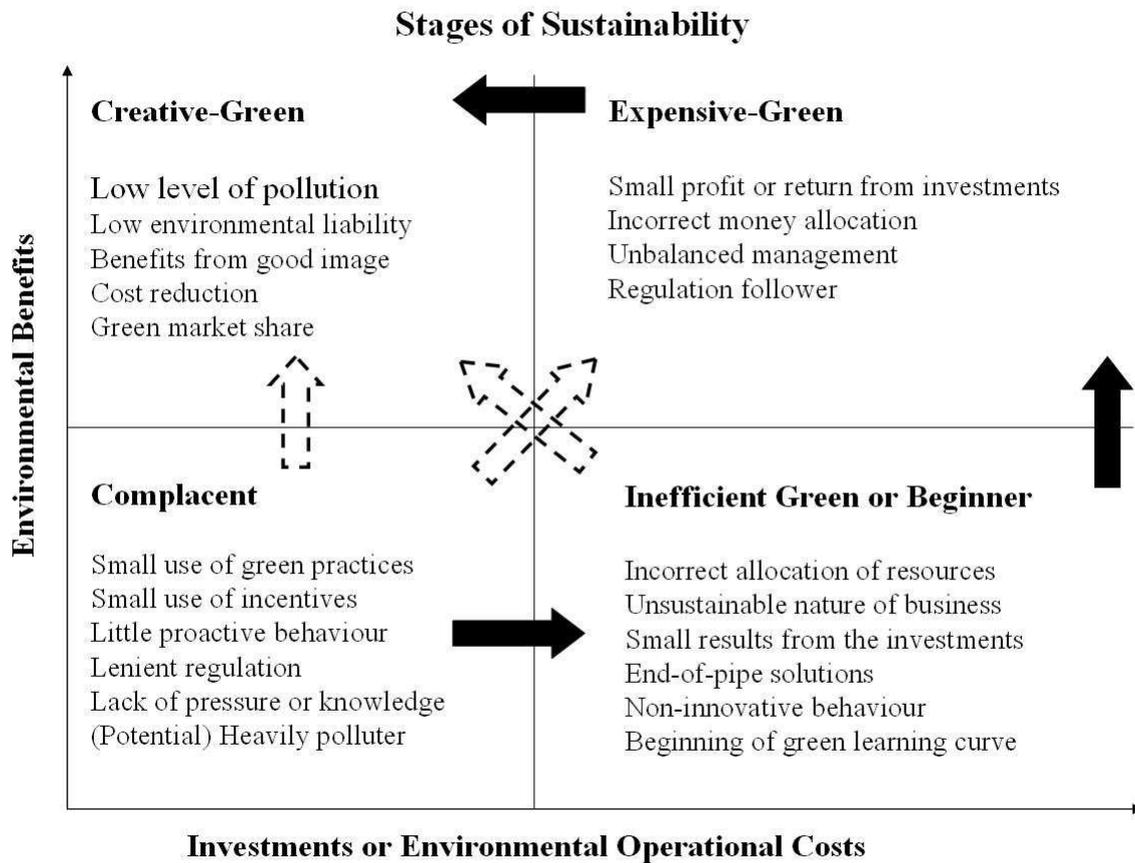
Because there is a need of innovation to enhance competitiveness and environmental performance, this paper establishes a relationship between the stages of sustainability and product and process level of sustainability. Thus, product and process innovation must consider environmental issues to achieve higher environmental benefits and reduce operational costs or investments at the same time.

Moreover, it is important to highlight that the concept of sustainable competitive advantage means not only achieving a privileged position ahead from the competitors. Today, it is necessary do this without damaging the ethical image of the company. This includes conservation of natural resources and respect for human health. Thus, in this work, the traditional view of competitive advantage as the possession of practices that are not easy to be duplicated or imitated in the long-term is extended to consider the relationship between the company and the environment (air, water, soil, fauna, flora and human beings). The next section shows an environmental performance matrix for assessing the operations function of organisations and its corresponding stages of sustainability.

## **ENVIRONMENTAL PERFORMANCE ASSESSMENT IN OPERATIONS FUNCTION**

As was mentioned earlier, the operations function encounters the biggest opportunity for companies to improve their environmental performance. Because environmental management becomes an essential competence to an organisation achieve a sustainable competitive advantage, environmental performance must be measured and taken into consideration to analyse company's overall performance.

Figure 1 presents the environmental performance matrix and the four stages of sustainability: “complacent”, “inefficient-green or beginner”, “expensive-green” and “creative-green”.



**Figure 1 – Stages of Sustainability**

- - - - Dotted arrows represents the possible leapfrogging moves

The natural development of companies is shown in the solid arrows from a complacent position to inefficient-green or beginner, then becoming expensive-green and finally, turning into a creative-green company. Although this is a natural path, it is not necessary for enterprises to start in the complacent stage. In fact, there are companies that started in a creative-green or expensive-green stage, because of their environmental concerns in the business formation or maybe due to the nature of its business. The dotted arrows represent possible leapfrogging improvements that companies can use to achieve higher levels of environmental performance.

The creative-green stage involves basically two types of companies. Firstly, there are companies that produce goods or services having high environmental benefits and need low investments to be created and operational costs to be run. Even if production does not use environmental technologies, the use of the products contributes to the increase of environmental

performance of other companies or has a positive impact on the environment. Secondly, there are companies that have clean processes through the use of innovative environmental technologies. These companies achieve higher environmental performance than their competitors and the operational costs provide high profit margins. Their products are not harmful to the environment because of their design or the company's activities for re-use or recycling processes. Companies in this stage are not only making use of cutting edge environmental technology, but also receiving the yields from its utilization. Cost reduction, market share and a good corporate image are among the main economic benefits.

The expensive-green companies are far from those that only follow regulation. However, they still struggle to be innovation owners and, because of this, their costs to maintain a good image or reduce pollution are still high. They use well-know environmental practices, but late adoption or incipient know-how of these techniques means they do not seize benefits at a low cost. Usually, inside-out innovations are needed for them to become creative-green companies.

The inefficient-green companies are also classified as beginners. They are in the early stages of the green learning curve, and thus they make investments but the results are mediocre. Companies still at this stage, wrongly allocate their resources, make use of end-of-pipe solutions, resist adopting new technologies, having a high environmental liability and are limited in following environmental regulations. Some companies in this stage might also be under badly designed regulation policies. They probably have poor access to relevant knowledge to increase their environmental performance. Also, the nature of business plays a very important role in this stage. For example, tobacco companies are examples in which the nature of the business makes the firm unable to be considered a green enterprise. Even if they have green processes, they are unable to have a high environmental performance due to harmful effects of using their products. It is important to highlight that some sectors of the economy, such as oil and gas, may be considered under the title of unsustainable; however, they remain important to economic development. Another point to be discussed is the role of the consumers because the level of sustainability also relates to

the level of consumption (or production from a company's perspective). Moreover, lenient regulation might be the reason for poor environmental performance.

In complacent enterprises, there is a lack of internal and external pressure or support to enhance environmental performance. Complacent companies have reactive behaviour or even no attitude at all towards environmental issues. They do not use free public information and incentives, are under lenient regulation and have few or none of the available and basic environmental practices (cleaner production, end-of-pipe solutions, etc). In the case of being under a lenient regulation and accomplishing its rules, it is very likely that the company would still be considered as a complacent enterprise.

Figure 2 shows the relationship between the stages of corporate sustainability and the product or process levels of sustainability.

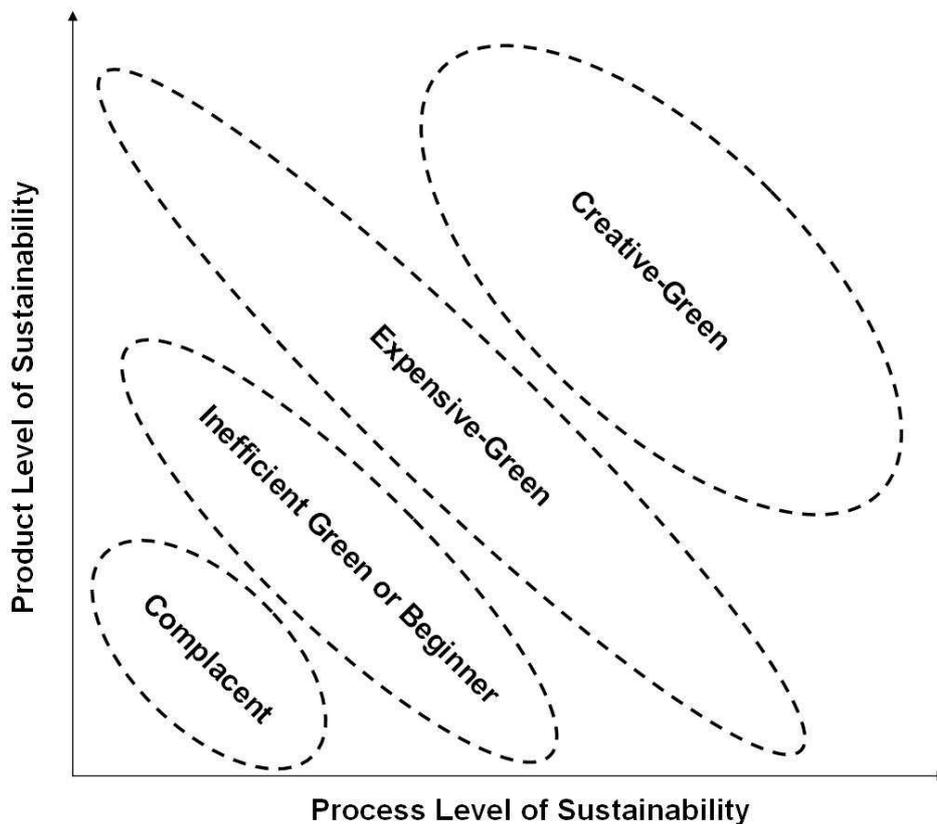


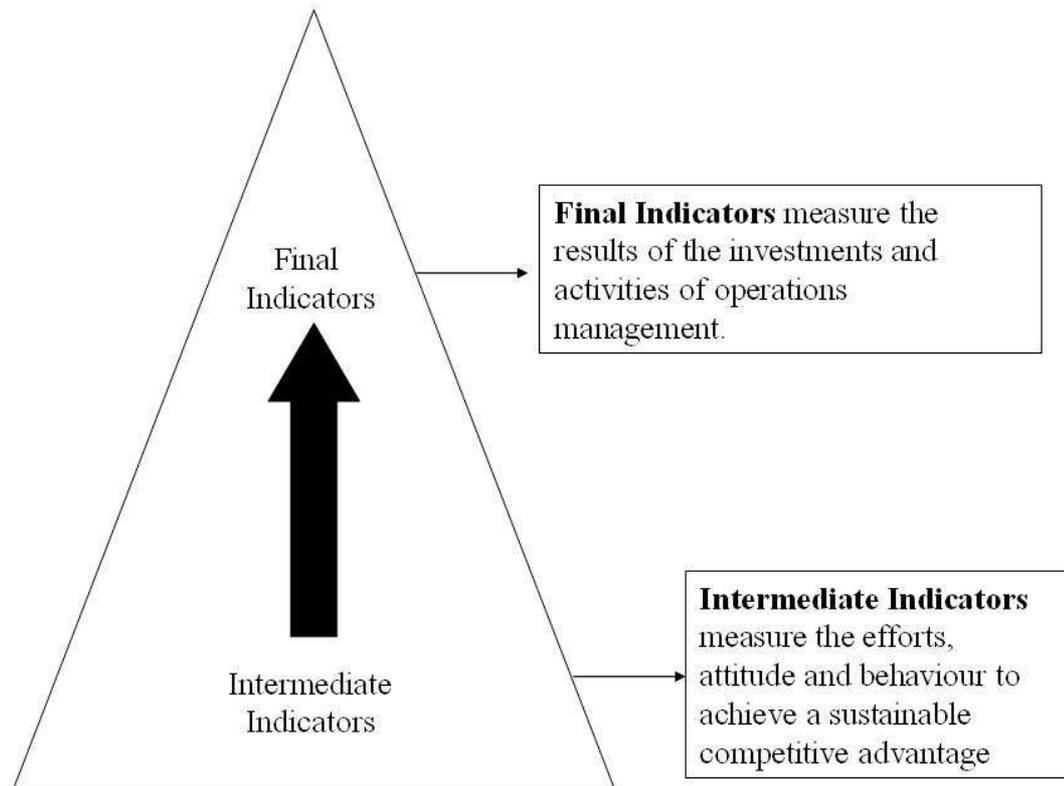
Figure 2 – Relationship between the Stages of Sustainability and the level of product and process sustainability.

Working with relevant sector for a social welfare (i.e. producing environmental-friendly products) and using sustainable production methods (environmentally-sound processes) are the basis towards a sustainable future.

It is possible to note from Figure 2 that companies should balance and innovate products and processes if they want to achieve higher levels of environmental performance. What is more, Figure 2 can be used not only by current companies, but also in the decisions of entrepreneurs for new business formation.

## **ENVIRONMENTAL PERFORMANCE INDICATORS**

In order to assess organisations through more than a qualitative analysis, this paper suggests a range of indicators to measure economic, social and environmental benefits. These indicators should be manageable (capable of measurement) to help the decision makers in taking better environmental decisions and reflecting as accurate as possible the organisation's environmental performance. Basically, there are 2 types of indicator: (1) final indicators, which represent the tangible and visible results from operations management, and (2) intermediate indicators, which show managers, stakeholders and customers the efforts made by the organisation to enhance its level of sustainability. Figure 3 shows that intermediate indicators must be linked to final indicators in order to define sustainability objectives and goals.



**Figure 3 – Final and Intermediate Indicators of Environmental Performance**

Various authors have suggested sustainability performance indicators. Rothenberg, Schenck, and Maxwell` (2005) suggest an environmental benchmarking for automotive manufacturers, which involves four categories: regulatory compliance, gross emissions, efficiency and life-cycle analysis. Veleva, Hart, Greiner and Crumbley (2001) listed indicators for sustainable production according to five levels of sustainability: facility compliance/conformance, facility material use and performance, facility effects, supply chain and product life-cycle and, sustainable systems. ISO 14031:1999 provides examples of approaches for selecting indicators for environmental performance evaluation.

Nevertheless, most of the literature measure environmental performance through the level of environmental impact; i.e., the lower the environmental impacts, the higher the environmental performance. In this paper, the following indicators of performance are aimed at benefits rather than

negative impacts; i.e., the more environmental benefits are achieved, the higher is the level of sustainability. This might seem a slight change to the normal approach; nevertheless, it tries to make operations function managers and researchers focus much more on solutions instead of problems.

Regarding environmental benefits, some examples of final and intermediate indicators that companies can measure are shown in Table 1.

**Table 1 – Environmental Benefit Indicators**

<b>Final Indicators</b>	<b>Intermediate Indicators</b>
Gross emissions minimisation or elimination in kilograms	Gross emission minimisation per production plant
Percentage of Regulation Compliance	Certification or environmental label conformity; Number of people in environmental education programmes;
Land under environmental protection in square metres	Land acquisition for reforestation programme in square metres;
Litres of water treated	Number of water treatment facilities
Energy Savings in Kilowatts	Investments in more efficient equipment
Tonnes of product recycled	Number of products designed for recycling

Table 2 presents some examples of economic benefit indicators among the variety of possibilities that organisations can assess:

**Table 2 – Economic Benefit Indicators**

<b>Final Indicators</b>	<b>Intermediate Indicators</b>
Cost Reduction per unit	Investment in Eco-design
Financial Aid from environmental programmes of Public or Private Institutions	Number of projects submitted for environmental programmes
Profit from greener products	Number of greener products produced
Market share	Level of environmental-friendly image; Investments in environmental marketing

Finally, example of social benefits indicators are shown in table 3.

**Table 3 – Social Benefit Indicators**

<b>Final Indicators</b>	<b>Intermediate Indicators</b>
Number of accident-free days	Number of employees receiving EHS* training
Number of employees	Number of recruitment
Turn-over	Safety, creativity stimuli and participation in the decision making programmes
Improvements in quality of life of local communities	Number of people attended in the corporative social programmes

\* Environmental, Health and Safety

In the end, it is important to define and establish benchmarking procedures. What is a high environmental benefit? What does low operational cost mean? Internal and External benchmarking will be useful to find out about the levels of environmental performance or investments and operational costs. Nevertheless, it is expected that subjectivity and qualitative analysis will still continue to playing a significant role in defining the sustainability level of an organisation.

It is important to highlight that the environmental performance matrix and the examples of indicators are not static, in the sense that businesses are able to innovate, change their nature according to time by adopting new technologies, or through scientific discoveries.

## **CONCLUSIONS**

This paper has presented a new perspective on environmental performance and sustainability indicators. The environmental performance matrix showed the four stages of corporative sustainability. Companies need to find creative alternatives to become greener, i.e, by pursuing high environmental payoffs through affordable investment and operational costs. Second, innovation in product and process designs can lead organisations to simultaneously reduce costs and enhance their level of sustainability. Last, but not least, finding appropriate indicators will help

managers, investors and customers to collaborate towards a more sustainable future. Indeed, identifying leading indicators of sustainability may never be a perfect science, but performance measurement that is incomplete and imperfect is better than measurement that is disconnected from business objectives (Funk, 2003).

In addition, Figures 1 and 2 in this paper show the need for alignment of sustainability goals and business and operations strategy. Motomura (2007) presents the concept of sustainable entrepreneurship, in which people create businesses or “make things happen” not only for themselves and at any cost. Sustainable entrepreneurs apply their energy in ethical ways to meet the real needs of modern society. Conducting or creating business in non-polluting and relevant sectors is a vital step to build up a future of creative-green enterprises.

## **ACKNOWLEDGEMENT**

This research is supported by Aston Business School and Alban, the European Union Programme of High Level Scholarships for Latin America, under the scholarship N° E06D103633BR. The authors are grateful to both institutions for their support.

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