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BUILDING A COMPETITIVE ADVANTAGE THROUGH SUSTAINABLE OPERATIONS STRATEGY

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ABSTRACT

This paper addresses an important gap in sustainability and technology management studies: the strategies for sustainable operations. Based on analysis of cases from automotive, textile, chemical, and food processing industries, the authors discuss the responses companies take to environmental and social pressures when aiming at increasing profitability. Our findings show that adaptations of traditional operations strategy frameworks can be useful when developing and assessing sustainability strategy for operations. Lastly, we also offer definitions for 'sustainable operations strategy' and 'sustainable technology' as those are not yet established in the literature. We consider the contribution of this article to be linked to the development and evaluation of sustainable operations strategies, which will invariably include the choice and use of technologies.

Keywords: sustainable operations strategy, manufacturing, choice of sustainable technologies

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Introduction

This paper discusses the theory and practice of sustainable operations strategy and its impact on sustaining a competitive advantage. It includes the development of new theoretical frameworks and assessment of sustainable operations strategic initiatives in manufacturing organisations.

Hayes and Wheelwright (1984) define operations strategy as consisting of a sequence of decisions that, over time, enables a business unit to achieve a desired manufacturing structure, infrastructure, and set of specific capabilities. Given the technological progress and the new demands of the 21st century, operations strategy has also to contribute towards a better sustainability performance. In fact, some authors have noticed the increasing awareness about environmental issues in the research agenda of manufacturing strategy, which needs to be aligned now in the context of green manufacturing (Frosch and Gallopoulos, 1989; Dangayach and Deshmukh, 2001; Azzone and Noci, 1998). Notwithstanding with these trends, the literature on sustainable operations strategy has not agreed on a unifying framework yet.

While companies are being pushed to enhance their sustainability performance (Gupta, 1995; Sarkis, 1995; Gupta and Sharma, 1996; Beamon, 1999; Van Hoek, 2002; Stonebraker et al, 2009), very little has been debated in the strategic role of sustainable technologies for operations. Green operations practices have indeed been identified (Gupta, 1995; Shrivastava, 1995; Sarkis, 1998; Angell and Klassen, 1999; Kleindorfer et al, 2005; Nunes and Bennett, 2010) but given the complexity and barriers for adoptions, it is still difficult to determine what to do first. For the social dimension, Porter and Kramer (2006) have shown corporate social responsibility initiatives were mostly generic (rather than strategic). These both issues are likely to be a direct consequence of the lack of a framework that translates the theory of sustainable operations strategy into practice. In this paper, we consider this gap in the literature to be very important and therefore it has become the focus of our research.

Our research included qualitative analysis of data from case study investigations undertaken in USA, UK, Thailand, and Germany in four industrial sectors. We have found that sustainable operations strategic decisions are embedded in complexity and uncertainty given their particular need of meeting multiple objectives from various drivers (legislation, internal policy and customer requirements, competition, image, etc). In order to facilitate the decision making process, our research has found that companies can assess competitors' actions and the strategic fit of their current and future initiatives in order to choose and implement sustainable technologies strategically.

Sustainable Operations Srategy

During the 1990s, when the scope of sustainability decisions in operations management (OM) was confined to manufacturing processes, studies showed that environmental decisions for pollution prevention technologies were superior and better aligned with business goals than pollution control technologies (Klassen and Whybark, 1999; Sarkis, 1995; Shirivastava, 1995; Beamon, 1999). Nevertheless, we need to advance knowledge on how better strategies can be made within the operations function beyond the pollution prevention versus pollution control dichotomy – a daunting task given the recently added complexities and the economic, social and natural environments in which companies operate. In theory, little has been done in the conceptualisation of sustainable operations strategy. With regard to the drivers for sustainable operations, they do not differ much from those for greening businesses generally. Hall (2000) has summarised the literature concerning the main environmental drivers. These drivers are largely the same as those identified in corporate sustainability studies (Epstein and Roy, 2001; Hoffman, 2000).

Sustainable Operations Strategy stretches the scope of sustainability analysis beyond manufacturing, increasing its complexity and uncertainty, resulting in the need for a theoretical framework that helps companies in making sustainability decisions. In fact, other business trends (e.g. market globalisation and outsourcing) bring further difficulties to evaluate/manage business sustainability performance (Hill, 2007). Regardless, within sustainable operations practices Presley, Meade, and Sarkis (2007) notice that most models support sustainability decisions at a broader dimension e.g. regional policy or industrial analysis. Thus, they present a Strategic Sustainability Justification Methodology (SSJM) comprising four phases: (1) identify system impact, (2) estimate impact, (3) perform decision analysis, (4) track operations. The authors test this in a reverse logistic outsourcing example including economic, social, and environmental dimensions.

Two main approaches have emerged from the literature on sustainable operations. The first is focused on the decision making processes. It aims to enhance sustainability performance by adding sustainability criteria on the strategic decisions in OM (Gupta, 1995; Sarkis, 1995; Gupta and Sharma, 1996; Beamon, 1999; Van Hoek, 2002; Stonebraker et al, 2009). The second is based on the adoption of (so-called) sustainable operations practices, which can be understood as the combination of green operations practices and corporate social responsibility initiatives. Various authors have tried to identify and classify the different sustainable and environmental operations practices (Gupta, 1995; Shrivastava, 1995; Sarkis, 1998; Angell and Klassen, 1999; Kleindorfer et al, 2005; Nunes and Bennett, 2010). From a compilation these studies, sustainable operations practices comprises 7 main initiatives that cover all areas of the operations function: (1) green buildings (facilities management); (2) eco-design (product and process development); (3) sustainable production (transformation processes); (4) sustainable supply chains (inbound and outbound logistics, and supplier relationships); (5) reverse logistics (backwards flow of materials and end-of-life products); (6) corporate social responsibility (internal and external communities); (7) innovation at business operations models (interface with other functions).

Sustainability issues have attracted considerable attention during the past ten years as part of the operations strategy agenda. Increasing environmental awareness in the research agenda of sustainable manufacturing strategy is aligned now in the context of green manufacturing operations (Dangayach and Deshmukh, 2001; Azzone and Noci, 1998). This is daunting for operations management given the large number of stakeholders and important trade-offs. Consequently, while questions of why a company should implement sustainable operations practices may have been addressed, other issues still remain e.g.: how companies make environmental decisions; how to select between methodologies to optimise strategic investments; or, how to implement sustainability initiatives, what sustainable technology to choose, and when to implement them.

These are definitely not simple questions. For instance, sustainable supply chain initiatives are hard to handle due to cost increase and the lack of certainty in reducing environmental impacts. This all makes the decision-making process more difficult for sustainable supply chains. Linton, Klassen and Jayaraman (2007) explain the challenges and complexity:

> "Supply chains must be explicitly extended to include by-products of the supply chain, to consider the entire lifecycle of the product, and to optimize the product not only from a current cost standpoint but also a total cost standpoint"

A movement towards sustainable supply chains becomes an issue of strategic decision making as found by Sarkis (2003). As businesses consider the importance of managing their own and their suppliers' intangibles, sustainability issues may develop into a more valuable business asset. Following this trend, sustainability and green operations management has gained special attention and, due to the complexity of issues and the range of possible resolutions, a systemic approach seems necessary to analyse how decisions impact on environmental aspects and the business/operations strategy. In fact, previous authors have already claimed the need for a systems view of environmental issues (Corbett and Klassen, 2006; Klassen, 2001; Graedel and Allenby, 1995, Kleindorfer et al, 2005; Orsato, 2006) and, as early as 1972, Bertalanffy stated the need for systems approaches.

In conjunction with globalisation and outsourcing trends, Child and Tsai (2004) explain that companies face different institutional constraints across countries that could affect their strategy environmentally. Van Hoek (2002) adds the importance of market willingness to pay for the green product and other market issues (e.g. barriers to imitation), and by adding new criteria to assess greening alternatives we increase the decision complexity.

Among these issues, manufacturing organisations need to make decisions for sustainable operations. These decisions are likely to be influenced by established drivers (Hall, 2000; Epstein and Roy, 2001; Hoffman, 2000; Sarkis et al, 2010; Sarkis, 2010) and involve the allocation of resources in the seven sustainable operations practices mentioned above. Based on the presented literature, Figure 1 shows the main sustainability drivers and the sustainable operations practices. Still, one unexplored issue is 'how well' a company should be doing in the different areas of environmental performance. To answer this question, we propose to examine sustainable operations practices under the lenses of manufacturing strategy.

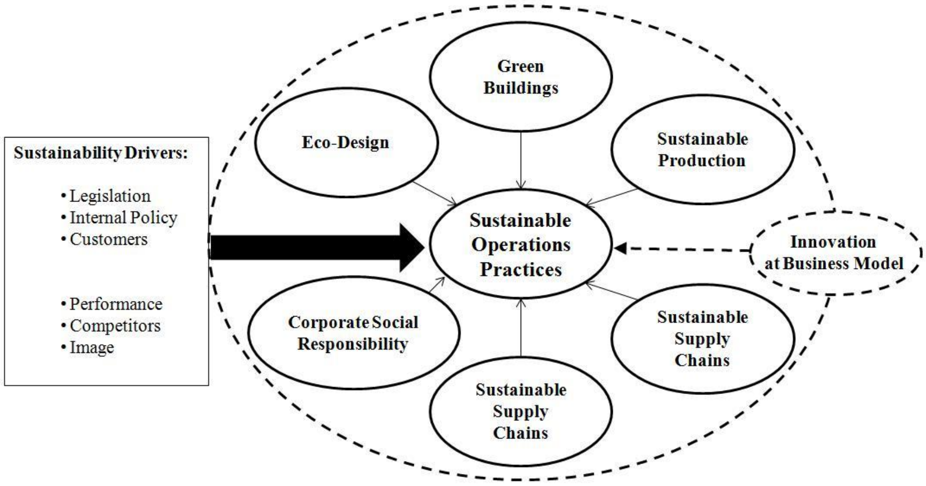

Figure 1 – Main sustainability drivers and sustainable operations practices.

Hayes and Wheelwright (1984) say manufacturing strategy is a deliberate plan to build capabilities and position the company better against competitors in the long term. Manufacturing capabilities are indeed an indispensible source of competitive advantage. Cheng and Bennett (2006) highlight the importance of an organisation's core capabilities such as corporate culture, managerial, operations and marketing that have a strong relationship with performance compared to ownership or restructuring. Their study in China recommends that enhancing organisations' core capabilities will lead to improvement in competitive advantage, sustainable resources and ultimately manufacturing performance. Cheng and Bennett's (2006) study highlighted how the case firms developed unique capabilities in human resources, corporate culture, management, and brand, which are difficult to imitate, to be successful in their respective markets. This is particularly interesting from a technology management perspective giving the recent results of a research investigation done by Das and Nair (2010). They have found that both external links to suppliers and internal capabilities are important to the design, planning, and use of manufacturing technology. At higher levels of outsourcing though, there is a reduction on the development and use of manufacturing technology.

Under the trade-offs and view of performance objectives, Skinner (1996) introduced the "Manufacturing in Corporate Strategy" (MCS) theory which relates to 'designing manufacturing systems for purpose'. This approach indicates that manufacturers will focus on a task that leads to strategic advantage. MCS deals with the most important dilemma inherent in managing manufacturing organisations that includes the costly manufacturing system as well as risk in capital, size and location, workers' training, etc. To change these factors is time consuming; however, in order to produce outputs that satisfy the market, the manufacturing system needs to be abreast with the rapidly changing economics, competition, technologies and government policies (Skinner, 1996).

The recent work of Hill and Hill (2011) states that in the phases of manufacturing strategy development and implementation, identifying the solution is an easy task; however, defining the problem and implementing the solution are tasks of high-difficult level. For instance, the subjectivity embedded in identifying and classifying order-winners and qualifiers (Hill, 1993) is one of high complexity in the current times of hyper competition. According to Lowson (2002), the internal and external contexts will make an operations strategy to reflect two main components demand trends (pull) and competitive concerns (push). In fact, a new criterion can emerge as new market requirements, which companies will need to understand the level of commitment and role it will play in the manufacturing strategy. For example, some authors have noticed the increasing awareness about environmental issues in the research agenda of manufacturing strategy, which needs to be aligned now in the context of green manufacturing (Dangayach and Deshmukh, 2001; Azzone and Noci, 1998).

Manufacturing strategy has also now the need to consider globalisation and the consequent dispersed manufacturing networks. When globalising operations, there is a natural increase in the difficulties and complexity associated with defining production capacity, technology choice, logistics routes, and risk assessment (Dornier et al, 1998; Hayes et al, 2004). Through case research, Miltenburg (2009) examine the use of six manufacturing objects within seven generic international manufacturing strategies in order to help companies to develop their international manufacturing network strategies.

The contrast between theory and practice is one to be noticed in the manufacturing strategy, which is not particularly a new one. Platts (1993) and Platts et al (1998) recommends testing feasibility, utility and usability of models in order to minimise the distance between theoretical and practical results on manufacturing strategy development and implementation. Platts (1993) provides definition to the concepts of feasibility, utility, and usability. According to the author, feasibility is understood as the ability of the model to be implemented in its whole. Utility refers to its capacity in delivering what it was designed to do, while, usability is measured by the easiness of future utilisation without a model expert facilitation. Commonly missed in theoretical models, Hill (1993) recommends Drucker's concept when designing strategies for manufacturing. Peter Drucker noted that "cost accounting gives you information on the cost of doing, but not on the cost of not doing - which is increasingly the bigger cost" (Hill, 1993). Barnes (2002), for example, cites the inappropriateness of manufacturing strategy theories with regard to manufacturing strategy process (especially to small and medium enterprises). For Barnes (2002), manufacturing strategy studies lack a critical empirical investigation that includes internal and external contextual factors and influences embedded in the manufacturing strategy process. This view is also shared by Boyer, Swink & Rosenzweig (2005). Corbett (2008) tried to fill up this gap conducting a 10-year longitudinal study with 10 manufacturing firms in New Zealand from 1990 to 2000. Corbett (2008) found that companies don't pursue a stable manufacturing strategy configuration over time, and most of them have been moving towards price-based configuration. As a result, companies more were more vulnerable to Asian low-cost competition and exchange rates fluctuations. The most successful companies in the sample had put greater investment in infrastructural activities and assets.

Despite the criticism on the theory of operations strategy, a number of frameworks were validated and can useful when developing, implementing, and assessing strategies for manufacturing, including sustainable manufacturing strategy. Table 1 provides an overview of the main operations strategy frameworks that exist in the literature up to this date.

Table 1 – Main Operations Strategy Frameworks

Framework	Contribution	Authors
Performance objectives	Operations Performance can be assessed against five main objectives: cost, speed, quality, dependability, and flexibility	Slack et al 2007
Operations Strategy Perspectives	There are four perspectives that should be analysed when formulating an Operations Strategy: Top-down; bottom-up; market-led; and operations-led	Slack and Lewis, 2008
Order-winning and order-qualifying criteria	Companies must identify trade-offs and performance thresholds for them to compete in the market	Hill, 1993
The contribution of Operations to Strategy	This framework suggests an analysis to check whether the operations function creates internal or external value to the overall strategy of companies – also based on the manufacturing consistence, e.g. purpose versus process choices (structural and infra-structural)	Hayes and Wheelwright (1984) [expanded from Skinner (1996)]
Sandcone Model	Companies should follow an ideal sequence in order to build their operations competences. It starts from quality, then dependability, flexibility, and finally cost.	Ferdows and Meyer, 1990
The Importance-Performance framework	This framework suggests a benchmarking process against main competitors based on criteria that have their importance assessed by customers	Slack, 1994

The literature review for this paper has seen a gap on the application of these frameworks (except Hayes and Wheelwright's 'the contribution of operations to strategy' already used in previous studies) for sustainable operations strategy. Here we have opted to use Slack's importance-performance framework for its dynamic approach when benchmarking companies' technology adoption.

Methodology

The data on which this paper is based were obtained between 2006-2011. The research methodology was primarily qualitative case studies, which was appropriate because of the dynamic nature of the research problem related to the company's context (Yin, 2003; Bryman, 2008; Eisenhardt, 1989),. For instance, sustainability pressures change according to factors such as industry sector and location. To control research variables, the unit of analysis was the companies' decision making teams and we explored different industries (automotive, textiles, food processing, and chemicals) across developed/developing countries. The diverse sample led to understanding across different sectors and locations (see Tables 2 and 3). Participants included those who contributed through individual interviews, focus groups or semi-structured questionnaires. Interviews and focus groups were audio recorded and extensive notes were made. Data were also collected from analysing sustainability reports and participant observation of operations in the case organisations. The flexible research design collected data from individuals and decision making teams totalling 20 interviewees and around 30 hours of interviews and focus groups. Table 2 lists the cases in the automotive sector, and Table 3 shows those in other sectors. The companies have been given fictitious names to preserve anonymity.

Table 2 – Summary of automotive case study companies

Companies (Brand nationality)	**Industrial sector (Plant location)**	**Area of research**	**Research methods**	**Number of participants (job position)**
AG Auto Group of Deutschland (German)	Car Manufacturer (USA)	Operations function	Personal interviews & Sustainability reports Participant observation	3 managers (environmental, communications, and energy)
GP German Premium Cars (German)	Car manufacturer (Germany)	Product development	Focus group Participant observation	6 Engineers / Product development team
W Waltham Luxury Cars (British)	Car manufacturer (UK)	Manufacturing	Personal interviews & Environmental reports Participant observation	1 Environmental Manager
BL Birmingham Luxury Cars (British)	Car manufacturer (UK)	Operations and Product Development	Personal interviews & Environmental reports Participant observation	1 Production engineer 1 Sustainable mobility team member
JM Japan Motor Corporation (Japanese)	Car manufacturer (Thailand)	Manufacturing / Supply chain	Personal interviews & Sustainability reports Participant observation	1 Environmental Manager and 1 Assistant
Total number of participants				**14**

Table 3 - Summary of non-automotive case study companies

Cases (Brand nationality)	Industrial sector (Plant location)	Area of research	Research methods	Number of participants (job position)
TK Thailand King's Sea food (Thai)	Food processing (Thailand)	Manufacturing / Supply chain	Personal interviews Environmental reports Participant observation	1 Managing Director's Assistant
TG Thai Garments (Thai)	Garment manufacturing (Thailand)	Manufacturing / Supply chain	Personal interviews Participant observation	1 CEO
CC Chemical Company of Thailand (Thai)	Chemical processing (Thailand)	Manufacturing / Supply chain	Focus group Environmental reports Participant observation	2 Top administrators 1 Plant manager
UC UK Premium Carpets (British)	Carpet producer (UK)	Manufacturing / Supply chain	Personal interviews Participant observation	1 Environmental manager
Total number of participants				**6**

Data Analysis Procedures

Qualitative data analysis techniques were applied to notes taken during the interviews, focus groups and observations (Miles and Huberman, 1994; Bazeley, 2007; Fielding, 2004; Ryan and Bernard, 2003). The data were thematically analysed from which case reports were written to crystallise the themes, particularly with reference to the research questions. These reports were validated and expanded upon by participants.

Using inductive and deductive reasoning in a multiple case research the results emerged from the data in a way that each case provided additional insights – building a comprehensive picture when combined. Each case had individual value as they covered different operations activities. Based on that we applied an adapted version of Slack's (1994) 'The Importance-Performance Matrix' framework to see how companies were strategically developing their choices. Below are our findings.

Findings & Discussion

Figure 2 shows the results of our analysis. It represents the paths and choices companies made when adopting sustainable technologies for operations. The strategic importance for business sustainability is a convergence of various factors that alone or combined can increase the pressure to adopt sustainable operations technologies.

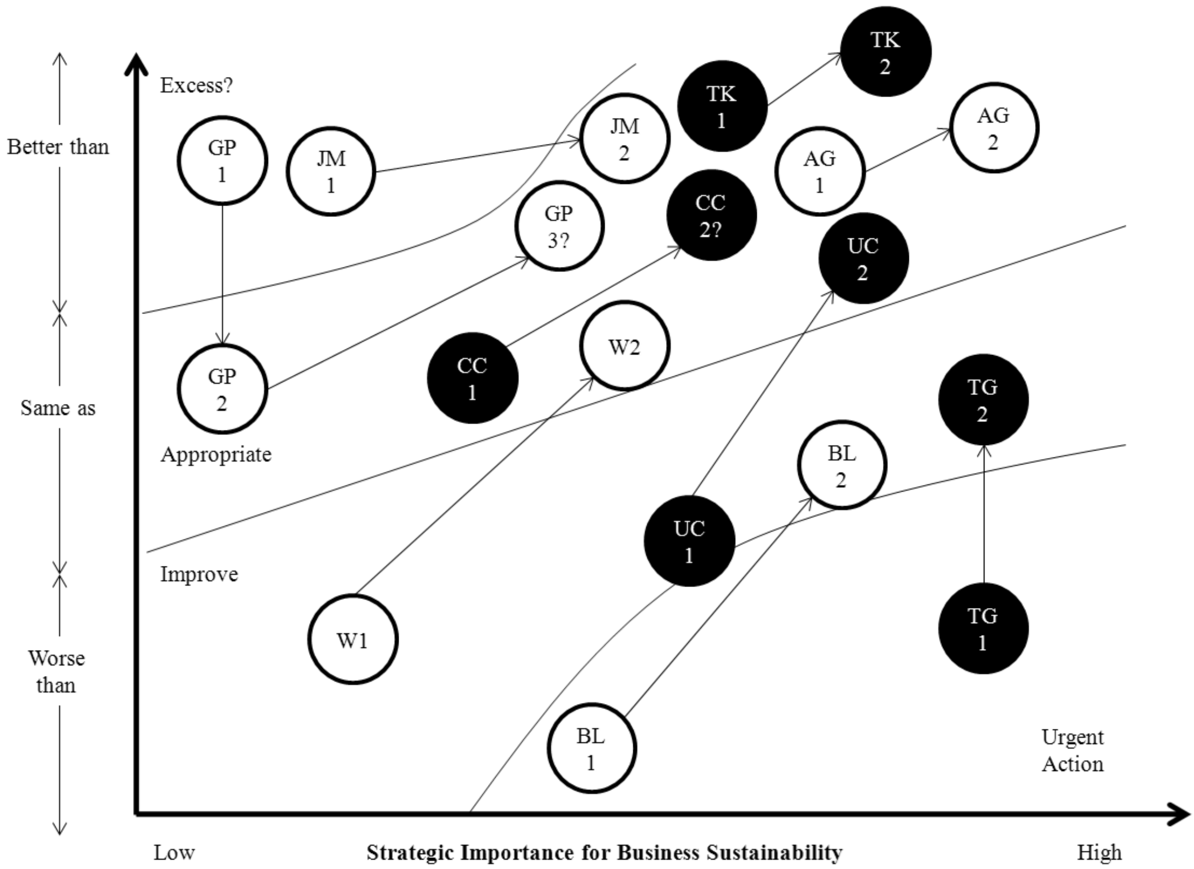

Figure 2 – Analysis of behaviour of companies for sustainability strategy

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Table 4 – Factors and their strategic importance for business sustainability

Low	Strategic Importance for Business Sustainability	High
Lenient	Legislation	Strict
Low	Reputational Risk & Corporate Image	High
Abundant	Resource Availability	Scarce
Unimportant	Corporate Values & Internal Policy	Important
Low EI	Environmental Impact (EI)	High EI
Low bargain power	Customers	High bargain power

What table 4 explains is that when legislation is strict, it is likely that it will be perceived as of high-importance for business sustainability. Corporate image and values have a direct influence and correlation with their strategic importance. On the other hand, companies will tend to give low importance for resources that are abundant, and high importance for scarce ones. As expected the higher the environmental impact, the higher the importance it will get in the business agenda. Customers will be seen as an important drivers for action if they have high bargain power; otherwise, they will tend to be rated low in the strategic importance for business sustainability. Next we discuss Figure 1 and each company's decisions.

Within the automotive companies, there is a clear behaviour of acting given the increasing importance of sustainability over time. JM and AG are particularly interesting because they are closer to the concept of environmental leadership (as defined by Hart, 1995). They have chosen to operate in higher performance than most competitors before the legislation got stricter avoiding high risk for their reputation (JM1 > JM2; AG1 > AG2). These were more process-based technologies; however, they have also starting to implement product-driven initiatives. In a different strategy, GP had launched a greener car than its competitor; but it was perceived as 'ahead of its time'. Then, the company retreated from the plans of leading in product environmental performance (GP1 > GP2). It is in debate now, when and where to position future models when the importance of product sustainability increases.

Waltham and Birmingham Luxury cars were companies that were below expected standards when they first started thinking of making environmental decisions. With change of ownership, Waltham was pushed to improve and join the new automotive group benchmarks in its manufacturing operations. Birmingham Luxury cars were actually requiring urgent action when environmental decisions took place. The company realised it does not pay to lead in environmental performance; but it has realised that it need to bring its performance to an appropriate level to avoid reputational risk.

Within non-automotive sector, we have also found companies in different stages of their environmental strategy. Thai Garments still adopts a reactive strategy. It prefers to wait for urgent action and delay investments as they still do not perceive green investments paying off. UK Carpets, however; have chosen to have a rapid upsurge in environmental performance. Despite operating in a developed country, its standards were too low compared to competitors. It was only when commercial customers requested that they took action – a similar path noticed by Green et al (2000). Nevertheless, they have taken action at strategy level. Thus, their intentions is to bring environmental performance above competitors and start acting with green technologies before they even gain importance (e.g. green buildings construction methods). The chemical company in the sample has been keeping itself within the appropriate boundaries of environmental performance. The main reason for that is because the industry is too regulated which makes most competitors to operate similarly when it comes to environmental standards. Finally, Tep Kinsho has responded to Japanese customers also in a strategic way. Despite being superior than most of its competitors, the case company predicts that the rules of international commerce will be stricter so they intend to continue improving as business sustainability gets more important.

Conclusions

From a theoretical perspective, it is interesting to see that we do not have an established concept for Sustainable Operations Strategy yet. Based on our review of the literature and empirical research, we can offer a definition:

"A sustainable operations strategy is a deliberate plan, primarily focused at the long term, aiming to respond to environmental and social pressures on production systems when creating socio-economic value. It is intended to position the company better against competitors under the view of sustainable development by considering the availability of resources, its impact on the environment, and social ethics for both products and transformation processes."

Sustainable technologies are also hardly conceptualised in the literature despite the long existence of several definitions for technology. Literally translated from the Greek as the 'Study of art, skill, or craf', the most widely used definition is perhaps is the one suggested by Bains (1937):

> "technology includes all tools, machines, utensils, weapons, instruments, housing, clothing, communicating and transporting devices and the skills by which we produce and use them"

One searching for technology definition in modern encyclopaedia (e.g. http://www.britannica.com) will find:

> "technology is the application of scientific knowledge to the practical aims of human life or, as it is sometimes phrased, to the change and manipulation of the human environment"

Thus, we define sustainable technologies as the means to achieve corporate and societal sustainability goals within the ecological boundaries our economy operates in. Sustainable technology is then 'the application of knowledge to reduce negative environmental impacts from economic activities or to enhance the conservation of ecological resources, and maintenance of the equilibrium between human beings, other species, and natural world'.

Due to the lack of theoretical background it is not surprisingly that on the side of practitioners, most of the case study companies did not have a formal structure to develop their sustainable operations strategy. Hence, sustainability decisions follow a path that is similar to other corporate decisions. Our paper contributes to the literature of sustainable technologies and operations strategy by providing a better understanding of how sustainability decisions need to be assessed against multiple objectives that need a strategic fit beyond the obvious accomplishment of legislation targets.

In our view, adapting the importance-performance framework is a valid approach that can help companies in developing, implementing, and assessing sustainable operations strategies. From a theoretical perspective, it also provides additional insights in understanding companies strategic behaviour beyond the usual 'reactive versus proactive' paradigm.

Finally, as sustainability issues gain importance in the strategic agenda of countries and companies, the traditional methods to assess business performance will change. A robust assessment of green and social technologies will be necessary to position firms better against their competitors under the coming sustainability performance indices.

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