Gaining understanding of the use of sustainability KPIs in practice

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Abstract

It is uncertain whether the use of sustainability KPIs leads to performance improvement. Surveys followed by interviews with practitioners were used to investigate sustainability KPIs in manufacturing. It was found that:

- Surveyed companies are not sure whether sustainability KPIs are leading to performance improvement. Choosing appropriate boundaries and metrics will greatly influence activities and improvement.
- It is difficult to make trade-offs between social, economic and environmental metrics, because all are important. In certain situations we may need to consider one metric more than others. Social metrics may be difficult to measure, but are of increasing interest to government and industry.
- Measurement and control of impacts outside of direct scope are of concern. Some companies in our initial survey consider themselves either too small (insufficient bargaining power) or too large (too many suppliers or customers, complexity) to manage this effectively.
- Leaders are looking beyond the metrics they have used in the past but require support from outside of industry. For instance, companies may want to move from the ethos "zero waste to landfill" to "resource efficiency", but do not know how to measure and compare these different approaches. Start-ups or "sustainability followers" may want to begin by using the best measurement available.
- There are opportunities in both internal and external sustainability reporting. Companies may not always measure what is needed, or make use of their own metrics to improve external communications.
- Learning within the company between different sites is important but may be difficult because of differences in energy management systems, geographical areas, age of equipment, personnel expertise and other factors. Also, the politics of inter-site competition may be a barrier.
- Future research requires a deeper understanding of the design of sustainability KPIs and the performance management systems needed to deliver improvement.

Background

Sustainability is an area of increasing interest for industry and its stakeholders. Globally, governments and organisations are beginning to address these issues through policy discussions and implementations. Non-Governmental Organizations (NGOs) continue to raise awareness of the negative consequences of industrial activity for the environment and society and hence for future generations, on the other. Mindful of the impact they can have, and the demand from various stakeholders, some companies now aspire to address the issues of sustainability at strategic and operational levels.

As companies are exploring the issues, they attempt to embed sustainability in their planning and management systems. It is at this point that the domains of sustainability and performance management meet. This research aims to gain an understanding of the nature of sustainability key performance

indicators (KPIs); how they are applied in practice and to what extent they differ from standard KPIs. Are the challenges different to the problems associated with standard KPIs and the performance management systems in which they sit? The main research question investigated in this paper is: *What are the challenges of using sustainability KPIs in practice?*

WHAT IS MEASURED GETS DONE?

It is often assumed that what gets measured, gets done. Quoting Lord Kelvin (1889-91; as quoted in Kuhn, 1961): "*When you cannot express it in numbers, your knowledge is of a meager and unsatisfactory kind*." The traditional basis for measurement is indeed control oriented and based on the vision that what gets measured and is made visible gets done, but there has been a major shift in the focus of performance measurement from controlling towards improving organisational performance. Neely (1998, p. 71) identified the following four generic reasons for measurement: to check position (similar to Lord Kelvin's views), to communicate a position, to confirm priorities and compel progress. According to Lynch and Cross (1995, p.1) the rationale for performance measurement is to stimulate behaviour, which leads to continuous improvement in customer satisfaction, productivity and flexibility. Ultimately, improvement is the aspired outcome of performance measurement in organisations.

Performance measures and Key Performance Indicators (KPIs) are often used as synonyms, but KPIs may be viewed as those measures that provide managers with the most important performance information to help them and their stakeholders understand organisational performance (Marr, 2012). KPIs should link to the strategic objectives of the organisation and therefore help monitor the execution of the business strategy. As Walsh (1996) describes: "*organisations strive to improve what they do and how they do it. The results of their efforts are measured through Key Performance Indicators*". According to Walsh (1996) KPIs consist of key performance outcomes (KPOs) and Key Performance Drivers (KPDs, the business processes to achieve the outcomes). Clearly, preferred outcomes need to be linked to the processes required to achieve these outcomes and the incentives to encourage desired outcomes to be achieved. The system put in place to link measures, businesses process and actions and aspired outcomes, is also referred to as a performance management system.

Metrics are important, but the performance management system itself is of great importance to achieve the desired effect. Table 1 shows the distinction between measurement and management. This indicates that merely having measures is insufficient and performance management (e.g. employee involvement, incentives) is required to ensure measures are acted upon.

Establishing a performance management system is not a straightforward process. For example, Fitzgerald and Moon (1996, p. v) argue there is broad consensus that some form of performance management system needs to be implemented as an essential part of organisational control, but there is no exact method to develop such a system. The definition of what constitutes a performance management system is not straightforward:

> *At one level it is simply a set of metrics used to quantify the efficiency and effectiveness of past actions. [This] ignores the fact that a performance measurement system encompasses a supporting infrastructure. (…) A more complete definition is that a performance management system enables informed decisions to be made and actions to be taken because it quantifies the efficiency and effectiveness of past actions through the acquisition, collation, sorting, analysis, interpretation, and dissemination of appropriate data.* (Neely 1998, p. 4–5)

There is no clear definition of a performance management system, but there are some basic elements. Fitzgerald and Moon (1996, p. v) refer to the following considerations to develop performance management systems (developed by Prof. David Otley): the dimensions of performance an organisation seeks to encourage; appropriate standards set for these measures; rewards given for achieving these. This suggests that a vision needs to be formed of the desired performance; this desired performance needs to be made concrete, and incentives need to be put in place throughout the organisation to achieve performance. Fitzgerald and Moon (1996, p1) list five characteristics of performance management systems: performance management systems are driven by corporate strategy, financial and non-financial metrics are adopted; comparative measures are implemented (to benchmark performance); results are reported regularly to promote knowledge and action; and the system needs to be driven by top or senior management. Similarly, Maskell (1991, p. 19) lists the following characteristics of performance management systems: these must be directly related to the manufacturing strategy; primarily use non-financial measures; vary between locations; change over time; be simple and easy to understand; provide fast feedback to operators and managers; and be improvement rather than solely monitoring focused. Moreover, having predictive performance measures is important (Neely et al., 1995). Walsh (1996) created a "KPI checklist" which highlights some of the requirements for performance management systems: KPIs need to be aligned with corporate strategy, be traceable to business processes, there should not too be few (sufficient coverage is required) or too many KPIs (measurement costs time and resources), KPIs should encourage "win-win" situations (benefits to all departments), and be relevant to all people. Marr (2010) documented

Table 1. The difference between measurement and management. Adapted from Lebas (1995).

Performance measurement	Performance management
Measures based on Key Performance Indicators	Training
Measures to detect deviations	Team work
Measures to track past achievements	Shared vision
Measures to describe status (potential)	Management style
Measures of output	Employee involvement, Dialogue
Measures of input	Incentives, rewards

how to design KPIs and found similar requirements. The link to strategy is important, the person who uses the information and their requirements should be known, each KPI should have an owner, data collection methods need to be developed, reporting guidelines and responsibilities should be assigned and cost-and benefits of reporting should be defined, and unintended consequences should be anticipated, amongst others (Marr, 2010).

From the above, it can be concluded that the link to strategy, employee engagement and responsibility, clear measures, regular monitoring, incentives to drive action and improvement, and incorporation of non-financial metrics are important elements of performance management systems.

SUSTAINABILITY MEASUREMENT

The sustainability movement has its roots in sustainable development. The notion of sustainable development was first coined in the report "Our common future", produced by the World Commission on Environment and Development (WCED, 1987). The WCED (1987) describes the process of economic development as essential for raising the quality of life of those around the planet but highlights the deleterious consequences of industrial activity on global and local eco-systems. Sustainable development is termed as "development that meets the needs of the present without compromising future generations ability to meet their own needs" (WCED, 1987, p. 43). The WCED (1987) document is framed at a national and geopolitical level and focuses on equity (intergenerational and global) and needs, in particular the needs of the poorest in the world. In developed markets, where basic needs are widely met, this notion can be a difficult concept to translate into business terms and therefore address as part of strategy and operations. There have however been several attempts to reframe 'sustainability' to make it more relevant to business.

The term *triple bottom-line* coined by Elkington (1997) uses "business language" to explain sustainability and includes economic, environmental and social bottom lines. Similarly, Jackson et al. (2011) refer to the following sustainability dimensions: *profit* (financial performance, flow of capital, and a company's economic involvement in society), *people* (a company's impact on its employees and the social system within its community) and *planet* (effects on they local, national, and international resources). Krajnc and Glavič (2005) defined a composite sustainability index, which consists of *economic* (corporate impacts on economic well-being of its stakeholders and local, national and global economic systems), *social* (attitude of the company to the treatment of its employees, suppliers, customers, and impact on society at large), and *environmental* (impacts of the company on living and non-living natural systems) dimensions. According to Elkington (1997) the three bottom lines are constantly changing to social, political, economic and environmental pressures, so the sustainability challenge is tougher than each individual bottom line in isolation. Moreover, Elkington (1997, p. 91) argues the triple bottom line itself could raise a number of ethical issues: How should economic, social and environmental priorities be assessed and traded off?

Over a decade after the concept of the triple bottom line was coined, a diverse range of companies have begun to address sustainability. In some cases these companies report on their progress externally, often in the form of company reports but there are various forms of triple bottom line disclosure. Elkington (1997, p. 165 based on joint project with SustainAbility, Deloitte & Touche and IISD) describes the following forms of triple bottom line disclosure: involuntary (e.g. accidents, campaigns); mandatory (e.g. annual reports and accounts) and voluntary (e.g. sustainability supplements to annual reports) reporting. In general, these documents tend to report on outcomes, and say little about the internal processes and devices for delivering improved sustainability performance within the organisation or the wider supply or value chain.

NON-FINANCIAL MEASURES AND USER INVOLVEMENT IN PERFORMANCE MANAGEMENT

Tackling sustainability at a company level, appears to present a novel challenge. Organisations are charged with acting upon more factors than the dominant model of firm management had previously demanded. What are the implications for performance management in organisations? Two elements of effective performance management systems – the need for incorporating non-financial metrics and the involvement of users of the system – will be highlighted because they are of special interest for sustainability performance improvement.

Effective performance management systems link financial *and* non-financial performance measures in an organisation. The most well known framework for performance management is Kaplan and Norton's (1992) "balanced scorecard", which allows managers to look at the business from four key perspectives (the financial, customer, internal business and innovation and learning perspective). The authors demonstrate that business measures are linked (e.g. satisfying customer goals affects financial goals). Fitzgerald et al. (1991) also effectively link different dimensions of business performance, and distinguish between performance measures that relate to results (e.g. financial performance) and those that determine the results (quality, flexibility). A third example is Lynch and Cross' (1995) pyramid of measures that integrates performance through the hierarchy of the organisation.

To make the link with sustainability specifically: good environmental performance (e.g. corporate carbon emissions reductions) and societal contributions (e.g. community outreach) may affect financial performance directly (e.g. carbon emissions reductions may save cost) or indirectly through an improved image. For example, Carbon Trust (2011) interviewed 200 leaders in large companies and found that their main expected benefits of green business development included "enhanced green reputation" (75 %), whereas 40 % quoted "increased revenues" and 30 % "increased profits". By adding sustainability KPIs, companies appear to hope to boost some of their more conventional KPIs (revenue, profit) and satisfy stakeholders. Including financial performance measures and non-financial measures (e.g. social and environmental) and identifying the levers between them is recommended in the performance management literature (e.g. Maskell, 1991; Kaplan and Norton, 1992) and may be of particular interest to drive sustainability projects and improvements forward.

The successful implementation of performance management systems depends on involvement of users of the system (in effect everyone in the organisation). For instance,

the main barriers to performance management system implementation mentioned by Bourne et al. (2000) include: the resistance to measurement during performance management system design and use phases; computer systems issues during implementation; and top management commitment distraction between design and implementation. According to Clarke (1994) a major source of failure in change programmes is the lack of communication – managers need to "overdose" communication, and as bottom-up change is essential early involvement and genuine consultation are essential. It is also important to involve internal users and stakeholders as suggested by Clarke (1994) – awareness of stakeholder needs is part of being an effective organisation. Walsh (1996) argues that KPIs need to be relevant for all people in the organisation, and each job level should be able to contribute ideas towards what should be measured, as what works at management level does apply to the factory floor. Toor and Ogunlana (2010) investigated stakeholder perceptions of KPIs in the public sector and found that the "iron triangle" of cost/price, time, and specifications (or quality) does not longer apply but other performance indicators such as safety, efficient resource use, effectiveness, stakeholder satisfaction, and reduced conflicts are increasingly important. Although there are technical challenges (e.g. the implementation of IT systems) stakeholder engagement and involvement are increasingly important for the development of effective performance management systems.

When considering the triple bottom line of sustainability in performance management, the group of "interested and involved" people expands outside company boundaries, which adds to the challenge. In effect, in the case of environmental and social issues, it may not be the CEO of a company who determines whether performance was up to par, but governments, NGOs, communities and customers affected, who decide to purchase a company's products or not. Stakeholder involvement and consultation are therefore important for performance management, which deals with sustainability issues.

SUSTAINABILITY PERFORMANCE MANAGEMENT

There is still debate on the exact definitions and measures of sustainability. Jackson et al. (2011) argued that in the literature there is no real consensus as to the exact dimensions used to measure sustainability performance, but there is broad agreement that it considers the impact of companies on society as a whole. If conventional performance management (e.g. quality, profitability) were difficult, sustainability reporting (including three dimensions – people, planet, and profit; Jackson et al., 2011) and performance management – would imply even bigger challenges as the "rules" of reporting are less clear-cut than mandatory financial reporting. A report from the environmental consultancy Trucost, published by the UK government Department for the Environment, Food and Rural Affairs (DEFRA, 2006), includes some of these challenges in corporate sustainability reporting: reports lack quantification, depth or rigour, and most businesses will have supply chain impacts they should understand and consider reporting. However, there is no single, quantifiable measure companies can use as a KPI for supply chain impacts (DEFRA, 2006, based on a research by The Environment Agency, 2004). According to Jackson et al. (2011) several arguments are made against triple bottom line reporting, perhaps because of the fear of the unknown, the feeling that in the end nothing will change or nothing stays the same so attempting to exert control is folly; time commitments, divergent expectations, implementation risks, and worries that corporate actions might not support intentions (e.g. although a company reduces its carbon footprint per product they may simultaneously aim to sell more which increases their overall footprint).

Table 2 draws an analogy between "conventional" economic performance management and sustainability measurement, based on 10 "tests" of effectiveness of measures developed by Neely et al. (2002). Although financial reporting is clearly laid out in financial reporting requirements, social and environmental reporting is not. Sustainability reporting is still largely voluntary and is open for interpretation, which is the source for the challenge of sustainability performance improvement.

The literature on sustainability measurement is substantial, although there is a lack of understanding of how sustainability can be integrated in practice and performance management of firms in particular. Some of the prevalent topics include the definition, identification and measurement of sustainability indicators. For example Arena et al. (2009) provide an extensive review of industrial sustainability definitions and include examples for each dimension, summarised in Table 3. It is beyond the scope of this study to include all sustainability metrics but some examples of studies are give which have sought to make a starting point: Székely and Knirsch (2005) listed a range of sustainability metrics based on corporate sustainability reports and Marshall and Brown (2003) investigated the use of environmental metrics in corporate reporting in particular. Lamberton (2005) performed a historical analysis of sustainability accounting and finds that, to add rigour to reporting, the objective of the reporting model; the principles underpinning use; data capture; reporting frameworks; and the qualitative attributes of the information produced, are critical issues which need to be addressed during the developmental phase need to be clear. To measure organisational performance, Hubbard (2001) suggests a sustainability scorecard, including financial, customer, internal process learning and development, environmental and social performance. Hubbard (2001) recognises the challenges of selecting indicators (to capture the essence of performance), collecting (e.g. data availability) and measuring and weighting indicators (e.g. quantitative or qualitative). Krajnc and Glavič (2005) developed an approach for sustainability measurement, which includes selecting, grouping, judging, weighting and normalizing, calculating and combining sub-indices. However, no evidence is provided on how these measures may lead to performance improvement in practice.

Despite the many literature contributions on defining sustainability, there is a lack of understanding of how sustainability may be embedded in corporate performance management systems. This paper seeks to contribute to the understanding of the use of sustainability KPIs in practice and the link to performance improvement. The methodology used to further explore this is described in the section below.

Table 2. Sustainability adds complexity to performance management. Note. The tests in the left column are taken from Neely et al. (2002), and the sustainability considerations are added by the authors.

Test	The added complexity of sustainability in performance measurement
1. The truth test: are we really measuring what we set out to measure?	Time and cost can be measured objectively in organisations but perceived quality is more difficult to objectively measure. Measuring environmental performance is challenging but social performance is even more challenging. For instance: Is the amount of donations to charity a good measure of corporate social responsibility?
2. The focus test: are we only measuring what we set out?	What is the ultimate focus of measuring environmental performance? If companies measure and reduce environmental impact of their manufacturing sites and products but intend to sell more, this will increase their total environmental impact.
3. The relevancy test: Is this the right measure of the performance factor we want to track?	Is the number of times customers filled out a consumer survey positively a relevant measure for customer satisfaction? Is waste reduction the ultimate measure, or do we need to develop a measure that focuses on rethinking product design?
4. The consistency test: will the data always be collected in the same way whoever measures it?	Generally accepted accounting principles specify how data need to be reported. Guidelines and standards exist for different types of sustainability reporting (e.g. ISO 14040 for Environmental management and Life Cycle Assessment) but these leave room for interpretation. How can there be consistency within and across company boundaries?
5. The access test: is it easy to locate the data needed for measurement?	There is consistency and clarity on the data that need to be reported yearly and these data are to be found in public annual reports. Companies can largely choose which sustainability data to report and there are complexities in obtaining data from suppliers.
6. The clarity test: is any ambiguity possible?	Investors generally know how to interpret financial data in annual reports, so whilst there is room for interpretation (e.g. forecasts) investors can cope with ambiguity. The definition of sustainability and its dimensions (the triple bottom line) leave much more room for interpretation and ambiguity than financial reporting, which will make interpretation even more complex.
7. The so-what test: can and will reported data be acted upon?	Use of the balanced scorecard (Kaplan and Norton, 1992) is an example of putting business performance measures into practice. Internal sustainability measures and supplier sustainability scorecards exist (e.g. Walmart, M&S) but what is the internal incentive scheme and management system to encourage performance improvement?
8. The timeliness test: can the data be accessed rapidly and frequently enough for action?	Financial markets run to quarterly and yearly reporting rhythms. Currently, there is no standard sustainability "accounting scheme". Until a similar scheme to generally accepted financial accounting rules emerges, companies will work with multiple systems and data collection and comparison may be cumbersome.
9. The cost test: is the measure worth the cost of collecting and processing?	Most economic measures reported annually are legal requirements, and these costs are budgeted for. Sustainability reporting is largely not mandatory and the cost of measuring (e.g. a full environmental Life Cycle Assessment) may not always be easy to justify
10. The gaming test: is the measure likely to encourage undesirable behaviours?	A pure cost focus may leave employees unmotivated and lead to unexpected cost (e.g. sick leave). Efficiency improvements in energy use at home may lead people to buy more products and services because they have more income left to spend (rebound effect; Grubb, 1990)

Methods to investigate sustainability KPI use

This work was conducted as part of the early activities of the EPSRC Centre for Innovative Manufacturing in Industrial Sustainability. The Centre is a collective of four universities and multiple partners from manufacturing, retail, employer organisations and unions as well as Quasi Autonomous Non-Government Organisations (QUANGOs) engaged in resource and carbon efficiency. The aim of the Centre is to address issues of industrial sustainability, delivering more value to a greater proportion of a growing population whilst significantly reducing green house gas emissions and halving resource use.

A dominant topic of member interest during one of the first meetings was that of KPIs or metrics and their link to performance improvement in sustainability. In response to this interest, a short study was commissioned to examine the current state of practice amongst the Centre's members and to help inform future research. The aim was to establish what works and what does not work and under which circumstances within the scope of sustainability metrics and their use. The results of this and subsequent follow up engagements forms the basis of the analysis presented in this paper.

Responding to the member interest a sustainability audit was developed, which consisted of a simple evaluation (Appendix A) supplemented with 5 questions. This was shared amongst the members to elicit their current practices in sustainability assessment. The following questionnaire text was used to support the simple audit:

1. Please list the sustainability metrics you measure (e.g. waste in factories; carbon emissions of products).
2. How do you do this? In other words: which sustainability measurements/evaluations do you typically use? (E.g. monthly factory reporting of total waste; full product LCA)
3. What is good and bad about your current measures? (e.g. effective; accurate; time-consuming; difficult to get data)

Table 3. Examples of sustainability dimensions. Based on indicators identified by Arena et al. (2009).

Economic	Environmental	Social
Economic performance (e.g. profitability) Market presence (e.g. market share per country) Indirect economic impacts (e.g. affluence)	Materials (e.g. % recycled) Energy (e.g. % renewable) Water (e.g. m^3 used, level of pollution) Bio-diversity (e.g. number of trees cut down and re-planted) Emissions (e.g. tonnes of CO_2 emitted by factories) Waste (e.g. waste to landfill/ waste diverted from landfill) Product and services (e.g. reusability, energy during product use) Compliance (e.g. environmental fines) Transport (e.g. mode of transport, distance from factory to retail)	Work practices and adequate working conditions (e.g. minimum wages, 5-day workweek) Diversity and equal opportunities (e.g. % of female employees, % female employees in management) Relations with the community (e.g. employment of local workers) Social policy compliance (e.g. training and development opportunities) Consumer health (e.g. number of incidents reported during product use, positive contributions to consumer health) Safety (e.g. number of accidents or deaths in factory operations) Human rights (e.g. no child labour, fair treatment of workers)

4. Which improvements would you want to see in the short and long-term?
5. How would you evaluate your performance? (*very* qualitative self-assessment – multiple answers are possible – e.g. factory X is best possible; factory Y is worst). Large companies may want to restrict themselves to a specific geographical area or product type.

Companies were asked to complete the self-evaluation in response to these questions and were given examples (drawn from the grey and academic literature) to stimulate their responses (Appendix A). Semi-structured interviews, based on the questions above were conducted with the UK-based QUANGOs, who have experience both in using metrics and observing practice. They were asked to draw on their own experience of metrics as well as the companies and organisations they interact with, to augment the findings from the survey. Follow up interviews were conducted with four of the surveyed members, to respond in more depth on the subject of the survey. A workshop to review results and engage with a leading exponent identified from the survey (large manufacturing organisation), a QUANGO (working on resource efficiency), and a start-up company that was beginning to assess sustainability, as well as researchers from each of the universities involved.

At each stage (survey, interview, workshop) the findings were fed back to the members to ensure that the researchers interpretation of the data collected reflected their understanding and worldview. The members were invited to give feedback via phone or e-mail. During the workshop, each of the researchers made notes on the discussions held and provided a summary of the issues raised. These summaries were then collated by the lead researcher. The participating organisations are listed in Table 4 (made anonymous). QUANGOs have observed a range of companies and so are in some way representative of a range of experiences in this area.

Sustainability KPIs in practice

This section describes the findings of the use of sustainability KPIs in practice and draws links with evidence found in the literature.

FINDING 1: SURVEYED COMPANIES ARE NOT SURE WHETHER SUSTAINABILITY KPIS ARE LEADING TO PERFORMANCE IMPROVEMENT

It was found that surveyed companies are unsure whether sustainability KPIs are leading to performance improvement. Moreover, choosing appropriate boundaries and metrics will greatly influence improvement.

- Survey findings: Most surveyed companies have some form of sustainability measurement in place. The companies that use sustainability KPIs indicated these facilitate monitoring and assigning ownership, but they do not always effectively lead to performance improvement. To give an example of Company-5's evaluation of sustainability KPIs: *"Good – visibility / ownership, Bad – not clear if all KPI's can drive the correct behaviours, benchmarking is complex"*. Some of the suggested improvements include: *"Global definitions and boundaries – KPI range that will drive the correct behaviours"*.
- Interviews findings: Two interviewees indicated they were not sure whether their sustainability KPIs are sufficient to drive performance improvement. For instance, environmental performance variation between factory sites shows that having metrics in place does not necessarily lead to the desired improvements, which augments the survey response that there is a need to transfer knowledge internally. Second, there is a discrepancy between the different behaviours KPIs are driving: KPIs which target to reduce energy use in factories will have different effects from a product life cycle approach which aims to reduce emissions across a product life cycle (from raw materials sourcing to production, storage, use and disposal). Anecdotal evidence from one of the interviewees shows that improvement in product life cycle car-

Table 4. Organisations engaged at each stage of research.

Note. **Maturity is based on self-assessment. * Indicates that the assessment was done by a researcher who works closely with the company.**

Organisation	Participant	SKPI Maturity	Survey	Interview	Workshop
Company 1 – Established – Large company	CEO	High	X		
Company 2 – Start-up – Small or Medium sized company (SME)	Sustainability lead	Medium	X	X	
Company 3 – Established – Large company	CEO	High	X		
Company 4 – Established – Multinational company	Sustainability lead	High	X	X	
Company 5 – Established – Multinational company	Manufacturing sustainability lead	High	X	X	X
Company 6 – Established – Multinational company	Manufacturing sustainability lead	High	X	X	
Company 7* – Established – Multinational company	Researcher (on behalf of company)	High	X		
Company 8 – Start-up – SME	Co-owner	Medium			X
QUANGO 1	Sustainability expert	N/A		X	
QUANGO 2	Regional leader	N/A		X	X

bon emissions has led to negative impacts on manufacturing energy use and carbon emissions on multiple occasions. It appears that both product life cycle and manufacturing sustainability KPIs are therefore required to drive change. One interviewee (Company 6) mentioned: *"Is it possible to play around with KPIs to get the right output? "[We need to gain] understanding [of] KPIs that contradict each other"*

- Workshop: During the workshop a discussion emerged on sustainability metrics and whether these lead to performance improvement. The SME noted that without sustainability metrics (but with a clear sustainability vision) it has developed a sustainable business. The multinational had been developing performance management systems (similar to a pyramid type of structure as suggested by Lynch and Cross, 1995) for over a decade, and noted that this performance management system was key to making sustainability improvements.
- Literature discussion: Despite having sustainability KPIs in place, improvement may not always occur. Incentives may be useful: Fitzgerald and Moon (1996) argue incentives are required in performance management systems and Clarke et al (1994) and Bourne et al. (2000) view user involvement as important for effective performance management systems. With the absence of "sustainability" measures (besides financial performance measures) in business bonus schemes, it may be hard to drive sustainability performance improvement.

FINDING 2: A BROADER SET OF SUSTAINABILITY KPIS IS FELT TO GIVE DEEPER INSIGHTS BUT WHEN ANALYSING POSSIBLE ACTIONS TRADE-OFFS NEED TO BE MADE BETWEEN SOCIAL, ECONOMIC AND ENVIRONMENTAL OUTCOMES

It was found that by measuring more (i.e. environmental and social performance), companies gain deeper insights. However, companies find it difficult to balance the decisions on how to allocate their resources: how can they choose between fair-trade and organic purchases? Moreover, certain actions have negative consequences (e.g. product improvements may lead to added complexity in manufacturing) so how to make the right decision? In certain situations companies may need to consider one metric more than others. Furthermore, social metrics may be difficult to measure, but are of increasing interest to government and industry.

- Survey findings: Social metrics seem to be of interest, but are more difficult to measure. Company 3 commented on a social metric: "*With more profit we would do it*" (i.e. the cost and resources associated with measurement is limited and this affects the inclusion of the social metric). Company1 commented the following: *"[this social metric] is not currently measured and [we are] unsure how to show this*". One of the bigger companies (company 6) mentioned: *"Social aspects [are assessed] more ad hoc."*
- Interview findings: Company 5 noted that many social sustainability initiatives were happening but these were "bottom-up" initiatives rather than top-down driven, which may be the case because of the nature of the measure (e.g. seeking to contribute positively to local communities). Company 2 noted that demonstrating quality is (obviously) the primary means of delivering customer value, followed by price. Although its products enable environmental savings, Company 2 found that quality and cost are (still) considered first by customers.
- Workshop findings: The participating companies and QUANGO recognised the difficulty of balancing different sustainability metrics, as companies are still valued based on profitability and shareholder value. According to the SME, the economic element of the triple bottom line is very important but often forgotten. Moreover, although measuring social sustainability has become more "popular", the ways to measure this are not clear as found by the QUANGO that gets specific queries from SMEs on how to measure social sustainability.

- Literature discussion: Elkington (1997, p. 91) already argued that the triple bottom line could raise a range of ethical issues: How should economic, social and environmental priorities be assessed and traded off? Despite of years of research in this area, the issue of trade-offs persists in practice. Currently, the company's vision helps companies balance decisions (as also suggested in the performance literature, e.g. Maskell, 1991; Walsh, 1996).

FINDING 3: EXPERIENCED COMPANIES IN THE SUSTAINABILITY FIELD ARE LOOKING BEYOND THE METRICS THEY HAVE USED IN THE PAST

It was found that sustainability leaders are looking beyond the metrics they have used in the past but require support from outside of industry. Start-ups or "sustainability followers" (i.e. those with an interest in actively managing for sustainability but have no experience) want to begin by using the best measurement available.

- Survey findings: Two examples of survey responses show the need to move beyond metrics used in the past: "*We would like to make further improvements in the re-use of our packaging as opposed to re-cycling of our packaging*" (Company 3); "*(…) There should be a standard measure that can compare resource usage/sustainability across different resource types. For example, we are used to a measure of carbon emissions when talking about a road vehicle travelling a mile but what is the [equivalent for other sectors]?*" (Company 2).
- Interview findings: It was found that the most mature companies in the field of sustainability are reconsidering their metrics continually in response to changing stakeholder requirements and growing improvement and understanding in the field of sustainability. Company 6 mentioned some metrics are more established (e.g. emissions per tonne of production in manufacturing), but others such as product life cycle footprints are still evolving, and there is data uncertainty in calculating these emissions (e.g. how to calculate supplier emissions?). Smaller companies and sustainability followers mentioned they are keen to learn from what leaders are doing, as they do not have the capacity and resources to develop best practice in this area. QUANGO 2 mentioned companies are moving from waste prevention to resource efficiency as an example of changing metrics.
- Workshop findings: The QUANGO mentioned many of the sustainability leaders they are working with want to move beyond metrics used in the past, for instance, they want to move from the ethos "zero waste to landfill" to "resource efficiency", but do not know how to measure and compare these different approaches. Start-ups as indicated by the QUANGO and the SME want to begin by using the best measurement available.
- Literature discussion: Neely et al. (1995) found that measurement in SMEs is a luxury, and often success and failure are obvious in the less complex environment of a SME. If SMEs can build on sustainability practices of industry leaders this can save them significant resources (research and development) they do not have.

FINDING 4: MEASUREMENT AND CONTROL OF IMPACTS OUTSIDE COMPANY BOUNDARIES ARE OF CONCERN

It was found that measurement and control of impacts outside of direct scope are of concern. Some companies in our initial survey consider themselves either too small (insufficient bargaining power) or too large (too many suppliers or customers, complexity) to manage this effectively.

- Survey findings: Emissions outside factory or company boundaries are of concern but cannot always be controlled. One SME mentioned: *"as a business we (…) have been measuring several [environmental metrics] on our partner/potential customer's sites* (Company 2)." A slightly larger company (Company 1) mentioned: *"we are mainly dealing with bigger companies who want to impose their understanding of this on us rather than use ours which tend to be further reaching". "In respect of the product emissions the data was difficult to get hold of for raw materials bought in from suppliers"*. Concerning sustainable material sourcing, Company 1 also mentioned: *"Due to our size it is difficult to always follow this or be able to purchase these"*. A multinational company (Company 6) commented on mechanisms overlooking the supply chain: *"This is a key area – but [we are] never free from it! There always seems to be something. Confusion. (…) Can kill brands if done improperly"*.
- Interview findings: For the bigger companies (Companies 4, 5, 6), engaging with customers is of special concern. They have established successful initiatives to help customers become more sustainable (e.g. by encouraging recycling and reuse) and are finding more novel ways to engage with customers. One SME (Company 2) indicated that its main purpose and selling point is to help reduce its customers' environmental footprints and it needs to cooperate with bigger companies to achieve this on a bigger scale.
- Workshop findings: The QUANGO mentioned the impacts of companies in rural areas: they may be major employers, which may also be a risk when the company leaves this area. For the multinational, working with suppliers is of great importance. It is important to consider resilience to natural disasters (e.g. due to climate issues) as a factor when selecting and working with suppliers.
- Literature discussion: Sustainability concerns the needs of current and future stakeholders (WECD, 1987). According to Clarke (1994) and Toor and Ongunlana (2010) awareness of stakeholder needs is part of effective (performance) management in organisations. Companies seem to be increasingly aware of their current and future stakeholders and want to consider their negative externalities but controlling impacts outside company boundaries may be difficult because of complexity (a wide range of suppliers) and bargaining power.

FINDING 5: LEARNING WITHIN THE COMPANY BETWEEN DIFFERENT SITES IS IMPORTANT BUT MAY BE DIFFICULT

It was found that learning within the company between different sites is important but may be difficult because of differences in energy management systems, geographical areas, age

of equipment, personnel expertise and other factors. Also, the politics of inter-site competition may be a barrier.

- Survey findings: One multinational mentioned there is a "need to transfer knowledge internally"(Company 6). Another multinational indicated: "each facility has its own energy/environmental management and so cross-implementation (multi-site) of initiatives is difficult"(Company 5).
- Workshop findings: The multinational mentioned learning across different manufacturing sites is very important. As most factory sites did not naturally cooperate, they set up a "teach-learn-do-teach" approach, where in return for learning from one factory site, employees need to teach another factory site about what they learned, which encourages cross-factory learning. The SME suggested an Open Innovation model to help competitors work together on sustainability. This can accelerate change across industries.
- Literature discussion: According to Lynch and Cross (1995, p.1) the rationale for performance measurement is to stimulate continuous improvement. It is important that the systems supporting sustainability KPIs stimulate improvement in individual businesses, the transfer of best practice across business unit or factories, and ultimately across companies and industries.

FINDING 6: THERE ARE OPPORTUNITIES TO IMPROVE INTERNAL AND EXTERNAL SUSTAINABILITY REPORTING

It was found that here are opportunities in both internal and external sustainability reporting. Companies may not always measure what is needed, or make use of their own metrics to improve external communications.

- Survey findings: An example of a direct need mentioned in the survey was:"*[Can you] help us communicate better"?* (Company 4) Internally, there is a need for training on sustainability. Company 1 noted on sustainability: *"This needs to be communicated more through all levels of staff".*
- Interviews: Company 2 mentioned its interest in seeing how others measure things, and finding a common language. As the definitions and measures of sustainability are not clear-cut, this will lead to confusion on what needs to be reported, and what should be reported to ensure the public understands the message. Company 2, a SME, indicated it does not have time to measure every metric they want to, let alone to write extensive corporate sustainability reports or update their websites. In bigger companies (e.g. Company 5), success stories are not always shared internally, although this could be a good source for internal learning.
- Workshop findings: The SME indicated there is insufficient time to report the efforts they take, such as the environmental indicators they take into account and how they engage with the community. The multinational also noted that many of their activities (related to social sustainability in particular) are not always reported, or communicated internally and externally so there is ample scope for improvement.
- Literature discussion: several studies have investigated the use of sustainability metrics which are externally reported, such as Székely and Knirsch (2005) who included a range of sustainability metrics in their paper and Marshall and Brown (2003) who investigated the use of environmental metrics. However, through the surveys, interviews and workshops it was found that not all sustainability efforts are externally and even internally "advertised" so there are still opportunities for companies to do this.

Implications

Companies are becoming increasingly interested in concepts of sustainability and the triple bottom line, which can be noticed from the growing reporting efforts on social and environmental matters, in addition to financial ones. This challenges companies to measure their performance in new areas. In this paper, the authors explored the challenges faced in developing and using sustainability KPIs in a manufacturing practice. Although only a small sample of companies took part in this research, this paper does illuminate some of the issues perceived by sustainability leaders in industry to achieve sustainability performance improvement.

Defining sustainability KPIs presents all the challenges and complexity of defining performance indicators in general (e.g. Neely, 2002), and specific additional challenges. The scope of performance management is expanded (e.g. an increased number of stakeholders and dimensions of performance) and concepts are introduced that are perceived to be more difficult to measure (e.g. social measures). Moreover, environmental and social reporting is largely voluntary, and there are no universally prescribed codes of practice for reporting although there are emerging standards (e.g. the Global Reporting Initiative). Therefore companies must largely define for themselves what performance in sustainability is and how it is measured. Potential barriers to companies developing their own strategies include a lack of resources (e.g. for SMEs), experience or motivation to develop these strategies.

Companies emphasise the need for a clear strategy and management system over the simple implementation of sustainability KPIs. The two start-up SMEs in our sample, which may not have performance management systems yet, have adopted a long-term sustainability vision, which may help to embed sustainability in their daily operations. Larger companies in our sample, which are effectively driving sustainability performance improvement, claim to have taken "sustainability performance" as seriously as financial performance and have developed similar KPI performance systems to drive improvement (e.g. KPI pyramids, incentive schemes). Even within these management systems there are challenges: how can means be developed to measure and manage effects that are not fully understood yet (e.g. rebound effect, social impacts) and how to balance between water reductions and energy efficiency for instance? Currently, company strategy and vision serve as a guideline to guide this type of decision-making.

It appears that it is challenging to replicate success stories in sustainable performance management, even in similar factories within the same company. Possible explanatory factors may include the age of facilities, reluctance to share with factories who are competing for the same overheads (inter-departmental competition; Walsh, 1996), the training or quality of the respective personnel, factory culture and the complexity of the

management system and decision making structures required. This reinforces the notion that the mere implementation of sustainability KPIs is not enough to achieve improvements in sustainability performance. More research is required to gain better understanding of how to encourage and enable inter and intra-company learning.

Leading companies may have a role to play in supporting their supply chain and wider industry. Leading companies may provide priorities and support for suppliers, for instance on what measures are important, and how can these can be managed and measured best. Second, manufacturing sites that have demonstrated improved performance in sustainability have much to offer follower sites or companies. The teach-learn-do-teach framework used by factory managers in Company 5 may be useful to implement in other companies too. Moreover, an Open Innovation model as suggested by the SME may help companies cooperate on joint sustainability challenges (e.g. joint logistics challenges) without competitive ground. Finally, having met earlier targets (e.g. zero waste), or been challenged by changing circumstances, sustainability leaders are constantly defining new KPIs. SMEs that do not have sufficient resources may build on knowledge accumulated in leading companies and reported externally.

Future work could focus on the management and governance systems that define sustainability goals (what is important and how do we define performance?) and the management systems to achieve that performance. Finally, although the field of sustainability performance improvement is evolving at a fast pace, more work is required in this area: for instance, how can trade-offs be made between the triple bottom-lines, how can sustainability reporting be further formalised, and how can inter- and intra-company learning be increased?

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Appendix A. Company self-evaluation

Note: The scoring (best possible-poor) is taken from the green performance matrix by Peattie (1992, p. 181). The indicators were further developed by the authors to conduct a sustainability (rather than "green") evaluation.

	Area	Indicators	Do you use it?	Do you want to use it?	Self evaluation						High variation between sites/ products ? Notes?
					Best possible	Among the best	Above average	Average	Better than some	Poor	
Environmental Sustainability	Factory/ Retail/ Depending on business)	Landfill waste generation									
		Water consumption									
		Energy consumption									
		Emissions to air									
	Products	Sustainable material sourcing									
		Product value to consumer									
		Recyclability									
		Reusability									
		Packaging: amount/ reusability/ recyclability									
		Multi-functionality									
		Energy use by consumer									
		Consumer change/ engagement									
		Product lifespan									
	Supply chain	Interaction/ positive changes driven in supply chain									
		Logistics & storage									
		Socio-economic – political impact/ engagement									
		Biodiversity & Land use change									
Social Sustainability	Internal	Workers and management relations									
		Employee well-being									
		Equality & diversity									
		Training, communication understanding of sustainability									
	Wider/ Supply chain impact	Mechanisms to overlook supply chain									
		Ethical material sourcing (e.g. fairtrade)									
		Human right issues (e.g. child labour)									
		Community relations									
		Product responsibility (e.g. health & safety)									