SUSTAINABLE SHIPPING – A WAY FORWARD? DEVELOPING ECONOMIC IMPERATIVES IN AN INTERNATIONAL MARKET

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ABSTRACT

This paper uses the framework of the Sustainability Assessment Model to consider the economic imperatives available to the International Shipping Industry to drive forward consideration of the environmental and social impacts of commercial decisions, alongside the well-known and understood economic drivers. It is the author's opinion, and the hypothesis underpinning this study, that in order for worldwide shipping to become truly sustainable as an industry, then the system of accountability must be adjusted so that decisions which are in the best interests of a sustainable solution become in the best interests of the company's, and ultimately shareholders, involved. Such a system would then allow traditional market forces to balance the equation. However, such a system requires a radical rethink of the way in which we account for our commercial activities, this is where the adapted *Sustainability Assessment Model* comes in. This extended abstract reports on efforts to develop such a model for the assessment of shipping as an industry, and considers the challenges facing the author's team in attempting to identify and discretise the relevant data sets. A full paper will follow reporting on the first iterations towards a model, and attempts to populate that model. The UK Engineering and Physical Sciences Research Council (EPSRC) is funding a three year cross disciplinary research project entitled *Low Carbon Shipping – A Systems Approach* which aims to develop a holistic systems model for world shipping capable of identifying pathways for the reduction of (primarily) carbon emissions from global shipping, through the design, powering, operation, routing, regulation and financing of the global shipping industry. This paper will look at the development of the economic imperative available via holistic measurement of the 'triple bottom line' – economic, environmental and social impact.
Keywords: *Full cost accounting, environment, sustainability, shipping, ship design, risk-based design*

1. INTRODUCTION

Sustainable approaches are becoming the norm throughout industry, and shipping can be no exception. In 2009 UNCTAD's Expert Meeting on Maritime Transport and the Climate Change Challenge highlighted that timeframe was a real concern:

"Current trends in terms of energy consumption and carbon path suggested that if no action were taken within the following two years … the world would forever miss the opportunity to stabilise emissions at "manageable" levels [and] a global and concerted solution was urgently required. … [N]egotiations towards regulation of CO_2 emissions from international shipping should be pursued with all due speed."

The concept of a sustainable industry or economy is an interesting one; oil is the major energy source powering the global economy and supplying 95% of the total energy fuelling world transport. Maritime transport relies heavily on oil for propulsion, and is not yet in a position to adopt effective energy substitutes, however, fossil fuel reserves are finite. The implications of rising and volatile oil prices for transport costs and trade will be very important, especially for developing countries.

If the shipping industry is to effectively and sustainably reduce its environmental impact, a model for assessing that impact against a cost base will be required. The full cost accounting sustainability assessment model (SAM), although designed for assessing the impact of an individual project, may be able to be adapted and applied to the shipping industry as a whole, a national industry (e.g. the UK's) or to individual companies shipping activities, even to an individual ship or voyage.

2. BACKGROUND AND MOTIVATION

The sustainability agenda has been applied to many areas of economic activity for a decade or so but it is only relatively recently that the scope for applying sustainability models has been applied to shipping. This paper approaches the issue of sustainability using a 'full-cost' lens to analyse the scope for sustainability assessment of shipping operations using an existing model (the 'SAM' – Sustainability Assessment Model) that has been conceptually employed in other contexts including petrochemicals and construction.

This paper will introduce the SAM model and scopes out the issues in applying it to a shipping context. In particular, the paper is concerned with the methods that might be employed in the measurement and analysis of environmental costs and how these might be internalised into economic calculations in the shipping industry. Recognising that 'full-cost' calculations can apply to capital investment and operational decisions, the SAM model, whilst superficially simple, can me made very complex. As (merely) a conceptual tool as far as shipping is concerned, SAM is employed in this paper as a basis for the development of method for sustainability measurement.

The generation of data for analysis is currently underway, and therefore beyond the scope of this paper. Due to the emerging nature of this area of research, this process will be iterative and will take several cycles before it begins to approach a final result in terms of a workable SAM for shipping. As Bebbington et al (2001:25) state with regard to FCA (full cost accounting):

"To illustrate how a complete FCA system might work for even one raw material would probably require a book in itself"

The focus therefore, is on scoping out the framework within which a simplified system for assessing the sustainability of shipping. This paper looks at the question, assesses the options available for addressing it and then discusses issues of method. The remainder of this paper proceeds as follows. The next section introduces the context and motivates the study. The subsequent two sections comprise the literature review and the paper then introduces the SAM model whilst examining some of the issues when applying it in a shipping context. The paper then concludes with some reflections on the constraints that an empirical experiment would be likely to encounter.

The notion of environmental sustainability is well-established as an aspirational concept in a range of commercial and non-commercial contexts, where "sustainability refers to the long term maintenance of systems according to environmental, economic and social considerations" (Crane and Matten, 2007). Specifically, however, sustainable development was defined in the 1987 Brundtland Report (UNWCED, 1987) as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs".

3. LITERATURE REVIEW

Companies are being encouraged, and will increasingly be forced, to take 'cradle-to-grave' responsibility for their products, which of course includes shipping. These pressures have seen an increasing move towards 'life cycle thinking', i.e. considering the whole life cycle of a product or facility when contemplating changes to one part of the system. (Elkington, 1999). This paper specifically considers a range of issues concerning accounting for these concerns. In doing so, it extends the SAM and applies it, for the first time as far as we are aware, to the context of shipping.

A number of full-cost accounting (FCA) approaches have been developed and applied by academics, non-governmental organisations and corporations, with the most sustained period of inquiry having been since 1990. However, the overall number of publications in the public domain remains small, and most applications have tended to be ad-hoc, experimental and incomplete in nature, with little consistency in application, although the Sustainability Assessment Model (SAM) offers some hope (Davies, 2009). Bebbington et al (2001) remind us that we do not yet know what a 'full cost' price would look like, but that economies must move towards generating an *increasingly full cost*. This notion is reinforced by Antheaume (2004), who reports that even the most complete attempt at modelling the full cost of an industrial process actually achieved monetisation of only 10% of processes involved. Achieving even a reasonably sustainable position will require 'the most profound, fundamental and visionary change' (Bebbington et al, 2001).

Implicit within, and underwriting, the European Commission's call for FCA are two assumptions: that current prices do not reflect the 'ecological truth', that is they do not reflect the true cost to society or the planet of the product, process or service; and secondly that if the market price of a product, for example, were to reflect accurately the environmental cost of that product, then market forces would encourage consumers to switch to 'more ethical' choices through financial incentives (Bebbington et al, 2001). These 'additional' costs are *externalities*: "costs borne by someone external to the system making the decision or taking the action", they can be public costs arising from private decisions, or private costs arising from private decisions, but borne elsewhere in the system. For the incumbent system of economic organisation to operate in an environmentally-sensitive and socially-just manner, these externalities must be *internalised* in some way so that business decisions which are not in the public's interests become contrary to the interests of the organisation, also (Bebbington & Frame, 2003).

Bebbington et al (2001) caution that the term FCA is commonly used, but with specific yet diverse meanings, often referring to only part of one of the four approaches mentioned above. For example, the USEPA/Tellus Institute approach, called FCA (Bebbington and Thomson, 1996:53), incorporates four tiers of costs, however these are all costs which under the current economic system of management would harm the company involved financially, and so it is really a more thorough method of internal management accounting; external costs are not considered. Central to full cost accounting, then, is the notion of external cost and effect, an emphasis drawn from neoclassical economic theory (Antheaume, 2004). It is in the identification and monetisation of these externalities, that the value of SAM is demonstrated.

The SAM was initially developed to assess the economic, resource, environmental and social impacts of a single project over its full life cycle and translates all impacts into monetary amounts using a damage cost approach. Two outputs are produced – a graph that highlights all positive and negative impacts (the SAM 'signature') and an indicator (the SAM*i*) that measures how sustainable the project is (100% represents a fully sustainable development). Figure 1 shows a notional SAM signature (see Baxter et al, 2003 for details of the original model; for application of the SAM, see Baxter et al 2004; Bebbington & Mcgregor 2005; Bebbington, 2007a&b; Bebbington & Frame, 2007; Bebbington et al, 2006&2007; Xing et al 2007&2008).

Environmental analysis of ships and shipping is a relatively new activity. Recent moves by IMO, particularly the Marine Environment Protection Council (MEPC; IMO, 2010), to consider the Greenhouse Gas Emissions (GHGs) of ships and shipping, coupled with the political shift towards a focus on reducing the impact of activity on climate change mean that for the first time ship owners, operators and designers are seriously considering the emissions generated by their operations. Currently the IMO are using two methods for the primary assessment (and eventual control) of emissions from shipping, the Energy Efficiency Design Index (EEDI); and the Energy Efficiency Operational Index (EEOI; MEPC, 2008) which assess the design and operational performance of a ship against a curve of achievable performance generated from the existing ship population.

Many other models have been developed to compare the carbon emissions of different methods of transporting a specified cargo (e.g. Kuhlwein & Fiedrich, 2000; Corbett & Koehler, 2003&2004; Corbett et al, 2007; Endresen et al, 2003; MOSES Project, 2007; IAPH, 2009; Faber et al, 2010; Browne et al, 2009; Leonardi and Browne, 2009; ESPO, 2009; McKinnon, 2010) and some (e.g. Ademe, 2009; VNF, 2008) have included measures of wider impacts such as noise pollution and congestion. Despite this, the focus of such methods is often extremely narrow. Simplified assessment of the emissions from shipping has often followed on from research in rail and road transport (e.g. TRL, 2010; Argonne National Laboratory, 2009; ARTEMIS Project, 2003), and is therefore rarely tailored to the characteristics of maritime operation.

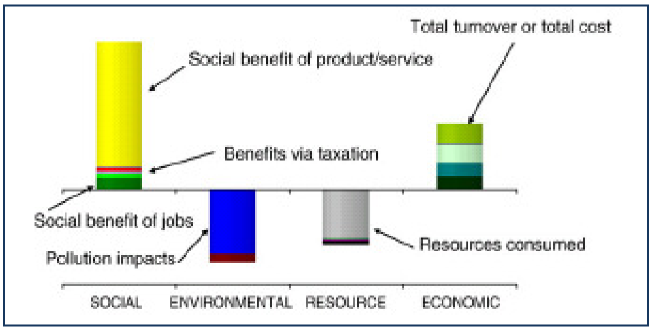

Figure 1: The SAM signature (Bebbington et al, 2006)

Whilst the impact of the whole activity (whole life) on all aspects – social and economical as well as environmental, needs to be considered if the sustainability of the operation is to be assessed, from an environmental point of view, the emissions during transit generally dwarf other impacts. For example, a life cycle analysis (LCA) carried out on a short sea container ship (port to port) operating across the North Sea by the CREATE3S project (Landamore, 2009&2010) assessed the emissions deriving from the burning of fuel to power the ship as almost 90% of the overall life cycle emissions of the ship. However, a balanced full cost/benefit analysis of the operation is required to identify the true cost to society, industry and the environment, allowing for proper comparison of options for reducing the impact of shipping.

4. METHODOLOGICAL CHALLENGES

In developing a comprehensive methodology for assessing the full cost of shipping to the UK, the costs and benefits associated with the industry in terms of social, economic, environmental and resource impacts need to be considered. As well as assessing the current state of affairs and immediately available alternatives, the model should be able to assess the effectiveness of future developments designed to reduce the environmental, economic and/or social impact of shipping to the UK, and in a global context. Building on the author's own prior work identifying environmental impact, assessing the environmental risk of various shipping activities and apportioning costs to the options (for example, see Landamore et al, 2006, 2007 & 2010), the approach of Baxter et al (2003&2004), and Davies (2009) after, provides the best basis for a framework to apportion value to externalities relevant to the marine industry, in the author's opinion. Whilst a number of approaches to an iterative design are possible, it was felt that the method proposed by Davies (2009), utilising a systems engineering inspired form of action research – *soft systems methodology* was the most appropriate to the task at hand. Davies reports on the initial use of the methodology to revise a SAM model for application to the building of a new University campus, and this construction element to the new methodology, not explicitly considered by the original SAM model, adds a useful dynamic to the assessment of a maritime system, as the building of a ship is a major construction project in itself. SSM also focuses on stakeholder engagement:

"the TBL agenda…is only the beginning. A much more comprehensive approach will be needed that involves a wide range of stakeholders and coordinates across many areas of government policy" Elkington, 2004.

Baxter et al (2003&2004) describe the Sustainability Assessment Model (SAM), a form of full cost accounting developed by BP, with other partners, as an accounting tool which could 'make sense' of the extent to which its operations could be viewed as being in accordance with the principles of sustainable development. SAM provides an indication of the most significant impacts of a project over its full life cycle taking into account positive and negative externalities. SAM seeks to track significant economic, resource, environmental and social impacts of a project over its full life cycle and then to translate these impacts into a common measurement basis – money. This process produces a graphical representation of the positive and negative impacts (the SAM ‘signature’), as well as constructing an indicator (the SAM*i*) of how well the particular project performs, useful for benchmarking. This information can then be fed back into project evaluation processes, to guide either (re)design of the project in question, or future project planning processes.

The SAM approach to the four generic steps of FCA begins by defining the cost objective as being a discrete project, e.g. a ‘typical’ oil and gas field development. The major problem facing SAM is the inclusion of impacts outside of the direct control of the project, however this is key if the results are to be of meaning to society. Responsibility for those impacts is a secondary consideration, however. Davies (2009) proposes the use of an action research model to refine SAM, specifically soft systems methodology (SSM), utilising a ‘learning for action’ cycle. The SAM, having been developed primarily for the oil and gas industry, addresses many of the specific issues associated with an engineering discipline. Whilst not specifically designed to consider a transport system, or to give an industry wide response, the refinements of Davies (2009) go some way to address the major concerns of SAM’s detractors. Other criticisms of SAM are that it uses damage costs, and allows substitutability between forms of capital, rather than defining sustainability at the operational level (Davies, 2009). However, it is the most complete and consistently used model available, which is why it has been utilised for the further consideration here of methodological issues pertinent to the assessment of environmental sustainability of shipping. The broad impact categories are economic flows, resource use flows, environmental flows and social flows. Each of these categories are problematic in terms of description and capture.

There is limited *hard* data available for the assessment of many facets of the sustainability equation, so much data collection will be qualitative; as such action research addresses many of the hurdles facing this implementation. Argyris & Schon (1978, 1996), and Greenwood & Levin (1998) after them, place the argument for action research within the context of espoused theory - the account actors give for their reasons; theory-in-use – the observer-analyst’s inferences about the theory that must underlie the observed actions of the same people if their actions are to be made sense of.

Utilising the SSM ‘learning for action’ cycle to adapt the SAM model to the shipping industry and to simplify the model, also enables its use on a large scale. The simplification will involve analysing the initial results and removing items from the assessment which can be demonstrated to have a statistically insignificant effect on the assessment. The SSM cycle will also aim to improve the accuracy of the monetisation of issues relating to the sustainability of shipping; for example, Antheaume (2004) found that the most complete method of evaluating the external cost monetised just 10% of flows studied, with huge variation in the value assigned. As with all existing examples of application of FCA, SAM has had its issues; this is where the ‘learning for action’ cycle approach aims to improve upon the experiences of previous research teams.

5. DISCUSSION

The consideration of boundary conditions and shipping’s role within the entire supply chain is important, and particularly the inclusion of impacts outside of the direct control of the ‘project’, as the intention of this model is to assess the impacts to UK society as a whole of the shipping industry. Equally important will be the identification of the most significant flows in this process, in order to simplify the analysis. Monetising all elements to within a suitably narrow range so as to be of value, and to the agreement of all actors will most likely take many iterations, hence the adoption of a learning cycle approach. The iterative process recommended to develop the final model will also allow the actors to simplify the model where possible, excluding from further iterations items which can be shown to have an insignificant impact.

The aim of this study is to identify the methodological issues facing the development of an FCA model for assessing the environmental sustainability of UK shipping.

The approach taken has been to consider what a new application of the Sustainability Assessment Model, modified through the application of a soft systems methodology stakeholder engagement process would look like, and what the key considerations are for the shipping industry. When identifying the changes which would be required within the impact categories, the shipping of crude oil to the UK has been considered as this is an extremely important factor in the UK economy; this also allows several parts of the SAM model to be retained, in particular the consideration of the end product impacts.

"Just over three quarters of the UK's current primary energy demand is met by oil and gas. In 2020, it is estimated that 70% of primary energy consumed in the UK will still come from oil and gas" (Oil & Gas UK, 2010)

Once populated with existing situational data, the model for shipping should have the functionality to allow proposed changes to e.g. operation, technology, or supply chain to be made and the predicted influence on impact will be returned. This information will help the Government, Industry and individual organisations decide where best to focus limited resources.

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